Manual of Evaluation Items in Physics for Pre-University Course of Karnataka State

R Narayanan
&
N.R. Nagaraja Rao
Academic Coordinators

REGIONAL INSTITUTE OF EDUCATION
[National Council of Educational Research & Training, New Delhi]
Mysore 570 006

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FOREWORD

Evaluation is an integral part of teaching learning process. If we wish to discover the truth about education system, we must look into its assessment procedure. The nature of assessment tends to influence students' approaches to learning. Assessment should promote search for meaning, understanding and self-directed learning. Any reform in education should also be accompanied by reform in question paper setting. Since 1990s educational reforms are seeking answers to two fundamental questions: (i) How well are students learning? (ii) How effectively are teachers teaching?

As the classroom paradigm shifts from teacher-centric to learner-centric, student assessments are undergoing changes. Students should be probed for understanding, reasoning and critical thinking rather than for rote memorization.

Creativity in the thought process of the students requires deeper understanding of the subject. Does the pattern of questions set in our schools really test the talent of the child? We have seen rising trend of the students scoring high marks in school examinations but ending up with poor performance in competitive examinations. Therefore, it is necessary to develop a wide range of well-designed assessment and evaluation techniques to help the teachers to closely follow students progress and facilitate future acquisition of knowledge. In this context, the question banks are of great help in storing large database of suitable questions framed for the subject area, instructional level, instructional objectives measured and various other question characteristics.

A question bank can store as many questions as possible so that generation of randomized tests is done without any difficulty. Question bank also helps in providing a platform in discussing critically students' misconceptions or preconceptions or alternate conceptions which might interfere with the students' learning process. While preparing questions, it is, therefore, necessary to keep in mind these aspects.

This manual of questions in Physics for PUC level of Karnataka State prepared by the team of experts at RIE, Mysore coordinated by Dr.R.Narayanan and Sri N.R.Nagaraja Rao is an outcome of a 5 day workshop held at this Institute. It is desired that question bank manual should be able to set new trends in the process of evaluation and motivate the teachers to have a rethinking on their classroom practices. The painstaking efforts of the team in bringing out the manual containing quality questions is highly appreciated.

Prof.G.T. Bhandage
Principal

PREFACE

The manual is an outcome of an inservice programme for developing a question bank in Physics for the pre-university class of Karnataka State. The programme was taken up by the Regional Institute of Education, Mysore at the request of the PU board, Karnataka. A one-day planning meeting was held at the Institute on 19.9.2008. The meeting was attended by the resource persons of the Institute and representatives from the pre-university board, Bangalore. The meeting concluded with a plan for the 5-day developmental workshop involving pre-university Physics teachers. The modalities for the 5-day workshop such as the scope of the workshop, nature and type of evaluation items to be prepared, topics for lecture sessions, details of the evaluation item sheets etc. were discussed and finalized. As most of the participants did not possess a degree in education, it was decided to provide adequate inputs about various aspects of evaluation, preparing a blue print of question paper, analyzing question papers of PU examination, etc.

A five-day developmental workshop was organized from 24th to 28th November 2008 (Annexure). Twenty pre-university Physics lecturers representing different districts of Karnataka attended the workshop. After a brief discussion on various aspects of evaluation, the teachers were divided into groups of 3-4 members. Each group prepared questions on specific chapters of I and II year PUC physics book that were allotted to them. Categories of questions prepared during the workshop broadly conform to the pattern followed in the second year pre-university Physics question paper. The categories are : multiple choice questions, very short answer questions, short answer questions and long answer questions. A clearly defined objective, specific action verb and the difficulty level have been indicated for each item. Marking scheme and answers/ value points are provided for each item. Although, the II PUC question paper does not have multiple choice items, they have been included as they would help students to familiarize with this pattern of *questioning followed in the Common Entrance Test (CET) conducted by the Government of Karnataka.*

The items written by the teachers have been thoroughly edited and presented in this manual. The chapter numbers and titles conform to the PU curriculum document in biology. Marking scheme and answers/ value points are provided along with the questions of that chapter. Although each chapter has a large number of questions, they are by no means exhaustive and ample scope is available for constructing many more evaluation items under each category..

We hope the manual meets the requirements of the PU Board and would be of help to teachers and students. Suggestions for improvement are welcome.

R.Narayanan & N.R.Nagaraja Rao
Coordinators

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We wish to express our sincere gratitude to the Director, NCERT for approving the programme and for providing complete financial assistance to the programme. We thank the Commissioner, P.U. Board, Bangalore for deputing the teachers for the programme. Our special thanks to Sri S.V. Mohan Kumar, Asst. Director (Academic), P.U. Board, Bangalore for the clear vision he had about the outcomes of the programme. We also thank all the resource persons, both internal and external for their valuable academic inputs during the programme. The sincerity and dedication of all the members who attended the programme made it possible to bring out the present manual.

We wish to thank the Principal, Regional Institute of Education, Mysore for his encouragement. We also thank the Dept. of Extension Education for their constant support through the different phases of this programme. The manual in its present form is a result of several months of hard work put in by Smt Chandrakala, Smt S.Imavathi and Shri V. Prabhakaran of the Computer Processing Unit. We are highly thankful to them for their cooperation.

R.Narayanan & N.R.Nagaraja Rao
Academic Coordinators

RESOURCE TEAM

R.Narayanan & N.R.Nagaraja Rao
Academic Coordinators

Resource Persons

1. Dr. S.S.Raghavan
Retired Professor
No.17, RCE Layout
Bogadi II Stage, Mysore

2. Dr.B.V.Sadasiva Murthy
Retired Professor
No.29A, 5th Main
Aravinda Nagara
Mysore 570 023

3. Shri S.V. Mohan Kumar
Assistant Director
Dept. of P.U. Education
Bangalore

4. Sri Ranganathaiah
Principal
D.V.S. Pre-University College
Shimoga

5. Dr.T.N. Chandrakanth
Principal
Vijayabharathi P.U. College
Cox Town, Bangalore

List of Participants

1. Shri Ananda P.
   Lecturer in Physics
   Govt. P.U. College, Puttur

2. Shri K.B.Veerabhadrappa
   Lecturer In Physics
   S C S V M P U College
   Sandur, Bellary District

3. Shri Sridhara S.B.
   Lecturer in Physics
   Nalanda National P U College
   J C Nagar, Bangalore

4. Shri N D Machenahalli
   Lecturer in Physics
   S J J M Govt. P.U. College
   Bydagi Haveri District

5. Shri Lingaraj A. Bellad
   Lecturer in Physics
   Govt. P.U. College for Girls
   Jamakhandi, Bagalkote

6. Shri S Prabhakara
   Lecturer in Physics
   S T S R P U College
   Nayakana Hutty, Challakere Taluk
   Chitradurga Dist.

7. Shri B S Koujalagi
   Lecturer in Physics
   Govt. Science P.U. College
   Kalgatagi, Dharwad District

8. Shri S U Chandraragi
   Lecturer in Physics
   R.V. Comp. P.U. College
   Raibag, Belgaum District

9. Shri Anjaneya A.R.
   Lecturer in Physics
   Govt. P.U.College
   Lexmeshwar, Shirahatti Taluk
   Gadag District

10. Shri G Narasimh a Murthy
Lecturer in Physics
Mycom – Co-Comp. P.U. College
Ammasandra, Tumkur

11. Smt K N Gayathri
Lecturer in Physics
S M S D Govt. P.U. College
Koppa, Chikmagalore Dist

12. Shri B S Keshava Kumar
Lecturer in Physics
M Krishna P U College
B M Road, Hassan

13. Shri B R Neelakanta
Lecturer in Physics
Marimallappa's P U College, Mysore

14. Smt M S Gayathri
Lecturer in Physics
Govt P U College
Kadugodi, Bangalore

15. Shri S Martin
Lecturer in Physics
Govt. P U College
National P U College
Magadi, Ramnagar Dist.

16. Shri G H Prabhukumar
Lecturer in Physics
Govt. P U College, Karwar

17. Shri N Ananda
Lecturer in Physics
Govt. P U College, Gudibande

18. Shri Sampathkumar S Yedrami
Lecturer in Physics
S K V M S P U College, Bijapur

19. Shri D G Biradar
Lecturer in Physics
Shivaji P U College
Bhalki, Bidar Dist

20. Shri Jamadar M D Rafi
Lecturer in Physics
National P U College, Gulbarga

Concept of Evaluation

Evaluation is universally accepted as an integral part of the teaching and learning process. Through evaluation a teacher can judge the growth and development of students, the changes taking place in their behaviour, the progress they are making and also the effectiveness of teaching in the class. In fact, evaluation plays a pivotal role in determining what the learners have learnt and what the teachers have taught. It is, therefore, acknowledged as a powerful means of improving the quality of education in schools. This makes evaluation an essential and integral component of a curriculum.

Meaning of Evaluation

The word 'evaluation' is often confused with testing and measurement. Often teachers who give a test to the students, think that they are evaluating the achievement of students. One must realize that testing is only a technique to collect evidences regarding pupil behaviour. Measurement in the educational context is limited to quantitative description of the pupil behaviour. But the term evaluation is more comprehensive and includes besides testing and measurement, quantitative and qualitative description of the pupil behaviour and also includes value judgement regarding the worth or desirability of the behaviour measured or assessed. Gronlund (1981) has summarized evaluation as :

Evaluation = Quantitative description of pupils (measurement) +
Value judgement

Evaluation = Qualitative description of pupils (non-measurement)
+ value judgement

Thus, conceptually evaluation is not based on measurement alone as it goes beyond the simple quantitative score. For example, if a child gets 60 marks in a Biology test, it alone does not tell us whether his achievement is satisfactory or not. It is only when we compare this mark (60 percent) with the marks obtained by other children in the class or with certain criteria laid down in advance, or with the child's own marks in previous tests that we are able to judge or evaluate whether his achievement is satisfactory or not. Thus, a students' achievement may be viewed at three different levels :

1. Self-referenced - how the students is progressing with reference to himself/herself.
2. Criterion-referenced- how the student is progressing with reference to the criteria set by the teacher
3. Norm-referenced - how the student is progressing with reference to his/her peer group.

Evaluation has been variously defined.

One of the accepted definitions is given by Tyler (1950) who defines evaluation as "a systematic process of determining the extent to which educational objectives are achieved by pupils". However, this definition excludes the casual, informal or uncontrolled observation of pupils. The definition also implies that without predetermined objectives, it is not possible to judge the progress, growth and development of students. Evaluation also enables the teacher to make judgement and helps in decision making.

In this systematic process of collecting evidences about students' progress and achievement in both cognitive and non-cognitive areas of learning the following three components are important:

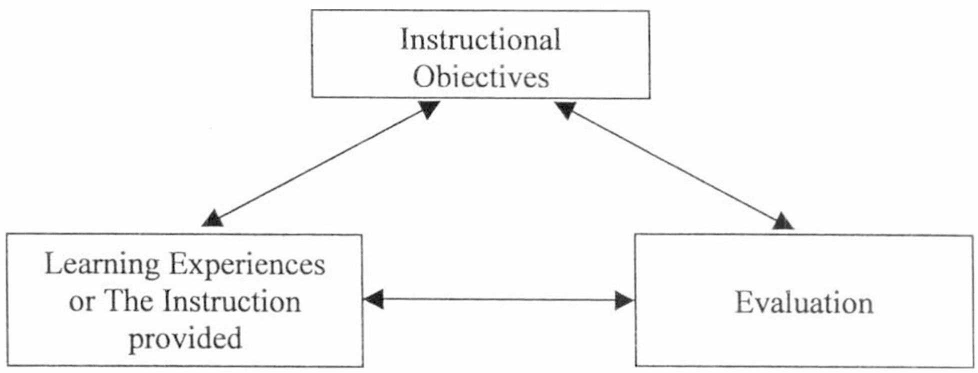
- information gathering
- information processing
- judgement forming and decision making

We not only want to know whether a student has developed a certain ability stated in the educational objectives or not but we also need to know about the progress during the course of teaching and learning. Thus, evaluation need not always be at the end of a course but a continuous process.

Evaluation in Teaching and Learning

Evaluation is an integral part of any teaching and learning programme. Whenever a question is asked in a class and answered by a student, the answer is judged by the teacher, evaluation takes place. Thus, both teaching and evaluation go hand in hand with each other. In fact, it is not possible to have teaching and learning without evaluation.

Both teaching and evaluation are based on the instructional objectives which provide direction to them. Instructional objectives are those desirable behaviours which are to be developed in students through the learning experiences. These are reflected in the form of syllabus, instructional material and information given by the teacher. Instructions are given for achieving the objectives and evaluation is done to see whether the instructional objectives have been achieved and also to what extent they have been achieved. The interrelationship of objectives, instructional process and evaluation can be expressed more clearly through the following diagram :



The above diagram illustrates that the three components - instructional objectives, learning experiences and evaluation constitute an integrated network in which each component depends on the other. Thus, through evaluation, the teacher not only assesses as to how far the students have achieved the objectives but also examines the effectiveness of the teaching strategy such as methodologies, means and materials used for achieving those objectives.

Defining the objectives in clear terms, organizing appropriate learning procedures, continuous and comprehensive appraisal of pupil achievement through suitable techniques and tools and using the information thus gained for modifying and improving all aspects of education constitute the process of evaluation.

Purposes of Evaluation

A number of important purposes are served by evaluation, which ultimately contribute to the improvement of the instructional methods, textbooks, the curriculum and advancements of our educational goals. Evaluation helps us to set tasks and goals which are bigger than what we aspired for earlier thus giving leadership in education. Certification, selection and classification of pupils, guidance and diagnosis of strengths and weaknesses are some of the important purposes of evaluation.

Evaluation is helpful to the teacher and the taught. The teacher comes to know the extent of success of his teaching and the effectiveness of his methodology. The pupil also knows where he is and how far his efforts have been successful. This enables him to renew his efforts or revise his study habits to facilitate better achievement.

Characteristics of Evaluation

Evaluation is one of the most important aspects of education. It can be defined as the process of collecting evidences of pupil growth in desirable directions. In order that it is meaningful and effective, it should satisfy some criteria. These could be enunciated as follows :

1. ***Evaluation is objective-based*** : The desirable directions in which education directs pupil growth are indeed the objectives of instruction. And evaluation is aimed at knowing the degrees of success that the entire teaching-learning process has been able to achieve in realizing these instructional objectives.

2. ***Evaluation is continuous*** : Evaluation does not operate in strokes, but it is a continuous process. It thus yields a constant flow of feedback both for the student and the teacher for further improving their performance.

3. ***Evaluation is comprehensive*** – Unlike other commonly used terms in the field of measurement, evaluation is by far the most comprehensive process in terms of its coverage. It covers all the aspects of pupil growth, scholastic as well as non-scholastic. This essentially involves the use of a great variety of tools and techniques several of which have to be specifically developed for the situation.

4. ***Evaluation is dynamic*** – With its coverage extending to all the aspects of pupil growth and also since it has to be continuous process, evaluation situations keep on changing. Each new situation presents a challenge to the teacher who has to be innovative for meeting it by developing new strategies, techniques and tools.

5. ***Evaluation can be a learning experience*** – Good evaluation situation can prove to be an excellent learning experience. In trying to find solutions to evaluation situations, the students may take recourse to several resources which may not otherwise do. Many of these could provide valuable learning to them.

6. ***Evaluation results have a wider usage*** – Examinations are almost sole means of evaluation today. Examination results are used only for purposes of grading, classification and certification. Results of evaluation can, however admit wider purposes like diagnosis, guidance and academic prediction as well besides those to which examination results are being currently used.

To conclude, it may be said that evaluation is a much wider concept than both measurement and examination, for both of which it is often erroneously used as a synonym. The above characteristics indeed distinguish it from not only these two but several other terms mistakenly deemed to be equivalent or interchangeable.

3. Instructional Objectives in Testing

What are Instructional Objectives ?

Education is a process of bringing about change in the individual in a desired direction to enable him to develop certain skills, certain understandings, thinking processes, insights, attitudes, etc. Our educational objectives, therefore, are the changes we wish to produce in the child. The changes that must take place through education are represented in the knowledge children acquire, the skills and abilities children attain, the interests children develop and the attitudes children manifest.

E.J.Furst defined educational objectives as "the desired changes in behaviour in a person that we try to bring about through education".

According to Edwin Harper, "objectives are the statements of expected results". This means that the objectives state in what way a pupil will be different at the end of a particular course or lesson. Therefore, objectives are also known as 'learning outcomes'. They are the products of learning and represent what the pupil does after receiving instruction. Instructional objectives, are, therefore, the predetermined targets of learning.

Terms like goals, aims and objectives are related terms. Educational goals are broad and nebulous e.g., goal of education may be to prepare a good man. Goals are divided into a number of aims e.g. the aim of education may be to prepare a good citizen. The aims are further specified into objectives. The objectives are tangible and achievable in educational terms.

Purpose of Instructional Objectives

Instructional objectives serve as the guide posts in teaching and learning. These are required for the purpose of clarifying to the teachers as to what they are expected to teach and to the students as to what is expected of them at the end of a given period of study. A teacher, therefore, needs to be clear about the objectives of his/her subject with a view to :

- bring about desired changes in the pupils
- decide how to bring about these changes
- evaluate whether the changes have taken place

Both teaching and evaluation are based on instructional objectives. The instructional objectives provide directions to them. *Instruction is provided to achieve the objectives and evaluation is carried out to find whether the objectives have been achieved and to what extent.* Thus,

- an objective is the first step in teaching and learning
- it is also the last step as it validates the instructional process
- it provides the basis for planning the learning experiences
- it helps in selection of evaluation procedures

Classification of Objectives

The taxonomy of educational objectives proposed by B.S.Bloom was a major breakthrough in the history of objectives. According to him, all instructional objectives fall under three main domains of human personality – cognitive, affective and psychomotor. These are related to head, heart and hand respectively. Thus, cognitive domain includes objectives related to intellectual aspect; affective domain is related to feeling i.e. with attitudes, interests and values and psychomotor domain is concerned with physical, motor and manipulative skills.

The classification of objectives in these three domains is as follows:

Cognitive Domain	**Affective Domain**	**Psychomotor Domain**
Evaluation	Characterizing	Naturalization
Synthesis	Organizing	Articulation
Analysis	Valuing	Precision
Application	Responding	Manipulation
Comprehension		
Knowledge	Receiving	Imitation
(By B S Bloom)	**(By Krathwohl)**	**(By R H Dave)**

In the cognitive domain Bloom has classified the objectives into six categories.

1. Knowledge - This is the information level and is essential for everything. It requires recall and recognition of facts, principles, concepts. It is based on simple memory and in other words can be called remembering information.

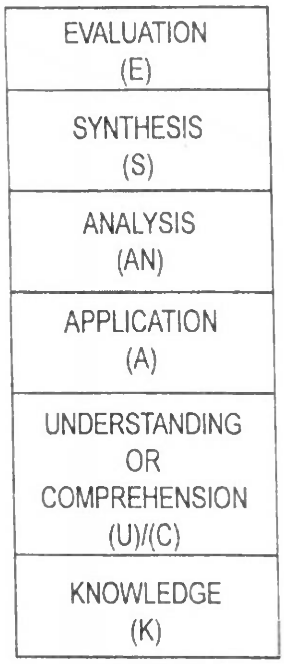
2. Comprehension - This includes knowledge and something more. Some thinking process starts at this level.

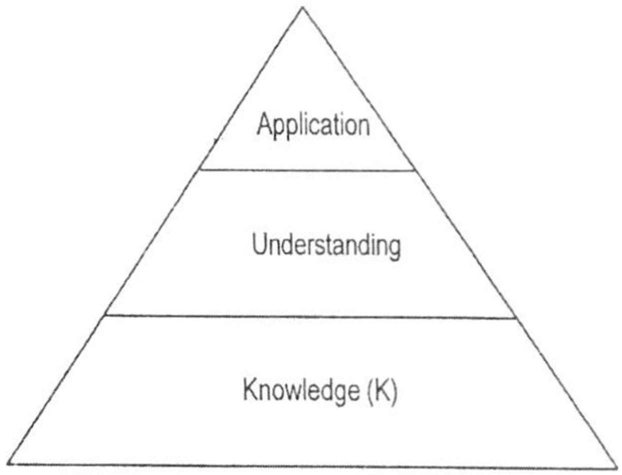
3. Application - This includes both knowledge and comprehension of the learnt material and ability to use it in unfamiliar situations.

4. Analysis - This means breaking the problem in parts or its constituent units and seeing their interrelationship. This includes all the above three objectives i.e. knowledge, comprehension and application.

5. Synthesis - This includes putting together elements and parts of concepts and forming a whole in order to form a theory or seek a salutation to a problem.

6. Evaluation - Evaluation is the highest level in cognitive domain. It is concerned with making value judgement about people, methods, processes, materials, ideas, purpose, etc.





Cognitive Domain
(Knowing Aspects)

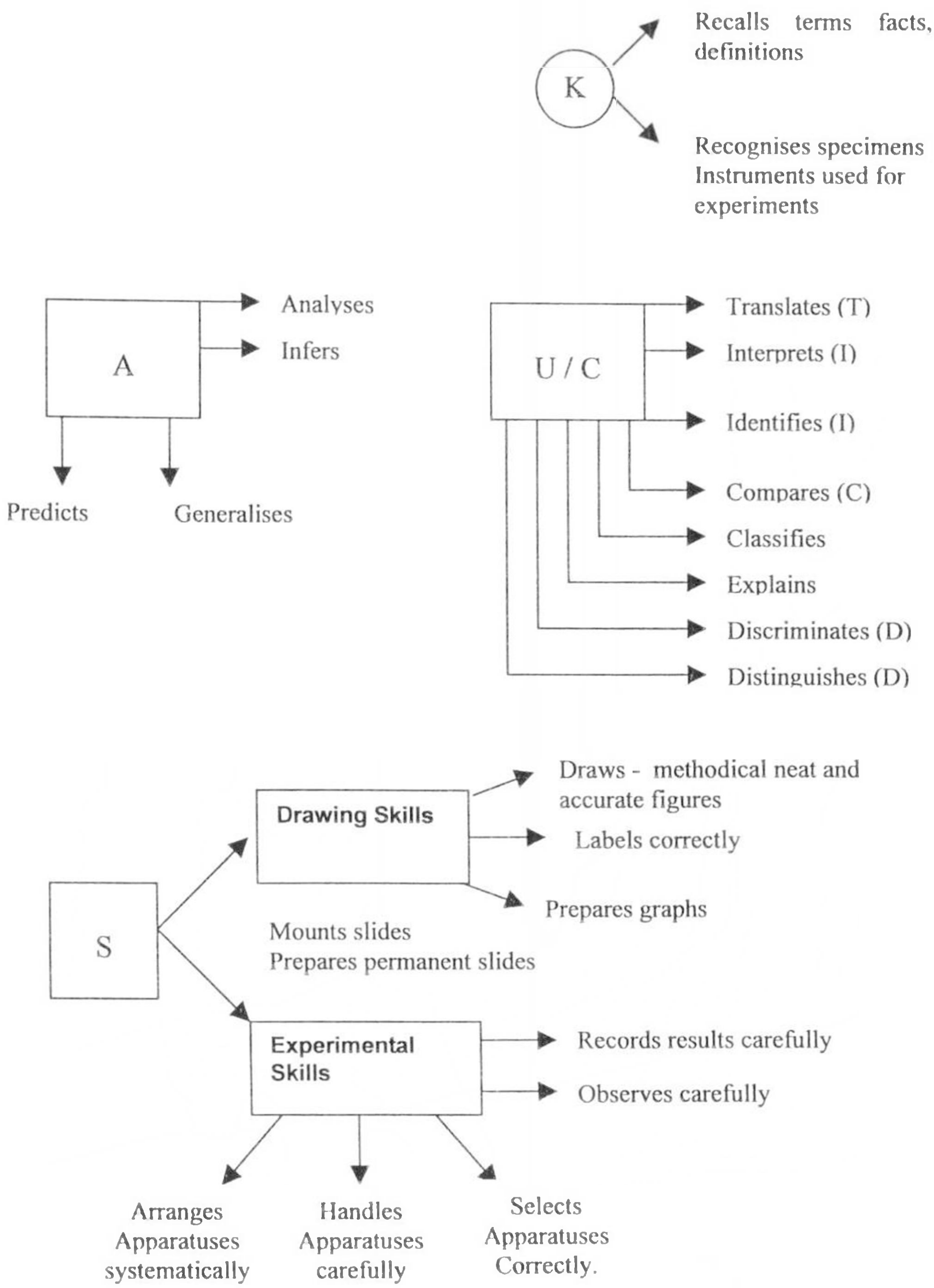
Description of the Specifications for Different Objectives

A brief explanatory description of the specifications of different instructional objectives is given below :

Objective	Specification	Explanatory Description
Knowledge	1. Recalls - Defines - Names - Mentions - Lists	It involves responding to a given stimulus, primarily on the basis of memory. The nature of information requires precision and exactness. It should not differ too much from the way it was originally learnt.
	2. Recognizes	It requires identifying the correct response merely on the basis of memory without going into the basis of inappropriateness of alternative responses.

Under-standing	3. Translates	Renders in the required medium material from another given medium faithfully, giving the closest possible equivalent of the original.
	4. Illustrates/ Cites examples	Cites (produces) some similar material verbal or otherwise to clarify a point.
	5. Identifies	Shows in a familiar situation as to what is the correspondence between two sets of familiar data.
	6. Compares	Draws out similarities and dissimilarities between sets of data, terms, trends, etc. It can be both on the basis of given criteria or unspecified criteria.
	7. Discriminates	Draws distinctions on some basis between closely related facts, events, ideas, etc.
	8. Classifies	Groups together facts, terms, etc. into homogeneous categories on the basis of criteria provided or implied.
	9. Interprets	Draws meaning from extracts, maps, charts, graphs, table, data, etc.
	10. Summarizes/ Sequences 11. Establishes relationship	Condenses a communication by picking up main ideas and deleting trivial details. Brings out new association(s) or relationship between sets of facts, principle, etc. for the understanding of the new problem.
	12. Gives reasons for cause effect relation	Using the systematic knowledge, explains why and how some process, procedure, material is taking place along with the underlying relationships.

Application	13. Analyses	Breaks down a communication or situation into components and according to the required criteria solves the issue. Clarifies communications, discovers basis for its organization and/or underlying assumptions.
	14. Predicts	Considers the situation in the light of available data and infers about the future events of phenomena, trends, etc.
	15. Infers	Analyses and examines the data and arrives at certain conclusions of decisions pertaining to a situation.
	16. Generalizes	Observes similarities in otherwise different things in a way to derive a principle inductively.
Skill	17. Draws diagrams	Draws diagrams accurately and neatly, etc. displaying the quality of skill expected of the class concerned.
	18. Labels diagrams	Puts correct names, etc. in the map, methodologically and in a systematic manner for recognition as desired.



Summary of Instructional Objectives and frequently used Action Verbs

Questions - Types, Characteristics and Limitations

1. Essay Type Questions

An essay type question is one where the response to a question is extended. There is no single correct response. Accuracy and quality of response can be evaluated by a person who knows the topic. These questions require the candidate to select relevant facts, organize them and write the answer in his own words. They generally open with such words as "Explain", "Describe", "Interpret", "Compare", "Discuss", etc.

Essay type tests have been repeatedly criticized by those who are interested in the scientific measurement of achievement but little effort has been made to improve their reliability in spite of the fact that they are widely used by the classroom teacher. If properly constructed, they can measure important outcomes of learning, which cannot be measured otherwise. They have other potential values and unique advantages as an educative influence. On account of their usefulness, there is a need to further improve these questions.

Essay type questions are easy to administer. They can be easily adapted to the various school subjects. Higher mental processes like ability to organize, interpret, summarize, etc. are better evaluated by essay type questions. For constructing better essay type questions, the following considerations may be kept in view :

Requisites of Essay Type Questions

1. Essay type questions should be set to test only those instructional objectives, which are not amenable to testing by other forms.
2. Each question should be set to test specific mental processes or learning outcomes implied by the objectives in view.
3. Phrase questions in such a way that their meaning and intent are clear to the examinee.

4. Structure questions in such a way that the scope of the expected answer is clear.
5. Directional words like "What do you know of", "Give an account of", "Write short notes" may be avoided or clearly defined to avoid vagueness of answers and consequent subjectivity of scoring.
6. Maturation level of examinee must be taken into consideration while constructing an essay question. Length and nature of answer will differ from class to class. For example, questions requiring discussion, interpretation, summarization and valuation may be asked in higher classes whereas questions like listing, describing, selecting etc. may be considered for lower classes.
7. Marks should be clearly allocated part-wise, whenever there are more than one parts in the same essay type question.

Need for Training of the Students

Reliability of essay type examinations can further be improved if the students are trained properly through the use of such questions in day to day testing programme in home examinations. They need to be familiarized with the method of attempting such questions in accordance with the connotation of the various words especially the directional words used to circumscribe the nature and scope of the answers expected. This will ensure to a great extent, the consistency in each students' understanding of what he is required to write in response to a particular question and the way the teacher is going to grade it.

Short Answer Questions

Essay type questions suffer from the lack of objectivity and reliability while objective type questions are often too small to test certain aspects of growth. Short answer questions are a good via-media between the two extremes and serve a useful purpose in overcoming the shortcomings of either type, if understood and framed properly by the teachers. Limits of short answer question cannot be clearly demarcated. For the sake of convenience we can adopt the following criteria. It may be a question whose answer

1. may be within 50-60 words
2. may be two to six-seven lines
3. may have 2 to 4 credit points
4. can be answered in 3 to 5 minutes

The advantages of short answer questions are as under :

- Short answer question can be used profitably in both external and internal examinations.
- It can be used to test almost all the objectives of teaching.
- It helps students to develop the ability of organizing and selecting relevant facts.
- They can be scored more objectively than essay type questions and thereby ensure reliability.
- These questions help in covering more syllabus because more number of these questions can be put in place of one essay type question. This improves the validity of the question paper also.

Constructing Short Answer Questions

Following suggestions can help in formulating good short answer questions :

- Determine the ability to be tested and frame the question based on it. Generally questions of understanding are best suited to short answer question. Compare and contrast, classify, explain in brief, summarize, etc. are the key words which can be used as directional words. Ability to express precisely can also be tested.
- Do not frame the short answer questions in such a way that a student is tempted to write a short note on the answer. The question should be pinpointed with a specific task.

A short answer question should be framed in such a way that it has a definite answer. Complicated questions involving discussions and explanations can be broken down into several short answer questions. To make the questions more precise, the writer should keep in mind the language and the directional words to be used and the scope of the intended answer.

Short answer questions are of different varieties :

i) What is the time period of Halley's comet? (Question Form).

ii) The dimensional formula for the coefficient of viscosity is

a)

b)

c)

d)

(Multiple choice type – Applies – Uses the relation)

3. Very Short Answer Questions

Very short answer type questions are those which require one word, one phrase or at the most one sentence answer. These questions generally are for one or half mark each and have one testing point.

Very short answer type questions can be profitably used in internal as well as external examinations. They ensure better validity because more syllabus can be covered by using a number of V.S.A. questions than an essay type question. Moreover, these questions can be scored more objectively than essay type questions, hence providing better reliability to the test.

Very short answer questions are very useful in testing definitions, meanings of scientific terms, equations, formulae etc. They can thus be very profitable items of evaluation.

Very short answer questions may be of different types like fill in the blanks, completion type, statement of definitions, formulae, values, etc.

Constructing Very Short Answer Question

The following points are suggested for constructing very short answer type questions.

- To require a single and unique answer, word the question or incomplete statement carefully.
- Before writing a question think of the intended answer first. Then write the question to which that answer is the only appropriate response.
- Use a direct question, unless the complete sentence permits a more concise or clearly defined correct answer.
- Avoid unintended clues to the correct answer.
- Word the item as precisely as possible without losing the meaning it intends to convey.
- Avoid using the textbook language in working of an important idea as the basis for a very short answer item.

Constructing Selection Type Questions

Selection type questions are all objective type questions. Objective-based and objective type tests are often confused with each other. When a question is framed with the deliberate attention to the objective which we want to measure, it is an objective-based or objective centred question. Such questions may be of any form like Essay type, Short answer type, Very short answer type or Objective type. But when a question is designed to test the students' achievement in an objective way rather than subjective we can call it objective type question. In an objective type question, there is no space for the evaluator's subjectivity. Whoever scores such questions, scores them the same way as the answers are not supplied by the student but selected by them.

Forms of objective Type Questions

There are various forms of objective type tests like True / False type, Yes/ No type, Multiple Choice type, Multiple Selection type, etc. Of these multiple choice type and multiple selection type are most important and widely used in many competitive tests.

3. Multiple Choice Questions

The basic form of all the objective tests is the multiple choice type. As said earlier, it consists of a stem which may be in the question form or in an incomplete statement. The students' task is to select from the given alternatives the one that is correct. For example :

i) *Electromagnetic radiation in the frequency range 6×10^{14} belong to*

   a) *IR region*

   b) *Visible region*

   c) *UV region*

   d) *Microwave region*

   (Knowledge, Recall)

ii) *A one meter long wire is bent at 180^o in the middle and the two halves are twisted together. The effective resistance of the wire*

   a) *increases*

   b) *decreases*

   c) *remains the same*

   d) *becomes zero*

   (Understanding, See relation)

The effectiveness of the item should depend on how best the item is framed to test the desired objective.

Constructing Multiple Choice questions

Following points may be kept in view while constructing the multiple choice items :

1. Do not use multiple choice type items when only some memorized fact has to be recalled or when answer in mathematical problem has to be got by simple calculation.
2. Give three or more but not more than five alternatives/ distractors.
3. See that there is only one choice which is correct and avoid choices overlapping with one another.

4. Have a clear central problem in each item. Multiple choice item should not be mere four or more unrelated true false statements connected by a leading question like “which is true”.
5. Make the stem part of the item containing the central problem including in it as much of the items as possible. Choices should not contain anything which would have better been out in the stem.
6. If possible, avoid negatively stated item, as it is likely to confuse the examinee. When it is given, the word, ‘not’ may be either given in capitals or underlined.
7. Avoid the use of textbook language. Mislead the rote learner by using familiar or stereotyped phrases for distractors.
8. See that all choices provided are sufficiently plausible to be selected by a fair proportion of the examinee. Both correct and incorrect choices should be homogeneous in their mode of expression, length and other external characteristics. The distracters should represent errors commonly made by the students who are to be tested.
9. Avoid making the correct response consistently longer or consistently shorter than the distracters.
10. The correct choice must be different from the distracters consistently in meaning only with no superficial verbal clues.
11. Make sure that articles that ‘a’, ‘an’, ‘the’, do not serve as clues to the correct choice.
12. Arrange the choices in logical order, if one exists.
13. See that the position of the correct answer in the series is chosen entirely at random. Use first and last places as often as the intermediate places.

Table 1

Summary comparison of different Forms of Questions

Sl. No.	Aspect	Essay	Short Answer	Objective Type
1.	Objectives tested	Can be used for testing all objectives, more effective for	Can be used equally effectively for all objectives.	Cannot be used for testing expression, ability to

		certain higher objectives.		organize skill, etc.
2.	Sampling of content	Gives a very poor sampling of content.	Helps in increasing the sample.	The use of a large number of items results in broad coverage, which makes representative sampling possible.
3.	Subjectivity of scoring.	There is a lot of subjectivity of scoring.	Subjectivity of scoring is controlled.	No subjectivity of scoring.
4.	Ease of scoring	Very difficult to score	Comparatively easy to score	Extremely easy score
5.	Ease of preparation	Very easy to prepare	Moderately easy to prepare	Difficult to prepare
6.	Bluffing in answers	Quite possible	Limited	Not at all
7.	Guessing	Not possible	Very little	Quite possible
8.	Halo effect	Predominant	Controlled	Impossible

Action Verbs for testing different objectives

Different action verbs or instructional words are used for testing different objectives. Some action verbs are given below objectivewise.

Knowledge : For testing knowledge of information, following action words may be used. Define, describe, explain, name, list, outline, state, select, recognize, pinpoint, reproduce, identify, match, relate, narrates, find errors, etc.

Understanding : As the abilities involved in understanding are translation, interpretation, inference, extrapolation, comparison, etc. the following action verbs can be used while framing different types of questions.

Write in your own words, rephrase, illustrate, give example, translate, convert, distinguish, compare, contrast, differentiate, classify, arrange, rearrange the sequence, give reasons, justify, discuss, explain, summarise, express, estimate, predict, identify, give the title, identify the main idea or theme, select etc.

Application : For testing application, the student has to analyze, synthesize, apply in an unfamiliar situation, solve problems and evaluate. The action words used for testing application will depend on the context. However, some commonly used action verbs are given below :

Analyse, categorize, synthesize, design, argue, appraise, rate, evaluate, support, defend, judge, value, predict, estimate, discuss, determine, formulate, construct, compose, assemble, combine, etc. It may be noted that many of the action verbs may overlap with different objectives and this will depend on the context in which these terms are being used. It is the context that will in fact decide the actual objective that is being tested.

Considerations for deciding a particular form of question :

Each form of question has its own specific nature and its own strengths and limitations. In fact it is the situation in which a question is used that gives it its advantages or disadvantages.

While selecting a particular form one should keep in mind :

- the purpose of testing
- the objective of testing
- the level of students
- the time and resources available

First PUC

UNIT 1 : INTRODUCTION

Chapter 1 : Introduction to Physics

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Which planet was discovered by the mathematical prediction? Ans: Neptune (1 mark)	K Recall Easy
2.	What is the time period of Halley Comet ? OR Halley's Comet entered the solar system in the year 1986; it is expected again in the year .... Ans: 76 years OR 2062. (1 mark)	K Recall Easy
3.	Name any one Indian scientist who was awarded the Nobel Prize in Physics. Any one name. Sir C V Raman and Prof.S.Candrashekhar (1 mark)	U Locate Easy
4.	Give an example for scientific discovery through theoretical prediction. Ans: Neptune (1 mark)	K Recall Easy
5.	Observations of irregular speed of which planet led to the prediction and subsequent discovery of the planet Neptune. Ans: Uranus (1 mark)	K Recall Easy
6.	What is scientific method? It is a method used in science which involves making a systematic observation using proper reasoning, taking the help of models and the theoretical calculation for the prediction. (1 mark)	U Recall Easy

Chapter 2 : Scalars and Vectors

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	What is a vector? Physical quantities having magnitude and direction. (1 mark)	K Recall Easy
2.	Give one example for a vector? Any example (1 mark)	K Recall Easy
3.	What is a scalar? Physical quantity which has only magnitude. (1 mark)	K Recall Easy
4.	Give the geometrical representation of a vector. Draw a straight line with an arrow mark. (1 mark)	K Recall Easy
5.	Name the vector which has unit magnitude. Unit vector (1 mark)	K Recall Easy
6.	Which are the basic properties of a vector? 1. Magnitude, 2. Direction (2 marks)	K Recall Easy
7.	A bus is moving with a velocity of 100 km/h from East to West represent the vector? Representation (2 mark)	A Applies Average
8.	Find the modulus of $\vec{A}$. Ans: A (1 mark)	U Relates Average

9. State triangular law of vector addition. K Recall Easy

Statement (1 mark)

10. State parallelogram law of vector addition. K Recall Easy

Statement (1 mark)

11. What is resolution of vector? K Recall Easy

Splitting of vectors into component. (1 mark)

12. Name the single vector which produces the same effect as that of individual vectors. K Recall Easy

Resultant (1 mark)

13. Write the expression for the resultant vector in parallelogram law. K Recall Easy

$\vec{R} = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$ (1 mark)

14. How a unit vector can be represented? K Recall Easy

$\hat{A}$ or any representation with cap. (1 mark)

15. How much is the magnitude of a unit vector? K Recall Easy

Ans: One (1 mark)

16. Write the value of the angle between $\hat{i}$ and $\hat{j}$. U Relates Average

Ans: $\theta = 90^{\circ}$ (1 mark)

17. If $\vec{A} = 9\hat{i} + 6\hat{j}$ and $\vec{B} = 6\hat{i} + 4\hat{j}$, find the value of $\vec{A} - \vec{B}$. A Applies Easy

$\vec{A} - \vec{B} = 3\hat{i} + 2\hat{j}$ (1 mark)

18. Define dot product of two vectors. K Recalls Easy

Correct statement. (1 mark)

19. Mention two types of vector multiplication. K Recalls Easy

1. Dot product
2. Cross product (1 mark)

20. Give one example for scalar product. K Recalls Easy

Ans: (work) W = $\vec{F} \cdot \vec{S}$ (1 mark)

21. Give one example for cross product. K Recalls Easy

Any one example. (1 mark)

22. If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$ find the angle between $\vec{A}$ and $\vec{B}$. U Applies Average

$\vec{A} \times \vec{B} = AB \sin\theta$

$\Rightarrow \theta = 90^{\circ}$ (1 mark)

23. If $\vec{A} \bullet \vec{B} = 0$ find the angle between $\vec{A}$ and $\vec{B}$. A Applies Average

$\vec{A} \bullet \vec{B} = AB \cos\theta = 0$

$\cos\theta = 0$

$\theta = 90^{\circ}$ (1 mark)

24. If $\vec{A} \times \vec{B} = 0$ find the angle between $\vec{A}$ and $\vec{B}$. A Applies Easy

$\vec{A} \times \vec{B} = AB \sin\theta$

$\sin\theta = 0$

$\theta = \sin^{-1}(0)$

$\theta = 0$

(1 mark)

25.	Which type of vector multiplication does not obey commutative law? Ans: Cross product (1 mark)	U Interpret Average
26.	For which angle between two vectors the sum of two vectors is maximum. Ans: $\theta = 0$ (1 mark)	U See relationship Average
27.	Group the following into vectors and scalars. 1. Mass, 2. Weight, 3. Speed, 4. velocity, 5. Momentum 6. Temperature Correct grouping (2 marks)	U Classify Average
28.	For which angle the sum of two vectors is minimum? Ans: $\theta = 180^{o}$ (1 mark)	U See relationship Average
29.	Distinguish between scalars and vectors. Any two differences. (2 marks)	U Classify Average
30.	Distinguish between scalar product and vector product. Any two differences. (2 marks)	U Classify Average
31.	Define scalar product. Give one example. Definition and one example. (2 marks)	K Recall Easy
32.	Define cross product. Give one example. Definition and example. (2 marks)	K Recall Easy
33.	State and explain triangular law of vector addition.	K Recall Easy

Explanation (1 mark), Diagram (1 mark)

34. State and explain parallelogram law of vector addition. K Recall Easy

Diagram (1 mark), Explanation (1 mark)

35. If $\vec{F} = 4\hat{i} + 6\hat{j}$ and $\vec{S} = 6\hat{i} + 3\hat{j}$, find $\vec{F} \cdot \vec{S}$. A Solves Average

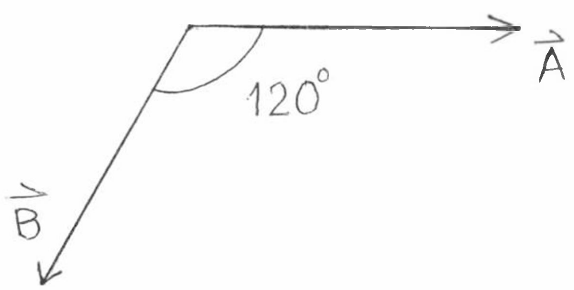
$\vec{F} \cdot \vec{S}$ = F $(4\hat{i} + 6\hat{j}) \cdot (6\hat{i} + 3\hat{j})$ (2 marks)

36. If $\vec{r} = 5\hat{i} + 6\hat{j}$ and $\vec{S} = 7\hat{i} + 8\hat{j}$, find $\vec{r} \times \vec{S}$. A Solves Average

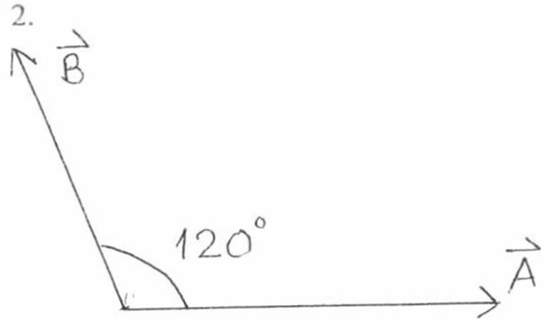
$\vec{r} \times \vec{S} = (5\hat{i} + 6\hat{j}) \times (7\hat{i} + 8\hat{j})$ (2 marks)

37. Find $\vec{A} \times \vec{B}$ in the following two figures. U See relation Average

1.



2.



