"Comprehensive Support Learning Material for Students in Physics Subject Seeking to Overcome Past Setbacks."

SUBJECT:- PHYSICS (054)

Prepared by: State Council of Educational Research and Training, Maharashtra, Pune -30

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QUESTION BANK'

SUBJECT:- PHYSICS (055)

OBJECTIVES OF THE QUESTION BANK :

This **QUESTION BANK** is prepared for the help of the students who will be appearing for the Supplementary Examination to be held in July 2024 and thereafter too. It is prepared as such students could not score the minimum score to pass in the written examination or even to score marks required for eligibility in entrance examination.

This **QUESTION BANK** is designed to boost the confidence of the students. It will definitely help them to score good marks in the forthcoming examination. It will be a great support for the students who lack behind others.

It is prepared in a systematic and easiest way by the expert teachers. The students are aware of the textbook as well as the examination pattern (four different sections). Still, this **QUESTION BANK** elaborates every segment in detail. It considers the level of the students.

By preparing questions in the **QUESTION BANK**, we are quite sure that the students will be able to score good marks.

The main objectives can be summarized as under:

1) To facilitate the essential questions that will help students to understand similar questions in the examination.
2) To help every average and the below average student to achieve 100% success at the HSC Board Examination.
3) To motivate the below average students to score more than their expectation in the Biology Subject which they find as most difficult.
4) To help the teachers to reach out to students who struggle to pass in the Biology subject at the HSC Board Exam with the help of this material.
5) Sample papers based on each chapter with hints and answers are given.
6) Model question paper will definitely help students.

INTRODUCTION

Dear Students,

It does not matter if you did not score well in the regular examination held in February 2024. Remember, "every setback is a setup for a comeback." Your previous attempt must have taught you something valuable. We believe in your potential to overcome this hurdle and excel in your upcoming exams.

After a comprehensive analysis of the results, SCERT, Pune has taken an initiative for the upliftment of students who could not achieve the minimum passing score.

Use this QUESTION BANK, seek help when needed, and stay committed to your studies. Underline all answers in your textbook. This material will also prove to be extremely useful for teachers as they assist students in preparing for the supplementary examination. It will boost your confidence to appear for the exam once again. New students in the coming years can also benefit from this QUESTION BANK.

Best wishes for your journey ahead.

Index

Chapter wise distribution of Marks in the question Paper

** Physics **

QUESTION BANK (2024)

1. Rotational Dynamics

Multiple choice questions (1 mark)

1. For a non-uniform circular motion

a. Magnitude of $\vec{a}_r$ is not constant.

b. Magnitude of $\vec{a}_r$ is constant.

c. Magnitude of $\vec{v}_r$ is not constant

d. Magnitude of both $\vec{a}_r$ bar and $\vec{v}_r$ bar is constant

2. If angular acceleration $\vec{\propto}$ is constant and is along the axis of rotation,

a. $\vec{\theta}$ will be directed along the axis.

b. $\vec{\omega}$ will be directed along the axis

c. $\vec{\propto}$ will be directed along the axis

d. All $\vec{\theta}$, $\vec{\omega}$ and $\vec{\propto}$ will be directed along the axis

3. The kinetic energy of rotating body depends upon

a. Distribution of mass only

b. Angular speed only

c. Distribution of mass and angular speed

d. Angular acceleration only

4. The body is rotating with uniform angular velocity (ω) having rotational kinetic energy (E). Its angular momentum (L) is

a. $\frac{2E}{\omega}$

b. $\frac{E^2}{\omega}$

c. $\frac{E}{\omega^2}$

d. $\frac{E}{2\omega}$

5. The dimensions of angular momentum are

a. $[L^{-2} M^1 T^{-1}]$

b. $[L^2 M^1 T^{-1}]$

c. $[L^1 M^2 T^1]$

d. $[L^2 M^2 T^{-2}]$

6. The difference between tensions in the string at lowest and highest points in the path of the particle of mass 'm' performing vertical circular motion is

a. 2mg

b. 4mg

c. 6mg

d. 8mg

7. A car is moving along a horizontal curve of radius 20 m and the coefficient of friction between the road and wheels of the car is 0.25. If the acceleration due to gravity is 9.8 m/s^2, then its maximum speed is

a. 3 m/s

b. 5 m/s

c. 7 m/s

d. 9 m/s

8. The frequency of revolution of round disco stage, revolving with an angular speed of $\frac{5\pi}{3}$ rad/s is

a. $\frac{5}{6}\ Hz$

b. $\frac{6}{5}\ Hz$

c. $\frac{5}{3}\ Hz$

d. $\frac{5}{2}\ Hz$

9. Moment of inertia of a uniform disc of mass 10 kg and radius 60 cm about an axis perpendicular to its length and passing through centre is

a. 18000 kg/m^2

b. 36000 kg/m^2

c. 1.8 kg/m^2

d. 3.6 kg/m^2

10. A body of moment of inertia 5 kg m^2, rotating with an angular velocity 6 rad/s has the same kinetic energy as a mass of 20 kg moving with a velocity of

a. 5 m/s

b. 4 m/s

c. 3 m/s

d. 2 m/s

VERY SHORT ANSWER TYPE (1 mark)

1. Write an expression/equation for tangential velocity in vector form, for circular motion.
2. Define Uniform Circular Motion.
3. Write an expression for centripetal acceleration, in case of uniform circular motion.
4. Which force is equal in magnitude but opposite in direction to that of centripetal force?
5. What is the other name given to Centrifugal force?
6. Define Banking of the road.
7. Define Angle of Banking.
8. Define Pendulum.
9. Define Conical Pendulum.
10. Define Moment of Inertia.
11. Define Radius of Gyration.
12. State Theorem of Parallel axes.
13. State Theorem of Perpendicular Axes.
14. Define Angular Momentum.
15. Write an expression for angular momentum in vector form.
16. Write an expression for angular momentum in scalar form.
17. State principle of angular momentum.
18. A car of mass 2000 kg rounds a curve of radius 250 m at 25 m/s. Calculate its Centripetal force.
19. A bucket containing water is whirled in a vertical circle of radius 1 m. Find the minimum speed at the top of the circle, so that water does not spill out. (Take, g = 10 m/s^2)
20. A motor van weighing 4400 kg rounds a level curve of radius 100 m at 9.8 m/s. Calculate the minimum value of coefficient of static friction to prevent skidding. (Take g = 9.8 m/s^2)
21. A torque of magnitude 500 Nm acts on a body to produce an angular acceleration of 1 rad/s^2. Calculate moment of inertia of a body.
22. A solid sphere of diameter 100 cm and mass 25 kg rotates about an axis passing through its centre. Calculate its moment of inertia.

SHORT ANSWER TYPE – I (2 marks)

1. State any two characteristics of Circular Motion.

2. Distinguish between Centripetal force and Centrifugal force.
3. Draw a neat labeled diagram of a vehicle moving on a banked road. (Neglect Frictional Forces)
4. Draw a neat labeled diagram of vehicle moving banked road, for lower speed limit (Consider Frictional Forces)
5. Draw a neat labeled diagram of vehicle moving banked road, for Upper speed limit (Consider Frictional Forces)
6. Draw a neat labeled diagram of a conical pendulum performing uniform horizontal circular motion, in an inertial frame.
7. Draw a neat labeled diagram of a conical pendulum performing uniform horizontal circular motion, in a non- inertial frame.
8. The maximum velocity of vehicle moving along a curved horizontal road is given by $V_{max} = \sqrt{\mu_s rg}$. Draw your conclusion.
9. The minimum velocity of vehicle moving along a Well (Wall) of Death is given by $V_{min} = \sqrt{\frac{\mu_s}{rg}}$. Draw your conclusion.
10. Derive expression for minimum velocity of a body at highest (Uppermost) position, while performing Vertical Circular Motion.
11. Derive expression for maximum velocity of a vehicle moving along the top of a convex bridge.
12. State Physical Significances of Moment of Inertia.
13. Explain physical significance of Radius of gyration.
14. Derive expression for rotational kinetic energy.
15. Derive expression for Total Kinetic Energy for a body in rolling motion.
16. A stone weighing 1 kg is whirled in a vertical circle attached at the end of a rope of length of 0.5 m. just crosses the highest position. Find the minimum tension at (a) Lowest position (b) Highest position.
17. An object of mass 0.5 kg attached to a rod of length 0.5 m is whirled in a circle at constant angular speed. If the maximum tension in the string is 5 kg-wt., calculate
    (a) Speed of stone
    (b) Maximum number of revolutions it can complete in a minute.
18. A racing car completes 5 rounds of a circular track in 2 minutes. If the car has uniform centripetal acceleration of π^2 m/s^2, find radius of track.
19. Find the radius of gyration of a rod of length 3 m about its transverse axis passing through its one end.