(1 mark each)

38. The magnitude of two vectors $\vec{A} = 4.0\hat{i} + 6.0\,\hat{j} - 1.0\,\hat{k}$ and $\vec{B} = 6.0\hat{i} + 5.0\,\hat{j} + 4\hat{k}$ are respectively. — A, Solves, Average

a) $\sqrt{53}$, $\sqrt{77}$

b) $\sqrt{52}$, $\sqrt{77}$

c) $\sqrt{52}$, 0

d) $\sqrt{77}$, $\sqrt{53}$

Ans: a)

Chapter 3: Units and Dimensions

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Give an example for a physical quantity. Any suitable example. (1 mark)	K Recall Easy
2.	What is meant by unit of measurement? The **standard quantity** in terms of which the physical quantity is measured. (1 mark)	K Recall Easy
3.	What are Fundamental Physical Quantities? The physical quantities which are measured and expressed *independently* are called Fundamental Physical Quantities. (1 mark)	K Recall Easy
4.	Give one example for Fundamental Physical Quantity. Any one example. (1 mark)	K Recall Easy

5. What is a derived physical quantity ? K Recall Easy

The physical quantity which is *derived from fundamental* physical quantity. (1 mark)

6. Give one example for a derived physical quantity. K Recall Easy

Any one example. (1 mark)

7. Which are the two desirable characteristics of a unit ? K Recall Easy

Accessible and invariable. (1 mark)

8. Define the dimensions of a physical quantity. K Recall Easy

Correct definition. (1 mark)

9. What is dimensional formula? K Recall Easy

Correct meaning (1 mark)

10. State the principle of Homogeneity. K Recall Average

Correct principle. (1 mark)

11. Write the dimensional formula for force. K Recall

Ans: MLT^{-2} (1 mark)

12. Write the dimensional formula for force. U Relate Average

Ans: $[LMT^{-2}]$ (1 mark)

13. Write the dimensional formula for surface tension. U Relate Average

Ans: $[L^{0}MT^{-2}]$ (1 mark)

14. Write the dimensional formula for Planck's constant. U Relate Average

Ans: $[L^2 MT^{-1}]$ (1 mark)

15. Write the dimensional formula for pressure. U Relate Average

Ans: $[L^{-1} MT^{-2}]$ (1 mark)

16. Write the dimensional formula for frequency. U Relate Average

Ans: $[L^o M^o T^{-1}]$ (1 mark)

17. Write the dimensional formula for Impulse of a force. U Relate Average

Ans: $[LMT^{-1}]$ (1 mark)

18. Write the dimensional formula for couple. U Relate Average

Ans: $[L^2MT^{-2}]$ (1 mark)

19. Write the dimensional formula for stress. U Relate Average

Ans: $[L^{-1}MT^{-2}]$ (1 mark)

20. Write the dimensional formula for work. U Relate Average

Ans: $[L^2MT^{-2}]$ (1 mark)

21. Write the dimensional formula for moment of Inertia. U Relate Average

Ans: $[L^2MT^o]$ (1 mark)

22. Write the dimensional formula for Torque. U Relate Average

Ans: $[L^2MT^{-2}]$ (1 mark)

23.	Give an example for dimensionless physical quantity. Ans: Strain, refractive index, angle measurement, etc. (1 mark)	K Recall Easy
24.	Mention a physical quantity which has a unit but no dimension. Angle, electric charge, temperature, etc. (1 mark)	K Recall Easy
25.	Name the two supplementary S.I. units. Plane angle and solid angle. (1 mark)	K Recall Easy
26.	Distinguish between Fundamental and derived Units. Any two differences. (2 marks)	K Recall Easy
27.	Give a pair of physical quantities having same dimensional formula. Work-energy, Impulse-momentum, work-couple, etc. (1 mark)	K Recall Easy
28.	Write the dimensional formula for Gravitational constant using Universal law of gravitation. $F = \frac{G\, m_1\, m_2}{d^2}$ or $G = \frac{Fd^2}{m_1\, m_2}$ (2 marks) $= [L^3M^{-1}T^{-2}]$	K Recall Easy
29.	Write the dimensional formula for coefficient of viscosity. Ans: $[L^{-1}\, MT^{-1}]$ (1 mark)	K Recall Easy
30.	Write any two merits of dimensional analysis. Any two merits. (1 mark each)	K Recall Easy

31.	Write any two demerits of dimensional analysis. Any two demerits. (1 mark each)	K Recall Easy
32.	Check the correctness of an equation v = u + at with dimensional notation. Verification (2 marks)	K Recall Easy
33.	Mention any two differences between fundamental and derived units. Any two differences. (2 marks)	K Recall Easy
34.	Derive an expression for velocity of sound in air using dimensional analysis if velocity of sound depends on pressure and density of the medium. 1. Factors depends 2. Applying of principle of homogeneity 3. Finding of constants 4. Obtaining final expression (1 mark each)	K Recall Average
35.	Derive an expression for the time period of simple pendulum using dimensional analysis. 1. Factors depends 2. Applying the principle of homogeneity 3. Finding of constants 4. Obtaining final expression (1 mark each)	K Recall Easy
36.	Derive the expression for pressure of a liquid using dimensional analysis if the pressure depends on (1) height, (2) density, (3) acceleration due to gravity. 1. Factors depends 2. Applying of principle of homogeneity 3. Finding of constants 4. Obtaining final expression (1 mark each)	K Recall Average

37. The centripetal acceleration depends on (1) velocity of a particle, (2) radius of circular orbit. Obtain the relation between them using dimensional analysis. — K Recall Easy

1. Factors depends
2. Applying of principle of homogeneity
3. Finding of constants

Obtaining final expression (1 mark each)

38. Check the correctness of an equation : — K Recall Easy
    a) PE = mgh
    b) KE = ½ mv^2

1. Writing dimension for LHS
2. Writing dimension for RHS
3. Verification

(1 mark each)

39. Convert 1 joule in terms of ergs using dimensional analysis. — K Recall Easy

1. Writing of dimension of work.
2. Writing of dimension of work in SI and CGS.
3. Applying
4. Getting final answer.

(1 mark each)

40. Convert 1 newton into dynes using dimensional analysis. — K Recall Easy

1. Writing dimensions for force.
2. writing dimensions for force in SI and CGS.
3. Applying
4. Getting final answer.

(1 mark each)

41. State the principle of homogeneity. Write any two advantages and disadvantages of dimensional analysis. — K Recall Easy

1. Principle
2. Any two advantages
3. Any two disadvantages

(1 mark each)

42. The dimensional formula for $\frac{1}{\mu_o \in_o}$ is

A
Applies
Average

a) $M^oL^1T^{-1}$
b) $M^oL^2T^{-2}$
c) $M^oL^2T^{-1}$
d) $M^1L^2T^{-2}$

Ans: a)

UNIT 2 DYNAMICS

Unit 4: Motion in one Dimension

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	What is a rigid body?	K Recall Easy
	A body cannot change its shape or size by the application of force. (1 mark)	
2.	When is the particle said to be at rest?	K Recall Easy
	If the particle does not change its position with respect to its surroundings. (1 mark)	
3.	When is the particle said to be in motion?	K Recall Easy
	If the particle changes its position with respect to its surroundings. (1 mark)	
4.	Give an example for one dimensional motion.	K Recognize Easy
	A particle moving along a straight line in direction. (1 mark)	
5.	What is a position - time graph?	K Recall Easy
	When instantaneous position of a particle is plotted versus time. (1 mark)	
6.	What does the slope of position-time graph represent?	K Recall Easy
	Ans: Velocity (1 mark)	

7. Draw a position-time graph when a particle is moving with uniform velocity. K Label Easy

Correct graph (1 mark)

8. Draw a P-t graph when a particle at rest. K Label Easy

Correct graph (1 mark)

9. A body is projected upwards in an inclined plane reaches the extreme point and returns back. Draw the v-t graph for the same. K Recall Easy

Correct graph. (1 mark)

10. Draw a P-t graph of a particle moving with increase in velocity. K Label Average

Correct graph. (1 mark)

11. Draw a P-t graph of a particle moving with decrease in velocity. K Label Easy

Correct graph. (1 mark)

12. What is v-t graph? K Recall Easy

A graphical representation of instantaneous velocity versus time. (1 mark)

13. What is the slope of v-t graph represent? K Recall Easy

Ans: Acceleration (1 mark)

14. Draw the v-t graph of a particle moving with uniform velocity. K Label Average

Correct graph(1 mark)

15. Draw the v-t graph of a particle moving with variable velocity. K Label Average

Correct graph (1 mark)

16.	Draw the v-t graph of a particle moving with uniform accelerated motion. Correct graph (1 mark)	K Label Average
17.	Draw the v-t graph of a particle moving with uniform retardation. Correct graph (1 mark)	K Label Average
18.	What does the area under v-t graph represent? Ans: Displacement (1 mark)	U Interpret Easy
19.	When a particle is moving with uniform velocity, what is its acceleration? Ans: Zero (1 mark)	K Recall Easy
20.	Under what conditions, the distance covered by a particle is equal to its displacement when the particle moves along a straight line? In the same direction and constant velocity. (1 mark)	U Discriminate Average
21.	What is a – t graph? Instantaneous acceleration of a particle against time. (1 mark)	K Definition Easy
22.	Draw the a-t graph representing a particle moving with constant acceleration. Correct graph (1 mark)	K Label Easy
23.	Draw the a – t graph representing a particle moving with increasing acceleration. Correct graph (1 mark)	K Label Easy
24.	Draw the a – t graph representing a particle moving with decreasing acceleration. Correct graph (1 mark)	K Label Easy

25. Draw the a – t graph representing a particle moving with various acceleration. K Label Easy

Correct graph (1 mark)

26. What is relative velocity? K Recall Easy

Velocity of one object with respect to another object. (1 mark)

27. Mention the S.I. unit of rate of change of acceleration. K Recall Easy

Ans: m / s^3 (1 mark)

28. Give an example for accelerated motion. K Recall Easy

Circular motion with uniform speed. (1 mark)

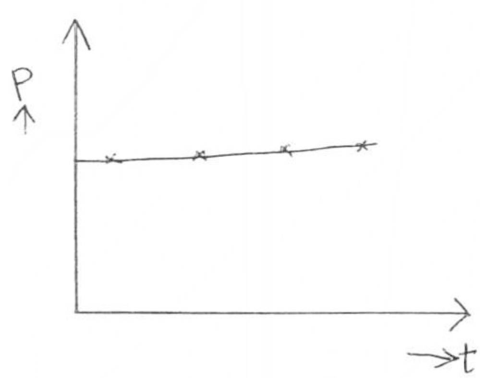
29. Distinguish between distance and displacement. U Classify Average

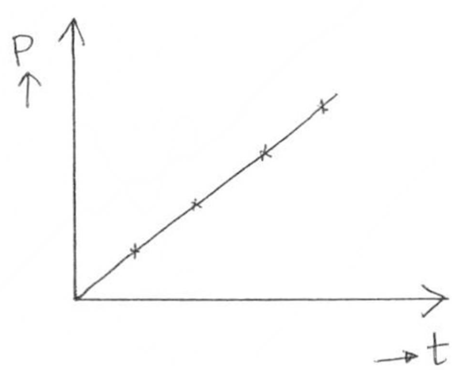
Any two relevant differences. (2 marks)

30. Distinguish between speed and velocity. U Classify Average

Any two relevant differences (2 marks)

31. What type of motion of a particle do the following graphs represent? K Recognize Easy





1. Rest. 2. Uniform velocity (1 mark each)

32. Derive $v = u + at$ by graphical method. — U, Describe, Average

Graph – 1 mark, Derivation – 1 mark

33. The equation of motion of a body is given by $s = 1.5\ t + 0.36\ t^2$. What is the acceleration of a particle? — A, Compute, Average

Ans: $a = 0.72\ m/s^2$ (1 mark)

34. Mention two uses of v – t graph. — A, Applies, Average

Any two. One mark each.

35. Write any one equation of motion and explain the terms used. — K, Recognize, Easy

Any one equation –1 mark. Term expansion – 1 mark.

36. Write the expression for the relative velocity when two particles are moving along the same direction. — U, See relationship, Average

Ans: $v_{AB} = v_A - v_B$ (1 mark)

37. Write the expression for the relative velocity when two particles are moving along the opposite direction. — U, See relationship, Average

Ans: $v_{AB} = v_A + v_B$ (1 mark)

38. Mention any two equations of motion under gravity in the case of a freely falling body. — U, Applies, Average

Any two equations. One mark each.

39. Define acceleration due to gravity. — K, Recall, Easy

The acceleration of a particle towards the earth under the action of gravity. (1 mark)

40. What does the area under the acceleration – time graph represent? K Recognize Easy

Increase in velocity. (1 mark)

41. What is v – t graph? Write its significance. K Recall Easy

Definition – 1 mark. Four significance – 1 mark each.

42. Derive $S = ut + \frac{1}{2} at^2$ by graphical method. K Recall Easy

Graph – 1 mark, S = Area of triangle + area of rectangle – 1 mark.
Substitution –1 mark, Simplification – 1 mark,
Final equation – 1 mark.

43. Derive $v^2 = u^2 + 2aS$ by graphical method. K Recall Easy

Graph – 1 mark, slope – 1 mark, squaring – 1 mark, simplification – 1 mark, final equation – 1 mark.

44. A body moving with constant acceleration travels 54 m in the 5th sec and 84 m in the 8th sec at its motion. Find the initial velocity and the acceleration. A Solve Average

$S_n th = u + \frac{a}{2}(2n - 1)$ - 1 mark

$S_5 th = u + \frac{a}{2}(2n - 1)$

$$\left.\begin{aligned} 54 &= u + \frac{a}{2}(9) \quad \ldots.(1) \\ 84 &= u + \frac{a}{2}(15) \quad \ldots..2 \end{aligned}\right\} \text{one mark}$$

$84 = u + \frac{15a}{2}$

$54 = u + \frac{9a}{2}$

Sub $30 = \frac{6a}{2}$ $\therefore$ $a = 10 \text{ m/s}^2$ - 1 mark

From (1)

$$54 = u + \frac{a}{2} \times 9$$

$$54 = u + \frac{10}{2} \times 9 \quad \text{- 1 mark}$$

$$54 = u + 45$$

$$u = 54 - 45$$

$$u = 9 \text{ m / sec} \quad \text{- 1 mark}$$

45. A cyclist moving with a velocity of 8 km/hr in the upward journey of a hill and 32 km/hr in the downward journey. Find the average speed, if the uphill stretches in the same as the downhill. — A Solve Average

Drawing of figure – 1 mark
Formula – 1 mark
Substitution – 1 mark
Simplification –1 mark
Final result with unit – 1 mark

$\frac{2\times 8\times 32}{8+32} = \frac{16\times 32}{\cancel{40}\,20} = \frac{\cancel{256}}{\cancel{20}}$ 12.8 12.8 km/hr

46. A stone projected from the top of a tower when the velocity is $19.6 ms^{-1}$ reaches the ground in 8 sec. What is the height of the tower and the velocity of the stone when it reaches the ground. ($g = 9.8 \text{ m/s}^2$). — A Solve Average

Formula – 1 mark, substitution – 1 mark, height – 1 mark
Formula for velocity – 1 mark, velocity result – 1 mark.

$H = \frac{u^2 \sin^2\theta}{2g} = \frac{19.6 \times 19.6}{19.6}$

$H = 19.6$ m

47. A ball is thrown vertically upwards with a velocity of 20 m/s from the top of a multistory building. The height of the point from where the ball is thrown is 25 mts from ground. The height raised by it is ($g = 10 \text{ m / s}^2$) — A Calculate Easy

a) 20 m
b) 25 m
c) 5 m
d) 45 m

Ans: a)

u = 20 m/s
H = 25 m
H = 1 m
$H = \frac{20\times 20}{20}$ 1m
H = 20 m
v = u + at
s = ?
25 = 20+20

Chapter 5: Newton's Laws of Motion

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	State Newton's first law of motion. Correct statement. (1 mark)	K Recall Easy
2.	Define inertia of rest. Correct definition. (1 mark)	K Recall Easy
3.	Give an example for inertia of rest. Any suitable example. (1 mark)	K Recall Easy
4.	Define inertia of motion. Correct definition. (1 mark)	K Recall Easy
5.	Give an example for inertia of motion. Any suitable example. (1 mark)	K Recall Easy
6.	Define force. Correct definition. (1 mark)	K Recall Easy
7.	Define inertia. Correct definition. (1 mark)	K Recall Easy
8.	Why the blades of a fan keep moving even after the current is cut off? Inertia of motion. (1 mark)	A Applies Average

9.	If a paper placed under a book is pulled out quickly, the book may not move along with it. Why ? Inertia of rest. (1 mark)	U Applies Average
10.	Define linear momentum of a body. Correct definition. (1 mark)	K Recall Easy
11.	How the liner momentum is measured? It is measured by the product of mass and velocity. (1 mark)	K Recall Easy
12.	Write the S.I. unit of momentum. Ans: Kg ms^{-1} (1 mark)	K Recall Easy
13.	Why does an athlete run before he takes a jump? To acquire the necessary momentum. (1 mark)	U See relationship Average
14.	Name the scientist who defined momentum as a quantity of motion. Ans: Sir Isaac Newton (1 mark)	K Recall Easy
15.	Name the factor on which the inertia of a body depends. Ans: Mass (1 mark)	K Recall Easy
16.	A rubber tube is floating on water. What is the resultant force acting on it? Ans: Zero (1 mark)	U See relationship Average
17.	What is the momentum of a body at rest? Ans: Zero (1 mark)	K Recall Easy

18. State Newton's second law of motion. K Recall Easy

Correct statement (1 mark)

19. What is the significance of Newton's second law of motion? K Recall Easy

Momentum, measurement of force. (1 mark)

20. Express Newton's second law in mathematical form. K Recall Easy

Ans: $F = ma$ (1 mark)

21. Mention the S.I. unit of force. K Recall Easy

Ans: Newton (1 mark)

22. Define : newton. K Recall Easy

Correct definition. (1 mark)

23. Mention the gravitational unit of force. K Recall Easy

Ans: kg wt. (1 mark)

24. Give the relation between gravitational unit and absolute unit of force. K Recall Easy

Ans: 1 kg wt = 9.8 N (1 mark)

25. When an automobile is moving with a uniform velocity, what is the net force acting on it ? K Recall Easy

Ans: Zero (1 mark)

26. Give an expression for spring force. K Recall Easy

Ans: $F = - k x$ (1 mark)

27. Define spring constant. K Recall Easy

Correct definition. (1 mark)

28. Mention any one of the basic forces in nature. K Recall Easy

Any one. (1 mark)

29. Which is the strongest force in nature? K Recall Easy

Ans: Nuclear force (1 mark)

30. Which is the weakest force in nature? K Recall Easy

Gravitational force (1 mark)

31. Define impulse of force. K Recall Easy

Correct definition. (1 mark)

32. Define impulsive force. K Recall Easy

Correct definition. (1 mark)

33. Give the S.I. unit of impulse of force. K Recall Easy

Ans: newton × second (1 mark)

34. Give an example of impulsive force. K Recall Easy

Any suitable example (1 mark)

35. Mention the force which is involved in the kicking of football. K Recall Easy

Ans: Impulsive force. (1 mark)

36. Mention any expression for the force acting on the system in the case of variable mass situation. K Recall Easy

$F = v\left[\dfrac{dm}{dt}\right] = velocity\left[\dfrac{change\ in\ mass}{change\ in\ time}\right]$ (1 mark)

37. Give an example for variable mass situation associated with Newton's second law of motion. K Recall Easy

Falling of rain, leakage of water in a moving tank. (1 mark)

38. State Newton's third law of motion. K Recall Easy

Correct statement. (1 mark)

39. Give the significance of Newton's third law of motion. K Recall Easy

Forces always exists in pairs (pair of forces). (1 mark)

40. Which law of motion is involved in swimming? K Recall Easy

Newton's third law of motion. (1 mark)

41. State the law of conservation of momentum. K Recall Easy

Correct statement (1 mark)

42. Give an example of law of conservation of momentum. K Recall Easy

Ans: Rocket (1 mark)

43. On which principle, the recoiling of gun works? K Recalls Easy

Law of conservation of momentum. (1 mark)

44. Mention any one factor on which recoil velocity depends. K Recall Easy

Mass of bullet, mass of gun, velocity of bullet. (1 mark)

45. Which type of frame of reference obeys Newton's laws of motion? K Recall Easy

Inertial frame of reference. (1 mark)

46. Give one example for inertial frame of reference. K Recall Easy

Ans: Earth (1 mark)

47. Which type of frame of reference does not obey Newton's laws of motion? K Recall Easy

Non-Inertial frame of reference. (1 mark)

48. What is the apparent weight of an object when the lift is at stationary? K Recall Easy

Ans: Zero [apparent weight = real weight] [w = mg] (1 mark)

49. What is the apparent weight of an object when the lift is moving downwards with uniform acceleration ? K Recall Easy

Ans: W = mg – ma = m (g – a) (1 mark)

50. What is the apparent weight of an object when the lift is moving upwards with uniform acceleration? K Recall Easy

Ans: W = mg + ma = m (g + a) (1 mark)

51. Give an example for non-inertial frame of reference. K Recall Easy

An elevator accelerating relative to the ground. (1 mark)

52. When does weightlessness of an object take place? K Recall Easy

When an acceleration of the object = acceleration due to gravity (g) (1 mark)

53. The body that is suspended by a rope as shown in the diagram has a weight of 75N. Is 'T' equal to, greater than or less than 75N when the body is moving downward at increasing speed? U Relation Easy

Ans: Less than 75N (app. Weight downward) (1 mark)

54. Compute the weight of 75 kg space ranger (1) on earth, (2) on mass if g = 3.8 ms^{-2}. U Relation Average

1. W = mg = 75 × 9.8
2. W = mg = 75 × 3.8

(2 marks)

55. Distinguish between mass and weight. U Interpret Average

Any two differences (2 marks)

56. Mention the expression for spring force and explain the terms. K Recall Easy

Expression – 1 mark, Terms – 1 mark

57. Give any two basic forces in nature. K Recall Easy

Any two basic forces. (2 marks)

58. Show that the impulsive force is equal to the change in momentum. K Recall Easy

I = force × time - 1 mark
= mat
I = mv - 2 marks.

59. A ball is hit by a batsman. Identify the action and reaction force. U Interpret Average

A ball is hit by a bat – action
After hitting – reaction (1 mark each)

60. Distinguish between inertial and non-inertial frame of reference. (Any two) — K, Recall, Average

Any two differences. (1 mark each)

61. A constant force of 20 N acts on a body of mass 7 kg. Find its acceleration. — U, Computes, Easy

F = ma .....1 mark

$a = \frac{F}{m} = \frac{20}{7}$ ....1 mark

62. Mention an expression for apparent change in the weight of the body when the lift is moving upwards. What is the apparent change in the weight of the body? — K, Recall, Easy

Ans: W = m (g + a) ; increases (1 mark each)

63. Mention an expression for apparent change in the height of the body when the lift is moving downwards. What is the apparent change in the weight of the body? — K, Recall, Easy

Ans: W = m (g – a) ; decreases (1 mark each)

64. Mention an expression for apparent change in the weight of the body when the lift is at rest or moving with uniform acceleration. What is the apparent change in the weight of the body? — K, Recall, Average

Ans: W = mg; No change (1 mark each)

65. A body of mass 40×10^{-3} kg is moving with a constant velocity of 10 ms^{-1}. What is the linear momentum of a body? — U, Computes, Easy

M = mV (1 mark)
$M = 40 \times 10^{-3} \times 10$
$M = 400 \times 10^{-3}$ kg ms^{-1} (1 mark)

66. A bicycle of mass 10 kg and a bus of mass 1000 kg is moving with the same speed in the same direction. Which will have more momentum? — U, Computes, Easy

Ans: Bus (because of more mass) (1 mark)

67. Name any two commonly encountered forces in mechanics. K Recall Easy

Gravitational force; contact force. (2 marks)

68. Name the force which governs the motion of satellite round the earth. K Recall Easy

Ans: Gravitational force (1 mark)

69. Derive an expression for recoil velocity of a gun. K Recall Easy

$MV + mv = 0$ (1 mark)

$V = \frac{-mv}{M}$ (1 mark)

70. State Newton's laws of motion. Derive F = ma where the symbols have the usual meaning. K Recall Average

Statement – 1
Initial momentum–1; Final momentum–1; Change in momentum–1;
Find expression – 1

71. State the law of conservation of momentum and prove the law for a system consisting of two colliding objects. K Recall Average

Statement – 1
Force acts on one body – 1
Force acts on II body – 1
Applying III law – 1
Expression – 1

72. A body of mass 4 kg moving along a straight line with a velocity of 72 km / hr accelerates uniformly under the action of a constant force to attain a velocity of 108 km/hr in traveling a distance of 200m. Calculate the time for which the force acts and the force acting? A Solve Average

$m = 4$ kg; $u = \frac{72 \times 100}{3600} = 20\ ms^{-1}$
$v = 108$ km / hr $= 30\ ms^{-1}$

1. $v^2 = u^2 + 2\,a\,S$ (1 mark)

$900 = 400 + 400\ a$
$a = 1.2\ ms^{-2}$ (1 mark)

2. $v = u + at$ (1 mark)
   $30 = 20 + 1.2\ t$
   $t = \frac{10}{1.2}$ (1 mark)
3. $F = ma$
   $= 4.8\ N$ (1 mark)

73. A body of mass 10 kg moving with a velocity of 9 ms^{-1} splits into 2 parts. One part of mass 6 kg moves in the original direction with a speed of 5 ms^{-1}. What is the velocity of other part? Which direction it moves? — A / Solve / Average

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ (1 mark)
$10 \times 9 = 6 \times 5 + 4\ v_2$
$90 = 30 + 4v_2$
$v_2 = \frac{60}{4} = 15\ ms^{-1}$ (1 mark)
Same direction. (1 mark)

Chapter 6 : Friction

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	When a table is pulled it will not move in the direction of pull upto a limit of force . Name the opposing force present here. Friction (1 mark)	K Recall Easy
2.	A person cannot walk easily on an oiled surface? Why ? Friction reduces (surface - slippery) (1 mark)	U Interprets Easy
3.	Define : coefficient of static friction. Definition (1 mark)	K Recall Easy

4.	Give the definition of frictional force. Definition (1 mark)	K Recall Easy
5.	Define : coefficient of kinetic friction. Definition (1 mark)	K Recall Easy
6.	What is limiting friction? Correct definition (1 mark)	K Recall Easy
7.	Define : angle of friction for kinetic friction. Definition (1 mark)	K Recall Easy
8.	Define : angle of friction for static friction. Definition (1 mark)	K Recall Easy
9.	In which type of friction, the friction is minimum? Rolling friction (1 mark)	K Recall Easy
10.	Mention any one factor on which the coefficient of friction depends. Reactional force or limiting friction. (1 mark)	K Recall Easy
11.	Mention any one advantage of friction. Any one advantage. (1 mark)	K Recall Easy
12.	Mention any one disadvantage of friction. One disadvantage (1 mark)	K Recall Easy

13.	Mention any one method of reducing friction. Any one method (1 mark)	K Recall Easy
14.	Why lubricants are used in a machine? Reduce friction. (1 mark)	U Reason Easy
15.	Why ball bearings are used in vehicles? Reduce friction (1 mark)	U Sees relationship Average
16.	Why rusty materials are not used in machines? To get more efficiency. (1 mark)	U Reason Average
17.	Why frictional force is called as self-adjusting force? Because it is self adjustable when the applied force is increased. (1 mark)	K Recall Easy
18.	Write the relation between angle of friction and the coefficient of static friction. Ans: $\mu_s = \tan\theta$ (1 mark)	K Recall Easy
19.	Mention any two methods of reducing friction. Any two methods (1 mark each)	K Recall Easy
20.	Mention any two advantages of friction? Two advantages (1 mark each)	K Recall Easy
21.	Give two disadvantages of friction.	K Recall Easy

Any two disadvantages (1 mark each)

22. State any two laws of friction. K Recall Easy

Any two laws. (1 mark each)

23. A force of 80 N is required to pull a cart of mass 100 kg over ice. Calculate the coefficient of friction. A Solves Average

$$\mu = \frac{F_{max}}{R} \quad \text{(1 mark)}$$

$$= \frac{80}{mg} = \frac{80}{9.8\times 100} = \frac{80}{980} = \frac{8}{98} \quad \text{(1 mark)}$$

24. Write four methods of reducing Friction. What is friction? K Recall Easy

Each method – 1 mark
Definition – 1 mark

25. Mention any three advantages and two disadvantages of friction. K Recall Easy

Each advantage – 1 mark each
Each disadvantage – 1 mark each

26. When a football is kicked, it rolls on the ground and after covering a short distance comes to rest because U Reason Easy

a) there is a force on the ball opposing its motion
b) the impulsive force acted on the ball is very large
c) there is no unbalanced force on the ball
d) It is its property.

Ans: a)

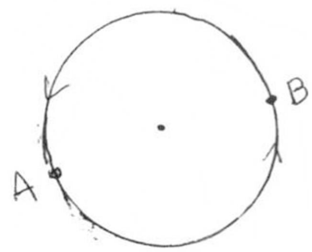
27. A horizontal force of 50 N is needed to hold the block stationary against a wall. The coefficient of friction between the block and wall is 0.2, then the weight of the block is U Compute Easy

a) 20 N
b) 50 N
c) 10 N
d) 50.2 N

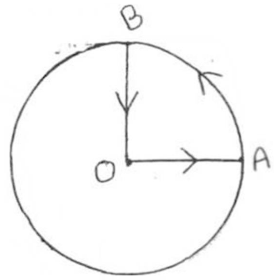
Ans: c)

Chapter 7 : Motion in Two and Three Dimensions

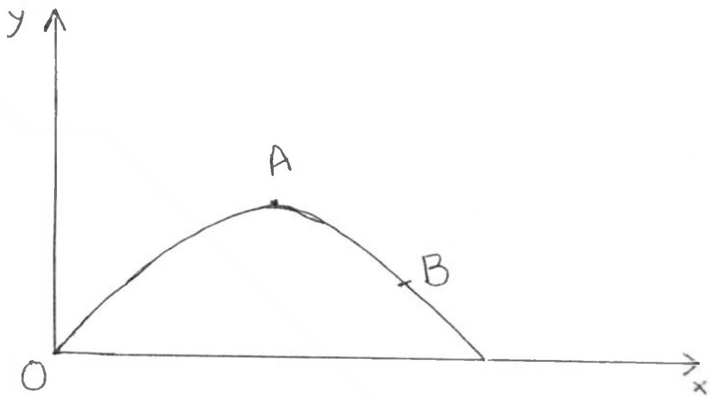
Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	A particle is moving along a circular path as shown in figure. Represent the directions of acceleration and velocity at points A and B. Each marking – 1 mark.	S Draw Difficult



Sl. No.	Question	Obj/ Spec./ Diff. Level
2.	A person starts from the centre of the circular path of radius 500m, reaches the edge A, then moves along the circumference and returns to the centre along BO as shown. If the round trip takes 10 min, what is the (i) net displacement, and (ii) the average velocity of the person? Displacement – 1 mark Average velocity – 1 mark	A Applies Average

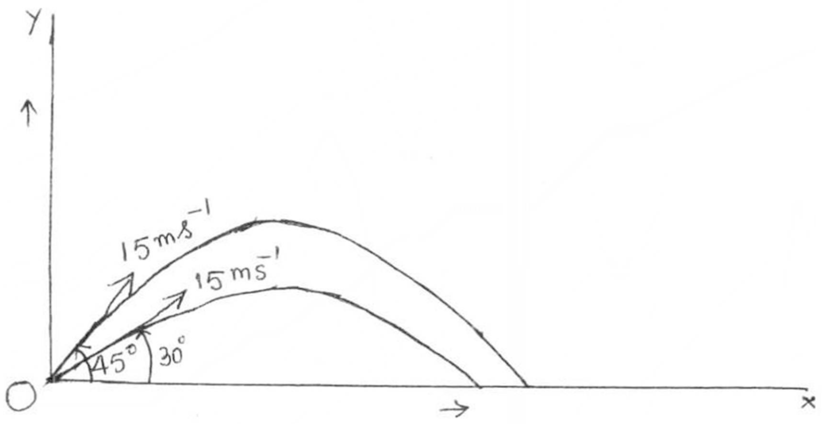


Sl. No.	Question	Obj/ Spec./ Diff. Level
3.	Show the directions of horizontal component, vertical component and resultant velocity of a particle at A and B shown in the graph. For each point 1 mark.	A Applies Average



4. A disc is thrown with an initial velocity 15 m/s into air making an angle at 30^0 with the horizontal. In second throw he throws the disc with the same velocity making an angle at 45^0 with the horizontal. Draw a graph representing it. — S, Draws, Difficult

A graph with proper scale (1 mark)



5. Name the path traced by the projectile. — K, Recall, Easy

Trajectory (1 mark)

6. Give one example for projectile motion. — K, Recall, Easy

One example (1 mark)

7. Define the angle of friction. — K, Recall, Easy

Definition (1 mark)

8. Which component of velocity of projection remains constant with time? — U, See relationship, Average

Horizontal component. (1 mark)

9. Which component of velocity of projection varies with time? — U, See relationship, Average

Vertical component (1 mark)

10. Write the expression for the maximum height of the projectile. K Recall Easy

Expression (1 mark)

11. Write the expression for the horizontal range of the projectile. K Recall Easy

Expression (1 mark)

12. Write the expression for the time of flight of projectile. K Recall Easy

Expression (1 mark)

13. For what angle of projection range is maximum? K Recall Average

Ans: $\theta = 45^{o}$ (1 mark)

14. What is the relation between height and range of projectile when angle of projection is 45^{o}? K Recall Easy

Ans: R = 4 H (1 mark)

15. Define angular velocity. K Recall Easy

Definition (1 mark)

16. Mention S.I. unit of angular velocity. K Recall Easy

Ans: Rad / sec (1 mark)

17. How is frequency related to the time period? K Recall Easy

Ans: $f = \frac{1}{T}$ (1 mark)

18. Write the expression for centripetal acceleration in the form of linear velocity and radius? K Recall Easy

Ans: $a = v^2 / r$ (1 mark)

19.	Write the expression for centripetal force in the form of linear velocity and radius.	K Recall Easy
	Ans: $F = \frac{mv^2}{r}$ (1 mark)	
20.	Mention the force acting through the string when a stone tied to a string rotates?	K Recall Easy
	Centripetal force (1 mark)	
21.	Write expression for linear velocity in the form of angular velocity.	K Recall Easy
	Ans: $v = r\,\omega$ (1 mark)	
22.	Define : period of revolution.	K Recall Easy
	Time required to complete one rotation. (1 mark)	
23.	Define: angle of banking.	K Recall Easy
	The angle by which the outer edge is raised with respect to the inner edge at curved roads. (1 mark)	
24.	Mention one factor on which angle of banking depends.	K Recall Easy
	Velocity, radius of 'g'. (1 mark)	
25.	If the velocity of the vehicle increases, how the angle of banking changes?	U Relation Easy
	Increases (1 mark)	
26.	Instead of a sharp curve, when the radius is more, how the angle of banking changes?	U Relation Easy
	Decreases (1 mark)	
27.	Mention an expression for velocity of a particle in three dimension?	K Recall Easy

Ans: $\vec{v} = v_x \hat{i} + v_y \hat{j} + v_z \hat{k}$ (1 mark)

28. Give one example for three dimensional motion. K Recall Easy

Any example. (1 mark)

29. Mention the factors on which the maximum height of a projected particle depends. K Recall Easy

Ans: u or g. (1 mark)

30. Mention the factors on which horizontal range of projectile depends. K Recall Easy

Ans: u and g. (1 mark)

31. Mention factors on which time of flight depends. K Recall Easy

Depends on u and g. (1 mark)

32. Mention the expression for the angle of banking and explain the terms. K Recall Easy

Expression (1 mark)

33. Mention two factors on which the angle of banking depends? K Recall Easy

Any two factors (1 mark each)

34. Mention the expression for the position of a particle in three-dimensional motion and explain the terms. K Explain Easy

Ans: $\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j} + z(t)\hat{k}$. (1 mark)

35. An object is moving in a horizontal circular path of radius 4 m. Find the centripetal acceleration if it makes 6 rotations/sec. A Computes Average

$$a = \frac{v^2}{r} = \frac{r^2\omega^2}{r} \quad \text{(1 mark)}$$

$$= r\omega^2$$

$$= 4 \times 36 = 144 \text{ m/s}^2 \quad \text{(1 mark)}$$

36. A cyclist moving in a circular path at a speed of 10 m/s with radius 25 m, what is the angle of banking (g = 9.8 mts). — A, Computes, Average

$\theta = \tan^{-1}\left(\frac{v^2}{rg}\right)$ (1 mark)

Answer (1 mark)

37. A projectile is projected with an initial velocity of 25 m/s takes an angle of 30° with the horizontal. Find the maximum height attained by the projectile. — A, Computes, Average

Ans: $H = \frac{u^2 \sin^2 \theta}{2g}$ (1 mark)

Answer (1 mark)

38. A bullet is fired from the gun with a velocity 250 m/s, if the angle of projection is 15°, find the range of projectile. — A, Computes, Average

$R = \frac{u^2 \sin 2\theta}{g}$ (1 mark)

90m (1 mark)

39. A projectile projected with the velocity of 15 m/s at an angle of 45° to the horizontal. Find the time of flight of the projectile ($g = 9.8\ m/s^2$) — A, Computes, Average

$T = \frac{2u \sin \theta}{g}$ (1 mark)

Answer (1 mark)

40. What is a projectile? Show that the trajectory of a projectile is a parabola. — K, Recall, Easy

Definition – 1 mark.
Horizontal velocity, vertical velocity – 1 mark each
Substituting and arriving final expression – 2

41. An object is moving in a circular path with acceleration acting towards its centre. Derive the expression for it. — K, Recall, Easy

Centripetal acceleration – 1 mark
Diagram – 1 mark
Change in velocity along horizontal and vertical – 1 mark
Arriving final formula – 2 marks

42. A javelin is thrown into air with the speed of 30 m/s with an angle of projection 60^o. Find range, height and time of flight of motion.
A
Solves
Average

Range – 1 mark, height – 1 mark,
time of flight – 1 mark, formula – 2 marks

43. A body is projected with the velocity of 10 m/s at an angle of 45^o to the horizontal. Find the trajectory of the projectile.
A
Solves
Average

$y = ax - bx^2$ - 1 mark
$a = \tan\theta$ - 1 mark
$a = 1$

$b = \frac{-g}{2u^2\cos^2\theta}$ - 1 mark

$b = -0.98$
$y = x - 0.98x^2$ - 2 marks

44. Obtain an expression for the horizontal range of a projectile.
K
Recall
Easy

Correct expression. (1 mark)

45. Mention the expression for the time of flight of a projectile and explain the terms used.
K
Recall
Easy

Correct expression (1 mark) and explanation (1 mark).

46. Mention the expression for horizontal range of a projectile and explain the terms used.
K
Recall
Easy

Correct expression (1 mark) and explanation (1 mark)

47. Mention an expression for the maximum height of a projectile and explain the terms used.
K
Recall
Easy

Correct expression (1 mark) and explanation (1 mark)

48. A shell of mass 0.02 kg is fired from a gun of mass 50 kg. If the muzzle speed of the shell is 150 m/s, the recoil speed of gun is
A
Solves
Average

a) 0.02
b) 0.06
c) 0.1
d) 0.6

Ans: b)

49. When a projectile covers some horizontal distance, the angle of projection are

U
See relation
Average

a) 30^{o} and 60^{o}
b) 40^{o} and 80^{o}
c) 30^{o} and 80^{o}
d) 25^{o} and 50^{o}

Ans: a)

50. At the maximum height of a projectile, the direction of its velocity and acceleration are

U
Interprets

a) perpendicular to each other
b) parallel to each other
c) zero and downward
d) opposite to each other

Ans: a)

51. In 1.00 second a particle goes from point A to B, moving in a semi circle of radius 2.0 m, the average speed and magnitude of velocity is

A
Solves
Average

a) 1.571, 4
b) 3.142, 4
c) 2,4
d) 6.284, 4

Ans: a)

52. In which two points in the diagram the magnitude of vertical component are equal.

U
Locate
Average

a) A and C
b) A and B
c) B and D
d) I and /b

Ans: a)

53. Which of the following is zero in a uniform circular motion?

K
Recall
Easy

a) Speed
b) Displacement
c) Acceleration
d) Distance

Ans: b)

54. A passenger in a moving train tosses a coin. If the coin falls behind him, the train must be moving with Average
    a) an acceleration
    b) a deceleration
    c) a uniform speed
    d) any of the above

Ans: a)

55. A food packet is released from a helicopter rising steadily at the speed of 2 m/s. After 2s the velocity of the pocket is ($g = 10\ m/s^2$).
    a) 22 m/s
    b) 20 m/s
    c) 18 m/s
    d) none of the above

Ans: c)

56. A mass 'm' slips along the wall of a semispherical surface of radius R. The velocity of the bottom of the surface.
    a) $\sqrt{Rg}$
    b) $\sqrt{2Rg}$
    c) $2\sqrt{\pi Rg}$
    d) $\sqrt{\pi Rg}$

Ans: b)

57. A body is thrown vertically upward. Which of the following graphs represent the velocity of the body with time?

Ans: d)

58. If an iron ball and a wooden ball of the same radius are released from a height h in vacuum, then time taken by both of them to reach ground will be — U Interpret Difficult
    a) unequal
    b) exactly equal
    c) roughly equal
    d) zero

Ans: (b)

Chapter 8 : Work, Power and Energy

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	When is work said to be done? When a force acts on a body and when it displaces the body in any direction except perpendicular to the direction of the force. (1 mark)	K Recall Easy
2.	Mention the formula for work done, when a body displaced in a direction making an angle with the direction of the force. Ans: $W = F\,S\cos\theta$ (1 mark)	K Recall Easy
3.	Give the mathematical expression for work done on a body displaced in the direction of the force. Ans: $W = F\,S$ (1 mark)	K Recall Easy

4.	Write the S.I. unit of work. Ans: joule (1 mark)	K Recall Easy
5.	Define S.I. unit of work. 1 newton force acting on a body of mass 1 kg, displaces through a distance of 1 m in the direction of force. (1 mark)	K Recall Easy
6.	Give an example, when work done is said to be zero. Earth revolving around the circular orbit. Planets revolving around the circular orbit. Force and work done are perpendicular to each other. (1 mark)	U See relationship Average
7.	When is work done (i) minimum, (ii) maximum? i) $\theta = 90^{o}$, ii) $\theta = 0^{o}$ (1 mark each)	K Recall Easy
8.	A man walks 2m carrying a mass of 15 kg on his hands. Another man walks the same distance pulling the rope behind him. The rope goes over a pulley and a mass of 15 kg hangs at its other end. In which case is the work done greater? Second case (1 mark)	U Interpret Average
9.	Give the graphical representation of work done by a constant force. Correct graph (1 mark)	K Recall Easy
10.	Give the graphical representation of work done by a variable force. Correct graph (1 mark)	K Recall Easy
11.	What does the area under the force against displacement curve represent? Work done (1 mark)	K Recall Easy

12.	Define power. Rate of doing work. ($P = W/t$) (1 mark)	K Recall Easy
13.	Define the S.I. unit of power. 1 joule work is done in one second. (1 mark)	K Recall Easy
14.	Mention the relation between instantaneous power, force and velocity. Ans: $P = Fv$ (1 mark)	K Recall Easy
15.	A person is completing 20J of work in 5 min, another person is completing the 20 J of work in 10 mm. Which person has more power? A person completing the work in 5 min has more power. (1 mark)	U See relationship Average
16.	Give the physical quantity which define the ability to do work or capacity to do work. Ans: Energy (1 mark)	K Recall Easy
17.	Write the types of mechanical energy. 1. Potential energy 2. Kinetic energy. (1 mark each)	K Recall Easy
18.	Define potential energy. Energy possessed by the body by virtue of its position. (1 mark)	K Recall Easy
19.	Give the physical quantity, which define the energy possessed by a body, by virtue of its motion. Kinetic energy (1 mark)	K Recall Easy

20.	Give an example for potential energy. Any one relevant example. (1 mark)	K Recall Easy
21.	Give an example for kinetic energy. Any one relevant example. (1 mark)	K Recall Easy
22.	Mention the expression for potential energy of a spring. Potential energy of a spring = $\frac{1}{2} kx^2$ (1 mark)	K Recall Easy
23.	State Work-Energy theorem. Change in kinetic energy or potential energy of a system is equal to the work done. (1 mark)	K Recall Easy
24.	What is the change in kinetic energy of a particle moving on a circular path with a constant speed? Zero (1 mark)	U See relationship Average
25.	How does the kinetic energy of a particle change when its velocity changes from $-5\ ms^{-1}$ to $+5\ ms^{-1}$? No change (1 mark)	U See relationship Average
26.	Which type of energy is stored in the winding of watch spring? Potential energy (1 mark)	U Interpret Average
27.	State the law of conservation of energy. Statement (1 mark)	K Recall Easy

28.	Energy can neither be created nor be destroyed, what changes take place? Transforms from one form to another. (1 mark)	K Recall Easy
29.	Mention the commercial unit of energy. Ans: kwh (1 mark)	K Recall Easy
30.	When a body is moving along a inclined plane, what is the change in total mechanical energy ? Constant or no change. (1 mark)	K Recall Easy
31.	What is conservative force? Work done by a force depends on only initial and final positions of the object. (1 mark)	K Recall Easy
32.	Give an example for conservative force. Any one relevant example. (1 mark)	K Recall Easy
33.	Mention the work done by a force depends only on the path followed. Non-conservative force. (1 mark)	K Recall Easy
34.	Give an example for conservative force. Any one relevant example. (1 mark)	K Recall Easy
35.	In which type of a collision both momentum and kinetic energy are conserved? Elastic collision. (1 mark)	K Recall Easy
36.	Give an example for elastic collision. Mention any one relevant example (1 mark)	K Recall Easy

37. In which type of collision only momentum is conserved but not kinetic energy? K Recall Easy

Inelastic collision. (1 mark)

38. Give an example for inelastic collision. K Recall Easy

Any one of the relevant example. (1 mark)

39. Define coefficient of restitution. K Recall Easy

Related definition. (1 mark)

40. What is the value of the coefficient of restitution in the case of perfectly elastic collision? K Recall Easy

Ans: $e = 1$ (1 mark)

41. What is the value of the co-efficient of restitution in the case of perfectly elastic collision? K Recall Easy

Ans: $e = 0$ (1 mark)

42. Derive the expression for potential energy. K Recall Easy

Explanation – 1 mark, Derivation – 1 mark.

43. Derive an expression for kinetic energy of a particle. K Recall Easy

Explanation – 1 mark, Derivation – 1 mark.

44. Mention the expression for Potential Energy of a spring and explain the terms. K Recall Easy

Expression – 1 mark, terms explanation – 1 mark.

45. Show that power is equal to the product of force and velocity. K Relation Easy

Definition for power, $P = W/t$ - 1 mark
Final expression $P = F v$ - 1 mark

46. In the special case of an inclined plane, what is the value of θ and find the acceleration in terms of acceleration due to gravity? — K Recall Easy

Ans: $a = g \sin \theta$ 1 mark
showing $a = g$ 1 mark

47. A person weighing 40 kg skips 0.6 m high 20 times. Calculate the work done by the person. — S Solve Average

$W = F S$ 1 mark
Final answer 1 mark

48. Water is falling on the blades of a turbine at a rate of 18000 kg/min. The height of fall is 200 m, find the power gained by the turbine. — U Solve Average

$P = \frac{W}{t} = \frac{mgh}{t}$ 1 mark
Final answer 1 mark

49. Distinguish between conservative and non-conservative forces. — U Classify Average

Any two differences. (1 mark each)

50. Distinguish between elastic and inelastic collisions. — U Classify Average

Any two relative difference (one mark each)

51. An engine lifts 6000 litres of water per hour from a well 25m deep. If 10% of energy of the engine is wasted, the power of the engine is …… — A Solves Average

Formula : 1 mark.
$W = mgh$

Substituting $P = \frac{mgh}{t}$ … 1 mark

Energy used … 1 mark
Final calculation ….. 2 marks

(90% of actual power $= \frac{90}{100} \times P$)

52.	State the law of conservation of energy and prove this in the case of an object sliding down in an inclined plane. Statement : 1 mark Diagram : 1 mark Verification for two steps : 2 marks Final conclusion : 1 mark	K Recall Easy
53.	A body of mass 5 kg at rest explodes into three fragments with masses in the ratio 1 : 1 : 3. The fragments with equal masses fly in mutually perpendicular direction with speeds 2100/s. The velocity of the heaviest fragment is a) 9.9 m/s b) 10.9 m/s c) 99.9 m/s d) 999 m/s Ans: a)	A Solves

Chapter 9 : Rotational Motion and Rigid Body Dynamics

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	When is a body said to be rigid? By the action of external force, there is no change in shape and size of the object. (1 mark)	K Recall Easy
2.	Define angular displacement. Definition (1 mark)	K Recall Easy
3.	Define angular velocity. Definition (1 mark)	K Recall Easy
4.	Define angular acceleration. Definition (1 mark)	K Recall Easy

5. Write any one equation of motion in terms of angular motions. K Recall Easy

Any one (mention) (1 mark)

6. Define moment of inertia. K Recall Easy

Definition (1 mark)

7. Define radius of gyration. K Recall Easy

Definition (1 mark)

8. What is meant by axis of rotation? K Recall Easy

It is the line in the rigid body, along which particles remains at rest during the rotation. (1 mark)

9. Write the expression for moment of inertia of a thin rod. K Recall Easy

Correct expression. (1 mark)

10. Write the expression for moment of inertia of a thin rod. K Recall Easy

Expression (1 mark)

11. Write the expression for moment of inertia of a cylinder. K Recall Easy

Expression (1 mark)

12. Write the expression for moment of inertia of a sphere. K Recall Easy

Expression (1 mark)

13. State law of conservation of angular momentum. K Recall Easy

Statement (1 mark)

14. Mention an example for law of conservation of angular momentum. K Recall Easy

Any one example.