20. A solid sphere of mass 1 kg rolls on a table with linear speed 2 m/s. Find its total kinetic energy.

21. The radius of gyration of a body about an axis, at a distance of 0.4 m from its centre of mass is 0.5 m. Find its radius of gyration about the parallel axis passing through its centre of mass.

SHORT ANSWER TYPE – II (3 marks)

1. Derive expression for maximum velocity of a vehicle moving along a Horizontal Curved Road.

2. Derive expression for minimum velocity of a vehicle moving along a Well (Wall) of Death.

3. Derive expression for the most safe speed of a vehicle, moving along a banked road.

4. Derive expression for banking angle of a vehicle, moving along a banked road.

5. Show that, the most safe speed of a vehicle moving along a banked road, is independent of mass of the vehicle.

6. Show that, (banking angle) / angle of banking, is independent of mass of vehicle.

7. Derive expression for period of conical pendulum.

8. Derive expression for frequency of conical pendulum.

9. Show that the period of the conical pendulum is independent of mass of the conical pendulum.

10. Show that frequency of conical pendulum is independent of mass of conical pendulum.

11. Show that the period of the conical pendulum is directly proportional to the square root of the length of the conical pendulum.

12. Show that frequency of conical pendulum is inversely proportional to square root of length of conical pendulum.

13. Derive expression for minimum velocity of a body at lowermost position, while performing Vertical Circular Motion.

14. Show that the difference between the tensions at uppermost and lowermost position of a body performing Vertical Circular Motion is 6mg.

15. Derive expression for the difference between the tensions at uppermost and lowermost position of a body performing Vertical Circular Motion.

16. Derive expression for Moment of Inertia in case of Parallel Axes Theorem.

17. Derive expression for Moment of Inertia in case of Perpendicular Axes Theorem.

18. Derive expression for angular momentum in terms of Moment of Inertia.

19. Derive expression for Torque in terms of Moment of Inertia.

20. State and prove Conservation of Linear Momentum.

21. Derive expression for speed of a body rolling down on an inclined plane.

22. A circular race course track of radius 500 m is banked to 10^0. The coefficient of static friction between tyres of a vehicle and the road surface is 0.25. Calculate

(a) The maximum speed to avoid slipping

(b) The optimum speed to avoid wear and tear of tyres ($g = 9.8\ m/s^2$)

23. A pilot of mass 50 kg in a jet aircraft executing a loop with constant speed of 250 m/s. If the radius of circle is 5 km, calculate the force exerted by the seat on the pilot,

(a) at the top of loop (b) at the bottom of the loop.

24. In a conical pendulum, a string of length, 120 cm is fixed at rigid support and carries a mass of 150 g at its free end. If the mass is revolved in a horizontal circle of radius 0.2 m around a vertical axis, calculate tension in string.

25. A solid cylinder of uniform density of radius 2 cm has mass of 50 g. If its length is 12 cm, calculate its moment of inertia about an axis passing through its centre and perpendicular to its length.

26. A solid sphere of radius 25 cm and mass 25 kg rotates about an axis through its centre. Calculate its moment of inertia. If its angular velocity changes from 2 rad/s to 12 rad/s in 5 seconds, calculate the torque applied.