15. Give the relation between angular acceleration and linear acceleration. K Recall Easy

Ans: $a = r\alpha$ (1 mark)

16. Mention the relation between angular acceleration and torque. K Recall Easy

Ans: $\vec{\varsigma} = I\vec{\alpha}$ (1 mark)

17. Mention the expression for moment of inertia and explain the terms used. K Recall Easy

Expression – 1 mark, terms used – 1 mark

18. Mention any two factors on which the moment of inertia depends. K Recall Easy

Mass and radius. (1 mark each)

19. Mention the expression for radius of gyration and explain the terms. K Recall Easy

Expression – 1 mark, Terms – 1 mark

20. Mention the factors on which the radius of gyration depends. K Recall Easy

Mass and perpendicular distance. (1 mark each)

21. State and explain parallel axis theorem. K Recall Easy

Statement – 1 mark, Explanation – 1 mark

22. State and explain perpendicular axis theorem. K Recall Easy

Statement – 1 mark, Explanation – 1 mark

23.	Illustrate the principle of conservation of angular momentum in the case of a spinning ballet dancer. Principle – 1 mark, explanation – 1 mark	K Recall Easy

Chapter 10: Gravitation

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	State Newton's universal law of gravitation. Correct statement – 1 mark.	K Recall Easy
2.	Define gravitational constant. Correct definition – 1 mark	K Definition Easy
3.	Write the relation connecting g and G. Ans: $g = \frac{GM}{R^2}$ (1 mark)	K Recall Easy
4.	Give the value of G in S.I. system. Ans: 6.673×10^{-11} Nm^2 / kg^2 (1 mark)	K Recall Easy
5.	Will the gravitational force between two bodies change, if the medium between them is changed? No, the gravitational force is independent of the medium. (1 mark)	K Recognize Easy
6.	What is the weight of a body? The force of attraction exerted by the earth on a body. (1 mark)	K Recall Easy

7. How does 'g' vary with altitude? — U, Interpret, Average

Decreases (1 mark)

8. How does acceleration due to gravity vary with depth? — U, Recognize, Average

Decreases (1 mark)

9. At which point on the surface of the earth acceleration due to gravity is maximum? — K, Recall, Easy

'g' is maximum at the poles. (1 mark)

10. At which point on the surface of the earth, acceleration due to gravity is minimum? — K, Recall, Easy

'g' is minimum at the equator. (1 mark)

11. What is acceleration due to gravity? — U, Recall, Easy

The acceleration produced in a body due to gravitational force of earth. (1 mark)

12. Write an expression for the mass of the earth in terms of density ρ. — U, Recall, Easy

Ans: $m = \frac{4}{3}\pi R^3 \rho$ (1 mark)

13. How does acceleration due to gravity vary with latitude? — U, Recall, Easy

Increases (1 mark)

14. At infinite distance from the surface of the earth, what is the value of acceleration due to gravity? — U, Recall, Easy

Zero (1 mark)

15. What is the value of acceleration due to gravity at the centre of the earth? — U, Recognize, Average

Zero (1 mark)

16. What will be the weight of an object at the centre of the earth? | U Recognize Average

Zero (1 mark)

17. Define orbital velocity. | K Define Easy

Correct definition. (1 mark)

18. Mention the expression for orbital velocity. | K Recall Easy

$v_o = \sqrt{\frac{GM}{R}}$ or $v_o = \sqrt{\frac{GM}{R+h}}$ or $v_o = \sqrt{gR}$, (1 mark)

19. What is escape velocity? | K Recall Easy

Correct statement (1 mark)

20. Mention the expression for escape velocity. | K Recall Easy

Ans: $v_e = \sqrt{\frac{2GM}{R}}$ or $v_e = \sqrt{2gR}$ (1 mark)

21. Write the value of escape velocity of an object from the earth. | K Recall Easy

Ans: 11.2 km/s (1 mark)

22. Mention any one factor on which the escape velocity depends. | K Recall Easy

Radius of earth, g. (1 mark)

23. The escape velocity is independent of the mass of the object. Justify your answer. | K Recall Easy

The escape velocity is remains constant for all objects. (1 mark)

24.	What is the time period of a geostationary satellite? Ans: 24 hours (1 mark)	K Recall Easy
25.	What is a geostationary satellite? A satellite whose time period is equal to the earth. (1 mark)	K Recall Easy
26.	When do astronaut's feel weightlessness? Correct statement (1 mark)	K Recall Easy
27.	Write any one application of geostationary satellite. Communication, broadcasting, weather condition. (1 mark)	K Recall Easy
28.	We are watching TV programmes. Through which satellite we are getting the information? Geo-stationary satellite. (1 mark)	K Recall Easy
29.	State and explain Newton's universal law of gravitation. Statement – 1 mark, Explanation – 1 mark.	U Explain Easy
30.	Why Newton's law of gravitation is called universal law of gravitation? It does not depend on mass of a body. It does not depend on P, t of the atmosphere. (1 mark each)	U Explain Average
31.	Derive the relation connecting 'g' and 'G'. F = mg and F = $\frac{GMm}{R^2}$ (1 mark) $g = \frac{GM}{R^2}$ (1 mark)	K Recall Easy

32.	Give an expression for the escape velocity and explain the terms. Expression (1 mark), abbreviation expansion (1 mark)	K Recall Easy
33.	Give an expression for the orbital velocity of a satellite/ planet and explain the terms. Expression (1 mark), Abbreviation Expansion (1 mark)	K Recall Easy
34.	Write the expression for the variation of 'g' with altitude. Explain the terms. Expression (1 mark), Abbreviation Expansion (1 mark)	K Recall Easy
35.	Write the expression for the variation of 'g' with depth. Explain the terms. Expression (1 mark), Abbreviation Expansion (1 mark)	K Recall Easy
36.	Give any two differences between inertial and gravitational mass. Any two differences. (1 mark each)	U Classify Average
37.	State any two Kepler's laws of planetary motion. Any two (1 mark each)	K Recall Easy
38.	Find the acceleration due to gravity at a depth 20 km from the surface of earth. $g = 9.8 m/s^2$, $R = 6.4 \times 10^6$ m. Formula – 1 mark, Final result with unit – 1 mark	A Solve Average
39.	Find the acceleration due to gravity at an altitude of 40 km above the surface of the earth. $g = 9.8 m/s^2$, $R = 6.4 \times 10^6$ m Formula – 1 mark, Final result with unit – 1 mark	A Solve Average
40.	State and explain Kepler's laws of planetary motion. Statement – 3 marks, Explanation – 2 marks.	K Recall Easy

41. State and explain Newton's universal law of gravitation and arrive the relation connecting between 'g' and 'G'. — K / Recall / Easy

Statement – 1 mark, Explanation – 1 mark

Derivation of $g = \frac{GM}{R^2}$ (3 marks)

42. 'A' and 'B' are two objects having the gravitational force 6.4×10^{-7} N. When the distance between them is reduced by 2 m, the force increases to 14.4×10^{-7} N. Find their original distance and find the mass of 'A' and 'B' if the mass of 'A' is twice that of 'B'. — A / Calculate / Difficult

$F = \frac{G m_1 m_2}{d^2}$ - 1 mark

Substitution for two distance – 1 mark.

d = 1.5 m (1 mark)

Substitution for one equation – 1 mark

$\left.\begin{array}{l} m_1 = \ldots\ldots\ldots\ldots\ldots \\ m_2 = \ldots\ldots\ldots\ldots\ldots \end{array}\right\}$ 1 mark

43. The mean distance of mars from the sun is 1.524 times that of earth from sun. Then the number of years required for mars to make one revolution about sun is — A / Solves / Average

a) 1.88 years
b) 1.99 years
c) 2.8 years
d) 3.4 years

Ans: a)

Chapter 11: Elasticity

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Mention the property by which matter regains its original shape and size after the removal of deforming force. Elasticity (1 mark)	K Recall Easy

2.	Name the force acting on a body which tends to change its original shape and size. Deforming force (1 mark)	K Recall Easy
3.	When is a body said to be perfectly elastic? Both kinetic energy and momentum is conserved. (1 mark)	K Recall Easy
4.	When is a body said to be inelastic? Only momentum is conserved but not kinetic energy. (1 mark)	K Recall Easy
5.	Define stress. Force / unit area. (1 mark)	K Recall Easy
6.	Mention any one type of stress. Any one of the type. (1 mark)	K Recall Easy
7.	Define strain. Change in dimension to the original dimension. (1 mark)	K Recall Easy
8.	Mention any one type of strain. Any one of the type. (1 mark)	K Recall Easy
9.	State Hooke's law. Statement (1 mark)	K Recall Easy
10.	Define modulus of elasticity. Ratio of longitudinal stress to the longitudinal strain within the elastic limit. (1 mark)	K Recall Easy

11. Give the S.I. unit of modulus of elasticity. K Recall Easy

Ans: N/m^2 or pascal (1 mark)

12. Mention an expression for the Young's modulus of elasticity in the case of a stretched string. K Recall Easy

Expression (1 mark)

13. State and explain Hooke's law. K Recall Easy

Statement – 1 mark, Explanation – 1 mark.

14. Write the expression for the Young's modulus of elasticity in the case of a stretched string. Explain the symbols. K Recall Easy

Expression – 1 mark, explanation of symbols – 1 mark

UNIT 3 STATICS

Unit 12: Concurrent Co-planar Forces

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	What are concurrent forces? Number of forces acting at a point. (1 mark)	K Recall Easy
2.	What are co-planar forces? Forces acting in the same plane. (1 mark)	K Recall Easy
3.	Two forces are acting at a point at an angle 'θ' with each other. Write the expression for the magnitude of the resultant force. Ans: F = $\sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$ (1 mark)	K Recall Easy
4.	Define the equilibrium of a body under the action of system of forces. The state of the body is at rest. (1 mark)	K Recall Easy
5.	State the law of parallelogram of forces. Correct statement (1 mark)	K Recall Easy
6.	State the law of triangle of forces. Correct statement (1 mark)	K Recall Easy
7.	What is the magnitude of the resultant of two forces $\vec{P}$ and $\vec{Q}$ acting in the same line and in the same direction? $\underset{P}{\longrightarrow}\underset{Q}{\longrightarrow}$ (1 mark) $\lvert \vec{R} \rvert = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$	K Recall Easy

$$= \sqrt{P^2 + Q^2 + 2PQ\cos 0^o}$$

$= P + Q$ (1 mark)

8. What is the magnitude of the resultant of two forces $\vec{P}$ and $\vec{Q}$ acting in the same line and in the opposite direction? U Recall Easy

(1 mark)

$|\vec{R}| = P - Q$ (1 mark)

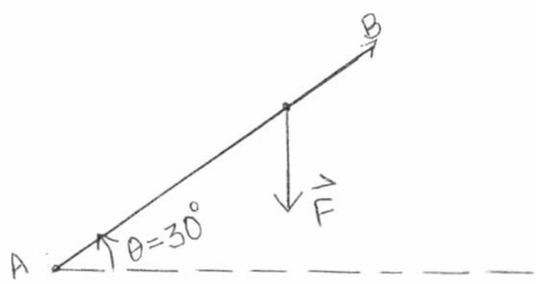
9. State Lami's theorem. K Recall Easy

Correct statement. (1 mark)

10. State and explain the converse of law of triangle forces. K Recall Easy

Correct statement – 1 mark, explanation with diagram – 1 mark

11. What is the component of $\vec{F}$ along AB in the diagram. A Solving Difficult



Component of $\vec{F}$ along AB is F sin θ (1 mark)

F sin 30° = F × ½ (∵ cos 60° = sin 30°)

$= \frac{F}{2}$ (1 mark)

12. A force of 10 N makes an angle of 60° with positive x-axis. What is its magnitude along x-axis? K Recall Average

x - component is, $\vec{F_x} = \vec{F}\cos\theta$ (1 mark)

$F_x = 10 \times \cos 60^o$

$F_x = 10 \times ½ = 5$ N (1 mark)

13. Two nails are driven into a wall 1.5 m apart along a horizontal line. A weight of 5 kg is hung from a string tied to the two nails. The length of the sagging strings are 0.9m and 1.2 m respectively. Calculate the tension in the strings. A Calculate Average

Figure (1 mark)
Formula (1 mark)
Substitution and simplification (2 marks)
Result with unit (1 mark)
$T_1 = 4$ kg wt.
$T_2 = 3$ kg wt.

14. Two forces 5 kg wt and 3 kg wt act at a point making an angle of 60^o with each other. Find the magnitude and direction of the resultant force. A Calculate Average

Figure – 1 mark
Formula – 1 mark
Substitution and calculation – 1 mark
Answer : R = 7 kg . wt (1 mark)
Direction $\alpha = 38^o\ 13'$ (1 mark)

15. Obtain an expression for the magnitude and direction of the resultant of two forces acting at a point. K Recall Easy

Figure (1 mark)
Explanation (1 mark)
Arriving at the expression $R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$ (2 marks)
Direction of Resultant $\tan\alpha = \dfrac{Q\sin\theta}{P + Q\cos\theta}$ (1 mark)

16. State the law of moments. Using the law find the resultant of two like parallel forces. K Recall Easy

Statement (1 mark)
Diagram (1 mark)
Applying the law of moments (1 mark)
Arriving at the expression R = P + Q (2 marks)

Multiple Choice Questions

17. Which of the following sets of concurrent forces F_1, F_2 and F_3 (in N) respectively may be in equilibrium — K Recall Easy
    a) 3,5,6
    b) 3,5,15
    c) 3,5,1
    d) 3,5,9

    Ans: a)

18. Two concurrent forces of equal magnitude 5N each, act at an angle 120^o. The magnitude of their resultant is — K Recall Easy
    a) 15 N
    b) $5\sqrt{3}$ N
    c) 5 N
    d) 10 N

    Ans: c)

19. The resultant of two forces 3P and 2P is R. If the first force is doubled, then the resultant is also doubled. The angle between the two forces is — A Solving Difficult
    a) 180^o
    b) 90^o
    c) 120^o
    d) 60^o

    Ans: c)

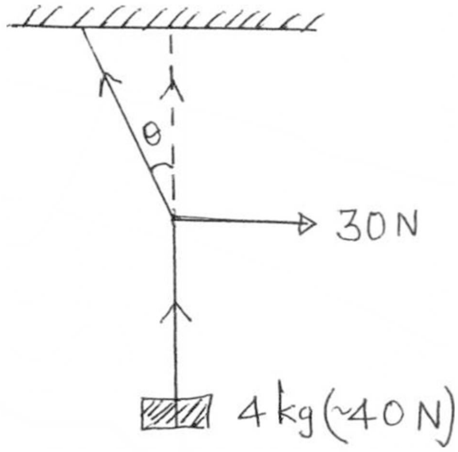
20. The resultant of two forces, one double the other in magnitude, is perpendicular to the smaller of the two forces. The angle between them is — S Draw Average
    a) 60^o
    b) 120^o
    c) 150^o
    d) 120^o

    Ans: b)

21. A mass of 4 kg is suspended by a rope of length 3.0 m from the ceiling. A force of 30N in the horizontal direction is applied to the midpoint of the rope. The angle the rope makes with the vertical in equilibrium is (Take g = 10 m/s^2. Neglect the mass of the rope) — U, Compute, Difficult

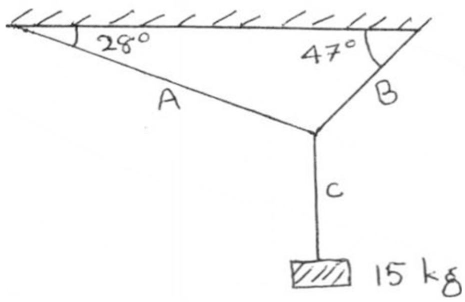
   a) 37°
   b) 47°
   c) 57°
   d) 27°

   Ans: a)



22. A block of mass 15 kg hangs from three chords as shown in figure. The tension in the chord is — U, Compute, Average

   a) 134 N
   b) 103 N
   c) 147 N
   d) 175 N



   Ans: c)

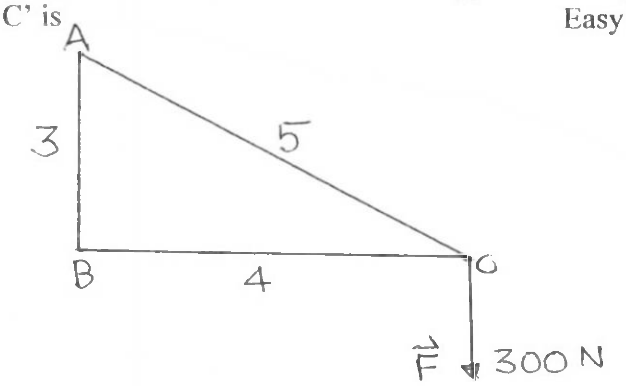
23. The resultant of two forces 3P and 2P is R. If the first force is doubled, then the resultant is also doubled. The angle between the two forces is — U, Compute, Average

   a) 180°
   b) 90°
   c) 120°
   d) 60°

   Ans: c)

24. Figure below shows three light rods forming a right angled triangle. The tension in the rod AC, when a force of 300N is applied vertically downwards at 'C' is — U Compute Easy

a) 100 N
b) 300 N
c) 400 N
d) 500 N



Ans: d)

25. Describe an experiment to verify the law of parallelogram of forces. — S Draw Average

Scheme :
Diagram – 1 mark
Tabular column – 1 mark
Formula – 1 mark
Procedure – 2 marks
Total – 5 marks

26. Describe an experiment to verify the law of triangle of forces. — S Draw Average

Scheme :
Diagram – 1 mark
Tabular column – 1 mark
Formula – 1 mark
Procedure – 2 marks
Total – 5 marks

27. Describe an experiment to verify Lami's theorem. — S Draw Average

Scheme :
Diagram – 1 mark
Tabular column – 1 mark
Formula – 1 mark
Procedure – 2 marks
Total – 5 marks

Unit 13: Moment of a Force

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	When is the moment of a force negative? Clockwise (1 mark)	K Recall Easy
2.	Write the S.I. unit of moment of a force. Newton – metre (N.m) (1 mark)	K Recall Easy
3.	Define moment of a force. Rotational effect produced by the force about the axis. (1 mark)	K Recall Easy
4.	When is the moment of force positive? Anticlockwise (1 mark)	K Recall Easy
5.	Define a couple and give a suitable example. Correct definition – 1 mark. Example – 1 mark	K Recall Easy
6.	What are the factors on which moment of a couple depend? 1. Magnitude of force 2. Perpendicular distance (1 mark each)	K Recall Easy
7.	State the law of moments. Correct statement (1 mark)	K Recall Easy
8.	Give an example for moment of a force. Correct example (1 mark)	U Example Easy

9. When does the moment of a couple become zero? — K Recall Easy

When the lines of action of two forces that constitute a couple coincide. (1 mark)

10. Write the expression of the resultant of two like parallel forces acting on a body. — K Recall Easy

$\vec{R} = \vec{P} + \vec{Q}$ (1 mark)

11. Describe an experiment to verify the conditions of equilibrium of parallel forces. — A Drawing and explaining Difficult

Diagram – 1 mark
Tabular column – 1 mark
Relevant formula – 1 mark
Procedure –2 marks
Total – 5 marks

12. Verify the conditions of equilibrium of a system of coplanar forces acting on a uniform metre scale, the following readings are obtained. Verify the conditions. — S Verifies Difficult

Weight of the metre scale (W) = 75×10^{-3} kg

Trial No.	P× 10^{-3} kg wt.	Q 10^{-3} kg wt.	R 10^{-3} kg wt.	S 10^{-3} kg wt.	OA10^{-3} kg wt.	OB10^{-3} kg wt.	OC10^{-3} kg wt.	OD10^{-3} kg wt.
1	150	175	100	150	25	75	20	74
2								
3								

1. $P + Q = 150 + 175 = 325 \times 10^{-3}$ kg wt (1)
2. $R + S + W = 100 + 150 + 75 = 325 \times 10^{-3}$ kg wt (2)

(1) and (2) are equal $P + Q = R + S + W$

2. $P \times OA + Q \times OB = 150 \times 25 + 175 \times 75$ (3)

$R \times OC + S \times OD + W \times OE = 100 \times 20 + 150 \times 74 + 75 \times 50$ (4)

(3) and (4) are equal.

$P \times OA + Q \times OB = R \times OC + S \times OD + W \times OE$

This verifies the second condition.

Formula – 1 mark
Each condition verification : 2 + 2 = 4 marks
Total : 5 marks

UNIT 4 FLUID MECHANICS

Unit 14: Fluid Thrust

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	State Pascal's law. Correct statement (1 mark)	K Recall Easy
2.	Write the relation between 1 atm and 1 Pascal. Express one atmosphere in SI unit of pressure. 1 atm = 1.01×10^5 N/m^2 or Pa. (1 mark)	K Recall
3.	What is buoyancy? Correct definition (1 mark)	K Recall Easy
4.	An ice cube floats on water. Why ? Density of ice in less than that of water. (1 mark)	K Recall Average
5.	State the laws of floatation. Correct statement. (1 mark)	K Recall Easy
6.	State and explain Archimede's principle. Correct statement – 1 mark. Brief explanation – 1 mark.	K Recall Easy
7.	Why does a cloudy track form behind an aeroplane flying at a high altitude? When an aeroplane is flying fast, a stream of air also moves behind it at a greater speed. Thus pressure is lowered behind it and at once water vapour condenses in the form of droplets of water. (2 marks)	U Explain Average

8. The blood pressure in humans is more at the feet than at the brain. Why ? — U, Generalize, Average

The height of the blood column is more at the feet than at the brain. (1 mark)

9. When will a body float in a liquid? — K, Recall, Easy

The weight of the body is less than the upthrust. (1 mark)

10. What is centre of buoyancy? — K, Recall, Easy

The resultant of thrust acts through the centre of gravity of the displaced liquid. (1 mark)

11. Give any two applications of Pascal's law. — K, Recall, Easy

1. Hydraulic Brakes
2. Hydraulic lift

(related to any example) (1 mark each)

12. Write an expression for pressure at a point in a liquid. Explain the symbols used. — K, Recall, Easy

Ans: $P = \rho gh$ (1 mark) Explanation (1 mark)

13. Calculate the specific gravity of the solid and the liquid, the following readings are obtained. Hence calculate the error involved. — A, Calculation, Average

Mass of solid in air $W_1 = 25.5 \times 10^{-3}$ kg
Mass of solid in water $W_2 = 23 \times 10^{-3}$ kg
Mass of solid in liquid $W_3 = 24.2 \times 10^{-3}$ kg

Specific gravity of solid S = $\dfrac{W_1}{W_1 - W_2} = 10.2$ (3 marks)

Specific gravity of liquid $S_L = \dfrac{W_1 - W_3}{W_1 - W_2} = 0.52$

Percentage of error in solid $\frac{\Delta S}{S} \times 100 = 0.0121\%$

Percentage of error in liquid $\frac{\Delta S_L}{S_L} \times 100 = 0.0162\%$ (2 marks)

14. Describe an experiment to determine specific gravity of an insoluble solid and a liquid by using Archimede's principle. Also estimate the error involved in the experiment. — A Describe Average

Scheme :
Diagram – 1mark
Formula – 1 mark
Observations – 1 mark
Procedure and error calculation – 2 marks
Total – 5 marks

15. A piece of wood floats on water. When it is placed in alcohol, the piece — U Relation Average
    a) floats higher
    b) sinks
    c) has no change in floating level
    d) may sink or float depending on its density

Ans: d)

16. The buoyant force on an object, immersed in a liquid depends on — K Recall Easy
    a) its depth in liquid
    b) density of the solid
    c) density of the liquid
    d) both on depth and density of the solid

Ans: c)

17. A coin is at the bottom of a beaker containing water. If the beaker is allowed to fall freely, during the free fall — U Compare Easy
    a) the coin comes to the surface of water
    b) the coin comes out of the beaker
    c) the coin continues to be at the bottom
    d) the coin stays exactly at half the water level

Ans: c)

18. A boat having a length of 3 m and breadth 2 m is floating on a lake. When a man gets into it, the boat sinks by 0.01 m. The mass of the man is — A Average Infer

a) 60 kg
b) 62 kg
c) 72 kg
d) 50 kg

Ans: a)

19. Which of the following devices is used to measure the atmospheric pressure? K Recall Easy

a) Venturimeter
b) Pyrometer
c) Barometer
d) Hygrometer

Ans: c)

20. A body floats in a liquid when K Recall Easy

a) the weight of the body is less than the upthrust
b) the weight of the body is greater than the upthrust
c) the density of the body is greater than liquid.
d) Weight of the body does not depend on floating

Ans: a)

21. The pressure at a point in a liquid depends K Recall Easy

a) only on the depth of the point in the liquid
b) only on the density of the liquid
c) depth, density and acceleration due to gravity
d) only density and acceleration due to gravity

Ans: c)

Unit 15: Fluid Dynamics

1. Define critical velocity of a liquid in motion. K Recall Easy

   Correct definition (1 mark)

2. When does the flow of a liquid become turbulent? K Recall Average

   The flow of liquid becomes turbulent when its velocity of flow becomes greater than critical velocity. (1 mark)

3. What is streamline flow of fluid? K Recall Easy

   Correct definition (1 mark)

4. Define turbulent flow of a liquid. K Recall Easy

   Correct definition (1 mark)

5. State and explain Bernoulli's theorem. K Recall Easy

   Statement – 1 mark. Explanation – 1 mark

6. Write an expression for the equation of continuity for fluids. K Recall Easy

   $a_1v_1 = a_2v_2$
   av = a constant
   a = area of cross section of the tube
   v = velocity of fluid (1 mark)

7. Write the expression for the pressure energy of a liquid. K Recall Easy

   Pressure Energy = $\frac{P}{\rho}$ (1 mark)

8. Write any two conditions for applying Bernoulli's theorem. K Recall Easy

1. The flow of liquid must be steady.
2. The fluid should be incompressible
3. Friction and viscosity should be negligible.

Any two – one mark each.

9. What shapes of aeroplane wings are desirable so that it can fly in air? — U Explain Average

Velocity of air becomes larger at the upper surface and lower at the lower surface. (1 mark)
The pressure on the upper surface is less than that of the lower surface. (1 mark)

10. Mention two applications of Bernoulli's theorem. — K Recall Easy

1. Sprayer
2. Uplift of an aircraft

(1 mark each)

11. Write an expression for kinetic energy of a liquid in steady flow with usual meaning. — K Recall Easy

$KE = \frac{1}{2}\left(\frac{m}{v}\right)v^2$ (1 mark)

Or $KE = \frac{1}{2}\rho v^2$

$\rho = ?$
$v = ?$ (1 mark)

12. A liquid is flowing through a tube of different cross sections; then the velocity of the liquid is — K Recall Easy

a) greatest at the least cross section
b) least at the least cross section
c) same at all cross section
d) greatest at greatest cross section

Ans: a)

13. A paint-gun is based on — U Generalize Easy

a) Bernoulli's theorem
b) Archimede's principle
c) Boyle's law
d) Newton's law of motion

Ans: a)

14. A liquid flows through a horizontal tube of different cross-section A_1 and A_2. Then the ratio of the speed of the liquid at the two cross sections is — U Relation Average
    a) $A_1 : A_2$
    b) $A_2 : A_1$
    c) $A_1^2 : A_2^2$
    d) $A_2^2 : A_1^2$

    Ans: b)

15. The lift of an airplane is based on — U Reason Average
    a) Torricelli's theorem
    b) Bernoulli's theorem
    c) Law of gravitation
    d) Conservation of linear momentum

    Ans: b)

Unit 16: Surface Tension

1. Define surface tension of a liquid. — K Recall Easy

   Correct definition (1 mark)

2. Write the S.I. unit of surface tension. — K Recall Easy

   Ans: N/m (1 mark)

3. Define angle of contact. — K Recall Easy

   Correct definition (1 mark)

4. What should be the angle of contact of a liquid that can wet a contact surface? — K Recall Easy

   $\theta < 90$ (1 mark)

5.	What should be the angle of contact of a liquid that cannot wet a contact surface?	K Recall Easy
	$\theta > 90$ (1 mark)	
6.	What is capillarity?	K Recall Easy
	Correct definition (1 mark)	
7.	Why water wets glass?	U Generalize Easy
	Adhesive force is more than the cohesive force. (1 mark)	
8.	Why does mercury not wet the glass?	U Generalise Average
	Cohesive force > adhesive force (1 mark)	
9.	Write an expression for the capillary rise of a liquid and explain the terms.	K Recall Easy
	$h = \frac{2T\cos\theta}{r\rho g}$ (1 mark) Explanation of terms (1 mark)	
10.	Explain how liquid drops are formed.	U Explain Easy
	1. Gravitational potential energy 2. Potential energy due to surface tension (1 mark each)	
11.	Explain the capillary action in the wick of a lamp.	K Recall Easy
	1. Capillary rise. 2. Surface tension. (1 mark each)	
12.	Explain the action of detergents in cleaning of dirty clothes.	K Recall Easy

1. Capillary rise. 2. Surface tension (1 mark each)

13. Distinguish between cohesive and adhesive forces with suitable example. U Discriminate Easy

Correct explanation – 1 mark. Example – 1 mark

14. Define surface energy of a liquid. K Recall Easy

Correct definition (1 mark)

15. What are cohesive forces? K Recall Easy

Correct definition (1 mark)

16. What are adhesive forces? K Recall Easy

Correct definition (1 mark)

17. If a graph of capillary rise (h) versus radius (r) of the capillary tube for a given liquid is plotted, what is the shape of the resulting curve? S Draw Difficult

The shape of the curve is rectangular hyperbola. (1 mark)

18. Why is it difficult to introduce mercury into a capillary tube? U Explain Average

The angle of contact is obtuse. (1 mark)

19. How do trees draw water from the ground? U Explain Easy

Capillary action (1 mark)

20. Calculate the surface tension of water from the following observations recorded in capillary rise method experiment. U Computes Average

i) L.C. of traveling microscope = 0.001 cm
ii) Radius of capillary tube = 2×10^{-4} m
iii) Density of water = 10^3 kg m^{-3}

Tr. No.	Reading of T.M.			
	For meniscus R_1		For Pin (R_2)	
	MSR	CVD	MSR	CVD
1.	6.55cm	21	3.65cm	21
2.	5.8cm	25	2.9cm	34

Scheme of Valuation :
Calculating h_1 and h_2 : 2 marks
Formula : 1 mark
Substitution : 1 mark
Result with unit : 1 mark

21. Describe an experiment to determine the surface tension of water by capillary rise method. K Recall Average

Diagram – 1 mark
Tabular column – 1 mark
Formula – 1 mark
Procedure – 2 marks

22. Name the intermolecular forces acting between molecules of same substance. U Generalize Easy

   a) Cohesive force
   b) Adhesive force
   c) Gravitational force
   d) Nuclear force

Ans: a)

23. Name the intermolecular forces acting between molecules of different substances. U Generalize Easy
   a) Cohesive force
   b) Adhesive force
   c) Gravitational force
   d) Nuclear force

Ans: b)

24. Surface tension arises due to U Generalize Average
   a) adhesive force between molecules
   b) cohesive force between molecules
   c) gravitational force between molecules
   d) electrical force between molecules

Ans: a)

25. When salt is added to pure water, the surface tension — K Recall Easy
   a) increases
   b) decreases
   c) remains unchanged
   d) becomes zero

   Ans: a)

26. A capillary of diameter 10^{-3} m is vertically dipped in water ($\rho = 10^3$ kg m^{-3} and T = 0.072 Nm^{-1}), then the capillary ascent is (g = 10 m sec^{-2}) — U Compute Average
   a) 28.8 mm
   b) 2.88 mm
   c) 0.288 m
   d) 2.88 m

   Ans: a)

27. R and 2R are the radii of two capillary tubes A and B respectively. Tube A is dipped vertically in a liquid of surface tension T_1 and B in a liquid of surface tension T_2. If h_1 and h_2 are the capillary ascents then $h_1 : h_2$ is equal to — U Compare Difficult
   a) $T_1R_2 : T_2R_2$
   b) $T_1R_1 : T_2R_2$
   c) $T_1^2 R_2 : T_2^2 R_1$
   d) $T_1 R_1^2 : T_2 R_2^2$

   Ans: a)

28. Two capillary tubes T_1 and T_2 are of same radius. T_1 is made up of glass of density 2×10^3 kg m^{-3} and T_2 is of density 4×10^3 kg m^{-3}. If h_1 and h_2 are the capillary ascents when the two tubes are dipped vertically in water then — U Compare Average
   a) $h_1 < h_2$
   b) $h_2 < h_1$
   c) $h_1 = h_2$
   d) $h_1 = 2h_2$

   Ans: c)

29. The dimensional formula for surface tension per unit mass is — K Recall Easy
   a) $M^1L^oT^{-2}$
   b) $M^oL^1 T^{-2}$
   c) $M^oL^oT^{-2}$
   d) $M^1l^1T^{-2}$

   Ans: c)

Chapter 17 : Viscosity

1. Write the Poiseuille's formula for the flow of a liquid through a capillary tube and explain the symbols used. K Recall Easy

$V = \frac{\pi P r^4}{8 l \eta}$ (1 mark) Explanation (1 mark)

2. State and explain Stoke's law. K Recall Easy

Statement – 1 mark. Explanation – 1 mark

3. Which is more viscous? Castor oil or kerosene? U Classify Average

Castor oil is more viscous than kerosene. (1 mark)

4. Why does a larger raindrop fall faster than a smaller raindrop? U Explain Average

The terminal velocity of a drop is directly proportional to the square of its radius. (1 mark)

5. What is the effect of temperature on the viscosity of liquids? K Recall Easy

Viscosity decreases as temperature increases. (1 mark)

6. What is the effect of temperature on the viscosity of gases? K Recall Average

Viscosity of gases increases with increase in temperature. (1 mark)

7. Why does hot liquid move faster than cold liquid? U Discriminate Average

This is due to decrease of viscosity with increase of temperature. (1 mark)

8. Define velocity gradient of a liquid. K Recall Easy

Rate of change of velocity of a flow of liquid with a distance measured normal to the direction. (1 mark)

9. Why does a briskly-stirred liquid in a beaker come to rest after a short time? U Explain Average

This is due to the viscosity of the liquid. (1 mark)

10. A beaker containing water and another beaker containing glycerine are both stirred rapidly and kept on the table. In which beaker will the liquid come to rest earlier? Why? U Discriminate Average

In the beaker containing glycerine (1 mark)
Due to the greater viscosity of glycerine (1 mark)

11. Give the dimensions of coefficient of viscosity. K Recall Easy

Ans: $[L^{-1} MT^{-1}]$ (1 mark)

12. Define coefficient of viscosity. K Recall Easy

Correct definition (1 mark)

13. Define viscosity of a fluid. K Recall Easy

Internal fluid friction is called viscosity. (1 mark)

14. Write S.I. unit of coefficient of viscosity. K Recall Easy

Ans: NSm^{-2} / Poise (1 mark)

15. When air is blown between two balls suspended close to each other they come closer. Why ? U Explain Average

The reason of blowing of air between the balls increases speed of air and decreases pressure. There is atmospheric pressure in the region outside the balls. Hence the balls get attracted towards a region of lower pressure. (2 marks)

16. State any two differences between streamline and turbulent flow of liquids. — K, Recall, Easy

Any two differences (1 mark each)

17. Calculate the coefficient of viscosity of water using the following data. — U, Calculate, Average

i) Radius of the capillary tube = 0.06×10^{-2} m
ii) Length of the capillary tube = 0.38 m

Tr No.	Time of Flow	Height of the water level (h_1) m	Height of the water level (h_2) m	Volume of water in cc
1	120 sec	0.244	0.242	40
2	180 sec	0.240	0.237	60

Assuming g = 9.8 m sec^{-2}
Density of water = 10^3 kg m^{-3}

Scheme of valuation :

Trial No. 1 $\frac{h_1 t_1}{V_1}$ (1 mark)

Trial No. 2 $\frac{h_2 t_2}{V_2}$ (1 mark)

Mean $\frac{ht}{V}$ (1 mark)

Formula (1 mark)
Result with unit (1 mark)

18. Describe an experiment to determine the coefficient of viscosity of water by Poiseuille's method. — K, Describe, Average

Diagram – 1 mark
Formula – 1 mark
Tabular column – 1 mark
Procedure – 2 marks
Total : 5 marks

19. A hole is near the bottom of a tank. The volume of liquid emerging from the hole does not depend upon — K, Recall, Easy

a) area of hole
b) height of liquid level
c) density of water
d) gravitational acceleration

Ans: c)

20. Which of the following substances has greater viscosity? — U, Cite example, Easy
    a) Mercury
    b) Water
    c) Oxygen
    d) Glycerine

Ans: d)

21. The clouds float in atmosphere because of — U, Reason, Easy
    a) low temperature
    b) low viscosity
    c) low density
    d) creation of low pressure

Ans: c)

22. Viscosity is most closely related to — K, Recall, Easy
    a) Friction
    b) Adhesive force
    c) Cohesive force
    d) Bernoulli's theorem

Ans: a)

23. The dimensional formula for the coefficient of viscosity is — A, Applies, Average
    a) $M^1L^1T^{-1}$
    b) $M^2L^2T^{-2}$
    c) $M^1L^{-1}T^{-1}$
    d) $M^0L^1T^{-2}$

Ans: c)

Unit 5 HEAT AND THERMODYNAMICS

Unit 18: Gas Laws

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Name the two coefficients of expansion of gases. Volume coefficient Pressure coefficient (1 mark each)	K Recall Easy
2.	Define the volume coefficient of gas. Correct definition (1 mark)	K Recall Easy
3.	Define pressure coefficient of gas. Correct definition (1 mark)	K Recall Easy
4.	Write the expression for volume of a gas at any temperature 't', if V_o is its volume at 0^oC. $V = V_o\left(1 + \frac{t}{273.15}\right)$ (1 mark)	K Recall Easy
5.	Write the expression for ideal gas equation. Ans: $PV = RT$ (1 mark)	K Recall Easy
6.	State and explain Boyle's law. Statement (1 mark), Explanation (1 mark)	K Recall Easy
7.	What is absolute zero temperature. Definite lower limit of temperature (-273.15^oC) (1 mark)	K Recall Easy
8.	Give the value of universal gas constant for 1 kg mole of a gas.	K Recall

Easy

Ans: $R = 8.31 \times 10^{8}$ J mol^{-1} K^{-1} (1 mark)

9. State and explain Charle's law. K Recall Easy

Statement (1 mark), Explanation (1 mark)

10. Write the expression for Van der Waal's equation of state for real gases with usual meanings. K Recall Easy

$$\left(P + \frac{q}{V^2}\right)(V - b) = \text{nR}$$

Equation – 1 mark, Explaining terms – 1

11. Give the mathematical representation of Boyle's law. K Recall Easy

PV = constant

$P_1V_1 = P_2V_2$ when T – constant. (1 mark)

12. Give the mathematical representation of Charle's law. K Recall Easy

P/T = constant

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ at V = constant (1 mark)

13. Define: isothermal process. Give one example. K Recall Easy

Statement – 1 mark, example – 1 mark.

14. Define: adiabatic process. Give one example. K Recall Easy

Statement – 1 mark, Example – 1 mark

15. Write the relation between P and V for (i) isothermal processes and (ii) adiabatic processes. K Recall Easy

PV = constant (1 mark)

PV^{γ} = constant (1 mark)

16. A gas contained in a sealed container is heated up. What is the effect on its pressure? K Recall Easy

Increases (according to Charle's law) (1 mark)

17. At constant temperature, the volume of a gas is doubled. What will happen to its pressure? K Recall Easy

Halved (reduced to half) (from Boyle's law) (1 mark)

18. At constant pressure, the temperature of a gas is halved. What will happen to its volume? K Recall Easy

Halved (from Charle's law) (1 mark)

19. When automobile travels for a long distances air pressure in the tyres increases. Why ? U Generalize Average

i) Due to friction between tyres and road temperature increases.
ii) According to Charle's law pressure increases.
(1 mark each)

20. What is absolute zero temperature? Explain the absolute (or Kelvin scale) of temperature. K Recall Easy

Lowest possible temperature ($-273.15^{o}C$)

Volume coefficient $\alpha = \frac{1}{273.15}$ (1 mark)

Relation $V = V_o(1 + \alpha t)$ (1 mark)

At $t = -273.15^{o}C$, substitution and arriving $V = 0$ (2 marks)

21. Write the perfect gas equation for 'n' mole of a gas. Calculate the value of universal gas constant for one kg mole of gas. U Generalize Average

$PV = nRT$ (1 mark)

$R = \frac{PV}{T}$ for $n = 1$ k mole (1 mark)

Substitution and calculation of $R = 8.31 \times 10^3 \text{ J mol}^{-1} \text{ K}^{-1}$ (2 marks)

Unit (1 mark)

22. Absolute zero of temperature is | K Recall Easy

a) 273. 15° C
b) 0° C
c) The temperature of liquid Helium
d) – 273.15° C

Ans: d)

23. An ideal gas has a volume of 3 *l* at atmospheric pressure. Keeping the temperature constant, the pressure is doubled. Then the volume of gas will be | U See relation Easy

a) 3 *l*
b) 6 *l*
c) 1.5 *l*
d) any value

Ans: c)

24. At constant pressure V_1 and V_2 are the volumes of a given mass of a gas at temperature 27° C and 54° C respectively. Then the ratio $\frac{V_1}{V_2}$ is | U Compute Easy

a) $\frac{54}{27}$
b) $\frac{27}{54}$
c) $\frac{100}{109}$
d) $\sqrt{\frac{100}{109}}$

Ans: c)

25. A monoatomic gas is suddenly compressed to 1/8th of its initial volume adiabatically. The ratio of its final pressure to initial pressure is ($\gamma = \frac{5}{3}$) | U See relation Easy

a) $\frac{40}{3}$
b) 32
c) 8
d) $\frac{24}{5}$

Ans: b)

Unit 19: Specific Heat Capacities of gases

1.	Define: specific heat of a gas at constant volume. Correct definition (1 mark)	K Recall Easy
2.	Define : specific heat of a gas at constant pressure. Correct definition (1 mark)	K Recall Easy
3.	Write the SI unit of specific heat. Ans: J Kg^{-1} K^{-1} (1 mark)	K Recall Easy
4.	Write the relation between the specific heat at constant volume and specific heat at constant pressure for a gas. Ans: $C_p - C_v = R$ (1 mark)	K Recall Easy
5.	Mention two factors on which the degrees of freedom of a gas depends. i) atomicity, ii) temperature (1 mark each)	K Recall Easy
6.	The internal energy of a monoatomic gas is directly proportional to RT. Write the dimensional formula for RT. Ans: Joules (ML^2 T^{-2}) (1 mark)	U Recall Easy
7.	Why different materials possess different specific heat? The atomic or molecular structures are different. (1 mark)	U Generalize Average
8.	Define degrees of freedom of a molecule. Correct definition (1 mark)	K Recall Easy
9.	State the law of equipartition energy for a gas. Statement (1 mark)	K Recall Easy

10. What is the importance of γ, the ratio of specific heats of a gas? K Recall Easy

i) Atomicity, ii) Molecular structure (1 mark each)

11. What is the value of mean kinetic energy per molecule per degrees of freedom? K Recall Easy

Ans: $\frac{1}{2}$ kT (1 mark)

12. Mention the number of degrees of freedom for a monoatomic and a diatomic molecule. K Generalize Easy

For monoatomic – 3 (1 mark)
For diatomic – 5 (1 mark)

13. When is the specific heat of a gas a) zero and (b) infinity U Generalise Average

a) In adiabatic processes, it is zero. (1 mark)
b) In isothermal processes, it is infinity (1 mark)

14. Why C_p is greater than C_v ? U Generalize Easy

1. In case of C_v heat supplied is used to increase the internal energy. (1 mark)
2. While in C_p heat supplied is used to increase the internal energy and to do an external work. (1 mark)

15. Establish the relation between velocity of sound in a gas and degrees of freedom of gas. A Formulate Difficult

Velocity of Sound, $v = \sqrt{\frac{\gamma P}{\rho}}$ (1 mark)

$V = \sqrt{\left(1+\frac{2}{n}\right)\left(\frac{RT}{m}\right)}$ (1 mark)

16. Write the S.I. unit of C_p dT.

A
Compute
Difficult

Ans: joule (J) (1 mark)

17. Draw the graph showing the variation of internal energy of the gas with respect to the change in temperature for constant volume.

S
Draw
Difficult

Correct graph (1 mark)

18. Describe an experiment to verify the Newton's law of cooling using calorimeter.

S
Draw
Average

Diagram – 1 mark
Tabular column – 1 mark
Graph – 1 mark
Procedure – 2 marks
Total – 5 marks

19. Derive Mayer's equation.
OR
Derive the expression for $C_p - C_v = R$

K
Recall
Easy

Diagram – 1 mark
External work done by the heat energy
$W = P\,dv$ (1 mark)
$C_p\,dT = C_v\,dT + PdV$ (1 mark)
For perfect gas, $PV = RT$ (1 mark)
$C_p - C_v = R$ (1 mark)

20. Describe an experiment to determine the specific heat of solid by the method of mixture using calorimeter.

U
Describe
Average

Diagram – 1 mark
Formula – 1 mark
Observations – 1 mark
Procedure – 2 marks
Total – 5 marks

21. Calculate the specific heat of solid by the method of mixture by using calorimeter, the following reading were obtained.

A
Calculation
Average

Mass of the calorimeter + stirrer, $m_1 = 68.5 \times 10^{-3}$ kg
Mass of the calorimeter + stirrer + water, $m_2 = 130 \times 10^{-3}$ kg
Mass of the calorimeter + stirrer + solid, $m_3 = 211.8 \times 10^{-3}$ kg
Initial temperature, $\theta_1 = 23^oC = 286$ K
Temperature of the solid , $\theta_2 = 95^oC = 368$ K
Resultant temperature of the mixture, $\theta_3 = 32^oC = 305$ K
Specific heat of material of calorimeter $S_c = 385$ Jkg^{-1} K^{-1}
Specific heat of water $S_w = 4200$ J / kg / K

Scheme :

$$S = \frac{[m_1\ s_c + (m_2 - m_1)\ s_w]\ (\theta_3 - \theta_1)}{(m_3 - m_1)\ (\theta_2 - \theta_3)}$$

$$S = \frac{[\ 68.5\times 10^{-3}\ \times 385 + (130 \times 10^{-3} - 68.5 \times 10^{-3})\ 4200]\ (305.296)}{(211.8 \times 10^{-3} - 130 \times 10^{-3})\ (368 - 305)}$$

Specific heat of the solid = 502.4Jkg^{-1} K^{-1}

Formula : 1 mark
Substitution : 1 mark
Calculation : 2 marks
Answer with unit : 1 mark
Total : 5 marks

22. At 4^o C, a given mass of water has the maximum — K, Recall, Easy
    a) specific heat
    b) density
    c) energy
    d) volume

Ans: b)

Chapter 20: Mode of Heat Transfer

1. Name any two methods of transmission of heat energy. K Recall Easy

   Gives any two methods. (1 mark each)

2. What is conduction of heat ? K Recall Easy

   Correct definition (1 mark)

3. What is meant by steady state of a body? K Recall Easy

   Correct statement (1 mark)

4. Define : temperature gradient. K Recall Easy

   Correct definition (1 mark)

5. Define: coefficient of thermal conductivity. K Recall Easy

   Correct definition (1 mark)

6. Give the dimensions of thermal conductivity. K Recall Easy

   Ans: $[LMT^{-3}\theta^{-1}]$ (1 mark)

7. Give the SI unit of thermal conductivity. K Recall Easy

   Ans: $W\ m^{-1}\ K^{-1}$ (1 mark)

8.	Why does the temperature of every part of a metal rod remains constant in steady state?	U Generalize Easy
	Because in steady state, no part of the metal rod absorbs any heat. (1 mark)	
9.	State and explain convection of heat.	K Recall Easy
	Statement – 1 mark, Explanation- 1 mark	
10.	Define : emissive power of a body. Write its SI unit.	K Recall Easy
	Definition – 1 mark, Unit (1 mark)	
11.	Define : emissivity of a body. What is the emissivity of a perfect black body?	K Recall Easy
	Definition – 1 mark Emissivity, e = 1 mark	
12.	Define : absorptivity of a body. What is the absorptive power of a perfect black body?	K Recall Easy
	Definition – 1 mark , a = 1 mark	
13.	State and explain Kirchhoff's law of radiation with an example.	K Recall Average
	Statement – 1 mark Explanation – 2 marks Relation- 1 mark Example – 1 mark Total : 5 marks	
14.	State and explain Newton's law of cooling.	K Recall Easy
	Statement –1 mark, explanation – 1 mark	

15. Write an expression for Planck's law of radiation. Explain the symbols therein. K Recall Easy

Equation – 1 mark, Explanation of terms – 1 mark

16. Write the characteristics of thermal radiation. K Recall Easy

Write any four properties. (½ mark each – 2 marks)

17. State and explain Stefan's law of radiation. K Recall Easy

Statement – 1 mark, Explanation – 1 mark

18. State and explain Wein's displacement law of radiation. K Recall Easy

Statement – 1 mark, Explanation – 1 mark

19. What is meant by a perfect black body? Explain construction and working of Fery's black body. K Recall Easy

Scheme of Valuation :
Definition – 1 mark
Figure – 1 mark
Construction and working – 3 marks
Total : 5 marks

20. State and explain Planck's law of radiation. K Recall Easy

Scheme of Valuation :
Statement – 1 mark
Explanation- 1 mark

21. Write the expression for Stefan's law of Radiation. Give the unit/ dimension of Stefan's constant. K Recall Easy

Scheme of Valuation :
$E = \sigma T^4$ (1 mark)
$\sigma = 5.672 \times 10^{-8}$ W/ m^2 / K^4 (1 mark)

22. Double walled containers are used for keeping ice. Why ? U Reason Average

Ice box is constructed with a double wall and the space between them is filled with non-conducting material. This provides thermal insolation and loss of heat is minimized. (2 marks)

23. Define solar constant. Describe the method of estimating the temperature of the sun. K Recall Easy
OR
Explain how the temperature of the sun can be estimated.

Scheme of Valuation :
Definition – 1 mark
Explanation – 2 marks
Expression – 2 marks
Total – 5 marks

24. Describe the construction and working of total radiation pyrometer. K Recall Easy

Scheme of valuation :
Figure : 1 mark
Construction : 2 marks
Working : 2 marks Total : 5 marks

25. A spherical perfectly black body of radius 0.01 m is at 400 K. Calculate the energy radiated by the body per second per unit area. What is the total energy radiated by the entire body per second? Assume the body to be perfectly black. A Calculate Average
(Given $\sigma = 5.7 \times 10^{-8}$ W m^{-2} K^{-4}).

Energy radiated by the body / sec/ unit area is
$E = \sigma T^4$
$E = 5.7 \times 10^{-8} \times (400)^4 = 1459$ J (2 marks)
Area of the body, $A = 4\pi r^2$
$A = 4 \times 3.142 \times (10^{-2})^2 = 12.57 \times 10^{-4}$ m^2 (1 mark)
Total energy radiated by the body / sec
$E = A \times \sigma \times T^4$
$E = 12.56 \times 10^{-4} \times 5.7 \times 10^{-8} \times (400)^4$
$= 1.833$ J (2 marks)

26. A rectangular slab of stone of length 1.30 m and breadth 0.20 m and area 2600×10^{-4} m^2 and thickness 0.1m is exposed to steam on the lower surface at 373 K. A block of ice at 273 K rests on the upper surface of the slab. In one hour, 2.4 kg of ice is melted. Calculate the thermal conductivity of the stone. Given $L = 336 \times 10^3$ J kg^{-1}.

A
Calculate
Average

Quantity of heat conducted is $Q = \dfrac{KA\,(\theta_1 - \theta_2)}{d} \times t$

But Q is also the head that melts the ice i.e. Q = mL (1 mark)

$$mL = \frac{KA\,(\theta_1 - \theta_2)}{d}\,t$$

$$K = \frac{mLd}{A(\theta_1 - \theta_2)\,t} = \frac{2.4 \times 336 \times 10^3 \times 0.1}{2600 \times 10^{-4}\ (373 - 273)\ 3600} \quad \text{(2 mark)}$$

$K = 0.86$ JS^{-1} $m^{-1}K^{-1}$ (1 mark)

27. Give any two applications of thermal conductivity.

U
Generalize
Easy

Each application – 1 mark

28. What is the importance of Wein's displacement law?

K
Recall
Easy

To determine the temperature of heavenly bodies such as sun.
(1 mark)

29. Assume that the thermal conductivity of copper is four times that of brass. Two rods of copper and brass having the same length and cross section are joined end to end. The free end of copper is kept at 273 K and the free end of iron is kept at 373 K. Calculate the temperature of the junction of the two rods at equilibrium.

A
Calculation
Easy

Scheme of Valuation :

$K_1 = 4\ K_2$

Let 'θ' be the temperature of the interface.

At equilibrium, $\dfrac{K_1\ A_1\ (\theta - 273)'}{d_1} = \dfrac{K_2\ A_2\ (373 - \theta)\ t}{d_2}$

$d_1 = d_2$ $A_1 = A_2$ (1 mark)

$4K_2\ (\theta - 273) = K_2\ (373 - \theta)$ (1 mark)

$5\ \theta = 373 \times 4 \times 273 = 1465$ (1 mark)

$\theta = 293$ K (1 mark)

30. Which law explains correctly the distribution of energy in the spectrum of black body? U Recall Easy

Planck's law of radiation based on quantum theory of radiation. (1 mark)

To verify the Newton's law of cooling graphically, the following readings were obtained. Draw a graph of rate of cooling versus temperature and interpret the graph.
Room temperature $\theta_0 = 25^\circ$ C

Trial No.	Temperature °C 'θ'	Time (s)
1	70	0
2	68	108
3	66	221
4	64	340

Scheme of Valuation :
Correct graph (1 mark)
Rate of cooling vs. Excess temperature (a straight line graph) (1 mark)

31. A thermos flask contains hot coffee. The flask is vigorously shaken. Then the temperature of the coffee will U Interpret Average

a) rise
b) fall
c) remains the same
d) fall below 0° C

Ans: a)

32. 2 kg of water at 60° C is mixed with 1 kg of water at 30° C kept in a vessel of heat capacity 200 J K^{-1}. The specific heat of water is 4200 J kg^{-1} k^{-1}. Then final temperature is nearly U Calculate Average

a) 55° C
b) 50° C
c) 35° C
d) 45° C

Ans: b)

Chapter 21: Thermodynamics

1.	What is meant by isothermal process? Give an example. Definition – 1 mark. Example – 1 mark	K Recall Easy
2.	State the first law of thermodynamics. Correct statement (1 mark)	K Recall Easy
3.	What is the significance of the first law of thermodynamics? Energy (1 mark)	K Recall Easy
4.	What is a reversible process? Give an example. Definition – 1 mark. Example – 1 mark.	K Recall Easy
5.	What is the function of a heat engine and define efficiency of a heat engine? Function (1 mark), correct definition (1 mark)	K Recall Easy
6.	What is an adiabatic process? Give an example. Definition – 1 mark. Example – 1 mark	K Recall Easy
7.	What is an isochoric process and what is an Isobaric process? Correct definition – one mark each	K Recall Easy
8.	Name the thermodynamic variables. Pressure, volume and temperature are the basic thermodynamic variables or parameters. (1 mark)	K Recall Easy
9.	What is a thermodynamic process?	K Recall Easy

A process in which thermodynamic parameters of a system undergo a change. (1 mark)

10. State the zeroth law of thermodynamics. K Recall Easy

Correct statement

11. Give the Kelvin–Planck statement of second law of thermodynamics. K Recall Easy

Correct statement (1 mark)

12. Write the Claussius-Clapeyron equation and explain the symbols. K Recall Easy

$$\frac{dP}{dT} = \frac{L}{T\,(V_2 - V_1)}$$ (1 mark)

$$\left.\begin{array}{l} L = \\ V_1 = \\ V_2 = \\ T = \\ dP = \\ dT = \end{array}\right\} \text{(1 mark)}$$

13. What is a cyclic process? K Recall Easy

Correct definition (1 mark)

14. What is the change in internal energy of a system subjected to a cyclic process? K Recall Easy

The change in internal energy is zero. (1 mark)

15. Explain briefly the action of a refrigerator on the basis of (or using) the second law of thermodynamics. K Recall Easy

OR

Give a brief explanation of the working of a refrigerator using thermodynamic principle.

Block diagram of refrigerator – 1 mark, Explanation – 1 mark

16.	What is a heat engine? Explain the parts of a Carnot heat engine. Definition of engine – 1 mark Figure – 1 mark Explanation of parts of engine – 3 marks Total : 5 marks	K Recall Easy
17.	What is meant by entropy ? Entropy of an isolated system is a measure of the state of the system. (1 mark)	K Recall Easy
18.	Distinguish between reversible and irreversible process. Each difference – 1 mark	K Recall Easy
19.	Explain the different stages of Carnot cycle with the help of a (P – V) diagram. Write the expression for its efficiency. Explanation of stages : 3 marks (P – V) diagram : 1 mark Expression of efficiency : 1 mark Total : 5 marks	K Recall Easy
20.	A reversible heat engine of efficiency 40% has its efficiency increased to 50% when the temperature of the sink is lowered by 50K. Find the temperatures of the source and the sink. Formula : 1 mark Discuss 3 cases : 2 marks Temperature of source T_1 = 500 K = 1 Temperature of sink T_2 = 300 K = 1 Total : 5 marks.	A Calculation Average

21. In a cyclic process the amount of heat given to a system is equal to — K Recall Easy
   a) network done by the system
   b) net increase in internal energy
   c) net decrease in internal energy
   d) net change in volume

Ans: a)

22. "Heat cannot flow from a cold to a hot body without the aid of any external agency". This was enunciated by — K Recall Easy
   a) Kelvin and Planck
   b) Clausius
   c) Joule and Thomson
   d) Einstein

Ans: b)

23. The internal energy of an ideal gas depends only on — K Recall Easy
   a) temperature
   b) pressure
   c) volume
   d) temperature and volume both

Ans: a)

24. If dQ is heat supplied, 'dU' is the change in internal energy of gas and dW the work done by the gas, the first law of thermodynamics states — K Recall Easy
   a) $dQ = dU - dW$
   b) $dU = dQ - dW$
   c) $dU = dW - dQ$
   d) $dQ + dU + dW = 0$

Ans: b)

25. The area under P – V diagram represents — K Recall Easy
   a) the state of the system
   b) heat supplied to system
   c) change in internal energy of the system
   d) work done by the system

Ans: d)

26. Which of the following relations between C_p and C_v is correct? K Recall Easy
    a) $C_p - C_v = R^{-1}$
    b) $C_p + C_v = R$
    c) $\frac{C_p}{C_v} = R$
    d) $C_p - C_v = R$

Ans: d)

27. The first law of thermodynamics is connected with the conservation of U Relation Easy
    a) number of molecules
    b) energy
    c) mass
    d) temperature

Ans: b)

28. The first law of thermodynamics is a special case of K Recall Easy
    a) Newton's law
    b) Charle's law
    c) Law of heat exchange
    d) Law of conservation of energy

Ans: a)

29. The second law of thermodynamics implies U Infer Easy
    a) whole of heat can be converted into mechanical energy
    b) no heat engine can have efficiency 100%
    c) some heat engines working in reversible process can have efficiency 100%
    d) a refrigerator can reduce the temperature to absolute zero.

Ans: b)

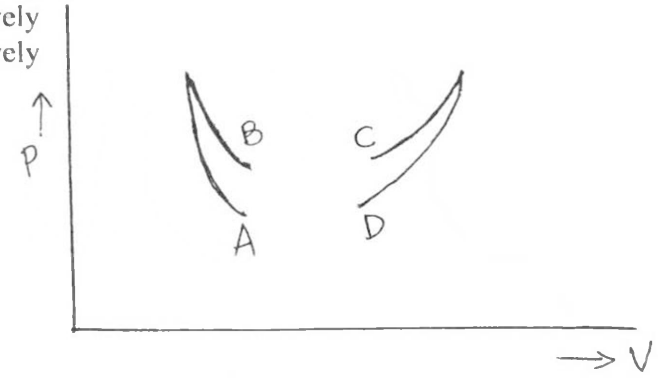
30. By opening the door of a refrigerator which is inside a room, the temperature of the room A Infer Average
    a) decreases
    b) increases
    c) remains unchanged
    d) first decreases and then increases

Ans: c)

31. In the gas equation PV^{γ} = constant (with $\gamma = 1$) the process is — K Recall Easy
   a) isothermal
   b) Adiabatic
   c) Isobaric
   d) Irreversible

Ans: a)

32. Four curves A, B, C, D are drawn in the figure for a given amount of gas. The curves which represent adiabatic and isothermal changes are — U Compare Difficult
   a) C and D respectively
   b) D and C respectively
   c) A and B respectively
   d) B and A respectively



Ans: c)

33. In an isothermal process — K Recall Easy
   a) pressure remains constant
   b) temperature remains constant
   c) volume remains constant
   d) kinetic energy remains constant

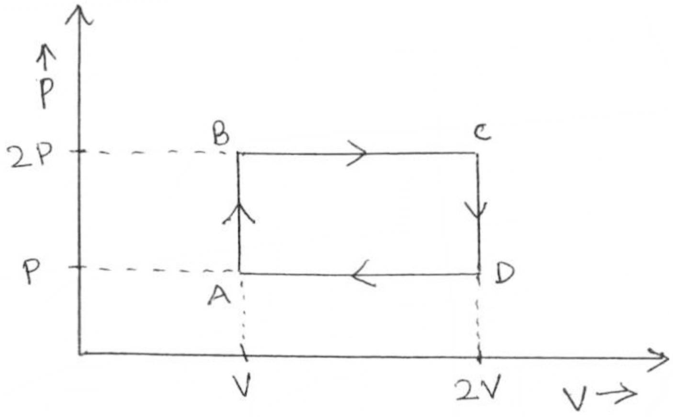
Ans: b)

34. System A is in thermal equilibrium with B and B is separately in thermal equilibrium with C. Then A and C are in thermal equilibrium. From which law of thermodynamics it follows ? — U Relation Average
   a) Zeroth
   b) First
   c) Second
   d) Third

Ans: a)

35. An ideal monoatomic gas is taken around the cycle ABCDA. The work done is — U Compute Average

a) ½ PV
b) PV
c) 2PV
d) 4PV



Ans: b)

36. Wavelength of radiations emitted by a body depends upon — U Infer Average

a) nature of the surface
b) area of the surface
c) temperature of the surface
d) all of the above factors

Ans: d)

37. A Carnot engine is made to work between 200°C and 0° C first and then between 0° C and –200°C. The ratio of efficiencies of the engine in the two cases — U Compute Average

a) 1.73 : 1
b) 1 : 1.73
c) 1 : 1
d) 1 : 2

Ans: b)

38. A Carnot engine takes heat from a reservoir at 627° C and rejects at 27° C. Calculate efficiency. — U Compute Average

a) $\frac{200}{209}$

b) $\frac{3}{5}$

c) $\frac{1}{3}$

d) $\frac{2}{3}$

Ans: d)

UNIT 6 OSCILLATIONS – WAVES AND SOUND

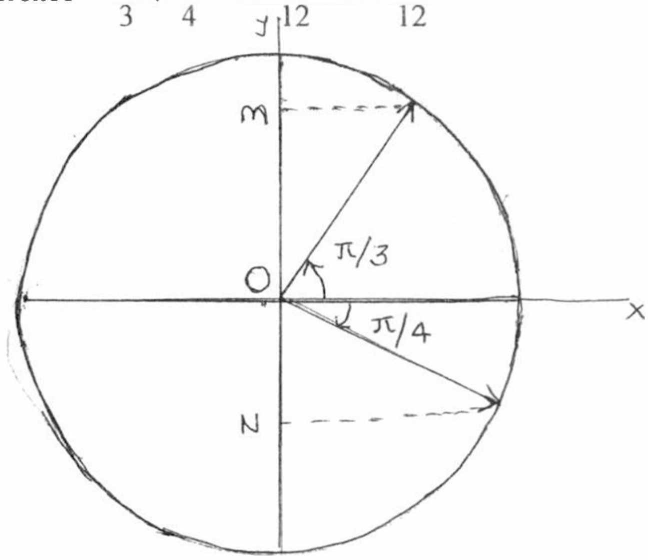
Chapter 22: Oscillations

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	$y_1 = A \sin \omega t$ and $y_2 = A \cos wt$ are the equations of motion of two particles. What is the phase difference between them?	K Recall Easy

Ans: $\frac{\pi}{2}$ OR 90° (1 mark)

Sl. No.	Question	Obj/ Spec./ Diff. Level
2.	A and B are two particles executing uniform circular motion with the same angular frequency Projections OM and ON executes SHM through the point O. What is the phase difference between them?	U Computing Average

Ans: $\Phi =$ Phase difference $= \frac{\pi}{3} + \frac{\pi}{4} = \frac{(4+3)\pi}{12} = \frac{7\pi}{12}$



(1 mark)

Sl. No.	Question	Obj/ Spec./ Diff. Level
3.	At which position of a particle executing simple harmonic motion, its potential energy is maximum?	K Recall Easy

At extreme point / maximum displacement position (1 mark)

Sl. No.	Question	Obj/ Spec./ Diff. Level
4.	A particle is executing SHM. Its displacement is given by the equation $y = A \sin(\omega t + \pi/2)$. Represent this graphically.	K Recall Average

Correct graph (1 mark)

5. At which position is the velocity maximum for a particle in S.H.M? K Recall Easy

At mean position / at equilibrium position (1 mark)

6. At which position is the acceleration a maximum for a particle in simple harmonic motion? K Recall Easy

At extreme position / maximum displacement position (1 mark)

7. Write two differences between rotational and vibrational motion. K Recall Easy

Rotational	Vibrational
1. It is motion of a body around a point or axis. 2. At a point in the path, direction of motion same.	1. To and fro motion about a point. 2. At a point in its path, it has two directions.

One mark each.

8. What is the direction of acceleration of a particle executing SHM? K Recall Easy

Acceleration is directed towards mean position / equilibrium position. (1 mark)

9. Write down the positions at which the acceleration is i) maximum, ii) minimum for a particle in SHM. K Recall Easy

1. Acceleration is maximum at maximum displacement position/ extreme position. (1 mark)
2. Minimum at mean / equilibrium position. (1 mark)

10. Write down the maximum and minimum values of acceleration for particle executing SHM. K Recall Easy

1. $A\omega^2$ / - $A\omega^2$ (1 mark)
2. Zero (1 mark)

11. In the equation y = A sin ωt where A is in meters, what is the displacement (y) at time $t = \frac{\pi}{2\omega}$ sec. Amplitude A = 10 m. — U Compute Average

y = 10 m (1 mark)

12. At which position of a particle executing SHM, the kinetic energy is a maximum and a minimum? — K Recall Easy

Maximum at mean position. (1 mark)
Minimum / zero at extreme position. (1 mark)

13. A mass of 10 kg suspended from a spring of negligible mass is pulled a little and released so that the mass executes SHM of period T. If the mass is increased by M, the time period is $\frac{5T}{3}$. Find increased mass, if k is the spring constant. — A Calculation Average

$$T = 2\pi\sqrt{\frac{m}{k}} \quad \text{(1 mark)}$$

$$T_1^2 = 4\pi^2 \frac{10}{k} \quad \text{(1 Mark)}$$

$$T_2^2 = 4\pi^2 \left(\frac{10+M}{k}\right) \quad \text{(1 mark)}$$

$$\left.\begin{aligned} &\frac{25}{9} \times 10 = 10 + M - 1 \\ &M = 17.77 \text{ kg} \end{aligned}\right\} \quad \text{(1 mark)}$$

14. y = 0.5 sin (31.4 t) is the equation of motion of a particle executing simple harmonic motion. Find — A Interpret Difficult

a) amplitude
b) period
c) Maximum velocity
d) Maximum kinetic energy of mass of particle is 10 mg
e) Displacement of particle

At t = 0.05 sec (follow SI system)

1. Amplitude A = 0.5 m (1 mark)
2. $\omega = \frac{2\pi}{T} = 31.4$, $\frac{2 \times 3.14}{T} = 31.4$, T = 0.2 s (1 mark)
3. $v = A\omega = 0.5 \times 31.4 = 15.7\ ms^{-1}$ (1 mark)
4. KE = $\frac{1}{2} m A^2\omega^2$
5. y = A sin ωt

y = 0.5 m (1 mark)

15. Write the equations for (i) the velocity and (ii) the acceleration of a particle executing SHM, explain their variations with respect to displacement.

1. $v = \omega\sqrt{A^2 - y^2}$ (1 mark)
   v → Minimum v = 0 y = A (1 mark)
2. $a = -\omega^2 y$ (1 mark) a = 0, y = 0
   v → Maximum when y = 0 (1 mark) a = max, y = A } 1 mark

16. The length of the string of a simple pendulum, executing SHM is increased by 44%. Find the percentage increase in its period. U Compute Easy

$T = 2\pi\sqrt{\frac{l}{g}}$ (1 mark)

$l = l_l$ $T_1 = 2\pi\sqrt{\frac{l}{g}}$

If length is increased by 44%

$l_2 = l_l + \frac{44}{100}l_1 = 1.44\, l_l$ (1 mark)

$T_2 = 2\pi\sqrt{\frac{1.44}{g}l_1}$ (1 mark)

$\frac{T_2}{T_1} = 1.2$

$\frac{T_2}{T_1} - 1 = 0.2$

$\frac{T_2 - T_1}{T_1} \times 100 = 0.2 \times 100$

= 20%

17. The length of a simple pendulum is increased by 4%, then calculate the percentage change in its time period. A Solves Average

Since $T = 2\pi\sqrt{\frac{l}{g}}$ (1 mark)

Therefore, $T_1 = 2\pi\sqrt{\frac{l_1}{g}}$, $T_2 = 2\pi\sqrt{\frac{l_2}{g}}$ (1 mark)

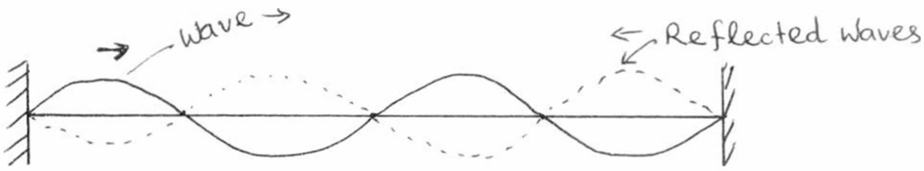
$\therefore \frac{T_2}{T_1} = \sqrt{\frac{l_2}{l_1}}$. As $l_2 = l_l + \frac{4\,l_1}{100} = \frac{104 l_1}{100}$ (1 mark)

$\therefore \frac{T_2}{T_1} = \sqrt{\frac{104\,l_1}{100\,l_1}} = \sqrt{1 + \frac{4}{100}} = \left(1 + \frac{4}{100}\right)^{1/2} = 1 + \frac{1}{2} \times \frac{4}{100} = 1.02$

$\therefore T_2 = 1.02T_1$ (1 mark)

Chapters 23 and 24 : Waves and Sound

1. In the diagram below for what value of phase the wave undergoes a reflection from a rigid surface. U Interpret Easy



When a wave undergoes a reflection from a rigid surface its phase changes by π radians. (1 mark)

2. What is the state of vibration of the particle midway between two antinodes? K Recall Easy

The particles midway between two antinodes is always at rest. (1 mark)

3. For what wavelength of waves, does a closed pipe of length 0.3m emit the first overtone? U Calculate Average

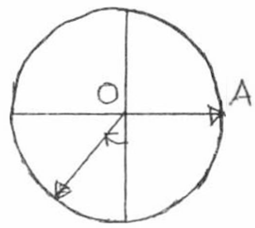
Frequency of first overtone $f = \frac{3V}{4l} = \frac{3V}{4(0.3)}$ (1 mark)

Since $\lambda = \frac{V}{f} = \frac{V}{\frac{3V}{1.2}} = \frac{1.2}{3} = 0.4m$ (1 mark)

4. Give an example for free vibrations. K Recall Average

Vibrations of a simple pendulum in vacuum (1 mark)

5. Particles A and B executes SHM with the same frequency. What is the phase difference between them? U Compute Easy



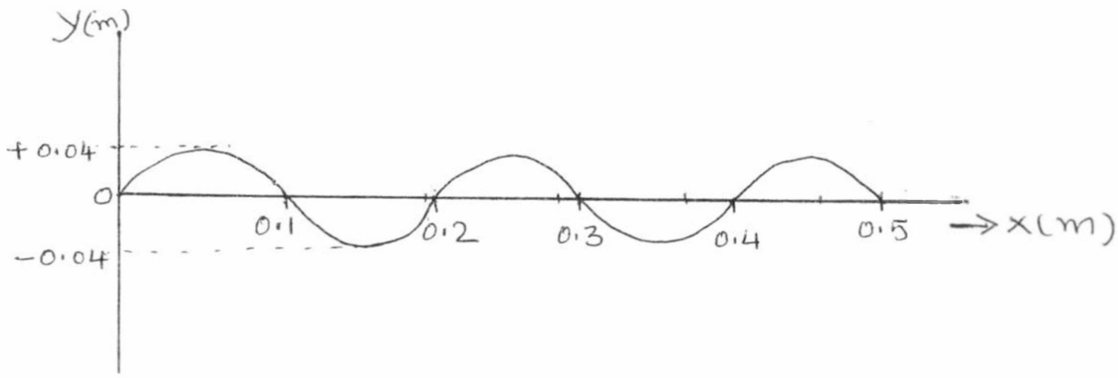
Phase difference = $\Phi = 90 + 45$ (1 mark)

$\Phi = 135^{o}$

6. Which variable quantity of a wave remains constant when it travels from one medium to another? — K, Recall, Easy
   a) wavelength
   b) amplitude
   c) frequency
   d) velocity

Ans : c)

7. A progressing wave traveling in positive x-axis is as shown. Write the wave equation if its position at t = 0 is as shown. — U, Interpret, Easy
   Given a = 0.04 m, v = 200 m/s, λ = 0.2 m.



$$y = a \sin \frac{2\pi}{\lambda}(vt - x)$$

$$y = 0.04 \sin (2000\,\pi - 10\,\pi x)$$

$$\text{or } y = 0.04 \sin \frac{2\pi}{0.2}(200\,t - x)$$

$$y = 0.04 \sin (2000\,\pi\,t - 10\,\pi\,x)$$ (1 mark)

$$y = a \sin \left(\frac{2\pi}{\lambda} vt - \frac{2\pi}{\lambda} x\right)$$

8. The shape of a pulse gets deformed during propagation in a dispersive medium. Explain. — K Understand Easy

The wavelength of the pulse changes as it passes through a dispersive medium. Hence its shape also changes. (1 mark)

9. The displacement y of a particle in a medium can be represented by $y = 10^{-6} \sin(100\,t + 20\,x + \frac{\pi}{4})$ m, where t is in second and x is in m. What is the speed of the wave? — U Compute Average

By comparing the given equation with the standard equation, speed of the wave is found to be v = 5 m / s.

Compare with $y = a \sin(\omega t + k + \phi)$ (1 mark)

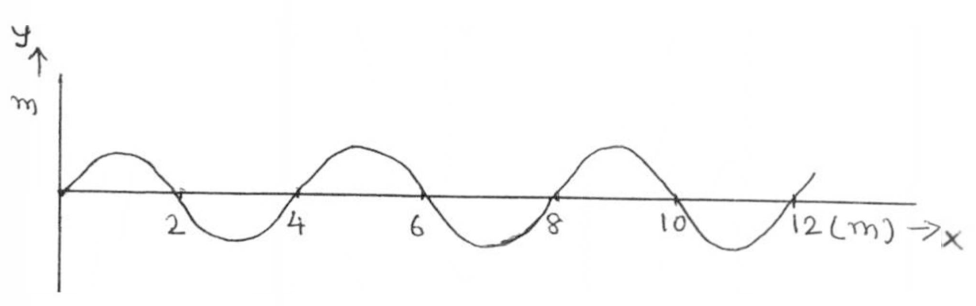
$$\omega = 2\pi\nu = \left(\frac{2\pi}{\lambda}\right) v = k v$$

$$v = \frac{\omega}{k} = \frac{100}{20} = 5\ ms^{-1}$$ (1 mark)

10. Write the equation of a sinusoidal wave traveling along the negative x-direction having angular frequency ω, amplitude A and wavelength λ. — K Recall Average

Ans: $y = A \sin(\omega t + kx)$ (1 mark)

11. A wave having a frequency of 50 Hz is as shown in the figure. Find its wavelength and speed.



Wavelength λ = 4 m (1 mark)
Speed $v = 200\ ms^{-1}$ (1 mark)

12.	Which of the following phenomena is not exhibited by sound waves? a) Interference b) Diffraction c) Beats d) Propagation in vacuum Ans: d)	K Recall Easy
13.	Name the property exhibited by electromagnetic waves, which is not exhibited by mechanical waves. Polarization (1 mark)	K Recall Easy
14.	The property exhibited by electromagnetic waves and not exhibited by mechanical waves is a) interference b) reflection c) refraction d) polarization Ans: d)	K Recall Easy
15.	What is the phase difference between the waves? $y_1(x, t) = a \sin (wt + kx)$ and $y_2 (x, t) = a \cos (wt + kx)$. Phase difference between the waves $y_1(x_1, t)$ and $y_2(x, t)$ is 90^o. Since wave and cosine waves differ by a phase of $\phi = \pi/2$ rad. (1 mark)	K Recall Easy
16.	If oil of density higher than that of water is used in place of water in resonance tube, its frequency will a) decrease b) increase c) remains the same d) cannot say Ans: c)	K Recall Easy

17. In a stationary wave, node is a point having — K Recall Easy

a) maximum density
b) minimum displacement
c) minimum density
d) maximum strain

Ans: b)

18. There is no net transfer of energy through the medium in — K Recall Easy

a) longitudinal wave
b) transverse wave
c) progressive wave
d) stationary wave

Ans: d)

19. Describe an experiment to find the velocity of sound at zero degree Celsius. — S Describe Average

Scheme of Valuation :

$v_t = 2f(l_2 - l_1)\ ms^{-1}$

$$v_o = \frac{V_t}{\sqrt{1+\frac{t}{273}}}\ ms^{-1}$$

TR	f in Hz	Resonating length × 10^2m		$V = 2f(l_2 - l_1)$
		l_1	l_2	

Diagram – 1 mark
Table – 1 mark
Procedure – 2 marks

20. Calculate the velocity of sound from following readings. — A Calculate Average

Scheme of Valuation :

TR No.	Fre 'f' in Hz	Resonating length in meter	
		L_1	L_2
1	520	0.16	0.49
2	480	0.18	0.54

Formula – 1 mark
Calculation l_1 and l_2 – 1 mark
Substitution and calculation – 2 marks
Correct result with unit – 1 mark

21. Following are the readings obtained in a sonometer experiment to determine the frequency of a tuning fork. — A Calculate Average
Mass of weight hanger = 0.5 kg
Length of the specimen wire = 4m
Mass of the specimen wire = 12.48 g

Trial No.	Mass added to the weight hanger $m_1$kg	Resonating length $l \times 10^{-2}$ m
1	0.5	6.6
2	1.0	8.0
3	1.5	9.3

Formula : 1 mark $f = \dfrac{1}{2\sqrt{m}} \times \left(\dfrac{\sqrt{T}}{l}\right)_{av} .Hz$

Finding $\dfrac{\sqrt{T}}{l}$ for each trial – 1 mark each.

$\left(\dfrac{\sqrt{T}}{l}\right)_{av} = 47.65$

Substitution and simplification – 1 mark.
f = 426.5 Hz

22. An air filled tube, closed at one end, resonates with a tuning fork of frequency 512 Hz. The first two successive lengths of the resonant air columns are 15.5×10^{-2} m and 50×10^{-2} m. If the experiment is performed at 30° C, calculate the speed of sound at 0° C. — A Calculate Average

$v_t = 2f(l_2 - l_1)$ (1 mark)
1. Find the speed of sound at 30° $v_t = 353.3$ m/s (1 mark)
2. Speed of sound at 0°C $v_o = \dfrac{v_t}{\sqrt{1 + \dfrac{1}{273}}}$ (1 mark)
3. Substitution and simplification (1 mark)
4. Final result with unit (1 mark)

$v_o = 335.2$ m/s

23.	Describe an experiment to determine the acceleration due to gravity at a place using simple pendulum.	U Describe Average

1. Figure – 1 mark
2. Formula – 1 mark
3. Empty tabular column – 1 mark
4. Procedure – 2 marks

24.	What is an open pipe? Obtain the relation between the fundamental frequency and overtones in an open pipe.	A Derive Difficult

Definition of open pipe (1 mark)
Diagram showing modes vibration in open pipe (1 mark)
Obtaining the fundamental frequency (1 mark)
Obtaining the equation for I and II overtone (1 mark)
Showing $f_1 : f_2 : f_2 = 1 : 2 : 3$ (1 mark)

25.	Write any four differences between progressive and stationary wave.	K Recall Average

One mark each

26.	Derive the expression for the frequency of vibration of a stretched string.	U Derive Difficult

Modes of vibration of the string (1 mark)

Expression for the velocity of wave in a string $v = \sqrt{\frac{T}{m}}$ (1 mark)

Fundamental frequency (1 mark) $f_1 = \frac{1}{2l}\sqrt{\frac{T}{m}}$

Expression I and II overtone (1 mark)

Arriving at $f = \frac{1}{2l}\sqrt{\frac{T}{m}}$ (1 mark)

27.	A simple harmonic wave is given by the equation $y = 4 \sin (8\pi t - 0.02\,x + 1.57)$, where x and y are in cm and t is in second. Calculate the (i) amplitude, (ii) frequency, (iii) wavelength, (iv) propagation constant and the (v) initial phase.	A Solve Average

$y = 4 \sin (8\,\pi\, t - 0.02\, x + 1.57)$
Std. Eqn. $y = a \sin (\omega t - kx + \phi)$

Comparing the two equations. (1 mark for each physical quantity)
a = 4 cm, f = 4 Hz, λ = 3.14 m, k = 0.02 rad/m.
Initial phase $\phi = 90^o$.

28. Reverberation time in an empty hall is longer than in a crowded hall. Explain. — U Interpret Average

1. In an empty hall reverberation time due to multiple reflections is longer (1 mark).
2. In a crowded hall each person will absorb sound. Hence reverberation time becomes shorter. (1 mark).

29. The fundamental frequency produced in a closed pipe is 500 Hz. What is the frequency of the first overtone? — U Compute Average

In a closed pipe, $f_1 : f_2 : f_3 = 1 : 3 : 5$ (1 mark)
For I overtone $f_2 = 3f_1 = 3 \times 500 = 1500$ Hz (1 mark)

30. Why should we apply end correction in the case of closed pipe/ open pipe? — U Interpret Average

Due to freedom of vibration of air molecules at the open end antinodes are formed a little distance beyond the open end of the pipe. (1 mark)
Nodes are formed. To measure this distance end correction should be applied (1 mark)

31. Show that the beat frequency is equal to the difference between the frequencies of two sound waves which produce beat. — A Formulate Easy
$y_1 = A \sin w_1 t \quad y_2 = A \sin w_2 t$
$y = y_1 + y_2$ (1 mark)

$$y \ [2A \cos 2\pi \left(\frac{f_1 - f_2}{2}\right) t \left[\sin 2\pi \left(\frac{f_1 + f_2}{2}\right) t \right] \quad \text{(1 mark)}$$

$$\text{Amplitude } R = 2 \,.\, A \cos 2\pi \left(\frac{f_1 - f_2}{2}\right) t \quad \text{(1 mark)}$$

$$\text{Intensity is Max when } \left(\frac{f_1 - f_2}{2}\right) t = \pm 1 \quad \text{(1 mark)}$$

$$\text{Period of beats} = T_b = \frac{1}{f_1 - f_2}$$

Frequency of beats $f_b = f_1 - f_2$ (1 mark)

32. How does the following factors affect the velocity of sound in gases?
i) Pressure, ii) temperature, iii) humidity and the density of the medium in which sound propagates.

K
Recall
Average

i) to iv) (one mark each).
$v \propto \sqrt{T}$ (1 mark)

33. Why is velocity of sound independent of change in pressure?

K
Recall
Easy

If pressure changes, density also changes so that ratio remains constant. (1 mark)

34. Derive Newton's formula for velocity of sound in a gaseous medium. What is Laplace correction ?

K
Recall
Average

Velocity of sound in a medium is the square root of ratio of elastic constant of the medium to the density of the medium.

$v = \sqrt{\frac{E}{\rho}}$ (1 mark) In space E = B.

$v = \sqrt{\frac{B}{\rho}}$ (1 mark) Elastic constant (E) = Bulk modulus, (B)

$v = \sqrt{\frac{P}{\rho}}$ (1 mark)

Propagation of sound in space is according to adiabatic process. (1 mark)

$v = \sqrt{\frac{\gamma P}{\rho}}$ (1 mark)

35. A source and listener approach each other with the velocity v_s and v_l respectively. Frequency of sound produced by source appears to be doubled. Then $\frac{v_L}{v_S}$ is (Given v = velocity of sound, $v_w = 0$, v_w= velocity of wind).

U
Relation
Average

a) $\frac{v}{v_s} - 2$

b) $\frac{v_s}{v} - 2$

c) $2 - \frac{v}{v_s}$

d) $2 - \frac{v_s}{v}$

Ans: a)

36. A sound wave is propagating in a medium. Its amplitude is 1.414. What is the required amplitude to double the intensity?

U
Computation
Average

a) 1.414
b) 1
c) 2
d) 3

c) 2

37. At one ATP the velocity of sound in a gas is v. At 4 ATP velocity of sound in same gas is

K
Relation
Easy

a) 4v
b) 2v
c) $\sqrt{2}$ v
d) v

d) v

38. A source of sound and listener moving with same velocity 60 ms^{-1}. Direction of source makes an angle 60^{0} with direction of listener. Source produces sound of frequency 900 Hz. What is the apparent frequency with respect to listener? If source is moving in opposite direction, what is the apparent frequency? Given velocity of sound is 3.30 ms^{-1}.

A
Calculate
Difficult

$v_s = 60 \times \cos 60^{0} = 30\ ms^{-1}$
$v_\lambda = 60\ ms^{-1}$ $v = 330\ ms^{-1}$
When $\theta = 60$

$$f' = \left(\frac{v - v_1}{v - v_s}\right) f \quad \text{(1 mark)}$$

$$f' = \left(\frac{330 - 60}{330 - 30}\right) 900 = 270 \times 3$$

$f' = 810$ Hz (1 mark)

Source in opposite direction :
$v_s = 120^o$
$v_s = 60 \cos 120^o$
$v_s = -30\ ms^{-1}$ (1 mark)

$$f' = \left(\frac{330 - 60}{330 + 30}\right) 900$$

$$= \frac{270}{360} \times 900$$

$f' = 675$ Hz (1 mark)

39. Define beats. Explain two applications of beats. K Recall

Definition (1 mark). Each application (2 marks)

40. Write three differences between music and noise and explain two characteristics of musical sound. K Recall Easy

Each difference (1 mark), each characteristic (1 mark)

41. What is Doppler effect? Write the expression for apparent frequency in general case. What is the cause for Doppler effect? K Recall Average

What is Doppler effect?	(2 marks)
Explanation of notation	(1 mark)
Expression	(1 mark)
Cause for Doppler effect	(1 mark)

42. The mean molecular weight of air is 28.8. If the ratio of the two specific heats is 1.4, calculate the velocity of sound in air at 300 K. Gas constant R = 8.31 J / mol / kelvin. U Calculate Easy

Velocity of sound in air $v = \sqrt{\frac{\gamma P}{\rho}}$ (1 mark)

PV= RT (1 mark)

Volume of 1 mole $V = \frac{mass}{density} = \frac{M}{\rho} = \frac{28.8 \times 10^{-3}}{\rho} = RT$

$$\frac{P}{\rho} = \frac{RT}{28.8 \times 10^{-3}} \quad \text{(1 mark)}$$

$$v = \sqrt{\frac{\gamma RT}{28.8 \times 10^{-3}}} \text{ m/s}$$

$$v = \sqrt{\frac{1.4 \times 8.31 \times 300}{28.8 \times 10^{-3}}} \quad \text{(1 mark)}$$

$v = 348\ ms^{-1}$ (1 mark)

43. The intensity of sound is $5 \times 10^{-5}\ Wm^{-2}$. If the frequency is 1000Hz, calculate amplitude of sound wave in air at STP. Also calculate amplitude of sound wave if temperature is 30°. Velocity of sound in STP is 332 ms^{-1} and density of air is 1.29 kg m^{-3}. — A Calculation Difficult

$$a = \frac{1}{\pi f}\sqrt{\frac{I}{2\rho v}} \quad \text{(1 mark)}$$

$a = 7.7 \times 10^{-8}$ m (1 mark)

Velocity at 30°C $v = v_o \sqrt{\frac{273 + t}{273}}$ (1 mark)

$v = 349.8\ ms^{-1}$ (1 mark)

$$\text{Amplitude } a = \frac{1}{\pi \times 1000} \times \sqrt{\frac{5 \times 10^{-5}}{2 \times 1.29 \times 349.8}}$$

$a = 7.49 \times 10^{-8}$ m (1 mark)

44. A listener is moving towards an excited tuning fork of frequency 100 Hz. With velocity of 1/20 of velocity of sound, the frequency of tuning fork as heard by listener is — U Calculation Average
   a) 105 Hz
   b) 100 Hz
   c) 95 Hz
   d) 10 Hz

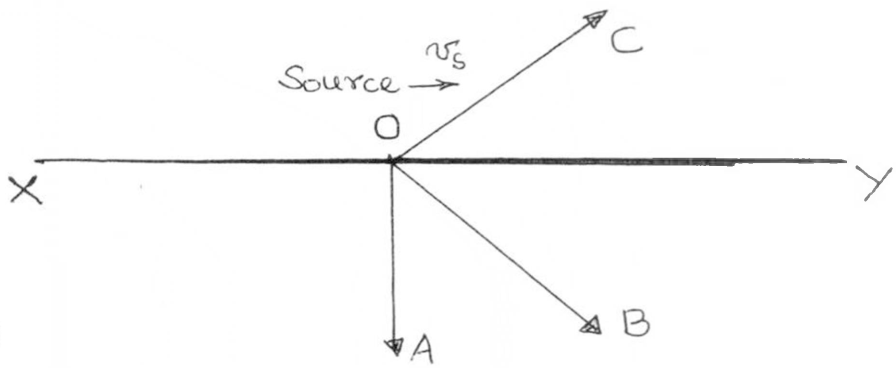
a) 105 Hz

45. A listener is moving away from stationary source with a velocity V_s. Frequency of sound produced by source changes by 5%. If velocity of sound is 300 ms^{-1}, the velocity of listener is — U Calculation Average
   a) - 15 ms^{-1}
   b) + 15 ms^{-1}
   c) 20 ms^{-1}
   d) 10 ms^{-1}

Ans: b)

46. A source of sound is moving along XY as shown in the figure with velocity v_s. A listener is also moving with speed v_s. For which direction of listener, there is no Doppler effect? — U Discriminate Average

a) along OB
b) along OC
c) along OA
d) xy direction



Ans: d)

47. Explain why a listener placing his ear to one end of a long pipe hears two distinct sounds, when a person hammers at the other end. U Explain Average

1. Sound waves travel through gases (air) and solid s (pipe) (1 mark)
2. As the speed of sound in solids is greater in solids than in gases, therefore two distinct sounds can be heard. (1 mark)

48. Sketch a graph showing the relation between speed of sound in a gas and its pressure. S Draw a graph Easy

Since the speed of sound is independent of pressure, hence V remains constant with change of P (1 mark).

49. A progressive wave is represented by y = 1.2 sin π $\left(\frac{2t}{5} - \frac{x}{4}\right)$ where x and y are in m and t in s. Find the intensity of the wave given ρ = 1.31 g/m³. A Solves Average

y = a sin 2π $\left(\frac{t}{T} - \frac{x}{\lambda}\right)$ Comparing a = 1.2 m, T = 5 s, λ = 8m,

f = $\frac{1}{8}$ = $0.125 Hz$ (1 mark)

y = a sin 2π $\left(\frac{t}{5} - \frac{x}{8}\right)$ (1 mark)

v = fλ = 0.125 × 8 = 10.00 m/s (1 mark).

Intensity $I = 2\ \pi^2\ a^2\ f^2\ \rho\ v$ (1 mark)

$= 2 \times \pi^2 \times 1.2^2 \times \left(\frac{1}{8}\right)^2 \times 1.3 \times 10$

$= 5.775\ \ Wm^{-2}$ (1 mark)

50. Deduce the general expression for a progressive wave. K Derives Average

Consider a simple harmonic wave produced at O traveling with a velocity v along the positive x-direction. The particle at O executes SHM due to the disturbance. The displacement from the mean position at any instant t is given by A – amplitude,
ω – angular frequency, T – period.

$y = A \sin \omega t \longrightarrow 1$ (1 mark)

Now consider a particle at P at a distance r from the origin would reach in a time $\frac{x}{v}$. (1 mark)

Therefore, displacement of the particle at P at a time t is same as that of the particle at O, at a time $\left(t - \frac{x}{v}\right)$ (1 mark)

$\therefore\ \ y = A \sin w \left(t + \frac{x}{v}\right)$ displacement of the particle at P.

(1 mark)

Chapter 25 : Stationary Waves

1. Why strings of different thickness and material are used in a sitar or violin? U Interpret Easy

Ans: $n \propto \frac{1}{\sqrt{m}}$ (1 mark)

2. A vibrating string is heated to higher temperatures. What happens to the pitch of the note produced? U Interpret Average

1. Due to heating of the string, it expands, hence density decreases. (1 mark)

2. As frequency is inversely proportional to the density, frequency of note emitted increases. Then the note becomes higher pitch. (1 mark)

3.	A tuning fork produces resonance with a closed pipe. But the same tuning fork is unable to produce resonance with an open organ pipe of same length. Why ? The fundamental frequency of closed pipe of given length is different from that of the open pipe of same length (1 mark)	U Reason Average
4.	State and explain the laws of vibrations in a stretched string. 1. Statement for each law (3 marks) 2. Explanation of symbols (1 mark)	K Recall Average
5.	Show that the overtones in a closed pipe are odd harmonics of the fundamental. 1. Writing the diagram to show modes of vibration of air columns in a pipe. (1 mark) 2. Fundamental frequency expressions (1 mark) 3. Expressions for II and III overtones – 1 mark each 4. Showing $f_1 : f_2 : f_3 = 1 : 3 : 5$ (1 mark)	A Applies Easy

UNIT 7 EARTH'S ATMOSPHERE AND ASTROPHYSICS

Chapter 27: Earth's Atmosphere

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Write the approximate height of earth's atmosphere in kilometers. 560 kilometers from the surface of earth. (1 mark)	K Recall Average
2.	Write the percentage of nitrogen present in the atmosphere. Ans: 78% (1 mark)	K Recall Easy
3.	Write the percentage of oxygen present in the atmosphere. Ans: 21% (1 mark)	K Recall Easy
4.	Write three main layers of the atmosphere. 1. Troposphere, 2. Stratosphere, 3. Mesosphere (1 mark each)	K Recall Average
5.	Write the range of troposphere from surface of earth. 8 km to 14.5 km (1 mark)	K Recall Average
6.	Write two lower layers of atmosphere. 1. Tropopouse 2. Troposphere (1 mark each)	K Recall Average
7.	Write the range of stratosphere from the surface of earth. 50 kilometers or 50 km (1 mark)	K Recall Average
8.	Which layer is close to the stratosphere? Ozone layer (1 mark)	K Recall Average

9.	Which is the topmost layer of atmosphere?	K Recall Average
	Ionosphere (1 mark)	
10.	How does air pressure vary with height ?	K Recall Average
	Atmospheric pressure decreases with increase in height. (1 mark)	
11.	Name the atmospheric layer, which absorbs high energy radiation from space.	K Recall
	Ionosphere (1 mark)	
12.	Name the thin layer which separates Troposphere and Stratosphere.	K Recall Easy
	Tropopouse (1 mark)	
13.	Which radiation is absorbed by the ozone layer?	K Recall Easy
	Ultraviolet radiation (1 mark)	
14.	What is the colour of ozone layer?	K Recall Easy
	Colourless (1 mark)	
15.	What happens when ozone layer is depleted?	K Recall Easy
	Amount of ultraviolet radiation reaching earth increases. This can cause skin cancer. (1 mark)	
16.	How the Van-Allen belts surround earth?	K Recall Easy
	The belts surround the earth like doughnuts. (1 mark)	
17.	Draw layers of the earth's atmosphere and label the layers.	A Draw Average

Ionosphere

Mesosphere

– ozone layer (1 mark each)

Stratosphere

18. On which base atmospheric layers are divided? K Recall Easy

Atmospheric layers are divided on basis of thermal conditions and density. (1 mark)

19. How does the atmosphere provide a moderate climate? K Recall Easy

The atmosphere provides a moderate climate by recycling water and other chemicals. (1 mark)

20. Write the formula for variation of atmospheric pressure with height. K Recall Average

The atmospheric pressure at height h above sea level is given by
$P = P_o e^{-Mgy / RT}$
Where P_o = pressure at sea level. (1 mark)

21. Write the importance of Ionosphere. K Recall Easy

Ionosphere is used as a means of radio communication. (1 mark)

22. Write one important function of magnetosphere. K Recall Easy

The magnetosphere shields the earth from solar wind. (1 mark)

23. Where is tropopause located in earth's atmosphere? K Location Easy

Stratosphere
Tropopause
Troposphere

Earth

(1 mark)

24. Indicate the location of ozone layer in earth's atmosphere.

K
Location
Easy

Mesosphere
Ozone layer
Stratosphere

(1 mark)

25. Mention the height at which Van-allen belts are situated.

K
Recall
Easy

The inner ring about 32000 km above and outer ring about 16000 km above the earth surface. (1 mark)

26. How do you measure atmosphere pressure?

K
Measure
Easy

Atmosphere pressure is measured using a barometer. (1 mark)

27. Draw a neat diagram of atmosphere, label the layers and write the ranges in kilometers.

S
Draw
Average

Neat diagram (1 mark) parts labelled (2 marks) and heights (2 marks)

28. Draw the π - diagram of earth's atmosphere and mention the percentage of composition of gases present.

S
Figure
Average

Diagram (1 mark), marking (1 mark), percentage (1 mark).
The earth's atmosphere primarily consists of about 78% nitrogen, 21% oxygen and 1% other gases like organ. The oxygen in the atmosphere is produced by plants i.e. blue-green algae.

Unit 28: Astrophysics

1. What is the magnitude of the faintest star? K Recall Easy

   Sixth magnitude of star is called faintest star. (1 mark)

2. What is the apparent magnitude of a star? K Recall Easy

   Light energy received at the earth is the apparent magnitude of a star. (1 mark)

3. How bright is a bright star, compared to a faint star? K Recall Easy

   A brightest star is 100 times brighter than the faintest star. (1 mark)

4. What is the range of diameter of stars in kilometers? K Interpret Average

   Few kilometers to billion kilometers (1 mark)

5. What is mass relation of stars? K Recall Easy

   Ans: $L \propto m^3$ (1 mark)

6. What is a black hole? K Recall Easy

   Definition of black hole. (1 mark)

7. Which stars die first ? K Recall Easy

   Massive stars die first. (1 mark)

8. At which location in a star is the pressure higher? U Discriminate Average

Pressure of stars is large near the centre of the star. (1 mark)

9. Draw HR diagram to show red giants and white dwarf. — K and S, Recall & Draw, Easy

Diagram (1 mark), marking (1 mark)

10. On what factor does the life of a star depend on ? — K, Recall, Easy

Lifetime of a star depends on its mass (1 mark)

11. Write any two properties of a star. — K, Recall, Easy

1. Luminosity 2. Brightness (1 mark each)

12. What is indicated by the given equation? — K, Recognize

$$R = \left(\frac{L}{4\pi 6 T^4}\right)^{1/2}$$

Stellar radius (1 mark)

13. Draw HR diagram and identify the informations contained in it. — K & S, Recall, Average

Diagram (1 mark), information as below (1 mark each)

a) At the lower right, coolest, reddish least bright have low mass.
b) Farther up towards left, hotter, more luminous, yellowish. Still further UP more luminous, more massive.
c) Red giant
d) White dwarfs

14. What are the main physical properties of a star? — K, Recall, Average

a) Luminosity
b) Brightness
c) Size of star
d) Mass of star (½ mark each)

15. Give brief account of stellar evolution.

K
Recall
Average

1. Draw HR diagram. (1 mark)
2. Formation of a star from a protostar (1 mark)
3. Formation of red giant. (1 mark)

16. Which one of the following decides the life time of a star?

a) mass
b) volume
c) temperature
d) pressure

K
Recall
Easy

Ans: a)

17. Locate the position of sun in HR diagram.

U
Classify
Average

Main sequence (1 mark)

18. Luminosity of a star depends upon its

a) mass
b) volume
c) temperature
d) pressure

U
Classify
Average

Ans: a)

19. At the sunspots which of the following is maximum? U Classify Average
    a) temperature
    b) volume
    c) magnetic field
    d) pressure

    Ans: c)

20. The temperature of the sun is maximum at K Recall Easy
    a) centre
    b) outer side
    c) above the sun
    d) inner side

    Ans: a)

I PUC Practicals

Long Answer Type Questions

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Describe an experiment to determine the diameter and radius of wire using screw gauge. Neat diagram – 1 mark , Formula – 1 mark, Tabular column – 1 mark, Procedure – 2 marks.	K Recall Easy
2.	The following were the observations while determining the diameter of a given wire using a screw gauge. Calculate the diameter and hence the radius of the wire. No. of divisions on the head scale = 100 No. of divisions moved on the pitch scale = 5 [Each division is equal to the length of a mm] No. of rotations moved on the pitch scale = 5 Zero error = -5	A Measure Difficult

Trial No.	PSR (mm)	HSR
1	1	56
2	1	58
3	1	54

Scheme :
Finding LC – 1 mark
Formula – 1 mark
Calculations – 2 marks
Answer with unit – 1 mark

Sl. No.	Question	Obj/ Spec./ Diff. Level
3.	Describe an experiment to determine the acceleration due to gravity at a place using simple pendulum. Diagram – 1 mark; Formula with unit – 1 mark; Tabular column – 1 mark; Procedure – 2 marks.	K Recall Easy
4.	Calculate the acceleration due to gravity at a place from the following data.	S Measure Difficult

Trial No.	Length of the Pendulum 'L' (m)	Time taken (s) for 20 oscillations		
		1	2	3
1	0.6	34	33	35
2	0.8	36.5	36	35.5

Scheme :
Formula – 1 mark
Trial No.1 (L/T^2) – 1 mark
Trial No.2 (L/T^2) – 1 mark
Finding final answer with unit – 2 marks

5. The following observations were taken while conducting an experiment to determine the length, outer and inner diameter of the hollow tube. Calculate length, outer and inner diameter.

A
Calculate
Difficult

Dimension	Trial No.	MSR	CVD
Length	1	5.4	6
	2	5.4	5
	3	5.4	7
Outer diameter	1	2.6	3
	2	2.6	2
	3	2.6	4
Inner diameter	1	2.2	5
	2	2.2	5
	3	2.2	6

Value of one M.S.D. = 0.1 cm
No. of V.S.D. = 10
Scheme point :
LC – 1 mark
Formula – 1 mark
Calculation of length – 1 mark
Calculation of outer diameter – 1 mark
Calculation of inner diameter – 1 mark

6. Describe an experiment to determine the length, outer and inner diameter at the hollow tube.

K
Recall
Easy

Figure – 1 mark
Formula – 1 mark
Tabular column – 1 mark
Procedure – 1 mark

7. In an experiment to determine the spring constant of a given spring, the following readings were recorded. S
Calculate
Difficult

Trial No.	Load W 10^{-3} kg Wt	Pointer reading cm	
		Load increasing	Load decreasing
1	0	11.2	11.2
2	50	11.8	11.8
3	100	12.6	12.6
4	150	13.5	13.5
5	200	14.7	14.7
6	250	15.9	15.9

Draw a graph of load against extension. Hence, calculate spring constant.
Plotting the graph – 1 mark
Scale – 1 mark
Slope – 1 mark
Calculation – 1 mark
Solution with accuracy – 1 mark

8. Describe an experiment to determine the spring constant of a given spring by plotting load extension graph for it. K
Recall
Easy

Figure – 1 mark
Formula – 1 mark
Tabular column – 1 mark
Procedure – 2 marks

Second PUC

UNIT 1 GEOMETRICAL OPTICS

Chapter 1 : Refraction at plane surface

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Draw a ray diagram, when a ray of light travels from glass to water. Indicate the critical angle and the phenomenon of total internal reflection of the ray. OR Illustrate using a ray diagram, the phenomenon of total internal reflection. OR Illustrate the phenomenon of total internal reflection and critical angle when a ray of light passes from a denser medium to rarer medium. Ray diagram indicating critical angle and total internal reflection. (2 marks)	S Drawing Average
2.	A ray of light travels from a medium of R.I. 1.56 to a medium of R.I. 1.68. Does the ray suffer total internal reflection? Justify your answer. No, since the ray passes from rarer to denser medium. (2 marks)	A Reasoning Average
3.	A coin at the bottom of a beaker 0.1 m deep appears to be raised by 0.03 m when the beaker is filled with a liquid upto its brim. Calculate the R.I. of the liquids. Expression (1 mark) Computing n = 1.43 (1 mark)	U Compute Average
4.	When a glass plate of R.I. 1.5 is placed on an ink dot drawn on a paper, it appears to be raised by 1 cm. Calculate the thickness of the glass plate. Formula (1 mark) t = 3 cm (1 mark)	U Compute Average
5.	What is lateral shift?	K Recall Easy

Sidewise shift when a ray of light is incident obliquely on a parallel sided glass slab. (1 mark)

6.	When is lateral shift zero? When does a ray of light get refracted with no lateral shift? Ans: At normal incidence (1 mark)	U Recall Average
7.	Mention any one factor on which lateral shift depends. Any one factor. (1 mark)	K Recall Easy
8.	For what angle of incidence is the lateral shift maximum? Ans: 90^o (1 mark)	U See relationship average
9.	The quantity which does not change during refraction is a) amplitude of light b) wavelength of light c) phase angle d) speed of light Ans: c)	K Recall Average
10.	The ray of light travels from a medium of refractive index 1.5 to another medium of refractive index 1.0. If the angle of incidence is 42^o, the angle of deviation of the incident ray is a) 50^o b) 132^o c) 48^o d) 90^o Ans: c)	K See relationship Average
11.	How does the lateral shift vary with the increase in R.I. of the medium? Increases (1 mark)	K Recall Average

12.	Name the colour of light for which lateral shift is maximum. Violet (1 mark)	U See relationship Average
13.	Name the colour of light for which lateral shift is minimum. Ans: Red	K Recall Average
14.	What is normal shift ? Apparent shift in the position of an object placed in one medium and viewed from other medium. (1 Mark)	K Recall Easy
15.	A person standing on the bank of a swimming pool looks at a swimmer under water. Does the person look longer or shorter? Longer (1 mark)	A Applies Average
16.	Define normal shift. Definition (1 mark)	K Define Easy
17.	Write the expression for normal shift. Expression (1 mark)	K Recall Easy
18.	Define critical angle for a total internal reflection of a body. Correct definition (1 mark)	K Recall Easy
19.	Write the relation between R.I. of the medium and critical angle. Relation (1 mark)	K Recall Easy

20. When refraction takes place from denser medium of R.I. n_2 to rarer medium of R.I. n_1 the critical angle c is given by — K Recall Easy

a) $\sin^{-1}\left(\frac{n_2}{n_1}\right) = c$

b) $\frac{\sin n_2}{\sin n_1} = c$

c) $\sin^{-1}\left(\frac{n_1}{n_2}\right) = c$

d) $\frac{\sin n_1}{\cos n_2} = c$

Ans: a)

21. Name the colour of light for which the critical angle is minimum. — K Recall Easy

Ans: Violet (1 mark)

22. The critical angle for total internal reflection is

a) minimum for green light
b) minimum for violet light
c) the same for all colours
d) minimum for red light

Ans: b)

23. Mention two factors on which critical angle of a medium depend. — K Recall Easy

R.I. of medium colour or wavelength. (1 mark)

24. Find the critical angle for a material of R.I. $\sqrt{2}$. — U Compute Average

Relation finding, $C = 45^o$ (1 mark)

25. For which colour of light is the critical angle of medium maximum? — U Compute Average

Ans: Red (1 mark)

26. What is an optical fibre ? — K Recall Easy

Device which conducts the light along any desired path. (1 mark)

27. Calculate the R.I. of the medium for which the critical angle is 42^{o}. U Compute Easy

Expression (1 mark)
Finding n = 1.49 (1 mark)

28. Mention the conditions for total internal reflection of a light ray. K Recall Easy

Ray should travel from denser to rarer medium. (1 mark)
$i > C$ (1 mark)

29. Mention any two applications of total internal reflection. K Recall Easy

Any two applications (each 1 mark)

30. Write any two advantages of optical fibres over metallic cable in communication. K Recall Easy

Any two advantages (each 1 mark)

31. A tank contains a slab of glass 8 cm thick and of refractive index 1.6. Above this, is a depth of 4.5 cm of an oil and upon this a layer of water 6 cm thick and of refractive index 4/3. To an observer, looking down from above, a mark at the bottom appears to be raised upto position 6 cm from the bottom of the slab. The refractive index of oil is U See relationship Difficult

a) 0.8
b) 1.2
c) 1.5
d) 1.8

Ans : c) 1

32. A diverging beam of light from a point source S having divergence angle α, falls symmetrically on a glass slab as shown in the figure. The angles of incidence for two extreme rays are equal. If the slab has the thickness t and refractive index n, the divergence angle of the emergent beam is U See relationship Average

a) zero
b) α
c) $\sin^{-1}\left(\frac{1}{n}\right)$
d) $2\sin^{-1}\frac{1}{n}$

Ans: b)

33. Draw a graph showing the relationship between angle of incidence and lateral shift when light passes through a glass slab. S Draw Difficult

Diagram (1 mark)

34. Draw the graph showing the relationship between the apparent shift and refractive index of denser medium when a point object in a denser medium is viewed through a rarer medium. S Draw Difficult

Apparent shift (1 mark)

35. Define lateral shift. Derive an expression for the lateral shift for a ray of light passing through a parallel sided glass slab. K Recall Average

Definition – 1 mark
Ray diagram – 1 mark
Showing i = i′
Obtaining final expression – 2 marks

Chapter 2 : Refraction through Prism

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Mention the formula for angle of deviation in terms of angle of incidence and angle of emergence when a ray of light passes through a prism at minimum deviation. Formula $d = i_1 + i_2 - A$ (1 mark)	K Recall Average
2.	When a ray of light passes through a prism of angle A with i_1 and i_2 as the angles of incidence and emergence, the angle of minimum deviation is equal to a) $i_1 - i_2 + A$ b) $i_1 + i_2 - A$ c) $i_1 + i_2 + A$ d) $i_1 + A$ Ans: b)	K Recall Average
3.	What is dispersion of light ? Splitting of white light into its constituent colours when passed through a dispersing medium (prism) (1 mark)	K Recall Easy
4.	The angle of minimum deviation of a ray passing through an equilateral prism is 50^o. Find the angle of incidence. Ans: 55^o (1 mark)	U Relation Difficult
5.	What is a thin prism? Angle of prism is less than 10^o (1 mark)	K Recall Easy
6.	Give an example for impure spectrum. Any one example, like rainbow. (1 mark)	U Example Average
7.	Write the expression for deviation produced by thin prism.	K Recall Easy

Expression (1 mark)

8.	For which colour of light is the deviation maximum in a prism. Ans: Violet (1 mark)	K Recall Easy
9.	Define dispersive power. Correct definition (1 mark)	K Define Easy
10.	Distinguish between deviation and dispersion. Correct answer (1 mark)	K Recall Easy
11.	Which colour of light produces minimum deviation in a prism? Ans: Red (1 mark)	U Recall Easy
11.	Define angular dispersion for a prism. Correct definition (1 mark)	K Define Easy
12.	For which colour of light is deviation maximum in prism? Ans: Violet (1 mark)	K Recall Easy
13.	A glass prism produces a minimum angle of deviation in air. How does the angle of minimum deviation vary when it is immersed in a liquid of R.I. 1.2? Justify your answer. Relative R.I. of glass (1 mark) Decreases (1 mark)	A Reasoning Average
14.	Calculate the R.I. of the material of an equilateral prism for which the angle of minimum deviation is 60°. Formula (1 mark) Arriving n = $\sqrt{3}$ (1 mark)	U Relationship Easy

15. When a ray of light passes through a prism it is found that the deviation at the first phase is $4^{o}\ 36'$ and that at the second phase is $5^{o}24'$. What is the net deviation of the ray ?

U
Recall
Average

$d = d_1 + d_2$ (1 mark)
$d = 10^{o}$ (1 mark)

16. What is the difference between pure and impure spectrum?

U
Relationship
Average

Distinct colours for precise measurement, Dispersing medium is enough. (1 mark each)

17. Draw a neat labelled diagram of an experimental arrangement to get pure spectrum using a prism.

K
Recall
Easy

Neat diagram with labelling (2 marks)

18. Mention the two conditions for dispersion without deviation.

K
Recall
Easy

Two prisms must be made up of different materials and of different angles. Refracting angles must be in opposite direction. (2 marks)

19. Two prisms are made up of materials having R.I. 1.50 and 1.54 respectively. If the angle of the prism having R.I. 1.50 is 40^{o}, what is the angle of second prism placed in opposite manner with the first one to produce dispersion without deviation.

A
Interpret
Average

Arriving $\frac{A'}{A} = \frac{n-1}{n-1}$ (1 mark)
Finding $A' = 37^{o}$ (1 mark)

20. A ray of light passes through an equilateral glass prism such that the angle of incidence is equal to the angle of emergence. If the angle of emergence is ¾ times the angle of the prism, calculate the angle of the glass prism.

U
Computes
Average

Writing $D = 2i - A$
$i = 45^{o}$
$D = 30^{o}$
Formula (1 mark)
Arriving $n = \sqrt{2}$ (1 mark)

21. Derive the expression for R.I. of the material of the prism in terms of the angle of prism and the angle of minimum deviation. — K Recall Easy

OR

Derive $n = \dfrac{\sin\left(\dfrac{A+1}{2}\right)}{\sin\dfrac{A}{2}}$ where the symbols have their usual meaning.

Ray diagram – 1 mark
Arriving $A = r_1 + r_2$ – 1 mark
Finding $d = i_1 + i_2 - A$ - 1 mark
Minimum deviation position – 1 mark
Arriving final expression – 1 mark

22. A ray of light incident on one face of an equilateral prism made of glass of R.I. 1.544 undergoes grazing emergence at the other face. Calculate the angle of incidence. — A Applies Average

Figure (1 mark)
Expression (1 mark)
Finding $C = 40^\circ 22'$ (1 mark)
$r_1 = A - C$ and finding $r_1 = 19^\circ 38'$ (1 mark)
Finding $i_1 = 31^\circ 15'$ (1 mark)

23. An equilateral prism of R.I. 1.54 is immersed in water of R.I. 1.33. Calculate the angle of minimum deviation and the corresponding angle of incidence. — A Applies Difficult

Expression ${}_wn_g = \dfrac{\sin\left(\dfrac{A+D}{2}\right)}{\sin A/2}$ (1 mark)

Substitution finding $\dfrac{A+D}{2}$ (2 marks)

Calculating $D = 10^\circ 44'$ (1 mark)

Identification of $i = \dfrac{A+D}{2}$ (1 mark)

24. Calculate the dispersive powers of crown and flint glass prisms from the following data. — K, U Recall Average

	CROWN	FLINT
Blue	1.526	1.666
Red	1.518	1.648

For crown glass n = 1.522
w = 0.0153
For flint glass n′ = 1.657
w′ = 0.-274 (5 marks)

25. A thin prism P_1, with an angle 4^o and made from glass of refractive index 1.54 is combined with another thin prism P_2 made from glass of refractive index 1.72 to produce dispersion without deviation. The angle of prism P_2 is — U Relation Average

a) 4^o
b) 5.33^o
c) 3^o
d) 2.6^o

Ans : c)

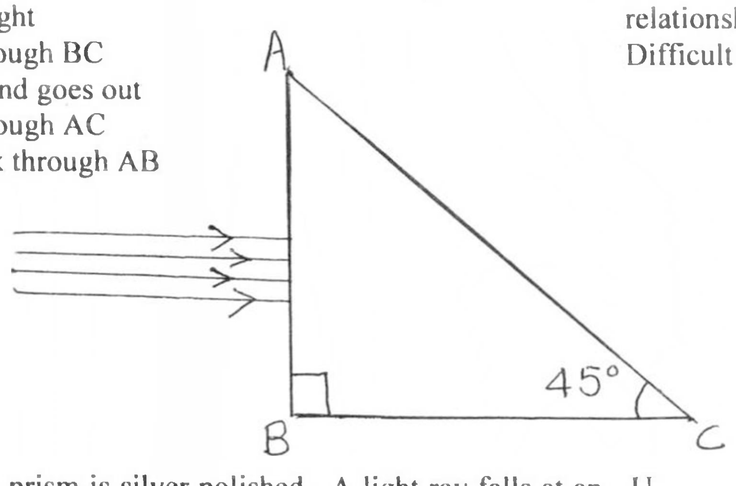
26. When a glass prism of refracting angle 60^o is immersed in a liquid, its angle of minimum deviation is 30^o. The critical angle of glass with respect to the liquid medium is — U See relationship average

a) 45^o
b) 42^o
c) 50^o
d) 52^o

Ans: a)

27. A beam of red light is incident on a right angled prism ABC as shown. The refractive index of the material of the prism for red light is 1.39. The light — U See relationship Difficult

a) goes out through BC
b) grazes AC and goes out
c) goes out through AC
d) reflects back through AB



Ans : c)

28. One face of a glass prism is silver polished. A light ray falls at an angle of 45^o on the other face. After refraction, it is subsequently reflected from the silver face and then it retraces its path. The refracting angle of the prism is 30^o. The refractive index of the material of the prism is — U See relationship Difficult

a) $\frac{3}{2}$

b) $\sqrt{2}$

c) $\frac{\sqrt{3}}{2}$

d) $\sqrt{3}$

Ans: b)

29.	A ray is incident at an angle of incidence i on one face of a prism of small angle A and emerges normally from the opposite face. If the refractive index of the prism is n, angle of incidence i is nearly equal to	U See the relationship

a) $\frac{A}{n}$ b) $\frac{A}{2n}$ c) nA d) $\frac{nA}{2}$

Ans: c)

Chapter 3 :Refraction at Spherical Surfaces

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	A convex lens of focal length 0.15 m is placed in contact with a concave lens of focal length 0.3m. An object placed at a distance of 0.15m from the lens combination. Find the position and the linear magnification of the image. Formula $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$ (1 mark) Finding f = 0.30 m (1 mark) $\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$ (1 mark) Substitution and finding v (1 mark) Magnification m (1 mark)	U Computes Average
2.	A small air bubble within a glass sphere of radius 9 cm is at a distance of 3 cm from the centre of the sphere. When viewed from the nearest side the air bubble appears to be at a distance of 5 cm from the surface. What will be its apparent distance when viewed from the farthest side? Figure (1 mark) Formula (1 mark) R.I. of object space n = 1.6 (1 mark) Substitution and arriving at v' = - 15 cm (1 mark)	K Recall Easy
3.	A glass lens of R.I. 1.6 has a focal length of 0.1 m in air. Find its focal length when immersed in a liquid of R.I. of 1.33. Also find the change in focal length. Lens maker's formula (½ mark) Finding $\left(\frac{1}{R_1}+\frac{1}{R_2}\right)=\frac{1}{0.06}$ (½ mark) Modified form of lens maker's formula $\frac{1}{f}=\left[\frac{ng}{nw}-1\right]\left[\frac{1}{R_1}+\frac{1}{R_2}\right]$ (1 mark) Substitution (1 mark) Finding f = 0.2956 m (1 mark) Change in focal length 0.1956 m (1 mark)	U See relationship average

4. What is an equivalent lens? Deduce an expression for the equivalent focal length of two thin lenses placed co-axially in contact with each other. K Recall Easy

Definition (1 mark)
Ray diagram (1 mark)
Applying Len's formula (1 mark)
Image produced by first thin lens acts as virtual object for second lens (1 mark)
Arriving the final relation (1 mark)

5. An equiconvex lens of glass of R.I. $\frac{3}{2}$ has a focal length of 30 cm. with respect to air. It is kept on the surface of water so that only the lower surface is touching the water. If the R.I. of water is $\frac{4}{3}$, where will a parallel beam of light incident normally on the lens converges to ? A Applies Average

Lens maker's formula (½ mark)
Finding R = 30 cm (1 mark)

For upper surface $\frac{n_1}{u} + \frac{n_2}{v} = \frac{n_1 - n_2}{R}$ (½ mark)

Finding v′ = 90 cm (1 mark)
Applying the formula for the bottom surface v = 60 cm (2 marks)

6. How does an air bubble inside water behave? A beam of light is incident on an air bubble inside water. What will be the nature of the beam emerging from the bubble? U Interpret Average

Diverging lens (2 marks)

7. What is the relation between the focal length of a convex lens and its refractive index with respect to the medium? U See relationship Average

Decreases

Use $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$ (1 mark)

8. Write an expression for the power of a spherical surface. K Recall Easy

$P = \frac{\mu - 1}{R}$ (1 mark)

9. Define power of a lens. K Define Easy

Ability to converge or diverge a beam. (1 mark)

10. Two convex lenses of focal lengths 0.20 m and 0.40 m are separated by a distance of 0.40 m. Find the equivalent focal length of the combination if the lenses are placed co-axially. K Recall Average

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$ (1 mark)

Substitution f = 0.40 m (1 mark)

11. A concave lens and a convex lens of the same power are placed co-axially in contact with each other. Find the focal length of the combination. U Recall Easy

Correct answer (1 mark)

12. The focal length of a convex lens is 20 cm. Find its power. K Recall Easy

$P = \frac{1}{f}$ (1 mark)

Calculation P = 5 dioptres (1 mark)

13. The power of a convex lens of focal length 20 cm is K Recall Easy
    a) 5 dioptres
    b) 0.05 dioptres
    c) 0.20 dioptres
    d) 0.5 dioptres

Ans: a)

14. Two thin lenses of focal lengths f_1 and f_2 respectively are combined coaxially with a separation d between them. The equivalent focal length of the combination is given by U Relation Average

a) $\frac{1}{f} = \frac{1}{f_1} - \frac{1}{f_2} + \frac{d}{f_1 f_2}$

b) $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}+\frac{\mu d}{f_1 f_2}$

c) $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{\mu d}{f_1 f_2}$

d) $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{d}{f_1 f_2}$

Ans: d)

15.	Give the expression for equivalent focal length of a combination of two thin lenses placed co-axially and separated by a distance d and explain the terms. Formula : $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{d}{f_1 f_2}$ (1 mark) Explain terms. (1 mark)	K Recall Average
16.	A small object is placed in air 1 m away from a convex spherical surface of radius of curvature 0.1m. Find the position of the image if the R.I. of glass is 1.5. Formula, substitution and arriving v = 0.375 m. (1 each)	K Recall Average
17.	Mention any two factors on which the focal length of a lens depends. Any two factors (1 mark)	K Recall Easy
18.	Write lens maker's formula for a convex lens and explain the symbols. Formula and explanation of symbols. (1 each)	K Recall Easy
19.	When an equiconvex lens of focal length is cut into two halves by means of a plane perpendicular to the principal axis, what is the focal length of each part? $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$ (1 mark) $f_1 = f_2$ Showing f_1 or $f_2 = 2f$ (1 mark)	U See relationship average

20.	Derive the lens maker's formula for a convex lens. OR Show that $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$ for a convex lens where the symbols have their usual meaning. Figure (1 mark) $\frac{1}{u} + \frac{n}{v'} = \frac{n-1}{R_1}$ (1 mark) $\frac{-n}{v'} + \frac{1}{v} = \frac{n-1}{R_2}$ (1 mark) $\frac{1}{f} = \frac{1}{u} + \frac{1}{v} = (n-1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$ (2 marks)	K Recall Easy
21.	Obtain an expression for refraction through a spherical surface concave side towards a point object in a denser medium. OR Derive the formula $\frac{n_1}{u} + \frac{n_2}{v} = \frac{n_1 \sim n_2}{R}$ for refraction at spherical surface in which concave side is towards a point object in a denser medium. Ray diagram (1 mark) Applying sine rule for both triangles. (1 mark) Taking ratio i.e. $\frac{\sin i}{\sin r}$ (1 mark) Substitution (1 mark) Arriving final expression (1 mark)	K Recall Average
22.	A thin lens of focal length of f has an aperture d. It forms an image of intensity I. The central part of the lens upto diameter $\frac{d}{2}$ is painted black. The intensity of the image will change to a) $\frac{I}{4}$ b) $\frac{I}{2}$ c) $\frac{3I}{4}$ d) I Ans: c)	A Solves and applies Difficult

23. The focal length of a convex lens of refractive index 1.5 is 40 cm. Then focal length of the same lens when it is immersed in a liquid of refractive index 2 is — U, Relation, Average

a) 40 cm
b) –40 cm
c) 80 cm
d) –80 cm

Ans: d)

24. A convex lens of focal length 40 cm is in contact with a concave lens of focal length 25 cm. The power of the combination is — K, Recall, Average

a) – 1.5 D
b) –6.5 D
c) +6.5 D
d) +6.67 D

Ans: a)

25 Two thin lenses of focal lengths f_1 and f_2 are placed coaxially in contact. The combination acts as a single lens of focal length of — U, See relationship, Average

a) $\dfrac{f_1\ f_2}{f_1+f_2}$
b) $\sqrt{f_1\ f_2}$
c) $\dfrac{f_1+f_2}{f_1\ f_2}$
d) $\dfrac{f_1+f_2}{2}$

Ans: a)

26. Describe the experiment to determine the focal length of the material of a convex lens by shift method and hence calculate the R.I. of a convex lens. — K, Recall, Average

Figure (shift method) – 1 mark
Procedure – 2 marks
Formula – 1 mark
Tabular column – 1 mark

27. The following readings were observed while determining the refractive index of the material of a convex lens. Calculate the refractive index by finding focal length by shift method and radii at curvature using Boy's method. — K, Recognize, Average

Sl. No.	Distance between screen and Object (m)	Shift in the position of lens (m)
1	0.80	0.201
2	0.85	0.205

Given $x_1 = 0.10$ m $x_2 = 0.10$ m

$$A = 1 + \frac{R_1 R_2}{f(R_1 + R_2)} \qquad \text{(1 mark)}$$

$$\left.\begin{aligned} f_1 &= \frac{D^2 - S^2}{4D} = \frac{(0.80)^2 - (0.201)^2}{4 \times 0.8} = 0.1875 \text{ m} \\ f_2 &= \frac{D^2 - S^2}{4D} = \frac{(0.85)^2 - (0.205)^2}{4 \times 0.85} = 0.20 \text{ m} \\ f &= \frac{f_1 + f_2}{2} = \frac{0.1875 + 0.20}{2} = 0.194 \text{ m} \end{aligned}\right\} \text{(2 marks)}$$

$$R_1 = R_2 = f - x_1 = \frac{0.194 \times 0.10}{0.194 - 0.10} = \frac{0.0194}{0.094} = 0.2064 \quad \text{(1 mark)}$$

$$n = 1 + \frac{0.2064 \times 0.2064}{0.194\,(0.2064 + 0.2064)} = 1.533 \qquad \text{(1 mark)}$$

UNIT 2 PHYSICAL OPTICS

Chapter 4 : Introduction to Theories of Light

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Mention the significance of Hertz's experiment on electromagnetic waves.	K Recall Average
	First experiment to confirm the existence of electromagnetic wave. (1 mark)	
2.	When does the particle nature of light become noticeable?	K Recall Average
	During the interaction of light with matter in atomic level. (1 mark)	
3.	What is the nature of electromagnetic wave?	K Recall Easy
	Transverse (1 mark)	
4.	What is the rest mass of a photon ?	K Recall Easy
	Zero (1 mark)	
5.	Name any two phenomena which can be explained/interpreted using particle nature of light.	K Recall Easy
	Any two phenomena (each 1 mark)	
6.	Draw a neat diagram of Hertz experimental set up on electromagnetic waves.	K Recall Average
	Neat labelled diagram (2 marks)	
7.	Mention any two reasons for discarding Huygen's wave theory.	K Recall Easy
	Two reasons or demerits. (each 1 mark)	

8.	Write a brief note on the dual nature of light. Dual nature – some phenomenon revealing wave nature and particle nature. (2 marks)	K Recall Easy
9.	Which are the oscillating field vectors in an electromagnetic waves? Electric and magnetic field vectors. (1 mark)	K Recall Easy
10.	The colour of light which travels fastest in free space is a) violet b) red c) yellow d) all the colours Ans: d)	K Recall Easy
11.	The colour of the light which travels fastest in glass is a) violet b) yellow c) red d) green Ans: c)	U See relationship average

Chapter 5 : Interference of light

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	In Young's double slit experiment using light of wavelength 5898A^{0}, 92 fringes are seen. How many fringes are seen in the same region if light of wavelength 5461A^{0} is used? Formula and substitution – 1 mark Answer – 1 mark	U See relationship Average
2.	Which of the following is conserved when the light waves interfere? a) Intensity b) Energy c) Amplitude d) Momentum Ans: b)	K Recall Easy

3. In the double slit interference experiment, the width of the two slits is halved. If 4I represents the original intensity of the bright fringe, the new intensity of the bright fringe is — A, Solves, Difficult
   a) I
   b) 2I
   c) 3I
   d) 4I

   Ans: b)

4. If yellow light is replaced by red light in Newton's ring experiment, the radius of bright rings — K, Recall, Average
   a) increases
   b) decreases
   c) remains the same
   d) gets doubled

   Ans: a)

5. A and B are two points on a traveling wave which differ in phase by 2π. How far are the two points ? — U, See relationship, easy

   Wavelength (λ) (1 mark)

6. What is the resultant intensity observed when two waves having a path difference of $\frac{3\lambda}{2}$ interfere? — K, Recall, Easy

   Zero (1 mark)

7. Write an expression for the fringe width in Young's double slit experiment. — K, Recall, Easy

   Expression $\beta = \frac{dD}{d}$ (1 mark)

8. How does the fringe width depend on the wavelength of light when two waves interfere? — U, See relationship, Average

   $\beta \propto \lambda$ (1 mark)

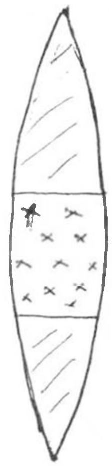
9. What is interference of light ? — K, S, Recall, Easy

   Correct definition (meaning) (1 mark)

10. State the condition for constructive interference in terms of phase difference between the two waves. — K, A / Recall / Easy

An even multiple of π (1 mark)

11. A lens is made up of two different materials as shown in diagram. How many images of an object placed in front of it is formed by the lens? — A / Applies / Difficult



2 images (1 mark)

12. The radius of curvature of a plano convex lens of material of R.I. 1.5 is 20 cm. Calculate its focal length. — K / Recall / Average

Formula (1 mark)
Calculation of f. (1 mark)

13. If a thin glass plate covers one of the double slits, what happens to the interference pattern observed in Young's double slit experiment? — U / Interpret / Average

The fringe pattern is shifted towards the side where the glass plate is introduced. (1 mark)

14. Name any one factor on which the radius of Newton's rings depend. — K / Recall / Easy

Wavelength of light or radius of curvature of the surface of lens. (1 mark)

15. For which colour of light is the fringe width minimum in an interference experiment ? — U / See relationship / Average

Violet (1 mark)

16. What happens if one of the slits is covered in Young's double slit experiment? U Interpret Average

Interference pattern will disappear. (1 mark)

17. Sketch the graph of fringe width versus the separation between the slits in the case of interference at double slits. S Draws Difficult

$\beta \propto \frac{1}{d}$ (1 mark)
Sketch (1 mark)

18. y_1 = a sin ωt and y_2 = a sin (ωt + π) represent two waves traveling in the same direction, meeting at a point P. Find the resultant intensity at P. K Recall Average

Zero (1 mark)

19. What are coherent sources ? K Define Easy

Two sources emitting waves with the same phase or with constant phase. (1 mark)

20. Consider the interference between two sources of intensities I and 4I. Obtain the intensity at a point where the phase difference is π/2. U See relationship Average

Formula : $I_R = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2} \cos\phi$ (1 mark)
Substitution and calculation $I_R = 5$ I. (1 mark)

21. In Young's double slit experiment, the slits are separated by 0.24mm. The screen is 1.2m away from the slits. The fringe width is 3mm. Calculate the wavelength of the light used. K Recall Average

Formula (1 mark)
Arriving $\lambda = 6000\ A^o$ (1 mark)

22. In Young's double slit experiment, each virtual source has an intensity I_o. What is the intensity at the point of constructive interference? U Computes Average

Formula I = $(\sqrt{I_1} + \sqrt{I_2})^2$ (1 mark)
Finding I = $4I_o$ (1 mark)

23. In Young's double slit experiment, what is the distance between the central bright fringe and fourth dark fringe in terms of the fringe width β? A Calculate Average

$$\lambda_n = \left(\frac{2n-1}{2}\right)\frac{dD}{d} \text{ (1 mark)}$$

substitution and arriving $\frac{7}{2}\beta$ (1 mark)

24. Draw the intensity level diagram for interference pattern in double slit experiment. S Draw Average

Draw the diagram I versus x. (2 marks)

25. Draw the ray diagram for interference at thin film due to reflected light. K Recall Average

Neat ray diagram (2 marks)

26. Mention any two factors on which the fringe width depends. K Recall Easy

Any two factors. (1 mark each)

27. Draw a labelled diagram of Newton's ring experimental set up. K Recall Easy

Diagram, labeling (1 mark each)

28. The colours observed in the beam reflected by a thin film will be missing in the beam transmitted through thin film and vice-versa. Explain. K Recall Average

The condition for maxima and minima is reflected and transmitted light are just opposite. (2 marks)

29. Draw the ray diagram for interference at a thin film due to refracted light. K Recall Easy

Neat ray diagram (2 marks)

30. What is the effect on interference fringes in Young's double slit experiment due to each of the following ? — U, See relationship, Average
 a) the screen is moved away from the slits
 b) the source is replaced by another source of shorter wavelength.

a) Fringe width increases (1 mark)
b) Fringe width decreases (1 mark)

31. Explain the term: interference and describe the Young's double slit experiment to obtain sustained interference pattern. — K, Recall, Easy

Meaning of interference (1 mark)
Explanation (1 mark)
Diagram (1 mark)
Description and conditions to get sustained interference
(2 marks)

32. Give the theory of interference and deduce the conditions for constructive and destructive interference in terms of phase difference/ path difference. — K, Recall, Easy

Writing both wave equations. (1 mark)
Arriving at resultant displacement. (1 mark)
Arriving at expression for resultant amplitude, conditions for constructive interference and conditions for destructive interference.
(3 marks)

33. Derive an expression for the fringe width in the interference pattern in double slit experiment. — K, Recall, Average

Diagram (1 mark)
Obtaining expression for path difference. (1 mark)
Equating this with nd or $(2n + 1)\ \frac{\lambda}{2}$. (1 mark)
Obtaining expression for λ_n (½ mark)
Writing expression for λ_{n+1} (½ mark)
Obtaining expression $\beta = \frac{\lambda D}{d}$ (1 mark)

34. In Young's double slit experiment the distance between the slits is 1.2 mm and the distance of the screen is 0.75 m from the slits. If the distance of 5^{th} bright fringe from the central fringe on the screen is 1.5 mm, calculate the wavelength of light used. What will be the distance of 5^{th} dark fringe from the centre of the screen ? — A, Calculate, Average

Value points :

Formula $\lambda_n = \frac{5\lambda\, d}{d}$ (1 mark)

Substitution (1 mark)

λ, wavelength calculation. (1 mark)

Calculation of $\lambda_m=(2m-1)\frac{\lambda\, D}{2d}$ (1 mark)

Arriving $\lambda_m = 1.35 \times 10^{-3}$ m (1 mark)

35. In Young's double slit experiment the two coherent sources are 1.74 mm apart. Fringes are formed on the screen at a distance of 1.5 m from the sources. If the wavelength of light used is 5800 A^o, find the number of fringes in the part of interference pattern which is 2mm long having bright fringes at ends. — A Solves Difficult

Expression $\beta = \frac{\lambda\, D}{d}$ (1 mark)

Fringe width β = 0.5 mm (1 mark)

No. of bright fringes = $\frac{2\,mm}{0.5\,mm} + 1$ (1 mark)

= 4 + 1 = 5

Among 5 bright fringes, there will be 4 dark fringes. (1 mark)

Total number of fringes = 9. (1 mark)

36. A beam of light consisting of two wavelengths 7000 A^o and 5000 A^o is used in the double slit experiment. The distance between the slits is 0.3mm and the distance of the slits from the screen is 1m. Find the least distance of the point from the central maximum, when bright fringes due to both wavelengths coincide. — A Compute Average

Value points :

$\lambda_n = n\,\lambda_1 \frac{D}{d}$ (½ mark)

$\lambda_m = m\,\lambda_2 \frac{D}{d}$ (½ mark)

$\lambda_n = \lambda_m$ (1 mark)

$\frac{n}{m} = \frac{5}{7}$ (1 mark)

For minimum distance n = 5 and m = 7. (1 mark)

$\lambda_n = 1.17$ mm (1 mark)

37. In Young's double slit experiment, the slits are separated by 1.1 mm. The screen is 3m away from the double slit. On the screen, 8 consecutive bright fringes separated by 9 mm are formed. Calculate the frequency of light used. — A Applies Average

Finding $\beta = 1.5 \times 10^{-3}$ m ($6\beta = 9$ mm) (1 mark)

Formula $\beta = \dfrac{\lambda D}{d}$ (1 mark)

Calculating $\lambda = 5500 \times 10^{-10}$m (1 mark)

Formula $\nu = \dfrac{c}{\lambda}$ (1 mark)

Finding $\nu = 5.454 \times 10^{14}$ Hz. (1 mark)

38.	Describe an experiment to determine the thickness of a paper forming interference pattern when placed in an air wedge. Diagram – 1 mark Procedure – 2 marks Formula – 1 mark Tabular column – 1 mark	K Recall Average

Chapter 6 : Diffraction

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Define diffraction of light. Bending of light around the edges of an obstacle. (1 mark)	K Recall Easy
2.	What should be the order of the size of the obstacle to observe diffraction phenomenon? A^{0} or order of wavelength of light. (1 mark)	K Recall Average
3.	Write the condition for the first minima in the case of diffraction due to a single slit. D sin $\theta = \lambda$ (1 mark)	K Recall Easy
4.	Why short wavelength radio waves are used in long distance broadcasts? Short wavelength radio waves are diffracted less and hence can be transmitted as a beam. (1 mark)	K Recall Easy
5.	Define Fresnel diffraction of light.	K Recall Easy

Light from near source is diffracted through a narrow slit.
(1 mark)

6. Define Fraunhofer diffraction of light. K Recall Easy

Light from distance source is diffracted through a narrow slit.
(1 mark)

7. How does the spreading of light due to diffraction depend on the wavelength of light ? K Recognize Average

Inversely proportional to wavelength. (1 mark)

8. Define resolving power of an optical instrument. K Recall Easy

The ability to distinguish two close objects. (1 mark)

9. Why does resolving power of a microscope increase when red light illuminating the object is replaced by the blue light ? U Relation Easy

R.P. $\propto \frac{1}{\lambda}$ (1 mark)
(λ is blue light is less than that of red light)

10. Define resolving power of a telescope. K Recall Easy

It is numerically equal to the reciprocals of the limit of resolution. (1 mark)

11. Define limit of resolution of a telescope. K Recall Easy

The angle subtended at the objective of the telescope by two distant objects whose images are just resolved. (1 mark)

12. What is the relation between the wavelength of light and the size of the obstacle for diffraction to be effective? K Recall Easy

Of comparable size (1 mark)

13. What is meant by wave front of a light wave ? K Recall Easy

The locus of all particles which are in the phase. (1 mark)

14. What is the shape of the wave front used in discussing Fresnel diffraction? K Recall Easy

Spherical (1 mark)

15. How can the resolving power of a microscope be increased ? K Recall Average

By increasing the R.I. of the medium or by decreasing the λ.
(1 mark)

16. How can the resolving power of a telescope be increased ? K Recall Average

By increasing the diameter of the objective. (1 mark)

17. Draw the intensity distribution curve for the diffraction of light at a single slit. K Recognize Easy

Drawing and labeling (1 mark)

18. On what factors does the diffraction of light depend? K Recall Easy

1. size of the obstacle, 2. λ of the wave (1 each)

19. Write the formula for the resolving power of a microscope and with usual meaning. K Recognize Easy

R.P. = $\dfrac{2n \sin \theta}{1.22 \lambda}$ (1 mark)

Labelling (1 mark)

20. State and explain Rayleigh's criterion for resolution of two nearby objects. K Recognize Average

Statement – 1 mark
Graph – 1 mark

21.	Write the expression for the limit of resolution of a microscope for luminous point objects and with usual meaning.	K Recognize Easy

$$d = \frac{1.22\lambda}{2n \sin\theta} \quad \text{(1 mark)}$$

Labelling (1 mark)

22.	Compare the two phenomena: interference and diffraction of light waves.	K Recall Easy

Each difference carries 1 mark.

23.	Distinguish between Fresnel diffraction and Fraunhofer diffraction.	K Recall Easy

Fresnel Diffraction	**Fraunhofer Diffraction**
1. Source of light and the screen are finite.	1. Source of light and the screen are at infinite.
2. Incident wave front is spherical.	2. Incident wave front is plane.

(1 mark each)

24.	Explain the phenomenon of Fraunhofer diffraction through a single slit and indicate in a diagram the variation of intensity in the pattern.	U Explain Average

Figure – 1 mark
Explanation – 1 mark
Equation - 1 mark

25.	A microscope is used to resolve two luminous point objects separated by 5.55×10^{-7} m. What is the numerical aperture if light of wavelength 546 nm is used? What will be the numerical aperture and limit of resolution if air between the objective and the objects is replaced by oil of R.I. 1.50 ?	A Compute Easy

Scheme :

$$d\theta = \frac{1.22\,\lambda}{2n \sin\theta} \quad \text{(1 mark)}$$

For air ;

$$n \sin\theta = \frac{1.22\lambda}{2d} = 0.6 \quad \text{(1 mark)}$$

For oil,

$$n \sin \theta = \frac{1.22\,\lambda}{2d} = 0.9 \quad (1 \text{ mark})$$

$$d\theta = \frac{1.22\,\lambda}{2n \sin \theta} = \frac{1.22 \times 546.1 \times 10^{-9}}{2 \times 0.9}$$

$$d\theta = 3.7 \times 10^{-7} \text{ m} \quad (1 \text{ mark})$$

26. Angular separation between two stars is 6×10^{-6} rad when they are just resolved by a telescope. Find the resolving power and radius of the objective of telescope. Wavelength of light is 5500 A°. U Compute Easy

$$\text{R.P.} = \frac{1}{6 \times 10^{-6}} = 1.667 \times 10^{5} \quad (1 \text{ mark})$$

$$\text{R.P.} = \frac{\lambda}{1.22\,\lambda} \quad (1 \text{ mark})$$

$$D = \text{R.P.} \times 1.22 \times \lambda$$

$$D = 1.667 \times 10^{5} \times 1.22 \times 55 \times 10^{-8}$$

$$D = 0.1118 \text{ m} \quad (1 \text{ mark})$$

$$R = \frac{D}{2} = 0.0556m \quad (1 \text{ mark})$$

27. In an experiment with microscope, the wavelength of light used is 5800 A°. If the semi vertical angle is 35°, calculate the limit of solution and resolving power. U Calculate Average

$$d\theta = \frac{\lambda}{2 \sin \theta} \quad (1 \text{ mark})$$

$$d\theta = \frac{58 \times 10^{-8}}{2 \times \sin 35^{o}} = \frac{58 \times 10^{-8}}{2 \times 0.5736} = 5.056 \times 10^{-7} \text{ m} \quad (2 \text{ marks})$$

$$RP = \frac{1}{d\theta} = \frac{1 \times 10^{7}}{5.056} = 0.1978 \times 10^{7}$$

$$RP = 1.978 \times 10^{6} \text{ m} \quad (1 \text{ mark})$$

28. With a neat labelled diagram, explain how to determine the wavelength of the spectral lines by using a diffracting grating. U, S Explain, draw Easy

Figure – 1 mark
Procedure – 2 marks
Formula – 1 mark
Tabular column – 1 mark

29.	In a single slit diffraction experiment, if the width of the slit is 10 cm, then the diffraction pattern will a) be prominent b) be less prominent c) remain the same d) disappear Ans : d)	U See relationship Average
30.	The resolving power of a telescope whose lens has a diameter of 1.22 m for a wavelength of 5000 A° is a) 2×10^5 b) 2×10^6 c) 2×10^2 d) 2×10^4 Ans: b)	K Recall Average
31.	Which of the following waves are diffracted by an obstacle of size 1 cm? a) Light waves b) Sound waves c) Ultra sonic waves d) X-rays Ans: c)	U See relationship average
32.	Angular width of the central maximum in single slit diffraction pattern does not depend on a) distance between slit and source b) wavelength of light used c) width of the slit d) frequency of light used. Ans : a)	U See relationship average

Chapter 7 : Polarisation

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Define Polarisation of light.	K Recall Easy
	The phenomenon of restricting the vibrations of light wave in a particular direction in a plane. (1 mark)	
2.	Define polarizing angle.	K Recall Easy
	The angle of incidence for which the reflected light from a surface is completely plane polarized. (1 mark)	
3.	State Brewster's law.	K Recognize Easy
	The tangent of the polarizing angle is equal to the refractive index of the material. (1 mark)	
4.	What is meant by optic axis ?	K Recall Easy
	The direction along which velocity of ordinary ray is equal to that of extraordinary ray. (1 mark)	
5.	When unpolarised light is incident on the polariser, what is the intensity of transmitted polarized light ?	U Generalize Easy
	Half of the intensity of unpolarised light. (1 mark)	
6.	Name the phenomenon taking place in a calcite crystal when light is incident on it. Double refraction (1 mark)	K Recall Easy
7.	Give the relation between polarizing angle and the R.I. of the material of a reflector.	K Recognise Easy
	$n = \tan i_p$ (1 mark)	

8. What is the polarizing angle of a medium of refractive index 1.732? K Recognise Easy

$n = \tan I_p$ (1 mark)
$i_p - \tan^{-1} 1.732 = 60^{\circ}$ (1 mark)

9. What is the angle of incidence for complete polarization of reflected light for a medium of R.I. $\sqrt{2}$? K Recall Easy

$n = \tan i_p$ (1 mark)
$i_p = \tan^{-1} \sqrt{2}$ (1 mark)

10. Name the phenomenon which confirms the transverse nature of light. K Recall Easy

Polarization (1 mark)

11. Give an example for a wave which cannot be polarized. K Recall Easy

Sound waves (1 mark)

12. Distinguish between ordinary and plane polarized light. K Recall Average

Two correct differences (each carries 1 mark)

13. On what factors does the optical rotation of the plane of polarization of polarized light produced by a solution depend ? K Recall Easy

1. Length of solution
2. concentration of solution

(1 mark each)

14. Define uniaxial and biaxial crystal. Mention one example each. K Recall Easy

Uniaxial crystal : A crystal having only one optic axis. (½ mark)
Ex: Quartz, Calcite, Tourmaline crystal. (½ mark)
Biaxial crystal : a crystal having two optic axes. (½ mark)
Ex: Selenite, mica, ice cube (½ mark)

15. Draw a neat diagram showing the plane of vibration and the plane of polarization of polarized light produced by a tourmaline crystal. K Recognize Average

Diagram – 1 mark
Labeling – 1 mark

16. Mention any two methods of producing plane polarized light. K Recall Easy

Each carries one mark.
1. by reflection
2. by refraction
3. by double refraction
4. by selective absorption

17. Explain the phenomenon: double refraction of light. K Recall Average

Definition – 1 mark
Diagram or explanation – 1 mark

18. The R.I. of a medium is 1.5. What is the polarizing angle in the medium? K Recognize Average

$n = \tan I_p$ (1 mark)
$i_p = \tan^{-1} 1.5 = 56^{\circ}\ 19'$ (1 mark)

19. Explain an experiment to show the transverse nature of light. U Explains Average

For two figures – 2 marks.
Explanation – 2 marks

20. Show that reflected and refracted rays are perpendicular to each other at the polarizing angle of incidence. K Recognize Easy

Figure – 1 mark

Snell's law $n = \dfrac{\sin i}{\sin r}$ - 1 mark

Brewster's law equation $n = \tan i_p$ (1 mark)
Obtaining $r + I_p = 90^{\circ}$ (1 mark)

21. Explain the phenomenon of optical activity with an example. Define specific rotation in solids and liquids. K Recall Average

Definition – 1 mark
Explanation / example – 1 mark
Specific rotation of solid – 1 mark
Specific rotation of liquid – 1 mark

22.	Define double refraction. Explain with a diagram the distinction between ordinary and extraordinary rays. Definition – 1 mark Diagram – 1 mark Three differences – 3 marks	K Recall Average
23.	What are polaroids? Mention any three applications. Polaroids are the crystals of Iodoquine sulphate. (1 mark) Applications : Any four (each 1 mark)	K Recall Easy
24.	Explain the phenomenon of optical activity with an example. Define specific rotation in solids and liquids. Definition –1 mark Example / explanation – 1 mark Specific rotation of solid – 1 mark Specific rotation of liquid – 1 mark	K Recall Easy
25.	A ray of light incident at 52^o on a refracting surface gets plane polarized on reflection. The critical angle is a) $51^o\,22'$ b) 52^o c) $46^o\,21'$ d) 90^o Ans: a)	U Relation Average
26.	A sugar solution of concentration 90 kg m^{-3} produces a rotation of 12^o. What is the length of the solution? Given specific rotation = 0.011 rad $m^2\ kg^{-1}$.	U Compute Easy

$$S = \frac{\theta}{lc} \quad \text{(1 mark)}$$

$$\left.\begin{aligned} l &= \frac{\theta}{S \times C} \quad \theta = 12^o = 0.20093 \text{ rad} \\ l &= \frac{0.2093}{0.011 \times 90} = 0.21 \text{ m} \end{aligned}\right\} \text{(2 marks)}$$

Result with unit (1 mark)

27. A sugar solution rotates the plane of the vibration by 10°. The length of the solution is 0.25 m and concentration is 80 kg m^{-3}. What is the specific rotation of sugar solution ? — U Compute Easy

$$S = \frac{\theta}{lc} \quad (1\text{ mark})$$

$$\left.\begin{aligned} \theta &= \frac{10 \times 3.14}{180} = 0.1744 \text{ rad} \\ S &= \frac{0.1744}{0.20 \times 90} = 0.0096 \end{aligned}\right\} \text{ 2 marks}$$

$S = 0.01$ rad m^2 kg^{-1} (1 mark)

28. An optically active solution of length 0.25 m produces a rotation of plane of polarization 8°. What is the concentration of the solution? Given S = 0.011 rad m^2 kg^{-1}. — U Compute Average

$$S = \frac{\theta}{lc} \quad (1\text{ mark})$$

$$\left.\begin{aligned} \theta &= \frac{8 \times \pi}{180} = 0.1395 = 0.14 \text{ rad} \\ C &= \frac{\theta}{Sl} = \frac{0.14}{0.011 \times 0.25} = 50.9 \end{aligned}\right\} \text{ (2 marks)}$$

$C = 51$ kg m^{-3}

Unit (1 mark)

29. Plane polarized light passing through a solution of length 0.25m rotates the plane of polarization by 8°. The concentration of the solution is — U Calculate Average

a) 32 kg m^{-3}
b) 51 kg m^{-3}
c) 0.14 kg m^{-3}
d) 0.28 kg m^{-3}

Ans: b)

30. Calculate the thickness of quartz plate cut with its faces perpendicular to the optic axis which would produce half the rotation of plane of polarization of an optically active solution 0.3m long and having concentration of 200 kg m^{-3}. Given specific rotation of quartz = 380 rad/m, specific rotation of solution = 0.01 rad m^2 kg^{-1}. — U Calculate Average

$\theta = slc$

$\theta = 0.011 \times 0.3 \times 200 = 0.66$ rad (1 mark)

For solid:

$\theta = 0.66/2 = 0.33$ rad (1 mark)

$t = \frac{\theta}{S}$ (1 mark)

$t = \frac{0.33}{380} = 8.68 \times 10^{-4}\ m$ (1 mark)

31. Describe an experiment to determine the specific rotation of sugar solution using a polarimeter. K Easy

Figure – 1 mark
Procedure – 2 marks
Formula – 1 mark
Tabular column – 1 mark

32. The following readings were obtained in an experiment to determine the specific rotation of sugar using a polarimeter. Calculate specific rotation of sugar. K Average
Length of the tube = 0.20 m
Reading with distilled water = $53^\circ\ 15'$

Concentration (C) 10^3 kgm^{-3}	**Reading with sugar solution**
0.20	$77^\circ\ 21'$
0.10	$65^\circ\ 27'$

$S = \left[\frac{\theta}{C}\right]$ rad m^2 kg^{-1} (1 mark)

Trial 1 : $\theta = \theta_2 - \theta_1 = 77^\circ 20' - 53^\circ 15' = 24^\circ\ 5' = 24.08^\circ$

$\frac{\theta}{C} = \frac{24.08 \times 3.14}{180 \times 0.20} \times 10^{-3} = 2.10 \times 10^{-3}$ (1 mark)

Trial 2 : $\theta = 65^\circ 27' - 53^\circ\ 15' = 12^\circ 12' = 12.2^\circ$

$\frac{\theta}{C} = \frac{12.2 \times 3.14}{180 \times 0.10} \times 10^{-3} = 2.182 \times 10^{3}$ (1 mark)

$\left(\frac{\theta}{C}\right) = \left(\frac{2.10 + 2.182}{2}\right) 10^{-3} = 2.141 \times 10^{-3}$

substitution (1 mark)

$\therefore S = \frac{2.141 \times 10^{-3}}{0.20} = 0.0107$ rad m^2 kg^{-1} (1 mark)

33. When light falls on a given plate at an angle of incidence, the reflected and infracted rays are found to be normal to each other. The angle of incidence is 60°, the refractive index of a material of a plate is U See relationship Average

a) 0.866
b) 1.5
c) 1.732
d) 2

Ans : a)

34.	A ray of light is incident on a surface of water at polarizing angle 53^o. The angle of deviation of the ray of light affected by refraction is a) 6^o b) 7^o c) 8^o d) 47^o Ans: a)	A Applies and solves Average
35.	When plane polarized light is passed through an analyser, it emerges out with maximum intensity. If the analyser is rotated through 90^o then intensity of emerging light a) varies between maximum and minimum b) becomes zero c) does not vary d) varies between maximum and zero Ans : b)	K Recall Average
36.	Angle of rotation is measured using polarimeter for two samples. In one sample, 10 gm of sugar is dissolved in100 cc. In another sample, 20 gm of sugar is dissolved in 100 cc. Then specific rotation is a) more for sample one b) more for second sample c) same for both d) cannot be estimated Ans: c)	U See relationship Average
37.	In a polarimeter, the concentration of the solution and the length of the tube have been doubled. Then angle of rotation of plane polarized light becomes a) doubled b) zero c) three fold d) fourfold Ans : d)	U See relationship Average

UNIT 3 ELECTROSTATICS

Chapter 9 : Electric Charges

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	What is an elementary charge ?	K Recall Easy
	Elementary charge is the smallest charge that can be added to or removed from an object. (1 mark)	
2.	Mention one method of charging an object.	K Recall Easy
	Friction / Induction / Conduction (any one) (1 mark)	
3.	How many electronic charges make one coulomb of charge?	K Recall Average
	6.25×10^{18} electronic charges (1 mark)	
4.	Define : surface density of charge.	K Recall Easy
	Surface density of charge at any point on the surface is defined as the amount of charge per unit area of the surface around that point. (1 mark)	
5.	How does the surface density of charge depend on the radius of curvature of the surface?	K Recall Average
	It is inversely proportional to square of the radius of curvature. (1 mark)	
6.	How does the surface density of charge depend on the curvature of the surface?	K Recall Average
	It is directly proportional to the curvature. (1 mark)	

7. Mention the SI unit of surface density of charge. K Recall Easy

Ans: C m^{-2} (1 mark)

8. What happens to the force between two charged objects, when a glass plate is introduced in between them? K Recall Easy

Decreases (1 mark)

9. Why do electrostatic experiments not work well on humid days? K Recall Easy

Leakage of electric charges (1 mark)

10. How are the charges produced in clouds ? U Recognize Average

Due to friction (1 mark)

11. Where do excess charges reside on a conductor? U Recall Easy

On the outer surface of conductor (1 mark)

12. Mention any two methods of charging of bodies. K Recall Easy

i) Friction, ii) Induction, iii) Conduction (1 mark each)

13. Write an expression for Coulomb's law in vector form and explain the terms. K Recall Easy

i) $\vec{F} = \dfrac{1}{4\pi \in_o} \dfrac{q_1 q_2}{d^2} \hat{d}$ (1 mark)

or $\vec{F} = \dfrac{1}{4\pi \in_o} \dfrac{q_1 q_2}{d^3} \vec{d}$

ii) Explanation (1 mark)

14. Calculate the electrostatic force between two protons separated by 1A° in air. Given : Charge of proton 1.6×10^{-19} C. A Computing Average

$$\left(\frac{1}{4\pi\epsilon_o}\right) = 9 \times 10^9 \text{ Nm}^2 \text{ C}^{-2}$$

$$F = \frac{1}{4\pi\epsilon_o} \cdot \frac{q_1 q_2}{d^2} \quad \text{(1 mark)}$$

$$F = 9 \times 10^9 \times \frac{(1.6 \times 10^{-19})^2}{(1 \times 10^{-10})^2} = 9 \times (1.6)^2 \times 10^{-18} \text{ N}$$

F = --------N -------------- (1 mark)

15. Write the relation between relative permittivity of a medium and absolute permittivity of free space. — K Recall Easy

Relation $\epsilon_r = \frac{\epsilon}{\epsilon_o}$ (1 mark)

16. 27 small drops of mercury each of radius r and charge q merge to form a big drop. Find the ratio of the surface density of each small drop to that of the big drop. — A Applies Difficult

$$\sigma_1 = \frac{q}{4\pi r^2} \qquad 27\,\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$$\sigma_2 = \frac{27q}{4\pi R^2} \qquad R = 3\text{ R}$$

$$\frac{\sigma_1}{\sigma_2} = \frac{1}{27}\left(\frac{R^2}{r^2}\right) \quad \text{(1 mark)}$$

$$= \frac{1}{27}\left(\frac{(3r)}{r^2}\right) = \frac{1}{27} \times \frac{9r^2}{r^2} = \frac{1}{3} \quad \text{(1 mark)}$$

$\sigma_1 : \sigma_2 = 1 : 3$ (1 mark)

17. Identical charges each of magnitude 10 nC are placed at the corners of the square of side 1m. what is the net force on a proton placed at the centre of the square. — A Application Difficult

i) Force due to opposite charges at corners cancel each other. (1 mark)

ii) Because they are at same distance from the centre. Hence net force is zero. (1 mark)

18. A comb run through the dry hair of a person attracts small bits of paper. Why ? What happens when hair is wet ? — U Interpretation Average

Due to friction charges introduced on comb and it attracts light bits of paper. When hair is wet, conduction of charges takes place through water and hence paper bits are not attracted by comb.
(2 marks)

19. The force between two charges separated by a certain distance in air is F. What will be the force between them at the same separation when it is placed in a dielectric medium of dielectric constant K? U Compares Average

$$F = \frac{1}{4\pi\epsilon_o}\frac{q_1 q_2}{d^2}$$

$$F_m = \frac{1}{4\pi\epsilon_o}\frac{q_1 q_2}{k \times d^2} \quad \text{(1 mark)}$$

$F_m = F/K$ (1 mark)

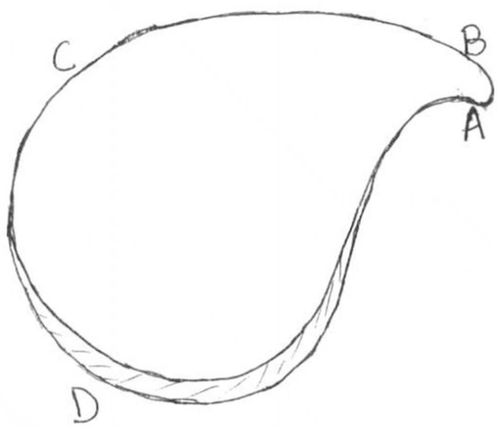
20. Two point charges q_1 and q_2 are such that $q_1 q_2 < 0$. The nature of the force between them is K Recall Average

a) attractive
b) repulsive
c) both (a) and (b)
d) either (a) or (b)

Ans : a)

21. For the surface of the conductor shown below identify the region where the surface density of charge is maximum. U Locate Average

a) AB
b) BD
c) CB
d) DC



Ans: a)

22. The force of repulsion between two point charges of 1 C each kept 1 m part in vacuum is — U, Compute, Average

a) 9×10^9 N

b) $\frac{1}{9 \times 10^9} N$

c) 0

d) 9×10^{-9} N

Ans : a)

23. If the dielectric constant of water is 80, then its permittivity is — A, Applies, Average

a) $80\ C^2\ N^{-1}\ m^{-2}$

b) $708.3 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$

c) $708.3\ C^2\ m^{-2}\ N^{-1}$

d) $70.8 \times 10^{-12}\ C^2\ N^{-1} m^{-2}$

Ans: b)

24. The dimensional formula of permittivity of free space is — K, Recall, Average

a) $L^{-3}\ M^{-1}\ T^{-4}\ A^2$

b) $L^3 M^1\ T^4\ A^{-2}$

c) $L^{-3} M^{-1}\ T^4\ A^2$

d) $L^3\ M^{-1}\ T^{-4}\ A^2$

Ans : c)

Chapter 10 : Electric Field

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	How do we represent the direction of the electric field at any point on a line of force? Tangent to the curve at any point on the line of force gives the dimension of electric field. (1 mark)	U Recognize Average
2.	How do we represent uniform electric field pictorially ? Parallel lines with arrows in the same direction (1 mark)	K Recall Average

3.	What happens to the strength of the electric field due to the presence of a dielectric medium? Electric field decreases (1 mark)	K Recall Average
4.	Mention the SI unit of electric flux. Ans: $Nm^2\ C^{-1}$ or Vm (1 mark)	K Recall Easy
5.	What is an electric dipole? Electric dipole is a system of two equal and opposite charges separated by a certain distance. (1 mark)	K Recall Easy
6.	Write the expression for the dipole moment of an electric dipole. P = (2a)q = 2aq where 2a is distance between the two charges. (1 mark)	K Recall Easy
7.	A charge of 20 pC is enclosed by a cubical surface. What is the total flux over that surface ($\epsilon_0 = 8.854 \times 10^{-12}\ Fm^{-1}$). $\phi = \frac{1}{\epsilon_o} \Sigma q = \frac{20 \times 10^{-12}}{8.854 \times 10^{-12}} = \frac{20}{8.854} = $ ----$Nm^2\ C^{-1}$ (2 marks)	U See relationship Average
8.	What is the potential difference between two points on an equipotential surface ? p.d = 0 (because at all the points potential is same). (1 mark)	U Recall Average
9.	Define electric potential. It is the amount of work done in moving a unit positive charge from infinity to a given point against the field direction. (1 mark)	K Recall Easy

10. A spherical surface surrounds a charge q at the centre of a sphere. What happens to the total flux through the surface when the surface is changed to a cube ? — U Interpret Average

Remains same (because charge inside is same and $\phi = \frac{\Sigma q}{\in_o}$.

(1 mark)

11. Write the expression for the electric field at a point on the axial line of a dipole and explain the terms. — K Recall Easy

$$E = \frac{1}{4\pi\in_o}\frac{2\,pr}{(r^2 - a^2)^2} \quad \text{(1 mark)}$$

p – dipole moment; r – distance from the centre of the dipole to the point. 2a – distance between two charges,

$\frac{1}{4\pi\in_o}$ – constant, $\in_0$ – permittivity of free space (1 mark)

12. Write the expression for the electric field at a point on the equatorial line of a dipole and explain the terms. — K Recall Easy

$$E = \frac{1}{4\pi\in_o} \cdot \frac{p}{(r^2 + a^2)^{3/2}} \quad \text{(1 mark)}$$

$$\left.\begin{array}{l} \text{p – dipole moment} \\ \in_0 \text{ - permittivity of free space} \\ \text{r – distance from point to the centre of dipole} \\ \text{2a – distance between two charges} \end{array}\right\} \text{(1 mark)}$$

13. Write the expression for the torque on a dipole and explain the terms. — K Recall Easy

$T = \vec{p} \times \vec{E} = pE \sin\theta$ (1 mark)

$$\left.\begin{array}{l} \text{p – dipole moment} \\ \text{E – electric field intensity} \\ \theta \text{ - angle between P and E} \end{array}\right\} \text{(1 mark)}$$

14. Indicate in a diagram a point in the (i) end on position, (ii) broad side on position of a dipole. — U Locate Average

Diagram of dipole (1 mark)
Marking of two points (½ each)

15. What is the magnitude of the electric field intensity inside a charged conducting sphere? — U, Recall and apply, Easy

Ans: Zero (due to symmetric distribution of charge) (1 mark)

16. What is the electric flux through a closed surface which encloses an electric dipole? — U, Recognize, Average

Zero (because surface encloses equal and opposite charges, therefore, net charge = 0). (1 mark)

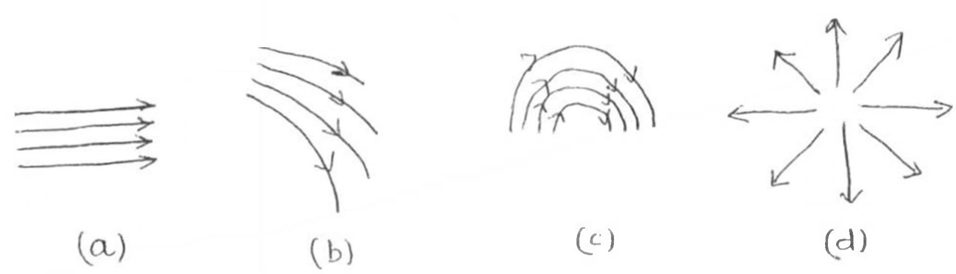
17. What is the nature of the equipotential surface due to a point charge? — U, Recall, Average

Spherical surfaces with common centre where the charge is placed. (1 mark)

18. A charge q is moved through a distance 'd' on an equipotential surface of field intensity E. What is the work done ? — U, Recognize, Average

Work done = 0 (because charge is moved on an equipotential surface) (1 mark)

19. Classify the following field representations into uniform and non-uniform electric field. — U, Classify, Average



(a) is uniform, (b), (c) and (d) are non-uniform. (½ mark each)

20. The potential at any point inside a hollow charged spherical conductor of radius 0.05 m is 3V. What is the potential on the surface of conductor ? — U, See relationship, Average

Potential inside the spherical conductor is same and is equal to potential on the surface of conductor i.e. 3V. (1 mark)

21. What is the effect of torque on an electric dipole placed in an electric field? — K, Recall, Easy

Rotating effect is produced due to the action of torque on dipole. (1 mark)

22. At what points around an electric the dipole the electric potential becomes zero? — U, Interpret, Easy

At all the points on the equitorial plane potential is zero. (1 mark)

23. A dipole consists of two charges +4e and –4e separated by 4A° What is its dipole moment? ($e = 1.6 \times 10^{-19}$ C). — U, Recall, Easy

p = 2aq (1 mark)
$= (4 \times 10^{-10})\ (4 \times 1.6 \times 10^{-19})$
$= 25.6 \times 10^{-29} = 2.56 \times 10^{-28}$ Cm. (2 marks)

24. A dipole consists of two charges +_ 4e and –4e separated by 4A.
Its dipole moment is
   a) 23.56×10^{-239} Cm
   b) 6.4×10^{-38} Cm
   c) 1.6×10^{-28} Cm
   d) 4.0×10^{-19} Cm.

Ans: a)

25. Derive an expression for the electric field due to an isolated point charge. — U, Recall, Easy

Diagram (½ mark)
Intensity = Force on a unit positive charge (½ mark)

i.e. $F = \frac{1}{4\pi \in_o} \frac{q \times 1}{d^2} = \frac{1}{4\pi \in_o} \frac{q}{d^2}$ (1 mark)

26. A charge is placed at the centre of a sphere of radius r. If the charge is moved through a distance r/3 from the centre, how does the flux through the surface change? — U, Interpret, Average

Remains same according to Gauss theorem. (1 mark)

27. When is the torque on a dipole maximum? — U, Recall, Average

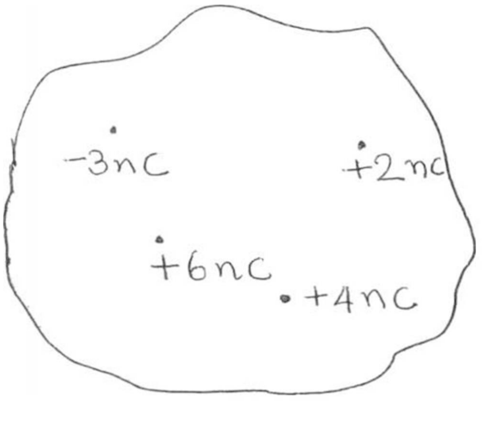
Torque is maximum when angle between electric field strength and dipole moment is 90°.
i.e. $\theta = 90$ (1 mark)

28. Mention any two properties of electric lines of force. — U, Describe / explain, Average

1. Electric lines of force never intersect.
2. They originate from the charge and terminate at negative charge.
3. Always perpendicular to the charged conductor.
4. It does not form any closed loop.

Any two (1 mark each)

29. Calculate the electric flux through a closed surface given below. — U, Compute, Average
$\epsilon_o = 8.854 \times 10^{-12}\ Fm^{-1}$



$$\phi = \frac{1}{\epsilon_o} \Sigma q \quad \text{(1 mark)}$$

$$\phi = \frac{1\,(-3 + 2 + 4 + 6)}{8.854 \times 10^{-12}} \times 10^{-9}$$

$$= \frac{9}{8.854} \times 10^{3} = 1.065 \times 10^{3}\ \text{Nm}^{2}\ \text{C}^{-1} \quad \text{(1 mark)}$$

30. A change is placed at the center of a sphere or radius r. If the change is moved through a distance r/2 from the center, the flux through the surface. — U, Relation, Easy
    a) doubles
    b) decreases by half
    c) remains the same
    d) becomes zero

    Ans: c)

31. A spherical Gaussian surface of radius R surrounds a point charge +q. What happens to the total flux if — U, Interpret, Average
    a) the charge is doubled
    b) the radius of the surface is increased to three times.

    a) remains the same (1 mark)
    b) remains the same (1 mark)

32. Draw a graph of electric intensity versus distance from the centre of a charged spherical conductor of radius R. — U, Graphical representation, Average

    Indication of E and d along axis correctly. (1 mark)
    Correct curve a least on one side (1 mark)

33. Draw a graph of electric potential vs. distance from the centre of a charged spherical conductor of radius R. — U, Graphical representation, Average

    Indication of V and d along axis (1 mark)
    Curve at least on one side of y-axis (1 mark)

34. Distinguish between electric-field intensity and electric potential. — U, Distinguish, Easy

Electric intensity	Electric Potential
i) Force experienced by unit positive. Charge m on electric field.	i) Work done in moving unit positive. Charge from infinity to a given point against field.
ii) It is a vector.	ii) It is a scalar.

2 correct points (2 marks)

35. Arrive the relation between electric field intensity and electric potential. K Recall Easy

Work done = Force × distance

= – E × dx (1 mark)

But work done = potential difference between two points

= dV = – E. dx

or $E = -\frac{dV}{dx}$ (1 mark)

36. Assume the expression for electric intensity outside the spherical conductor of radius r and hence obtain the expression for the intensity at a point very near to the surface of conductor. U Special application Average

$E = \frac{1}{4\pi \in_o} \cdot \frac{q}{d^2}$ outside the special conductor (1 mark)

If point is close to the surface, $d \approx r$

$\therefore\ E = \frac{1}{4\pi \in_o} \cdot \frac{q}{r}$ (1 mark)

37. State and explain Gauss's theorem in electrostatics. K Recall Easy

The total normal electric flux through a closed surface in air is equal to $\frac{1}{\in_o}$ times the algebraic sum of the charges enclosed by the surface (1 mark)

Figure (½ mark)

i.e. $\phi = \frac{\Sigma q}{\in_o}$

i.e. $\phi = \left(\frac{+q_1 - q_4 + q_3 - q_2}{\in_o}\right)$ (½ mark)

38. Calculate the torque on a dipole placed in an electric field of $200\ NC^{-1}$ with its axis at an angle of 60^o to the direction of field. The magnitude of each charge is $1\ \mu C$ separated by a distance of 1 cm.

U
Compute
Average

$\tau = PE \sin\theta = (2aq)\sin\theta$ 2a = 1 cm

$= 1 \times 10^{-2}$ m

p = 2aq $q = 1 \times 10^{-6}$ C

$\tau = 1 \times 10^{-2} \times 200 \times 10^{-6} \times \sin 60^o$ $E = 200\ NC^{-1}$

$= 200 \times \frac{\sqrt{3}}{2}$

$10^{-8} = \sqrt{3} \times 10^{-6}$ Nm $\theta = 60^o$ (1 mark)

39. The electric potential at a point distant r from a charge q is V. When the charge q is replaced by10q, what will be the potential at that point?

A
Applied to formula
Average

$V \propto q$ or $V = \frac{1}{4\pi\epsilon_o} \cdot \frac{q}{d}$ (1 mark)

$\therefore\ V^1 = \frac{1}{4\pi\epsilon_o} \cdot \frac{10q}{d} = (10)\ V$

$V^1 = 10$ V (1 mark)

40. 125 identical mercury droplets charged to same potential V merge to form a single bigger drop. What will be the potential of the new drop?

A
Application
Difficult

$$\left.\begin{aligned} V &= \frac{1}{4\pi\epsilon_o} \cdot \frac{q}{r} \\ V^1 &= \frac{1}{4\pi\epsilon_o} \cdot \frac{nq}{r^1} \end{aligned}\right\} \quad r^1 = n^{1/3}\ r$$

$V^1 = n^{2/3}$ V (1 mark)

$V^1 = (125^{2/3})\ V = 25 \times V = 25$ V (1 mark)

Chapter 11 : Capacitors

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Define electrical capacity of a conductor.	K Recall Easy
	Addition of charges raise the potential of a conductor. (1 mark)	
2.	Mention any one factor on which the capacity of a conductor depends on.	K Recall Easy
	Size and shape of a conductor/ dielectric constant of surrounding medium/ nature of nearby conductors. Any one. (1 mark)	
3.	Give the SI unit of capacitance.	K Recall Easy
	Farad (1 mark)	
4.	Find the dimensional formula for Farad.	K Recall Easy
	Ans: $[L^{-2} M^{-1} T^{4} \pi^{2}]$ (1 mark)	
5.	Define capacitance of a capacitor.	K Recall Easy
	Capacitance of capacitor is the ratio of the magnitude of charge on either conductors to the p-d between them. (1 mark)	
6.	Calculate the capacitance of a spherical conductor of radius 5m. when surrounded by a medium of dielectric constant 5.	U Compute Average
	Ans: $C = 4\pi \epsilon_0 \epsilon_r R = 2.8$ nF. Formula (1 mark), Answer (1 mark)	
7.	The capacitance of a spherical conductor of radius 5.0 m surrounded by a medium of dielectric constant 5 is a) 2.8×10^{-9} F b) 25×10^{-9} F	U Calculate Average

c) 9×10^{-9} F
d) 1.0×10^{-9} F

Ans: a)

8. Compute the radius of a spherical conductor of capacitance 1 nanofarad placed in air. — A Compute Average

Ans: $r = \dfrac{C}{4\pi \epsilon_o}$ (1 mark)

Ans = 9 m (1 mark)

9. The capacitance of a spherical conductor of radius r and surface area A kept in a medium of dielectric constant ϵ_r is — K Recall Average

a) $4 \pi \epsilon_o \epsilon_r r$
b) $4 \pi \epsilon_o \epsilon_o A$
c) $\dfrac{1}{4 \pi \epsilon_o \epsilon_r r}$
d) $\dfrac{1}{4 \pi \epsilon_o \epsilon_r A}$

Ans: a)

10. Capacitance of a capacitor is expressed as — K Recall Easy

a) $C = \dfrac{V}{Q}$
b) $C = \dfrac{Q}{V}$
c) C = QV
d) C = Q + V

Ans: b)

11. The energy stored in a capacitor is given by — K Recognize Easy

a) $U = \dfrac{Q^2}{2C}$
b) $U = ½ CV^2$
c) U = ½ QV
d) All of the above

Ans: d)

12. Capacitance of a spherical conductor — K, Recognize, Easy
    a) increases with the increase of radius
    b) decreases with the increase of radius
    c) remains same with the increase of radius
    d) first increases and then decreases with increase of radius.

Ans: a)

13. If two capacitors 2μF and 4μF are connected in parallel, the effective capacitance of the combination is — K, Recall, Average
    a) $\frac{4}{3}$ μF
    b) $\frac{3}{4}$ μF
    c) 6 μF
    d) $\frac{1}{3}$ μF

Ans: c)

14. If two capacitors 3μF and 6 μF are connected in series, the effective capacitance of the combination is — K, Recall, Average
    a) 9 μF
    b) 2 μF
    c) ½ μF
    d) 1/3 μF

Ans: b)

15. Two capacitors C_1 and C_2 are connected in series. The equivalent capacitance of the combination is — U, Recall, Average
    a) $C_s = C_1 + C_2$
    b) $C_s = \frac{C_1 C_2}{C_1 + C_2}$
    c) $C_s = \frac{C_1 + C_2}{C_1 C_2}$
    d) $C_s = \frac{C_1 + C_2}{C_1 - C_2}$

Ans: b) $\frac{C_1 C_2}{C_1 + C_2}$

16. Two capacitors C_1 and C_2 are connected in parallel. The equivalent capacitance of the combination is — U Recall Average

a) $C_p = \dfrac{C_1 C_2}{C_1 + C_2}$

b) $C_p = C_1 + C_2$

c) $C_p = \dfrac{C_1 + C_2}{C_1 C_2}$

d) $C_p = \dfrac{C_1 - C_2}{C_1 + C_2}$

Ans: b)

17. Write the expression for the capacitance of a cylindrical capacitor. Explain the terms. — K Recall Average

$C = \dfrac{2 \pi \in_r \in_o l}{2.303 \log (b/a)}$ (1 mark)

Explanation of the terms (1 mark)

18. Write the expression for the capacitance of a spherical capacitor. Explain the terms. — K Recall

$C = \dfrac{4 \pi \in_r \in_o ab}{(b - a)}$ (1 mark)

Explanation of terms (1 mark)

19. What is the equivalent capacitance of the combination of three capacitors connected in series. Draw the series circuit. — K Recall Average

$\dfrac{1}{C_s} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3}$ (1 mark)

Figure (1 mark)

20. What is the effective capacitance of the combination of three capacitors connected in parallel. Draw the parallel combination diagram. — U See relationship Average

$C_p = C_1 + C_2 + C_3$ (1 mark)

Figure (1 mark)

21. Derive an expression for an equivalent capacitance of the combination of three capacitors connected in series. | U
See relationship
Average

Figure (1 mark)

$V = V_1 + V_2 + V_3$ (1 mark)

$C_1 = \frac{q}{V_1}$, $C_2 = \frac{q}{V_2}$, $C_3 = \frac{q}{V_3}$, $C_5 = \frac{q}{V}$ (1 mark)

Explanation for effective capacitance (1 mark)

$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$ (1 mark)

22. Derive an expression for the effective capacitance of combination of three capacitors connected in parallel. | U
See relationship
Average

Figure (1 mark)

$q = q_1 + q_2 + q_3$ (1 mark)

$q_1 = C_1V$, $q_2 = C_2V$, $q_3 = C_3V$, $q = C_pV$ (1 mark)

Explanation of effective capacitance (1 mark)

$C_p = C_1 + C_2 + C_3$ (1 mark)

23. Explain the principle of a capacitor. | U
Interpret
Average

Three Diagram (1 mark each), Explanation (2 marks)

24. Arrive at an expression for the energy stored in a capacitor. | U
See relationship
Average

Diagram (1 mark)

The energy stored in a charged capacitor is the amount of work done.

$Q = CV$ (1 mark)

$dW = \left(\frac{Q}{C}\right) dQ$ (1 mark)

$W = \int_0^Q \frac{Q}{C}\, dQ$ (1 mark)

$$\left.\begin{array}{l} U = \dfrac{Q^2}{2C} \\ \text{Or } U = \tfrac{1}{2} CV^2 \\ \text{Or } U = \tfrac{1}{2} QV \end{array}\right\} \quad \text{(1 mark)}$$

25. Write down the expression for the capacitance of a parallel plate capacitor. K Recall Easy

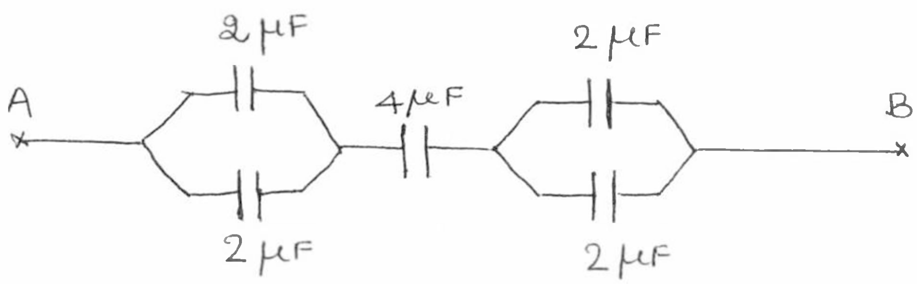
$C = \dfrac{\epsilon_r \, \epsilon_o \, A}{d}$ (1 mark)

26. The potential difference (V) between the two plates of a parallel plate capacitor of separation d is given by U See relationship Average

a) $\dfrac{E}{d}$
b) Ed
c) E^2 d
d) Ed^2

Ans: b)

27. Find the capacitance between A and B in the following combination. U Solve Average



$\dfrac{1}{C} = \dfrac{1}{4} + \dfrac{1}{4} + \dfrac{1}{4} = \dfrac{3}{4}\,\mu F$ (1 mark)

$C = \dfrac{4}{3}\ \mu F$ (1 mark)

28. Find the capacitance between B and C in the following figure. U
Solve
Average

$$\frac{1}{C} = \frac{1}{2} + \frac{1}{2} = 1\ \mu F \quad \text{(1 mark)}$$

$C = 1 + 1 = 2\ \mu F$ (1 mark)

UNIT 4 CURRENT ELECTRICITY

Chapter 12: Electric Current

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Define electric current. Charges in motion (1 mark)	K Recall Easy
2.	What is the net charge of a conductor? Zero (1 mark)	K Recall Easy
3.	Define strength of electric current. Rate of flow of charge (1 mark)	K Recall Easy
4.	Mention the SI unit of electric current. Ampere (1 mark)	K Recall Easy
5.	When do electric charges move through a conductor? Potential difference between two points. (1 mark)	K Recall Easy
6.	Define an ampere. One coulomb of charge flowing any cross section in one second. (1 mark)	K Recall Easy
7.	How many electrons flowing per second constitute a current of one ampere? 6.25×10^{18} (1 mark)	K Recall Easy
8.	Explain the concept of drift velocity of electrons.	U Explain Average

Equation for charge – 1 mark
Current equation – 1 mark
Arriving $v_d = \frac{I}{neA}$ (3 marks)

9. Mention the SI unit of mobility. — K Recall Easy

m^2 / volt – s (1 mark)

10. Define mobility. — K Recall Easy

Ratio between drift velocity and electric field. (1 mark)

11. Write the expression for the current strength in terms of drift velocity. — K Recall Easy

$I = neAv_d$ (1 mark)

12. State Ohm's law. — K Recall Easy

Statement (1 mark)

13. Name the device which does not obey Ohm's law. — K Recall Easy

Diode (1 mark)

14. Under which conditions is Ohm's law not obeyed by a conductor? — K Recall Easy

Very low temperature and very high temperature (1 mark)

15. Define internal resistance of a cell. — K Recall Easy

Statement (1 mark)

16. Define current density. — K Recall Easy

Statement : current flowing/ unit area (1 mark)

17. What is the cause of resistance in a conductor? K Recall Easy

Due to collision free motion of electron is opposed. (1 mark)

18. Five identical wires, each having a resistance of one ohm are joined parallel to one another, what is the equivalent resistance of this parallel combination? U Relation Easy

R_p formula (1 mark)
Ans: 0.2 Ω (1 mark)

19. If x amperes of current flows for y seconds in a conductor, how much charge in coulomb pass through the conductor during that time? U Relation Easy

$I = \frac{q}{t}$ (1mark)
$q = It, \quad = xy$ (1 mark)

20 What is the purpose of connecting a battery in an electrical circuit? K Recall Easy

To maintain pd across conductor (1 mark)

21 Why is the drift velocity of electron small in a conductor? K Recall Easy

Frequent collision suffered by electron (1 mark)

22 A wire is cut into half. What is the effect on its specific resistance? K Recall Easy

No effect on specific resistance (1 mark)

23 As the thickness of wire is increased, what happens to the resistance of wire? K Recall Easy

Decreases (1 mark)

24 Why is copper wire more suitable as a connecting wire in an electrical circuit? K Recall Easy

Low resistance (1 mark)

25	A one metre long wire is bent at 180^0 in the middle and the two halves are twisted together? What will be the effect on the resistance?	U Infer Average

If the length is half area of cross section is doubled. (1 mark)
Therefore, resistance decreases. (1 mark)

26	Why does the resistance of a superconductor become almost zero?	K Recall Easy

- Electrons are mutually coherent. (1 mark)
- At critical temperature, no collision between ions. (1 mark)

27	The light from an electric bulb gets dim for a moment when a geyser is switched on in your house. Why ?	U Reason Easy

The resistance of geyser is small and hence draws large current.
(2 marks)

28	When a battery 'E' of internal resistance 'r' is connected to a resistance 'R', a current I flows through it. Write down the relation between them.	U Interpret Easy

$I = \dfrac{E}{R + r}$ (1 mark)

29	Explain the concept of drift velocity.	U Explain Average

Figure (1 mark)
Definition (1 mark)
Average velocity with which charge carrier moves in a conductor under the influence of electric field.
Explanation – 3 marks

30.	Derive the expression $I = neAv_d$ for the current strength in a conductor.	K Recall Easy

$N = nA\,l$ (1 mark)
$l = v_d\,t$ (1 mark)
$I = ne\,Av_d$ (1 mark)

31.	Obtain an expression for the effective resistance of three resistors connected in series.	U Relation Easy

Figure : (1 mark)
Value Point : $V = V_1 + V_2 + V_3$ (1 mark)
$V = IR$ (1 mark)
Substitution arriving $R_s = R_1 + R_2 + R....$ (2 marks)

32. Obtain an expression for the effective resistance if three resistances are connected in parallel. U Relation Easy

Figure (1 mark)
$I = I_1 + I_2 + I_2$ (1 mark)
$I = \frac{V}{R}$ (1 mark)
Substituting and arriving final expression
$R_p = \frac{1}{R_1} + ...$ (2 marks)

33. What are branch currents? Obtain an expression for branch currents when two resistances are connected in parallel. U Derive Average

Figure (1 mark)
$I = I_1 + I_2$ (1 mark)
$I_1R_1 = I_2R_2$ (1 mark)
Finding I_1 (1 mark)
Finding I_2 (1 mark)

34. What is a thermistor? How does the resistance of a thermistor vary with temperature? Mention three applications of thermistor. U Explain Average

Definition of thermistor (1 mark)
Graphical representation (1 mark)
Application (3 marks)

35 What is the resistance value of a resistor, with the colour code Orange – orange – orange – silver K Recall Easy

$33 \times 10^3 \pm 10\%$ (1 mark)

36 Draw the V – I graph for ohmic and non-ohmic material. K Recall Easy

Ohmic (1 mark)
Non-ohmic (1 mark)

37 Expand SQUIDS. K Recall Easy

Acronyming SQUIDS. (1 mark)

38. Two wires A and B are of the same material. A is three times longer than B and diameter A is thrice that of B. If the resistance of A is 4 Ω find that of B. U See relation Average

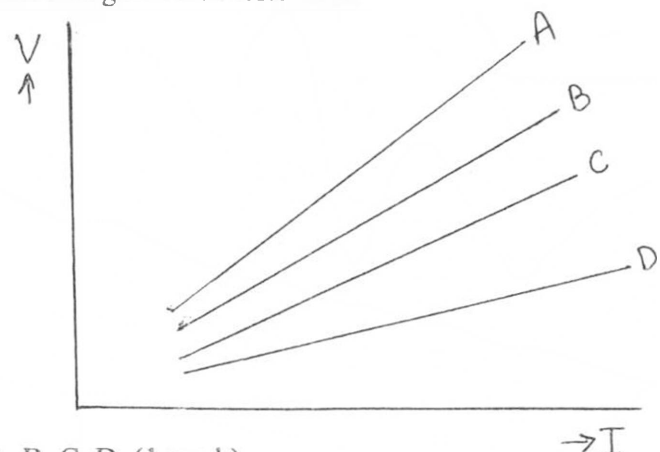
$R = \rho \frac{L}{A}$ (1 mark)

For wire A, $4 = \frac{12 \rho L}{9\pi d^2}$ (1 mark)

B, $R = \frac{4 \rho L}{\pi d^2}$ (1 mark)

Comparing A and B, find R = 12 Ω (2 marks)

39. For the V – I graph shown aside, arrange the resistance of the conductor in increasing order of resistance. U Interpret Average



Value point A, B, C, D. (1 mark)

40. Two wires A and B are of same material and A is three times longer than B and the diameter of a is three times that of B. If the resistance of A is 4 Ω. that of B is U Compute Easy

a) 12 ohms
b) 8 ohms
c) 4 ohms
d) 16 ohms

Ans: a)

Chapter 13 : Kirohhoff's law

1. State Kirchhoff's junction law. K Recall Easy

   1^{st} law – Statement (1 mark)

2. State Kirchhoff's loop law. K Recall Easy

   2^{nd} law – statement (1 mark)

3. What is the condition for balancing a Wheatstone bridge ? K Recall Easy

   $I_g = o$ or $\frac{P}{Q} = \frac{R}{S}$ (1 mark)

4. In a balanced Wheatstone network, if the galvanometer resistance is increased by 10 Ω, what happens to the balancing? K Recall Easy

   No change in balance. (1 mark)

5. If A is area of cross section of conductor, v_d the drift velocity of electron, e the charge on electrons and n, the number density of electrons, then the current density through the conductor is K Recall Easy

   a) $\frac{A}{nev_d}$
   b) $\frac{v_d}{Ane}$
   c) neA v_d
   d) ne v_d

   Ans: d)

6. When an electric field $\vec{E}$ is applied to the ends of a conductor, the free electrons start moving in the direction K Recall Easy
   a) similar to $\vec{E}$
   b) opposite to $\vec{E}$
   c) perpendicular
   d) cannot be predicted

   Ans: b)

7. Five identical wires, each having a resistance of one ohm are joined in parallel. What is the equivalent resistance of this parallel combination ?

U
Compute
Average

a) 5 Ω
b) 0.5 Ω
c) 2 Ω
d) 0.2 Ω

Ans: a)

8. A one metre long wire is bent at 180^{o} in the middle and the two halves are twisted together. What will be the effect on the resistance?

U
See relation
Average

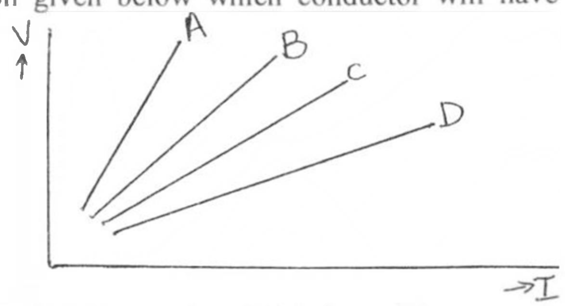
a) resistance increases
b) resistance remains same
c) resistance decreases
d) none of these

Ans: c)

9 Identify from the graph given below which conductor will have more resistance ?

U
Interpret
Easy

a) conductor A
b) conductor B
c) conductor c
d) conductor D



Ans: a)

10 When do we say that a Wheatstone network is balanced ?

K
Recall
Easy

If no current flows through galvanometer. (1 mark)

11 On what principle meter bridge works?

K
Recall
Easy

Wheatstone network (1 mark)

12. State and explain Kirchhoff's laws of electrical network.

K
Recall
Easy

Statement of two laws (1 mark)
EI = 0, EE = EIR (1 mark)

13. Derive the balancing condition of Wheatstone network. U Derive Average

Figure (1 mark)
Condition (1 mark)
2 Loop equation (2 marks)
Arriving final equation $\frac{P}{Q} = \frac{R}{S}$ (1 mark)

14. Two cells rated as 10V, 2Ω and 8V, 1Ω are connected in parallel to send current in the same direction across a 6 Ω resistor. Find the pd across the 6 Ω resistor. U Compute Average

Figure with direction (1 mark)
Applying KVL for 1st mesh
Getting equation $4I_1 + 3I_2 = 5$ (1 mark)
Similarly, KVL for 2nd mesh
$6I_1 + 7I_2 = 8$

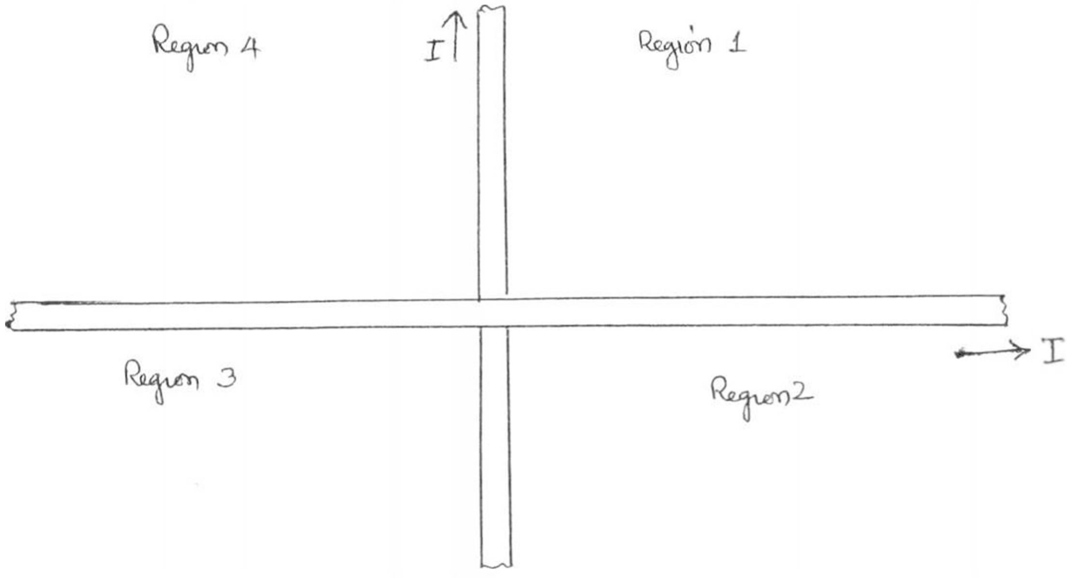
Finding $I_1 = \frac{11}{10}$ A (1 mark)

$I_2 = \frac{1}{5}$ A

Substituting find pd across 6 Ω = 7.8 V (2 marks)

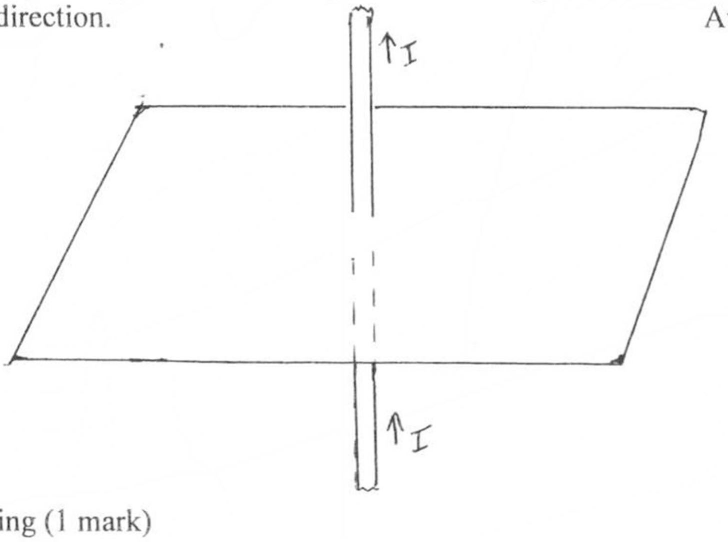
Chapter 14: Magnetic Effect of Electric Current

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Magnetic field due to a current carrying element of length d l at a point distant r from it is directly proportional to a) strength of the current I b) length of the current element dl c) $1 / r^2$ d) all these Ans : d)	K Recall Easy
2.	Two conductors of equal lengths carrying equal amount of current held perpendicular to each other. Mark the direction of the magnetic field due to this combination in the four regions by dots and crosses :	S Draws, locate Difficult



Correct marking : 2 marks

3. A current carrying conductor is passed through a cardboard on which iron filings are spread horizontally. Mark the magnetic lines of force with direction. U Draw Average



Correct marking (1 mark)

4. A coil consisting of 50 turns creates a field of 3.5×10^{-5} T. Compute the value of current flowing in the coil (Given radius of the coil = 0.08 m) A Solve Average

$$B = \frac{\mu_o}{4\pi}\left(\frac{2\pi n I}{r}\right) \text{ i.e. } I = \frac{2Br}{\mu_o n} \quad \text{(1 mark)}$$

$$I = \frac{2 \times 3.5 \times 10^{-5} \times 0.08}{4\pi \times 10^{-7} \times 50} = 0.089 \text{ A} \quad \text{(1 mark)}$$

5. The lines passing through places of equal declination are called — K, Recall, Easy
   a) agonic lines
   b) isoclinals
   c) isogonals
   d) isodynamic lines

   Ans : c)

6. Lines passing through places of the same value of horizontal component are called as — K, Recall, Easy
   a) isogonals
   b) isodynamic lines
   c) agonic lines
   d) isoclinals

   Ans : b)

7. A circular current carrying conductor produces a magnetic field. Derive an expression for the magnetic field at a point on the axial line. — U, Interpret, Explain, Derive, Average

   Diagram with specifications (1 mark)

   Apply Laplace Law $dB = \frac{\mu_o}{4\pi}\left(\frac{I\,d\,l\sin\theta}{r^2}\right)$ (1 mark)

   Show that the cosine components cancel (1 mark)
   Arrive at

   $$B = \frac{\mu_o}{4\pi}\left[\frac{2\pi n I r^2}{(r^2+x^2)^{3/2}}\right]$$ (2 marks)

8. State, explain and give the mathematical form Biot-Savart's law. Explain the terms with a diagram. Give the vector form of the law. — K, State, Recall, Label

   Explanation of the concept with diagram (1 mark).
   Statement of law (2 marks)
   Mathematical representation (1 mark)

   $$dB = \left(\frac{\mu_o}{4\pi}\right)\left(\frac{I\,d\,l\sin\theta}{r^2}\right)$$

   Vector representation of the law i.e.

   $$\overrightarrow{dB} = \left(\frac{\mu_o}{4\pi}\right)\frac{I\,\overrightarrow{d\,l}\times\vec{r}}{r^3}$$ (1 mark)

9. State Laplace's law for a current carrying element which produces a magnetic field. — K, State,Recall, Easy

Statement only (2 marks)

10. Write Laplace's law is mathematical form when a current carrying element produces a magnetic field. Give its vector form. — K, Recall, Easy

$$dB = \left(\frac{\mu_o}{4\pi}\right)\left(\frac{I\,dl\sin\theta}{r^2}\right) \quad \text{(1 mark)}$$

Vector form, $\overrightarrow{dB} = \left(\frac{\mu_o}{4\pi}\right)\frac{I\,\overrightarrow{dl}\times\vec{r}}{r^3}$ (1 mark)

11. Write an expression for the magnetic field produced by a current carrying circular coil at its centre. Show graphically the variation of field with distance on the axial line. — U, Recall and Draw, Average

Expression (1 mark)
Graph (1 mark)

12. Write an expression for the magnetic moment of a current loop and explain the symbols used. — K, Recall, Easy

M = nIA (1 mark)
M – magnetic moment
I – current in a loop
A – Area of the current loop (1 mark)

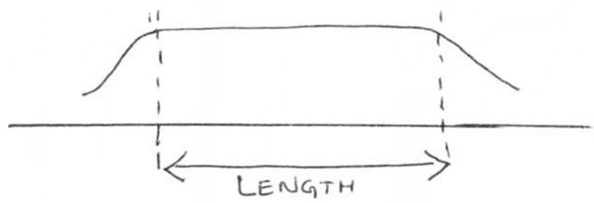
13. At one end of an ideal current carrying long solenoid, the magnetic field is — U, See relationship, Average

a) $B = \mu_o nI$
b) $B = \frac{\mu_o nI}{2}$
c) $B = 4\mu_o nI$
d) $B = 2\mu_o nI$

Ans : b)

14. Show graphically the variation of magnetic field along the axis of an ideal solenoid.
Mark the length of the solenoid in the graph.

S
Draw graph, interpret
Difficult



(1 mark)

Field is uniform over major part of the solenoid of length L.
(1 mark)

15. Write an expression for the magnetic field at a point on the axis of a solenoid. Explain the symbols with the help of a diagram.

K
Recall
Easy

$B = \frac{\mu_o \, nI}{2}(\cos \phi_1 - \cos \phi_2)$ (1 mark)

Explanation of the terms with diagram (1 mark)

16. Magnetic field due to a current carrying ideal solenoid at its mid point on its axis is

U
See relationship
Average

a) $B = \frac{\mu_o \, nI}{2}$
b) $2 \mu_o nI$
c) $B = 4 \mu_o nI$
d) $B = \mu_o nI$

Ans : d)

17. Give the theory of tangent galvanometer.

U
Explain
Average

Explaining that the coil must be placed such that its field at its centre is perpendicular to B_H. (1 mark)

$B = \frac{\mu_o}{4\pi}\left(\frac{2\pi n I}{r}\right)$ (1 mark)

$\frac{\mu_o}{4\pi}\left(\frac{2\pi n I}{r}\right) = B_H \tan\theta$ (1 mark)

$$I = \left\{ \frac{2r\ B_H}{\mu_o\ n} \right\} \tan\theta \quad \text{(1 mark)}$$

Reduction factor

$\therefore$ I = K tan θ (1 mark)

18.	State the tangent law in magnetism. Express it in mathematical terms.	K Recall Easy
	For a given restoring field, the deflecting field is directly proportional to the tangent of the angle of deflection. (1 mark) $B = B_H \tan\theta$ (1 mark)	
19.	Define the terms: (i) Declination, (ii) Magnetic dip θ	K Recall Easy
	Declination at a place is the angle between the geographic meridian and the magnetic meridian. (1 mark) Dip at a place is the angle between the earth's total magnetic field and the horizontal drawn in the magnetic meridian. (1 mark)	

Chapter 15: Mechanical Effect of Electric Current

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Force on a charged particle moving in a magnetic field is given by a) F = Bq v cos θ b) F = B q v sin θ c) $F = \frac{Bq}{v}\cos\theta$ d) $F = \frac{Bq}{v}\cos\theta$ Ans: b)	U See relationship, generalize Average
2.	The force on a charged particle moving in a magnetic field is maximum at a) θ = 0 b) θ = 45° c) θ = 90° d) θ = 180° Ans : c)	K Recall Easy

3. A charged particle at rest is placed in a magnetic field experiences zero force. Why ? — K, Recall, Easy

$F - B\,q\,v\sin\theta$
At rest $v = 0$, $\therefore$ $F = 0$ (1 mark)

4. State Fleming's left hand rule. — K, State, Easy

Statement – (1 Mark)
Show directions of Force field and velocity (1 mark)

5. Mention an expression for the torque acting on a current loop placed in a uniform magnetic field. — K, Recall, Easy

$\tau = M\,B\cos\theta$ (1 mark)

6. Mention an expression for the torque on a current loop placed in a uniform magnetic field with the normal to the plane of the coil making an angle α with the direction of the field. — K, Recall, Easy

$\tau = MB\sin\alpha$ (1 mark)

7. Write the relation for the force on a current-carrying conductor kept in a magnetic field. — K, Recall, Easy

$F = B\,I\,l$ (1 mark)
Or $F = B\,I\,l\sin\theta$

8. Briefly mention how a galvanometer can be converted to an ammeter. — K, Recall, Recognise, Average

By connecting a small resistance in parallel with galvanometer.
(1 mark)

$S = \dfrac{I_g\,G}{I - I_g}$ (1 mark)

9. Briefly mention how a galvanometer can be converted to a volt meter. — K, Recall and express

		Average
	By connecting a high resistance in series with galvanometer. (1 mark) $R = \frac{V}{I_g} - G$ (1 mark)	
10	Arrive at an expression for the force between two parallel conductors carrying currents.	U Explain and establish Average
	Field on second conductor due to current I_1 of first conductor $B = \frac{\mu_o I_1}{2\pi a}$ (1 mark) Force $F = B I_2 l$ (1 mark) $F = \frac{\mu_o I_1}{2\pi a} \times I_2 l$ (1 mark) $F_1 = \frac{\mu_o I_1 I_2}{2\pi a}$ (1 mark)	
11	Describe with theory the working of a moving coil galvanometer.	K Describe, locate, express Average
	Diagram (1 mark) Description of working (1 mark) $C = N B I l \times b = NB I A$ (1 mark) Restoring couple = deflecting couple $C_r = D_D$ (1 mark) Showing $I \propto \theta$ (1 mark)	
12	Describe an experiment to determine the current sensitivity of a pointer galvanometer.	U Recall, express, tabulate Average
	Diagrams (1 mark) Formula Current sensitivity = $\frac{d\,(P+Q)\,R \times 10^{-6}}{E\,Q}$ divisions/ μA (1 mark) Procedure in brief (2 marks) Tabular columns (1 mark)	

13 Calculate the current sensitivity of the pointer galvanometer using the following data. U Compute Average
EMF of the cell = 2V.

Trial No.	Resistance unplugged (ohms)		Current in one direction (A)		Current in the opposite direction (A)	
1.	5000	5000	23	4000	25	4100
2.	6000	4000	19	4100	19	4000
3.	7000	3000	15	4050	14	4050

Trial No. 1.
Formula (1 mark)
Mean deflection = 24 div.
Mean R = 4050 Ω (1 mark)
Current sensitivity = 0.097 div/ μA

Trial No.2 :
Mean deflection = 19 div.
Mean R = 4050 Ω (1 mark)
Current Sensitivity = 0.096 div / μA

Trial No.3.
Mean deflection = 14.5 div
Mean R = 4050 Ω (1 mark)
Current sensitivity = 0.098 div / μA
Overall - (1 mark)

14 Describe an experiment to convert a galvanometer into a voltmeter. U Recall, explain Average

Diagram (1 mark)

Formula R = $\dfrac{V}{I_g} - G$ (1 mark)

Procedure in brief (2 marks)
Tabular column (1 mark)

15 Calculate the resistance to be connected in series with the given galvanometer to convert it into a voltmeter using the following data. U Compute Average

Resistance of the galvanometer = 200 Ω
Current sensitivity of the galvanometer = 5 div / μ A
No. of div. On one side of the end of the galvanometer = 30 div.
Range of the voltmeter = 0 to 10 V.

$R = \frac{V}{I_g} - G$ (1mark)

$= \frac{10}{5 \times 10^{-3}} - 200 = 1800\ \Omega$ (1 mark)

16 Describe an experiment to determine the value of B_H at a place using a tangent galvanometer. U Recall, Express, Explain Average

Diagram (1 mark)

$$\left.\begin{aligned} \text{Formula } B_H &= \frac{\mu_o\, n\, K}{2\, r} \\ K &= \frac{I}{\tan\theta} \end{aligned}\right\} \quad \text{(1 mark)}$$

Procedure (2 marks)
Tabular column (1 mark)

17. Compute the value of B_H at a place using following data. A Compute Difficult
Circumference of the coil =0.50 m
No. of turns = 50.

Trial No.	Current through T.G. in mA.	Deflections			
		θ_1	θ_2	θ_3	θ_4
1	500 mA	40°	41°	41°	40°
2	800 mA	45°	46°	46°	45°

$c = 2\,\pi\, r = 0.50$

$\therefore\ r = \frac{0.5}{2 \times 3.142} = 0.079$ m

Trial No. 1

$K = \frac{I}{\tan\theta}$, mean $\theta = 41.5^\circ$ (1 mark)

$$K = \frac{0.5}{\tan 41.5^o} \quad \text{(1 mark)}$$

$$B_H = \frac{\mu_o\, n\, k}{2\, r} \quad \text{(1 mark)}$$

Trial No.2 also to be done.

Chapter 16: Electromagnetic Induction

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Derive an expression for the current in an AC circuit containing a pure inductor when a sinusoidal voltage $V = V_o \sin \omega t$ is applied. Show graphically the phase relation between V and I.	K Recall Average
2.	Derive an expression for the induced emf in an AC generator. Represent the variation of the induced emf in graph.	K Recall Easy
3.	Derive an expression for the current in an AC circuit containing a pure capacitor when a sinusoidal voltage $V = V_o \sin wt$ is applied.	K Recall Average

Answer 1:

Circuit and explanation (1 mark)

Explanation and $V = V_o \sin \omega t$ (1 mark)

Simplification $L \,.\, dI/ dt = V_o \sin \omega t$ (1 mark)

$$\left.\begin{array}{l} I = \dfrac{V_o}{\omega L} \sin (\omega t - \dfrac{\pi}{2}) \\ I = I_o \sin (\omega t - \pi/2) \end{array}\right\} \text{(1 mark)}$$

Phase relation between V and I by graph or phasor diagram (1 mark)

Answer 2:

Figure (1 mark)

$\phi = n\, AB \cos \theta = nAB \cos \omega t$ (1 mark)

$$E = \frac{-d\,\phi}{dt} \quad \text{(1 mark)}$$

$E = E_o \sin \omega t$ (1 mark)

$E_o = nAB\omega$ (1 mark)

Answer 3:

Circuit and explanation (1 mark)

$V = V_o \sin \omega t$ and $V_c = \dfrac{q}{c}$ (1 mark)

$I = \frac{dq}{dt} = CV_o\, \omega \cos \omega t$ (1 mark)

$I = I_o \sin(\omega t + \pi/2)$ (1 mark)

Where $I_o = C\omega\, V_o$

Phase relation between V and I by graphic or by phasor diagram (1 mark)

4. Derive an expression for the impedance and current in a series LCR circuit by phasor diagram method. Write the expression for phase difference between V and I. — K Recall Average

Circuit (1 mark)

$V = V_o \sin \omega t$

$V_R = I_o R$, $V_L = I_o X_L$, $V_C = I_o X_C$ (1 mark)

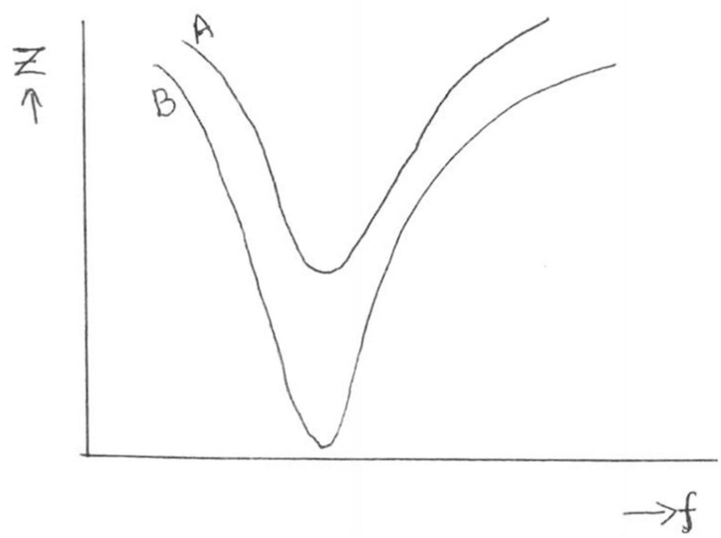
Phasor diagram (1 mark)

Arriving at $Z = \sqrt{R^2 + (X_L - X_C)^2}$ (1 mark)

And $I = I_o \sin(\omega t \pm \phi)$

$\tan \phi = \left(\frac{X_L - X_C}{R}\right)$ (1 mark)

5. Impedance versus frequency graph is as shown in the figure. A and B respectively correspond to resistances R_1 and R_2. Write the relation between R_1 and R_2. — U See relationship Easy



$R_2 < R_1$ (1 mark)

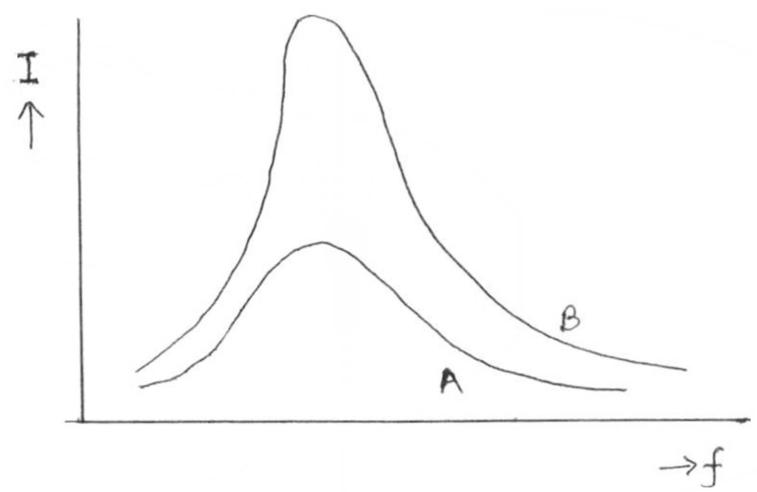
6. What is the principle used in moving iron type ammeter ? K Recall Easy

Motion of iron piece from region of weaker magnetic field to stronger magnetic field. OR iron piece attached to the pointer attracted due to magnetic field produced by the current through the coil. (1 mark)

7. Draw a graph of capacitive reactance versus frequency of alternating current applied to a capacitor. U Graphical interpretation Easy

$X_C \propto \frac{1}{f}$ (1 mark)

8. Current versus frequency graph for an LCR circuit is as in the figure. Curves A and B correspond respectively to resistances R_1 and R_2. Give the relation between R_1 and R_2. U See relationship Easy



$R_1 > R_2$ (1 mark)

9. X_C is the capacitive reactance at certain frequency f of AC. What is the new capacitive resistance when the frequency of AC is reduced to half the initial value ? A Interpret Average

$X_C \propto \frac{1}{f}$ $\therefore$ $X'_C = 2\,X_C$ (1 mark)

X_C becomes double the previous value.

10. Draw a graph of X_L versus frequency for an inductor. K Recall Easy

Correct graph(1 mark)

11. How does the inductive reactance depend on the frequency of AC? K Recall Easy

$X_C \propto f$. (1 mark)

12. How does the value of current depend on the resistance in a series LCR circuit under resonance? U See relationship Average

$I_{max} \propto \frac{1}{R}$ (1 mark)

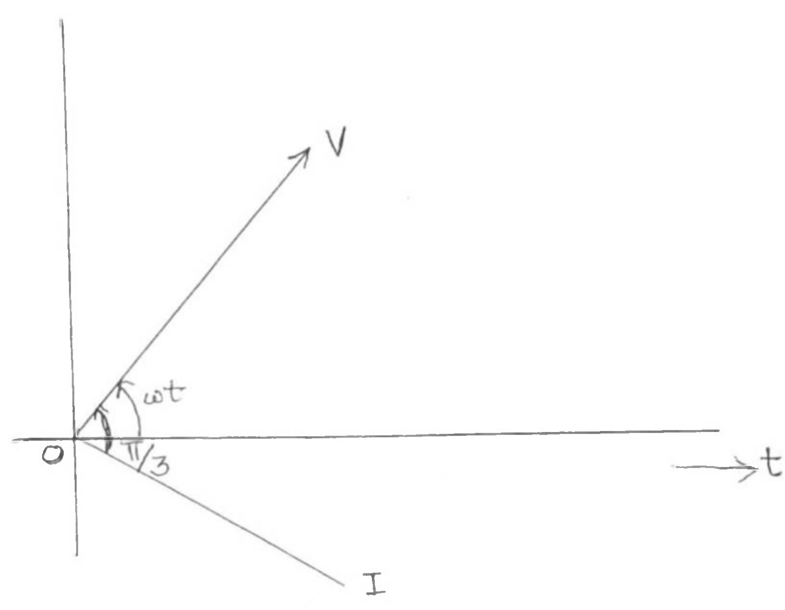
13. Draw the circuit symbol of choke. K Recall Easy

Correct drawing (1 mark)

14. If $V = V_0 \sin(\omega t + \pi/3)$, where V_0 and V are in volts represents the expression for the instantaneous voltage, then what is its initial phase ? U See relationship Average

$\phi = \pi/3$ radians (1 mark)

15. Write the expression for the phase difference between current and voltage in a series LCR circuit in the following phasor diagram. U See relationship Average



Voltage leads the current by π/3 rad or π/3 rad. (1 mark)

16. Draw phasor diagram if current leads the voltage by a phase angle of π/4 radians. S Draw Average

Correct diagram (1 mark)

17. Write the relation between rms value and peak value of AC. K Recall Easy

$I_{rms} = \frac{I_o}{\sqrt{2}}$ (1 mark)

18. Write the relation between rms and mean value of AC. K Recall Easy

$I_{mean} = \frac{2\sqrt{2}\ I_{rms}}{\pi}$ (1 mark)

19. What is the rms value of an AC when its peak value is $\sqrt{2}$ A ? U Relation Easy

$I_{rms} = \frac{I_o}{\sqrt{2}} = \frac{\sqrt{2}}{\sqrt{2}} = 1$ A. (1 mark)

20. What is the peak value of an AC if its mean value is 2A? U Relation Easy

$I_o = \frac{\pi\ I_{mean}}{2} = \frac{\pi \times 2}{2} = \pi\ A$ (1 mark)

$I_o = 3.142$ A

21. What is the significance of Lenz's law? K Recall Easy

It is the law of conservation of energy. (1 mark)

22.	Write the expression for the magnetic flux associated with a coil of area A and explain the symbols.	K Recall Easy

$\phi = B.A. \cos\theta$ (1 mark)

B – magnetic field
A – area of the surface
θ - Angle between B and normal to the surface.
(1 mark)

23.	The magnetic flux (ϕ) of a surface is given by $\phi = \vec{B} \cdot \vec{A}$ where B is the magnetic induction and A is the area of the surface. What is the direction of $\vec{A}$?	U Interpret Average

The direction of $\vec{A}$ is normal into the plane of the surface.
(1 mark)

24.	At what orientation of the coil in the magnetic field, the flux is maximum?	U See relationship Average

When plane of the coil is perpendicular to magnetic field.
OR
When θ = 0 where θ is perpendicular between normal to the plane of the coil and magnetic field.
(1 mark)

25.	If the frequency of AC is 50 Hz, then what is the period of AC ?	U See relationship Average

$T = \frac{1}{f} = \frac{1}{50} = 0.02$ s (1 mark)

26.	How can we minimize the loss of energy due to eddy currents in a transformer?	K Recall Easy

By laminating the core of the transformer. (1 mark)

27.	Draw a graph of current versus time in an inductance coil during the growth and decay of current.	S Sketch graph Average

Correct graph (1 mark)

28. Name a device which works on the principle of mutual induction. K Recall Easy

Transformer or Induction coil (1 mark)

29. What is mutual induction ? K Recall Easy

The phenomenon in which an induced emf appears in one coil due to the change in current in another coil near to it is called mutual induction. (1 mark)

30. Write Neumann's relation for induced emf. K Recall Easy

$e = \frac{-d\phi}{dt}$ (1 mark)

31 What is the direction of the induced emf with respect to the applied emf when the current in an inductance coil decreases? U Reasoning Average

The induced emf is in the same direction as that of applied emf. (1 mark)

32 Why the emf induced in a coil during the decay of current in an inductance is called the forward emf? U Reasoning Average

It is in the direction of applied emf. (1 mark)

33 In which form the energy is stored in an inductance coil? K Recall Easy

Magnetic field in and around the coil. (1 mark)

34 Name the device which works on the principle of self-induction. K Recall Easy

Choke (1 mark)

35 Generally, the forward emf is greater than the back emf. Why ? U Reasoning Average

Because, rate of decay of current is higher than the rate of growth of current. (1 mark)

36 Define the S.I. unit of self-inductance. K Recall Easy

The self-inductance of the coil is said to be one henry, if one volt of emf is induced in the coil, the current through it changes at the rate of 1 ampere per second. (1 mark)

37 A step down transformer having a power output of 10 kW and efficiency 90% reduces the voltage from 11 kV to 220 V. Calculate (i) the number of turns in the primary if the secondary has 100 turns and (ii) the current in the primary. A Compute Difficult

$P_o = 10$ kW

$V_o = 11$ kV $V_i = 220$ V, $n_s = 100$

$I_S = \frac{P_o}{V_o}$ (1 mark)

$n = \frac{V_S\ I_S}{V_P\ I_P}$ (1 mark)

$0.9 = \frac{11 \times 10^3}{220} \times \frac{I_S}{I_P} \Rightarrow I_P$ (1 mark)

$\frac{N_s}{n_p} = \frac{V_s}{V_p}$ (1 mark)

$n_p = \ldots\ldots\ldots\ldots$ (1 mark)

38. Calculate the self-inductance of the choke required to operate a bulb marked 100 W, 100 V on 220 V – 50 Hz ac supply. In place of inductance if another resistance is connected, then what is its value? A Compute Difficult

$$\left.\begin{aligned} I &= \frac{P}{V} = \frac{100}{100} = 1\ \Omega \\ R &= \frac{V}{I} = 100\ \Omega \end{aligned}\right\} \quad \text{(1 mark)}$$

$Z = \frac{V_{rms}}{I_{rms}} = \frac{220}{100} = 220\ \Omega$ (1 mark)

$L = \frac{\sqrt{Z^2 - R^2}}{2\pi f}$ (1 mark)

L = ------------- (1 mark)

Z = R + R′ ⇒ R′ = Z – R = ---------- Ω (1 mark)

39.	An inductance of 3H is connected in series with a resistance of 15Ω to a 220 V, 50 Hz ac supply What is the value of the capacitor to be connected in series to make the power factor unity? Calculate the impedance and current in the circuit.	A Compute Average

$\text{Cos } \phi = \frac{R}{Z}$ .... (1 mark)

$Z = \sqrt{R^2 + (X_L \; X_C)^2}$

$R = Z \Rightarrow X_L^2 = X_C^2 \Rightarrow X_L = X_C$ (1 mark)

$\therefore$ C = ...μF (1 mark)

$Z = \sqrt{R^2 + O} = R$ (1 mark)

$I = \frac{V}{Z} = \frac{V}{R} =$ .... (1 mark)

40	A bulb marked 60W, 60V is connected in series with a capacitor to a 220 V, 50 Hz ac supply. The bulb is found to operate under normal wattage. Calculate the value of the capacitance.	A Compute Difficult

P =60 W, V = 6 V

$I = \frac{P}{V} = 1$ A, $R = \frac{V}{I} = 60\ \Omega$ (1 mark)

$V_{rms} = 220$ V, $I_{rms} = 1$

$\therefore Z = \frac{V_{rms}}{I_{rms}} = 220\ \Omega$ (1 mark)

$X_C^2 = Z^2 - R^2$

X_C = ...Ω (1 mark)

$C = \frac{1}{2\pi f X_C}$ (1 mark)

C = ... Ω (1 mark)

41	Describe the construction, principle and working of a transformer. Mention any two sources of power loss in a transformer.	U Describe Average

Construction (1 mark)
Principle (1 mark)

Brief explanation of working (1 mark)
Two sources of power loss (2 marks)
Total (5 marks)

42 What is meant by resonance in a series LCR circuit? Derive an expression for the resonant frequency. Draw a graph of frequency vs. current in series LCR circuit. — U / Derive / Average

Definition (1 mark)
Condition for resonance (1 mark)

Applying and getting $f_o = \dfrac{1}{2\pi\sqrt{LC}}$ (2 marks)

Graph of I vs. f (1 mark)

43 Calculate the self-inductance of the coil by direct method using the following data. Frequency of AC = 50 Hz. — A / Calculation / Average

DC Reading		
Tr.No.	V in V	I in A
1	1.0	0.65
2	1.5	1.0
3	2.0	1.33

AC Reading		
Tr. No.	V in V	I in A
1	1.0	0.3
2	1.5	0.43
3	2.5	0.75

$R = \left(\dfrac{V}{I}\right)_{DC}$ $R = \left(\dfrac{V}{I}\right)_{AC}$ (1 mark)

Mean R = 1.51 Ω (1 mark)
Mean Z = 3.38 Ω (1 mark)

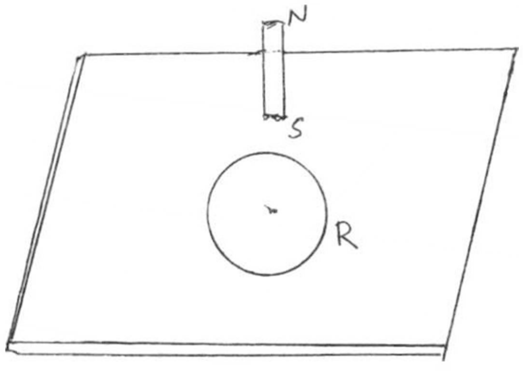
$L = \dfrac{\sqrt{Z^2 - R^2}}{2\pi f}$ (1 mark)

L = 9.63 mH (1 mark)

44 Describe an experiment to determine the self-inductance of a coil by direct method. — U / Describe / Average

Circuit diagram (1 mark)
Formula with graph (1 mark)
Procedure (2 marks)
Tabular column (1 mark)
Total (5 marks)

45 In figure below, when the magnet is moved towards the metallic plate P, eddy current is found to flow in the path given by R. Mark the direction of flow of free electrons in that path. — U Interpret Difficult



Electron flows opposite to induced eddy current. (1 mark)

46 How is the sharpness of resonance in a series LCR circuit related to resistance in the circuit? — U Reasoning Average

Sharpness of resonance decreases with increase in resistance.
(1 mark)

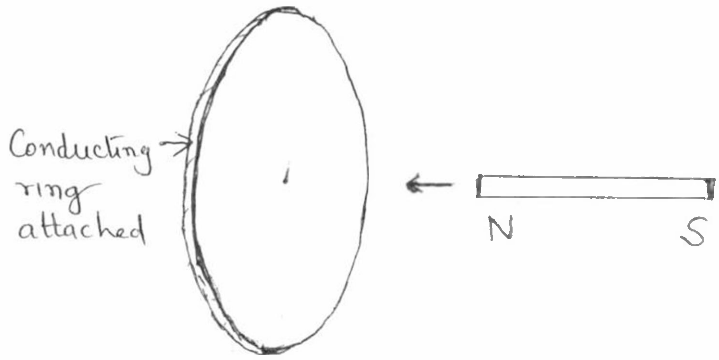
47\. How is the sharpness of resonance in a parallel LCR circuit related to resistance in the circuit? — U Reasoning Average

Sharpness of resonance decreases with increase in resistance.
(1 mark)

48 A magnet is held close to a coil and both the coil and the magnet are in motion. But the emf induced in the coil is zero. Under what condition this can happen? — U Interpret Easy

Whenever there is no relative motion between them, emf = 0 i.e. if both are moved in the same direction with the same speed.
(1 mark)

49 Figure shows a circular plate of an insulator with a conducting ring A on its circumference. When a magnet is moved toward the ring, what is the direction of the induced current in the ring? — U Interpret Average



Anticlockwise w.r.t. the magnet facing the coil. (1 mark)

50. A battery of emf 2V is connected across the primary coil of a step up transformer. The output across the secondary is — U, Reasoning, Easy
   a) 0
   b) 2V
   c) 4V
   d) 1V

Ans. a)

51. A hot wire ammeter reads 10 A in an AC circuit. The peak value of the current is — A, Reason, Difficult
   a) 10 A
   b) $\frac{10}{\sqrt{2}}$ A
   c) $10\sqrt{2}$ A
   d) $\frac{10}{\pi}$ A

Ans: c)

52. In a series LCR resonant circuit, the ac voltage across the resistance R, inductance L and capacitance C are 50 V, 40 V and 40 V respectively. The ac voltage applied to the circuit is — U, Relation, Difficult
   a) 40 V
   b) 90 V
   c) 50 V
   d) 130 V

Ans : c)

53. The reactance of a capacitor for alternating currents of frequency $\frac{200}{\pi}$ Hz is 25 Ω. The value of the capacitance is

U
Relation
Difficult

a) 10 μF
b) 100 μF
c) 25 μF
d) 1000 μF

Ans: b)

54. The resonant frequency of a series LCR circuit is 2500 Hz and the band width is 250 Hz. The Q factor of the circuit is

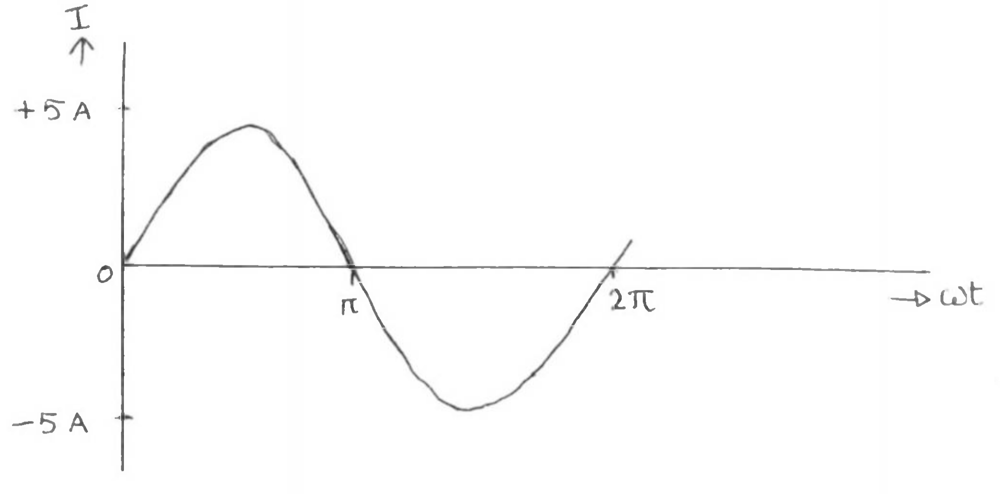
K
Recall
Easy

a) 1/10
b) 10
c) 250
d) 2500

Ans : b)

55. Calculate the mean value of the alternating current taken over half a cycle in the figure shown below.

A
Interpret
Average



Ans: $I_{ave} = \frac{2\,I_o}{\pi} = \frac{10}{\pi}$ A. (1 mark)

56. Direct current can flow easily through an inductor but an alternating one cannot pass through easily. Explain. U Reason Average

The inductance reactance $X_L = W_L = 2\pi f L$
For dc f = 0, $\therefore$ $X_L = 0$
Since indicator offers no resistance to the flow of dc. It can flow easily through the inductor. (1 mark)
For ac f = finite, therefore, X_C = finite value since inductor offers resistance to the flow of a.c. so it cannot flow easily through the inductor. (1 mark)

57. Distinguish between inductive reactance and capacitive reactance. U Discriminate Easy

Any two correct relevant differences (2 marks)

58. Mention any two applications of a choke. K Recall Easy

Two applications (one mark for each)

59. What is Q factor? Write the expression for Q factor in terms of R, L and C. K Recall Easy

Definition (1 mark)

$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$ (1 mark)

60. What is wattless current ? Why is it called so ? K Recall Easy

Definition (1 mark)
Because power loss is almost zero. (1 mark)

61. What is hysteresis? What does the area of hysterisis loop represent? K Recall Easy

Definition (1 mark)
Heat produced on the material i.e. loss of energy per cycle per unit volume (1 mark)

62. When does the current in a series LCR circuit a) lead the applied voltage, b) lag the applied voltage? — U Reasoning Average

$X_L > X_C$ - current lags the V (1 mark)
$X_L < X_C$ – current leads the V (1 mark)

63. Distinguish between resistance and impedance. — U Discriminate Average

Each relevant difference (1 mark)

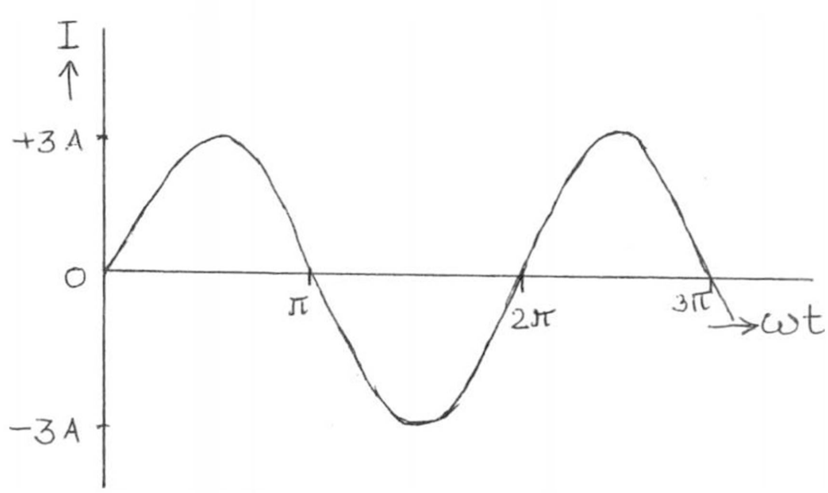
64. In an LCR series circuit the voltage across each of the components L, C and R is 60 V. What is the voltage across the LC combination? — A Compute Average

0 (because under resonance $X_L = X_C$ and $V_L = V_C$). (1 mark)

65. Arrange the following three quantities in an AC circuit in the increasing order of strength of current: I_{rms} - RMS value of AC, I_m - mean value of AC and I_{peak} - peak value of AC. — A Reason out Difficult

$I_m < I_{rms} < I_{peak}$

66. Calculate the rms value of AC shown in the following figure. — A Calculate Average



$$I_{rms} = \frac{I_o}{\sqrt{2}} = \frac{3}{\sqrt{2}} A \quad (1 \text{ mark})$$

67. If a conductor is moving along the positive Y axis perpendicular to a magnetic field which is along the negative X-axis then what is the direction of the induced current ? — U / Interpret / Difficult

Use right hand thumb rule along positive z-axis. (2 marks)

68. The impedance at resonance of a series LCR circuit with L = 10 mH, C = 10 μF and R = 50 ohms is — U / See relation / Easy

a) $\sqrt{70}$ ohms
b) 70 ohms
c) zero
d) 50 ohms

Ans: d)

69. The current in a coil of self-inductance 3 mH changes from 3.5 amp to 0.5 amp in 0.01 s. Find the emf induced in the coil. — U / Compute / Easy

$e = L \frac{dI}{dt}$ (1 mark)

e = ... (1 mark)

70. The magnetic flux linked with a coil at any instant 't' is given by $\phi = 5t^2 - 50t + 200$. Find the emf induced in the coil at t = 1 s. — A / Interpret / Difficult

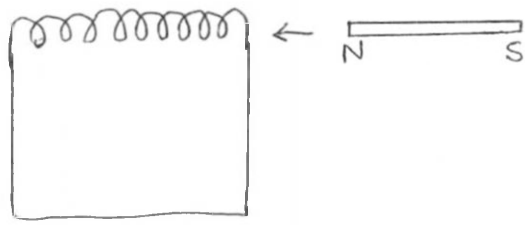
$e = \frac{-d\phi}{dt}$ (1 mark)

e = ...at t = 1 (1 mark)

71. Draw a graph of current vs. frequency in an ac circuit containing a pure resistor. — U / Drawing / Easy

Correct graph (1 mark)

72. Indicate the direction of the induced current in the following situation. — U / Reason out / Average



Anticlockwise w.r.t. to the magnet facing the coil. (1 mark)

73. Why alternating current cannot be used for electroplating? A Reason out Difficult

Because for every ½ cycle of AC there is a change in the direction of current. For every ½ cycle cathode and anode plates interchanged. (1 mark)

74. Why a transformer cannot be used to step up DC voltages? A Reason out Difficult

By using (steady voltage) DC, magnetic flux through the coil remains constant. (1 mark)

75. Represent in a graph two alternating quantities which are out of phase with each other. S Draw Easy

Correct graph (1 mark)

76. Phase difference between V and I is $\pi/3$ radians. What is its power factor ? U Compute Easy

Power factor = $\cos\phi = \cos\pi/3 = \frac{1}{2} = 0.5$. (1 mark)

UNIT 5 ATOMIC PHYSICS

Chapter 17 : Introduction to Atomic Physics

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Which electromagnetic waves are used in television broadcasting and reception? Radio waves (1 mark)	K Recall Average
2.	Which of the following has greater frequency range X - rays or infra-red-rays? X - rays (1 mark)	K Recognise Average
3.	The line spectrum of the sun seen during a total solar eclipse is a) Absorption line spectrum b) Emission line spectrum c) Continuous Spectrum d) Band absorption Ans: b)	K Recall Average
4.	A Sodium vapour lamp is introduced in the path of light from a mercury vapour lamp. The Spectrum obtained in this case will be a) line emission b) line absorption c) Continuous emission d) Band absorption Ans: b)	K Recall Easy
5.	The mass of ${}_7N^{14}$ is 14.00307 amu and the sum of atomic masses of ${}_1H^1$ and ${}_6C^{13}$ is 14.01117 amu. In the reaction ${}_1H^1 + {}_6C^{13} \longrightarrow {}_7N^{14}$ a) there is a net absorption of energy b) there is emission of energy c) in the condition of zero gravity d) emission of an uncharged particle Ans: b)	A Reasoning Difficult

6. Electromagnetic radiation in the frequency range 6×10^{14} Hz belongs to — K, Recall, Easy
   a) I R region
   b) Visible region
   c) UV region
   d) Microwave region

Ans: c)

7. Draw a neat labeled diagram of Dunnington's method of determining $^e/_m$ of an electron — K, Recall, Easy

Diagram – 1
Labelling – 1

8. Distinguish between emission and absorption spectra. — U, Explain, Easy

Production 1
Example 1

2

9. What is the nature of spectrum given by a candle light? — K, Recall, Easy

Continuous emission

10. Describe with a neat diagram the Dunnington's method of determining the $\frac{e}{m}$ of electron? — K, Recall, Average

Diagram (1 mark)

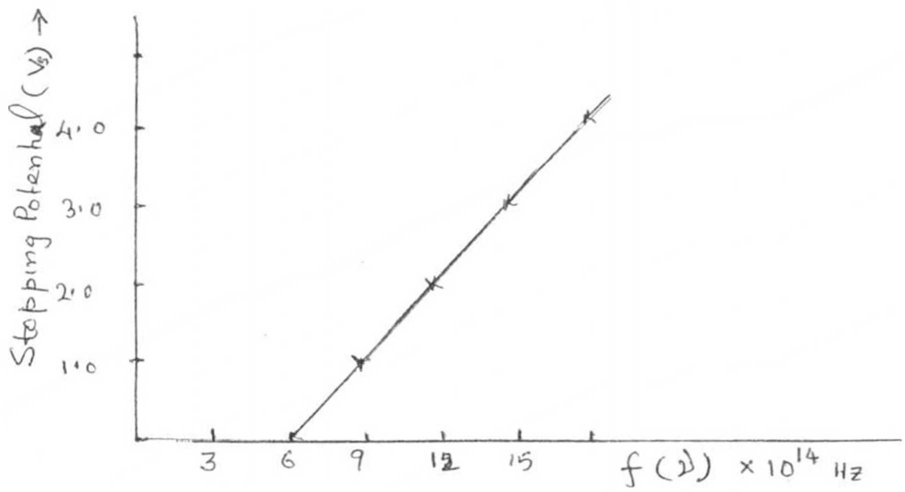
$Be\upsilon = \frac{mr^2}{r}$ (1 mark)

$$\upsilon = \frac{r\theta}{nT} = \frac{fr\theta}{n}$$

$$\frac{e}{m} = \frac{f\theta}{Bn}$$

Chapter 18 : Photoelectric Effect

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	In a photoelectric emission experiment the anode is made –ve with respect to the cathode. Write the conditions under which photoelectric current can be observed 1. frequency of incident radiation (1 mark) 2. stopping potential (1 mark)	U See relationship Difficult
2.	For which frequency of incident light the stopping potential becomes zero in photoelectric effect? Threshold frequency (1 mark)	U Sees relationship Average
3.	What is meant by threshold frequency in photoelectric emission? Particular frequency of incident radiation for a given metal below which there is no photoemission (1 mark)	K Recall Easy
4.	How does the kinetic energy of the photoelectrons vary with the frequency of incident radiation? KE is inversely proportional to λ (1 mark)	K Recall Average
5.	Why there is no photo emission if the frequency of the incident radiation is less than the threshold frequency? Explain. γ depends on energy (1 mark) Energy is not sufficient (1 mark)	U Explains Average
6.	Using the graph shown below, calculate the work function of the photomaterial. Planck's constant= 6.625×10^{-34} Js	A Calculation Average



Intercept gives threshold frequency
Work function

W= h v_o ----------------------- 1
 = $6.625 \times 10^{-34} \times 6 \times 10^{14}$
W = 39.750×10^{-20}J 1

02

7. Describe an experiment to demonstrate photoelectric effect. What happens to the photocurrent if the battery potential is increased above the stopping potential?

U
Explains
Average

Diagram (1 mark)
Explanation (3 marks)
Photo current is independent of battery potential (1 mark)

8. Using suitable diagrams, write the principle of any two applications of photoemissive/voltaic/conductive effect.

K
Recall
Easy

Figure 1 mark
Principle 2 marks
Each application 1 mark

9. Discuss how Einstein's theory could satisfactorily explain the photoelectric effect.

U
Explains
Average

1) Explanation of Instantaneous process (1 mark)
2) Threshold frequency (1 mark)
3) Kinetic energy dependence (1 mark)
4) Photo current (1 mark)
5) Stopping potential (1 mark)

10. List the experimental observations of photoelectric effect.

K
Recall
Average

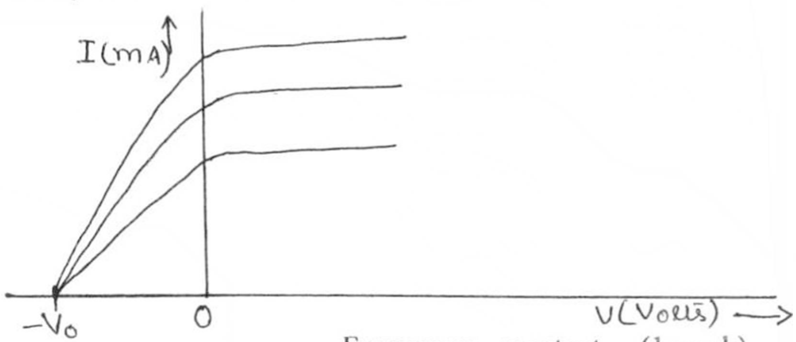
1. Instantaneous (1 mark)
2. Threshold frequency/wavelength (1 mark)
3. Above vo, KE of photoelectron $\propto$ frequency (1 mark)
4. Above vo, photocurrent $\propto$ intensity (1 mark)
5. Stopping potential (1 mark)

11. Write the S.I unit of Planck's constant.

J - s (1 mark)

12. A graph of photoelectric current versus voltage is as shown. What inference can be drawn from the graph about the frequency and intensity of incident radiation

A
Infer
Average



Frequency constant (1 mark)
Intensity – varies (1 mark)

13. Alkali metals are just photosensitive to visible light. Do they produce photo electric effect with (a) x-rays (b) I-R radiations ? Give reason for your answer.

A
Reasoning
Average

X-rays – produces – high frequency (1 mark)
I-R rays – does not produce (1 mark)

Chapter 19 : Dual Nature of Light

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Bring out any two differences between matter waves and electromagnetic waves 1) Production (1 mark) 2) Speed (1 mark)	U Experiment Average
2.	Explain the concept of matter waves. Give the expression for de Broglie wavelength in terms of (1) linear momentum, (2) kinetic energy of the particle. Concept of matter waves (1 mark) Expression for λ - (1 mark) $\lambda = \frac{h}{m\,v}$ (1 mark) $\lambda = \frac{h}{\sqrt{2mVe}}$ (1 mark)	K Recall Average
3.	With a neat diagram, explain the principle and working of G.P Thomson's experiment on electron diffraction. Diagram (1 mark) Principle (1 mark) Working (2 marks)	
4.	What are matter waves? Wave associated with material particle. (1 mark)	K Recall Easy
5.	Why electron microscope is better than an optical microscope? OR Compare the resolving power of an electron microscope with that of an optical microscope. Resolving power of electron microscope is much greater than that of optical microscope (1 mark)	A Reasoning Easy

6. Explain the principle of electron microscope. K Recall Average

Principle (2 marks)

7. Explain the principle of atomic microscope. K Recall Average

Principle (2 marks)

8. Calculate the change in energy of an electron so that its de Broglie wavelength decreases from 10^{-10} m to 0.5×10^{-10} m

Formula (1 mark)
Answer (1 mark)

9. What happens to the de Broglie wavelength of an electron when its velocity increases? K Recall Easy

Wavelength decreases. (1 mark)

10. Which of the following systems will have minimum radius of first orbit? (n=1) K Recall Easy
    a) Singly ionized helium
    b) Doubly ionized lithium
    c) Denetrium atom
    d) Hydrogen atom

Ans: b)

11. Why is the wave nature of matter not noticeable in our daily observations? K Recall Easy

Small wave length (1 mark)

12. Write down the relation between energy and momentum of photon. K Recall Easy

$P = \dfrac{E}{c}$ (1 mark)

Chapter 20 : Bohr's Atom Model

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Derive an expression for total energy of the electron in the nth orbit of a hydrogen-like atom. (Assuming the expression for the radius of the nth orbit). What is the significance of the negative sign in the expression for energy ?	U Explain Average

$$PE = E_p = \frac{-Ze^2}{4\pi \in_o r} \quad \text{(1 mark)}$$

$$KE = E_k = \tfrac{1}{2}\left\{\frac{Ze^2}{4\pi \in_o r}\right\} \quad \text{(1 mark)}$$

$$\text{Total energy } E_n = E_p + E_k = \frac{-Ze^2}{8\pi \in_o r} \quad \text{(1 mark)}$$

$$\text{Substitution of } r = \frac{\in_o n^2 h^2}{\pi m Ze^2} \text{ and } E_n = \frac{-m Z^2 e^4}{8 \in_0^2 n^2 h^2} \quad \text{(1 mark)}$$

The negative sign implies electron is bound to nucleus/ energy should be supplied to remove from field of the nucleus.
(5 marks)

Sl. No.	Question	Obj/ Spec./ Diff. Level
2.	Arrive at an expression for the wave number of a spectral line of hydrogen – like atom assuming the expression for energy in the nth orbit.	K Recalls Average

$$E_2 = \frac{-m Z^2 e^4}{8 \in_0^2 n_2^1 h^2} \text{ and } E_1 = \frac{-m Z^2 e^4}{8 \in_0^2 n_2^2 h^2} \quad \text{(1 mark)}$$

$$h\nu = E_2 - E_1 = \frac{m Z^2 e^4}{8 \in_0^2 h^2}\left\{\frac{1}{n_1^2} - \frac{1}{n_2^2}\right\} \quad \text{(1 mark)}$$

$$\frac{C}{\lambda} = \frac{m Z^2 e^4}{8 \in_0^2 h^3}\left\{\frac{1}{n_1^2} - \frac{1}{n_2^2}\right\}$$

$$\text{or } \bar{\nu} = \frac{m Z^2 e^4}{8 \in_0^2 c h^3}\left\{\frac{1}{n_1^2} - \frac{1}{n_2^2}\right\} \quad \text{(1 mark)}$$

$$\bar{\nu}\ R = \left\{\frac{1}{n_1^2} - \frac{1}{n_2^2}\right\} \quad \text{(1 mark)}$$

where $R = 1.097 \times 10^7\ m^{-1}$ (1 mark)
Total : 5 marks

3. State Bohr's postulates for Hydrogen-like atoms. Do any of these contradict the results of classical physics? Explain.

U
Explain
Average

1. Concept of stationary or selected orbits. (1 mark)
2. Quantization of stationary orbit

   Bohr Quantum Condition mvr = $\frac{nh}{2\pi}$ (1 mark)
3. Transition of electron and frequency of radiation emitted

   $v = \frac{E_2 - E_1}{h}$ (1 mark)
4. Yes, according to classical physics, electron in motion must emit radiation. (1 mark)

Total : 4 marks

4. Obtain an expression for the radius of the nth orbit of an electron in Hydrogen like atoms. Draw a graph between the radius of the orbit and the principal quantum number for hydrogen atom.

S
Draws
Average

Centripetal force = Electrostatic force

$$\frac{mV^2}{r} = \left\{ \frac{1}{4\pi \in_o} \cdot \frac{2e^2}{r^2} \right\} \quad \text{..........(1)} \qquad \text{(1 mark)}$$

Bohr's quantum condition

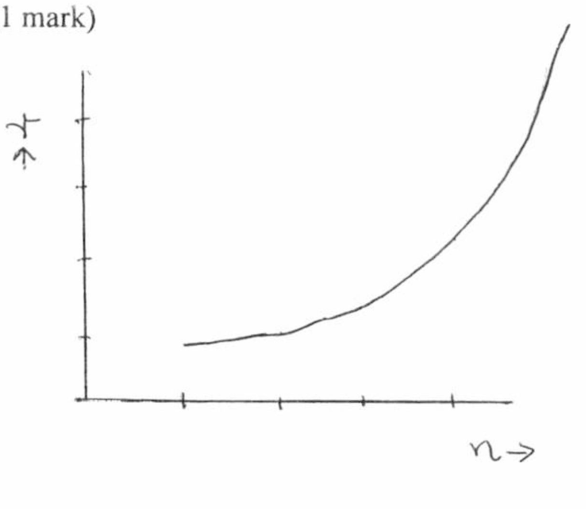
$$mvr = \frac{nh}{2\pi} \quad \text{..............(2)} \qquad \text{(1 mark)}$$

$$m^2v^2r^2 = \frac{n^2h^2}{4\pi^2} \quad \text{...... (3)}$$

Dividing 3 by 1

$$r = \frac{\in_o n^2 h^2}{\pi m 2e^2} \quad \text{(1 mark)}$$

Graph :



5. Calculate the radii of n = 2 and n = 3 electron orbits of a hydrogen atom if the radius of the innermost orbit is 5.3×10^{-11} m.
U
See relationship
Average

Writing expression for radius (1 mark)
$r_2 = 2.12 \times 10^{-10}$ m and $r_4 = 4.77 \times 10^{-10}$ m (1 mark)

6. Two energy levels in an atom are separated by 2.3 eV in energy. What is the frequency of radiation emitted when the atom moves from the upper level to the lower level?
U
See relationship
Difficult

Formula (1 mark)
$\gamma = 5.6 \times 10^{14}$ Hz (1 mark)

7. Give the expression for the orbital velocity of the electron in the first orbit of Hydrogen atom.
K
Recall
Average

Expression (1 mark)

8. What is relation between frequency and wave number of a spectral line?
K
Recall
Easy

Wave no = $\bar{v} = \dfrac{1}{\lambda} = \dfrac{v}{c}$ (1 mark)

9. In the Bohr model of hydrogen atom, what is the significance of 'stationary orbits'?
K
Recall
Easy

The electron in the stationary orbit does not emit radiation.
(1 mark)

10. If the velocity of an electron in the first orbit is v, what is the velocity in the 4th orbit ? K Recall Average

$v \propto \frac{1}{n}$, $v_4 = \frac{1}{4}$ v (1 mark)

11. What is spatial quantisation ? K Recall Average

Orientation of electron orbits fixed with respect to direction of applied magnetic field. (1 mark)

12. Name the model of atom proposed to explain fine structure of spectral lines which failed to predict the number of fine structure lines. K Recall Easy

Sommerfield's relativistic model of atom (1 mark)

13. Name the spectral series of Hydrogen atom in the visible region of electromagnetic spectrum. K Recall Average

Balmer series (1 mark)

14. An electron makes a transition from the 5th orbit to the 4th orbit in a hydrogen atom, to which series the corresponding spectral line belong? K Recall Easy

Bracket series (1 mark)

15. The excitation energy of a given electron is 13.6 eV. Calculate the corresponding excitation potential. K Recall Average

13.6V (1 mark)
Excitation energy in eV numerically equal to excitation potential in volt.

16. What is the value of Rydberg's constant for doubly ionized lithium atom? A Calculate Average

$R = Z^2 R_H$
$R = 9 \times 1.097 \times 10^7\ m^{-1}$ (1 mark)

17. Define excitation energy of an atom. K Define Easy

Energy in eV to raise an electron from a lower orbit to higher orbit (1 mark)

18. Write the value of ionization energy of hydrogen atom. K Recall Easy

Ans: + 13.6 eV (1 mark)

19. The wavelengths of some of the spectral lines obtained in hydrogen spectrum are 911 A^{o},. 3646 A^{o}, 8220 A^{o}. Which one of these wavelengths belongs to Paschen series? K Recall Average

Ans: 8220 A^{o} (1 mark)

20. The total energy of an electron in the first excited state of hydrogen is about –3.4 eV. What is the kinetic energy in this state ? K Recall Average

Ans: + 3.4 eV(1 mark)

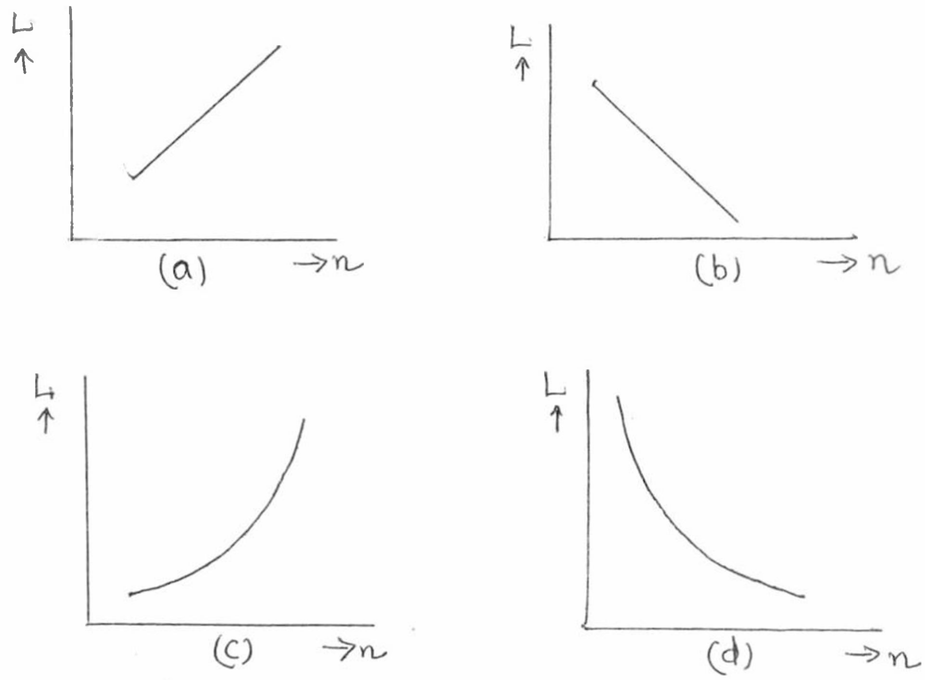
21. What is the angular momentum of an electron in the third orbit of hydrogen atom according to Bohr Model? K Recall Average

Ans: $mVR = \frac{nh}{2\pi}$; $L = \frac{3h}{2\pi}$ (1 mark)

22. Write the dimensional formula for Planck's constant. K Recall Average

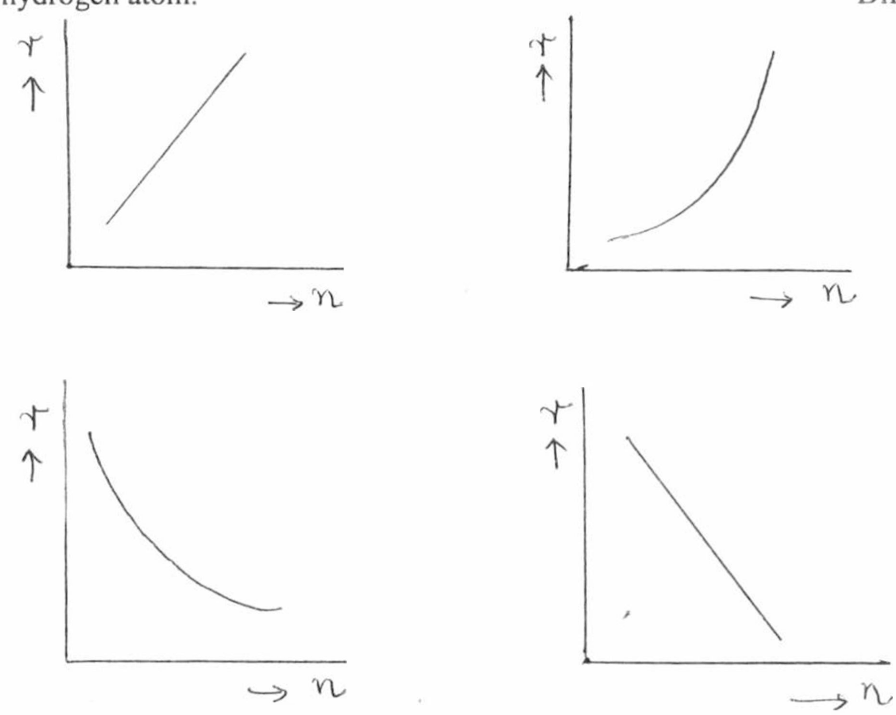
Ans: $L = \frac{nh}{2\pi} = mvr$ (kg ms^{-1} .m) $[ML^2T^{-1}]$ (1 mark)

23. Identify the graph showing the relation between the angular momenta of an electron and the principal quantum number of orbits in Bohr's theory of hydrogen atom. U Interpret Difficult



Ans : a)

24. Identify the graph showing the relation between radii of orbits and the principal quantum number of orbits in Bohr's theory of hydrogen atom. U Interpret Difficult



Ans: b)

25.	The total energy of an electron in the first excited state of hydrogen atom is about –3.4 eV. Its potential energy in this state is a) 3.4 eV b) 6.8 eV c)-6.8 eV d) –3.4 eV	U See relationship Average

Ans : c)

26.	Which of the following is proportional to quantum number n? r → radius of orbit, v → velocity of electron, E → total energy of electron.	U Relation Easy

a) vr

b) rE

c) $\frac{r}{E}$

d) $\frac{r}{v}$

Ans: a)

27.	A 10 kg satellite circles the earth every 2 hour in an orbit of radius 8000 km. Assuming Bohr's angular momentum postulate, find the quantum number of the orbit of the satellite.	A Compute Easy

Writing mvr = $\frac{n\,h}{2\,\pi}$ (1 mark)

v = $\frac{2\,\pi\,r}{T}$ (1 mark)

Calculation of v (1 mark)
Subtraction and calculation of quantum number (2 marks)
Total: 5 marks

28.	Ishanth Sharma bowls a ball of mass 0.3 kg with a speed of 145 km/hr. Calculate the de-Broglie wavelength associated with the ball. Compare this with the wavelength of visible light of frequency 6×10^{14} Hz. What is your inference?	A Computes Difficult

Formula (1 mark)
Calculation of wavelength of ball (1 mark)
Comparing the wavelength of visible light and comparing
(2 marks)
Inference (1 mark)
Total : 5 marks

29. A positronium atom corresponds to the bound state of an electron and its anti particle the positron, revolving round their centre of mass. In which part of the electromagnetic spectrum does the system radiate when it moves from its first excited state to the ground state? — A Predict Difficult

Comparing or applying Bohr model to positronium atom and replacing m_e by reduced mass of the electron (1 mark)
Reduced mass me/2 (1 mark)
For n =2 to n = 1 $\lambda = 1217\ A^o$ (1 mark)
Calculate wavelength $\lambda = 2 \times 1217 = 2434\ A^o$ (1 mark)
U – V region (1 mark)

30. The radius of the first orbit of the electron in a hydrogen atom is $0.53A^o$. The radius of the second orbit must be — K Recall Easy
a) $1.59\ A^o$ b) $1.06\ A^o$ c) $2.12A^o$ d) $4.24\ A^o$

Ans : c)

31. If the electron in a hydrogen atom jumps from the orbit $n_1 = 3$ to the orbit $n_2 = 1$, in terms of Rydberg constant R, the emitted radiation has the wavelength equal to — U Compute Easy

a) $\frac{8}{9}R$
b) $\frac{9}{8}R$
c) $\frac{9}{4}R$
d) $\frac{3}{1}R$

Ans: b)

32. A hydrogen atom and a Li^{++} ion are both respectively in their second excited state. The ratio of their angular momenta is — U Explain Average

a) 1 : 3
b) 3 : 1
c) 1 : 1
d) 1 : 2

Ans: c)

33. The electron in a hydrogen atom is in its second excited state. The energy required to ionize it is
   a) 1.51 eV
   b) 3.4 eV
   c) 13.6 eV
   d) 12.1 eV

Ans : a)

34. Draw the energy level diagram and the transitions of an electron in a hydrogen atom. K Recalls Difficult

Drawing (1 mark)
Representing energy levels and transition with region (1 mark)

35. What is the difference between angular momenta of the electron in the 2^{nd} orbit and 1^{st} orbit of hydrogen atom? U Compares Average

$$L_2\text{-}L_1 = \frac{h}{\pi} - \frac{h}{2\pi} = \frac{h}{2\pi} \quad - \; 2$$

36. Establish the relation between the de Broglie wavelength of linear momentum of the electron from first Bohr's orbit of hydrogen atom. A Compares Average

$$mvr = \frac{h}{2\pi} \quad \text{(1 mark)}$$

$$2\,\pi r = \frac{h}{p} = \lambda \quad \text{(1 mark)}$$

37. The ground state energy of a hydrogen atom is –13.6 eV. Determine A Solves Difficult
   (i) longest wavelength in the Lyman series of hydrogen atom spectrum.
   (ii) The excitation energy of the n = 31 level of He^+ atom.
   (iii) The ionization potential of ground state of Li^{++} atom.

$$E_n = \frac{-13.6\,Z^2}{n^2}\ \text{eV} \quad \text{(1 mark)}$$

i) For lyman series :

$E_1 = -13.6$ eV, $E_2 - E_1 = \dfrac{hc}{\lambda}$, $\lambda = 1225^{o}$ A (1 mark)

$E_2 = -3.4$ eV (in joules)

ii) For He^+ atom Z = 2

$$E_1 = \frac{-13.6 \times 4}{1} = 54.4 \text{ eV}$$

$$E_3 = \frac{-13.6 \times 4}{9} = 6.0 \text{ eV}$$

Excitation energy $E_3 - E_1 = 48.1$ eV (1 mark)

iii) For Li^{++}, Z = 3.

$$E_1 = \frac{-13.6 \times 9}{1} = 122 \text{ eV} \quad (1 \text{ mark})$$

Ionisation potential of Li^{++} = 122 V (1 mark)
Total Marks : 5 marks

38. The excitation energy of electron is 13.6 eV. Calculate the corresponding excitation potential. — A, Recall, Easy

Ans: 13.6 V (1 mark)

39. An electron jumps from an orbit n = 4 to n = 3. To which series the spectral line belong ? — K, Recognise, Easy

Paschen series (1 mark)

40. From Bohr's quantum condition $L = mvr = \frac{nh}{2\pi}$ plot a graph between angular momentum of electron and principal quantum number of orbits. Interpret the graph. — S, Draw, Easy

Drawing (1 mark)
Interpret (1 mark)

Chapter 21 : Scattering of Light

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Distinguish between Stokes and antistokes lines.	K Recall Average
	Any two differences (2 marks)	
2.	Mention two applications of Raman effect.	K Recall Average
	Write any two applications. (2 marks)	
3.	Give an example for incoherent scattering.	K Recall Easy
	Write any one example. (1 mark)	
4.	Mention one application of Raman Effect.	K Recall Easy
	Any one application (1 mark)	
5.	Give an example for coherent scattering.	K Recall Easy
	One example (1 mark)	
6.	What is incoherent scattering?	K Recall Easy
	The frequency of scattered light is different from that of incident light. (1 mark)	
7.	What is Raman Effect.	K Recall Easy
	Definition (1 mark)	

8.	What is coherent scattering?	K Recall Easy
	No change …… of scattered light. (1 mark)	
9.	Why red light is used in danger signals or stop signals?	K Recall Easy
	Red is least scattered. (1 mark)	

Chapter 22: Lasers

Sl. No.	Question	Obj/ Spec./ Diff. Level
1	What is meant by population inversion?	K Recall Average
	Correct explanation (2 marks)	
2	Distinguish between spontaneous and stimulated emission?	K Recall Average
	Write any two difference (2 marks)	
3.	Mention any two properties of laser?	K Recall Average
	Write any two properties (2 marks)	
4	Mention any two application of lasers	K Recall Average
	Write any two application (2 marks)	
5	What are the advantages of photonics over electronics	U Discriminate Easy
	Each advantage 1 mark	

6 Lasers are used for carrying out surgery because it — K, Recall, Easy

a) is highly monochromatic
b) is highly coherent
c) is highly directional
d) can be sharply focused

Ans: c)

7 A laser beam is used for locating distant objects because — K, Recall, Easy

a) it is monochromatic
b) it is coherent
c) it is not absorbed
d) it has smaller angular spread

Ans: d)

8 What is the need for population inversion in laser action ? — K, Recalls, Easy

Lasing action demands more number of atoms in the excited state.
(1 mark)

Chapter 23: Nuclear Physics

1. Distinguish between controlled and uncontrolled chain reaction. — U, Explains

Comparative explanation (1 mark)
Example (1 mark)
Total : 2 marks

2. Name a nucleus which lies on the peak of specific binding energy curve. — K, Recall, Easy

$_2H^4$, $_4Be^8$, $_6C^{12}$ (1 mark)

3. How is mass defect related to the binding energy ? — K, Recall, Easy

Binding energy is energy equivalent of mass defect. (1 mark)

4.	In a nuclear reaction, the number of protons and neutrons are conserved. But energy is absorbed or evolved. Explain how.	A Reason out Difficult
	Here mass number is conserved. But the average mass of the nucleons before the reaction and after the reaction is different. (1 mark) This mass defect appears as binding energy leads to the energy (1 mark) Total : 2 marks	
5.	In a nuclear reaction a neutron combines with a proton to give a deuteron and energy. Here mass number and charge number are conserved. Reason out for emission of energy.	A Reasons out Difficult
	Same as above (2 marks)	
6.	What is ratio of volume of an atom to the volume of the nucleus?	K Recall Average
	$\frac{V_A}{V_N} = \frac{(10^{-10})^3}{(10^{-15})^3} = \frac{10^{-30}}{10^{-45}} = 10^{15}$ (1 mark)	
7	M R I scanning is preferred to x-rays for diagnosis. Why?	U See relationship Average
	X-rays can cause damage to living cells. (1 mark)	
8	The atomic mass of nitrogen is 14.003 and its mass number is 14. What is its packing fraction? Ans: 2.14×10^{-4} (1 mark)	A Calculation Average
9	What safety measures should be taken while handling radioactive materials? Each measure (1 mark)	K Recall Easy
10	Which are the two cycles responsible for stellar energy?	K Recall Easy
	Proton – proton cycle - 1 Carbon-nitrogen cycle –1	

11	What is the significance of critical mass in a fusion process? To have sustained chain reaction. (1 mark)	K Recall Easy
12	Compare an atomic nucleus to a liquid drop as in liquid drop model. Each comparison (1 mark) Total 5 marks	K Recall Easy
13	What is the source of stellar energy? Thermo nuclear fusion/reaction (1 mark)	K Recall Easy
14	Explain the characteristics of nucleus with reference to (i) size (ii) charge (iii) mass (iv) density (v) magnetic moment. Explain Size (1 mark) Mass (1 mark) Charge (1 mark) Density (1 mark) Magnetic Moment (1 mark)	U Explain Average
15	Explain the terms mass defect and nuclear binding energy. Explanation mass defect - 2 marks B.E - 2 marks γ - ray photon - 1 mark	K Recall Average
16	List the characteristics of the nuclear forces Each characteristics – 1 mark (total 5 marks)	K Recall Average
17	What is the difference between nuclear fusion and fission? Each difference 1 mark (total 5 marks)	K Recall Average
18	Name any one type of nuclear reactor. Name any one (1 mark)	K Recall Easy

19 What is the relation between a.m.u and electron volt? K Recall Easy

Ans: 1 a.m.u = 931 amu (1 mark)

20 If the ratio of the mass numbers of two nuclei is 3:1, what is the ratio of their nuclear densities. K Recall Easy

a) 1:1
b) 1:3
c) 3:1
d) 27:1

Ans: a)

21 What is the consequence of an electron and a positron combining together? K Recall Easy

Correct answer (1 mark)

22. In the following nuclear equation, what is X? K Recognize Average

$_5B^{10} + X \longrightarrow {}_3Li^7 + {}_2He^4$

a) proton
b) neutron
c) electron
d) neutron

Neutron

$10 + A = 7 + 4 \therefore A = 1$

$5 + Z = 3 + 2 \therefore Z = 0 \quad \therefore {}_0X^1 \longrightarrow {}_0n^1$

23 Express 16mg mass into equivalent energy in electron- volt. U Relation Average

a) 14.4×10^{11} e V
b) 1.44×10^{12} eV
c) 9×10^{-30} eV
d) $9 \times 10^{+30}$ eV

Ans: c)

24	What is nuclear fusion? Definition (1 mark)	K Recall Easy
25	What is a thermonuclear reaction? Nuclear fusion (1 mark)	K Recall Easy
26	What is the charge of $_3Li^6$ nucleus if the charge on an electron is 1.602×10^{-19}C? $3e = 4.806 \times 10^{-19}$ C (1 mark)	U Compute Easy
27	Mention any one nuclear hazard. Any one (1 mark)	K Recall Easy
28	The binding energy of the nucleus $_2He^4$ is 28.3024 MeV. What is its specific binding energy? Formula (1 mark) 7.0756 Mev (1 mark)	K Recall Average
29	Nuclear forces are short range forces. Explain Explanation (2 marks)	K Recall Average
30	Write Einstein's mass energy relation and explain the symbols? $E = mc^2$ (1 mark) Explanation (1 mark)	K Recall Average
31	What is the density of nuclear matter? 1.815×10^{17} kgm^{-3} (1 mark)	K Recall Easy

32	What is meant by packing fraction of a nucleus? Definition (1 mark)	K Recall Average
33	Write the relation between radius and atomic mass number of a nucleus. $R = R_o A^{1/3}$ (1 mark)	K Recall Average
34	Which is the strongest force in nature? Nuclear force (1 mark)	K Recall Average
35	What is the approximate size of an atom? 10^{-10} m (1 mark)	K Recall Easy
36	What is the order of magnitude of the diameter of the nucleus? Ans: 10^{-15} m (1 mark)	K Recall Easy
37	What is nuclear fission? Definition (1 mark)	K Recall Easy
38	What is a nuclear reactor? Definition (1 mark)	K Recall Easy
39	Define electron volt? Definition (1 mark)	K Recall Easy

40	Define a.m.u? Definition (1 mark)	K Recall Easy
41	What is meant by the term : binding energy of nucleus? Correct definition (1 mark)	K Recall Easy
42	What is meant by the term : specific binding energy? Correct definition (1 mark)	K Recall Easy

Chapter 24 : Radioactivity

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Li^7 is bombarded with a certain particle. Two alpha particles are produced. Identify the bombarding particle.	A Solves Average
2.	$_{92}U^{238}$ is an α emitter and $_{83}B^{210}$ is an β emitter. Write the nuclear reactions in each case. Explain in each reaction whether the neutron to proton ratio increases or decreases.	A Reasoning Average

Answer to 1:

$X + {}_3Li^7 \longrightarrow 2\,{}_2He^4$

Ans: Proton or $_1H^1$ $({}_1H^1 + {}_3Li^7 \longrightarrow 2\,{}_2He^4)$ (1 mark)

Answer to 2:

$_{92}U^{238} \xrightarrow{{}_2He^4} {}_{90}{}^{Th234}$ (1 mark)

Before α - decay

$$\frac{No.\ of\ neutrons}{No.\ of\ protons} = \frac{238-92}{92} = \frac{146}{92}$$

After α - decay

$$\frac{No.\ of\ neutrons}{No.\ of\ protons} = \frac{234-90}{90} = \frac{144}{90} \qquad \frac{144}{90} > \frac{146}{92}$$

(ratio increases.

${}_{83}Bi^{210} \xrightarrow{\beta} {}_{84}Po^{210} + {}_{-1}e^{0}$ (1 mark)

Before β - decay

$$\frac{No.\ of\ neutrons}{No.\ of\ protons} = \frac{210-83}{83} = \frac{127}{83}$$

After β-decay

$$\frac{No.\ of\ neutrons}{No.\ of\ protons} = \frac{210-84}{84} = \frac{126}{84} \qquad \frac{126}{84} < \frac{127}{83}$$ (ratio decreases)

(1 mark)

Ratio increases in case of α decay and ratio decreases in case of β-decay (1 mark)

Total : 5 marks

3. A radioactive nucleus undergoes a series of decays according to the following scheme. — K Recall Average

$$A \xrightarrow{\alpha} B \xrightarrow{\beta} C \xrightarrow{\alpha} D \xrightarrow{\gamma} E$$

If the mass number and atomic number of A are 180 and 72 respectively, what are these numbers for the element E?

a) 69, 172
b) 172,69
c) 180,72
d) 72,180

Ans: b)

$${}_{72}A^{180} \xrightarrow{\alpha} {}_{70}B^{176} \xrightarrow{\beta} {}_{71}C^{176} \xrightarrow{\alpha} {}_{69}D^{172} \xrightarrow{\gamma} {}_{69}E^{172}$$

4. Define decay constant for radioactivity. — K Defines Easy

Definition (1 mark)

5. Define half life of radioactive element. — K Defines Easy

Definition (1 mark)

6. State Soddy's group displacement law for α decay — K, Recall, Easy

Statement (1 mark)

7. State the law of radio active decay. — K, Recall, Easy

Statement (1 mark)

8. State and explain Soddy's group displacement laws with examples. — K, Recall, Average

Statement for α - decay (1 mark)
Statement for β - decay (1 mark)
Example for α - decay (1 mark)
Example for β - decay (1 mark)

9. What is the antiparticle of electron?

Antiparticle – positron (1 mark)

10. Derive an expression for the half-life of a radioactive element. Define mean life. Write the relation between half-life and mean life. — K, Recall, Average

$N = Noe^{-\lambda t}$ (1 mark)

When t = T, $N = \frac{No}{2}$ (1 mark)

$T = \frac{0.693}{\lambda}$ (1 mark)

Definition mean life (1 mark)

Relation $T = 0.693\, T_m$ (1 mark)

11. State the law of radioactive decay.
Arrive at the relation $N = N_o e^{-\lambda t}$ symbols have usual meaning.
Define activity of radioactive sample. — K, Recall, Average

Statement - (1 mark)

$\frac{dN}{dT} \propto -N$ (1 mark)

$\log_e N = -\lambda t + C, \ C = \log_e{}^{No}$ (1 mark)

$N = N_o\ e^{-\lambda t}$ (1 mark)

Define activity (1 mark)

12. Define a.m.u and electron- volt.
Show that 1 a.m.u = 931MeV

K
Recall
Average

Define a.m.u (1 mark)
Define 1eV (1 mark)
$E = mc^2$ (1 mark)
1 a.m.u = 931 MeV (2 marks)

13. Write the S.I unit of radioactivity.

K
Recall
Easy

Curie (1 mark)

14. Mention any one application of radio isotopes?

K
Recall
Easy

One application (1 mark)

15. The mass number of a nucleus before β decay is 198. What is its mass number after β- decay?

U
Interprets
Average

(No change)
198 (1 mark)

Chapter 25 : Elementary Particles

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Write the quark model of proton. UUd (1 mark)	K Recall Easy
2.	What are leptons? Give an example. Definition (1 mark) Example (2 marks)	K Recall Easy
3.	How many leptons are there, name one of the leptons? 6 (1 mark) Naming (1 mark)	K Recall Easy
4.	Distinguish between hadrons and leptons. Type of force between them (1 mark) Example (1 mark)	K Classify Easy
5.	Reason out whether the following equation is correct or not. $_{92}U^{238} \longrightarrow {}_{91}U^{234} + {}_{2}He^{4} + {}_{-1}p^{0} + \lambda$ Correct or not (1 mark) Reasoning (1 mark)	A Reasoning Difficult
6.	Justify the need for neutrino hypothesis in β - decay. Violation of law of conservation of angular momentum (1 mark) Missing energy (1 mark)	U Explains Average
7.	Based on what factor the elementary particles are classified into hadrons and leptons? Type of force that act between them (1 mark)	K Recall Easy

Chapter 26 : Soft Condensed Matter Physics

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Why is the conductivity of n-type semiconductor greater than that of p-type semiconductor though they have the same level of doping? Mobility of electrons is greater than that of holes (1 mark)	K Recall Difficult
2.	With the same amount of impurity doped, the conductivity of an n-type semiconductor is greater than that of a p-type semiconductor because a) the effective charge of a hole is less than that of an electron. b) The mobility of electrons is greater than that of holes. c) The concentration of charge carriers is more in n-type than in p-type. d) Of all the above Ans: d)	K Recall Difficult
3.	Which of the following statements is true in the case of p-type semiconductors? a) Electrons are majority carriers and trivalent atoms are dopant. b) Electrons are minority carriers and pentavalent atoms are dopant. c) Holes are minority carriers and pentavalent atoms are dopant. d) Holes are majority carriers and trivalent atoms are dopant. Ans: d)	K Recall Easy
4.	Why is the energy gap called as a forbidden energy gap? Electrons cannot possess these energy values in the given solid. (1 mark)	U Reason Average
5.	The conductivity of a conductor decreases with increase in temperature but for semiconductors it increases. Why? More electrons from valence band rise to the conduction band in semiconductors (1 mark)	K Recall Difficult

6. What is a transistor? Describe the action of transistor. U Describe Average

Definition of transistor (1 mark)
Circuit diagram - (1 mark)
Explanation with E-B Junction
Forward biased and C-B Jn reverse biased - (2 marks)
$I_E = I_B + I_c$ (1 mark)

7. What is a rectifier? Describe the construction and working of a full wave rectifier. K Recall Easy

Definition of rectifier (1 mark)
Circuit diagram (1 mark)
Construction (1 mark)
Working with input wave form & output waveform (2 marks)

8. Describe the construction and action of a p-n junction diode in forward and reverse bias. Represent graphically the relation between voltage and current. K Recall Easy

Construction (2 marks)
Working (2 marks)
Graphical Representation (1 mark)

9. Explain the function of an N-P-N, transistor as an amplifier in C.E mode. K Recall Difficult

Circuit diagram (1 mark)
Explanation (3 marks)
Input and Output waveforms (1 mark)

What is a semiconductor? On the basis of energy band diagram, distinguish between conductors, semiconductors and insulators K Recall Average

Definition (1 mark)
Energy bond diagram (1 mark)
Distinguish each carry one mark (3 marks)

Chapter 27 Digital Electronics

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Describe an experiment to verify the truth tables of OR and AND logic gates. Circuit diagram (1 mark) Boolean equation (1 mark) Brief procedure (2 marks) Truth tables (1 mark)	K Recalls Average
2.	Draw a circuit symbol of Half adder. Circuit symbol (2 marks)	K Recall Average
3.	Write the truth table of Half adder. Truth Table (2 marks)	K Recall Average
4.	Write the circuit diagram of Full adder. Circuit (2 marks)	K Recall Average
5.	Write the truth table of full adder. Truth Table (2 marks)	K Recall Average
6.	Write the Booleon expressions for OR and AND gates. $Y= A+B$ (1 mark) $Y = A.B$ (1 mark)	K Recall Average
7.	Write the symbol and truth table of NAND gate Symbol and Truth Table (1 mark each)	K Recall Average

8. Write the symbol and truth table of NOT gate

K
Recall
Average

Symbol and Truth Table (1 mark each)

9. Write the logic circuit of the Boolean expression $Y = \overline{A + B}$.

K
Recognise
Average

Logic symbol (1 mark)

10 Write the logic circuit of Boolean expression $Y = A + B$

K
Recognise
Average

Logic symbol (1 mark)

11 What is a NAND gate?

K
Recall
Easy

AND followed by NOT (1 mark)

12 Write the symbol of OR gate.

S
Recall
Easy

Symbol (1 mark)

13 Write the symbol of AND gate.

K
Recall
Easy

Symbol (1 mark)

14 Name the three funademental gates.

K
State
Easy

OR gate, AND gate and NOT gate (1 mark)

15 Give the truth table of OR gate.

K
Recall
Average

Truth Table (1 mark)

16 Name the logic gate used to construct one logic level into the opposite logic level

K
Recall
Easy

NOT gate (1 mark)

17 Name the universal gates.

K
Recall
Easy

NOR & AND gates (1 mark)

18 Give the truth table of NOT gate.

K
Recall
Easy

Truth Table (1 mark)

19 Give the symbol of NOT gate.

K
Recognise
Easy

Symbol (1 mark)

20 Write the logic corresponding to the truth table given below.

U
Interpret
Easy

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	1

OR gate (1 mark)

Chapter 28 : Soft Condensed Matter Physics

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	What are liquid crystals? Intermediate phase between crystalline and liquid states (1 mark)	K Recall Easy
2.	Name the collidal system having gas as dispersed phase and liquid dispersion medium. Foams (1 mark)	K Recognise Easy

3. What is the other name given to the mesophase of matter? | K Recognise Easy

Liquid crystals (1 mark)

4. Compare the colloidal systems emulsions and gels by giving examples. | U Compare Easy

Explanation (1 mark)
Examples (1 mark)

5. Name the different types of thermotropic liquid crystals. What is the basis of their classification? | U Compare Easy

Naming (1 mark)
Basis (structure) (1 mark)

Questions on Practicals

Sl. No.	Question	Obj/ Spec./ Diff. Level
1.	Describe an experiment to verify the law of combination for two resistances in series using Ohm's law. Labelled diagram on circuit (1 mark) Formula with explanation of terms (1 mark) Tabular column (1 mark) Procedure (2 marks)	K, S Practical Easy
2.	Describe an experiment to verify the law of combination of two resistances in parallel using Ohm's law. Labelled diagram or circuit (1 mark) Formula with explanation of terms (1 mark) Tabular column (1 mark) Procedure (2 marks)	K and S Practical Easy
3.	Describe an experiment to determine the resistivity of the material of a conductor using meter bridge. Labelled circuit diagram (1 mark) Formula with explanation (1 mark) Tabular column (1 mark) Procedure (2 marks)	U & S Practical Easy
4.	Describe an experiment to determine the temperature co-efficient of resistance of a thermistor using meter bridge. Labelled diagram or circuit (1mark) Formula with explanation (1 mark) Tabular column (1 mark) Procedure (2 marks)	U & S Practical Easy
5.	Calculate the temperature co-efficient of a thermistor using the following data, obtained in a meter bridge experiment.	A Practical problems Easy

Trial No.	Temp °C	Resistance in resistance box Ω	Balancing length in m
1	27.5	200	0.5
2	29.5	200	0.48

Formula $\alpha = \dfrac{2.303\,(\log R_1 - \log R_2)}{T_1 - T_2}$ (1 mark)

Calculating $R_1 = \dfrac{Sl}{1-l}$ and R_2 (1 mark)

Substitution and calculation of α = - 0.040 / K (2 marks)
Result with unit (1 mark)

6. Calculate the value of the capacitor using the following data using graphical method. — A Calculation Average

Charging

Time second	Volts
0	0
40	5.15
80	5.30
160	7.75
240	8.64
320	9.00
400	9.17
480	9.30
560	9.41
680	9.53
1000	9.75

Discharging

Time second	V_{volt}
0	9.75
40	6.79
80	4.7
160	2.31
240	1.16
320	0.58
400	0.32
480	0.18
560	0.10

7. Describe an experiment to determine the capacitance of a capacitor by the charging and discharging method. — K & S Recall Easy

Circuit (1 mark)
Procedure (2 marks)
Tabular column (1 mark)
Formula and graph (1 mark)

8. Verify the law of combination of resistances, using Ohm's law. The following observations are recorded in an experiment, with two resistances 2 Ω and 4 Ω connected in series. — A & S Practical problems Easy

Trial No.	V(v)	I(A)
1	3.6	0.6
2	4.8	0.8
3	5.4	0.9

Formula R = $\frac{V}{I}$ Ω (1 mark)

Calculating R_1 = ……Ω (2 marks)
R_2 = ………Ω
R_3 = ….Ω

Finding average and writing correct result with unit (2 marks)

9. Verify the law of combination of resistances using Ohm's law. The following observations are recorded in an experiment with two resistors 2 Ω and 4 Ω connected in parallel. U Calculate Easy

Trial No.	V(v)	I(A)
1	0.4	0.3
2	0.8	0.6
3	1.6	1.2

Formula R = $\frac{V}{I}$ Ω (1 mark)

Calculating R_1 , R_2 and R_3 (2 marks)
Finding average and writing correct result with unit (2 marks)

10. Calculate resistivity of the material of the given wire using the following data obtained in a meter bridge experiment. U Calculate Easy

Trial No.	Resistance unplugged In Ω (right gap)	Balancing length In 'm'
1	2	0.42
2	3	0.33
3	4	0.27

Given that length of the given wire = 0.75 m.
Mean diameter of the wire is 0.3×10^{-3} m.
Formula (1 mark)
Finding R_1, R_2 and R_3 (1 mark)
Substituting and finding value of ρ (2 marks)
Result with unit (1 mark)

11. In the diffraction grating experiment the following readings are obtained. Calculate the wavelength of the yellow and violet lines in the first order spectrum if the light is incident obliquely on the grating. — U, Calculate, Easy

Number of lines/m = 5.9×10^5

L.C. of spectrometer = 1′

Direct reading = 85° 55′

Trial No.	Colour of the Spectral lines	MSR	CVD
1	Yellow	65° 30′	5
2	Violet	71°	49

Formula, $\lambda = \dfrac{2\sin\left(\dfrac{D}{2}\right)}{N \times n}$ (1 mark)

Trial 1 : For yellow (colour) line

$D_y = R_o - R_o = 85^\circ\, 55' - 65^\circ\, 35' = 20^\circ\, 20'$

$$\lambda = \frac{2\sin\left(\dfrac{20^\circ\ 20'}{2}\right)}{5.9 \times 10^5 \times 1} = \frac{2 \times \sin(10^\circ\ 10') \times 10^{-5}}{5.9}$$

$$\lambda = \frac{2 \times 0.1765 \times 10^{-5}}{5.9} = 5.983 \times 10^{-7}\ \text{m}$$

(2 marks)

Trial 2 : For violet line

$D = 85^\circ\, 55' - 71^\circ\, 49' = 14^\circ 6'$

$$\lambda = \frac{2\sin\left(\dfrac{140^\circ\ 6'}{2}\right)}{N \times n}$$

$$\lambda = \frac{2\sin(7^\circ\ 3')}{N \times n}$$

$$\lambda = \frac{2 \times 0.1228 \times 10^{-5}}{5.9 \times 1}$$

$\lambda = 4.163 \times 10^{-7}$ m

(2 marks)

12 Using the following observations made during an experiment to determine specific heat of liquid, calculate the specific heat of the given liquid . — A, Computes, Average

Mass of the empty calorimeter = 60.5×10^{-3} kg
Mass of the Calorimeter + liquid = 0.1598 kg
Initial temperature of liquid = 27^o c
Ammeter reading = 1.2 A
Voltmeter reading= 1.5 V
Time of flow of current = 900 Seconds
Final temperature of liquid = 32^o c
Specific heat of mateial of calorimetetr= 3.80J kg^{-1} K^{-1}

13 Describe an experiment to determine the specific heat of water using Joules calorimeter. — K, Recall, Average

Circuit diagram - 1 mark
Formula 1 mark
Proceduere 2 marks
Observations 1 mark

14 Describe an experiment to determine the forward resistance of a given semiconductor diode by plotting the V-I characteristics. — K, Recall, Average

Circuit diagram - 1 mark
Formula with graph 1 mark
Procedure 2 marks
Tabular Column 1 mark

15 Plot a graph of current against voltage and calculate the forward resistance of the diode from the following data — A, Calculates, Average

V (volt)	0.1	0.15	0.2	0.25	0.3	0.35
I (mA)	0	1	4	11	28	62

Plotting the graph - 3 marks
Calculation of resistance - 2 marks

16 Describe an experiment to determine the internal resistance of a cell using a potentiometer. — U & S, Practical, Average

Circuit diagram 1 mark
Formula with graph 1 mark
Procedure 2 marks
Tabular Column 1 mark