LONG ANSWER TYPE (4 marks)

1. Vehicle moving along a horizontal curved road has a maximum velocity V_{max}. If the same vehicle is moving in a Well (Wall) of death, its minimum velocity is found to be V_{min}. Find ratio of V_{max}: V_{min}.

2. Derive expression for the safest minimum speed of a vehicle moving along a banked road. (Consider Frictional Forces).

3. Derive expression for safest maximum speed of a vehicle moving along a banked road. (Consider Frictional Forces).

4. Derive expression for Moment of Inertia of a uniform disc.

2 Mechanical Properties of Fluids

Multiple choice questions (1 mark)

1) hectopascal is equal to
   a. 1000 Pa
   b. 105 Pa
   c. 100 Pa
   d. 10 Pa

2) Which of the following is non viscous liquid?
   a) Water
   b) Liquid nitrogen
   c) Liquid helium
   d) Liquid CO_2

3) Hydraulic lift is an application of
   a) Bernoulli's principle
   b) surface tension
   c) Pascal's law
   d) critical velocity

4) For a streamline flow, Reynolds number
   a) <2000
   b) >1000
   c) >2000
   d) <1000

5) The force due to surface tension inside a capillary containing water is given by
   a) $f_T = 4r^2T$
   b) $f_T = 24r^2$
   c) $f_T = 2\pi rT$
   d) $f_T = 4\pi rT$

6) Potential energy of a molecule on the surface of a liquid as compare to another molecule inside of the liquid is
   a) more
   b) less
   c) half
   d) same

7) A soap bubble in vacuum has a radius of 3 cm and another soap bubble in vacuum has a radius 4 cm. If the two bubbles coalesce under isothermal condition, then the radius of

the new soap bubble is

a) 2.3 cm
b) 4.5 cm
c) 5 cm
d) 7 cm

8) A square frame of length L is immersed in a soap solution and taken out. The force experienced by a square plate is

a) TL
b) 2TL
c) 4TL
d) 8TL

9) The height of water in a capillary tube of radius 2 cm, is 4 cm. What should be the radius of capillary, if the water rises to 8 cm in tube?

a) 1 cm
b) 0.1 cm
c) 2 cm
d) 4 cm

10) The surface tension of the soap solution is 0.035 N/m. The energy needed to increase the radius of bubble from 4 cm to 6 cm is ($\pi = 22/7$)

a) 1.76×10^{-5} J
b) 1.76×10^{-3} J
c) 17.6×10^{-3} J
d) 17.6×10^{-5} J

VERY SHORT ANSWER TYPE QUESTIONS (1 Mark each)

1. What is the dimension of pressure?
2. What is gauge pressure?
3. What is the difference between total pressure and gauge pressure?
4. Why are hydraulic brakes used in a vehicle?
5. Define sphere of influence.
6. What is capillarity?
7. In a hydraulic lift, the input has a surface area, 30 cm^2, and the output piston has a surface area of 1500 cm^2. If a force of 25 N is applied to the input piston, calculate weight on the output piston.

8. An air bubble of radius 0.2 mm is situated just below the water surface. Calculate the gauge pressure. (Surface Tension of water is 0.072 N/m)
9. Two soap bubbles have a radius in the ratio of 2:1. Calculate the ratio of the excess pressure inside them.
10. What should be the diameter of a water drop so that the excess pressure inside it is 80 N/m^2. (Surface tension of water is 0.072 N/m)

SHORT ANSWER TYPE QUESTIONS (2 Marks each)

1. Which are the factors affecting the angle of contact?
2. Write any four applications of capillarity.
3. Distinguish between streamline flow and turbulent flow.
4. What is the effect of impurities on surface tension?
5. Explain any one application of Bernoulli's equation.
6. Define (a) Surface Tension (b) Surface Energy
7. A swimmer is swimming in a swimming pool at 6 m below the surface of water. Calculate the pressure on the swimmer due to water above. (Density of water = 1000 kg/m^3, g =9.8 m/s^2)
8. Calculate the work done in blowing a soap bubble to a radius 1 cm. The surface tension of soap solution is 0.025 N/m.
9. A horizontal force of 1N is required to move a metal plate of area 10^{-2} m^2, with a velocity of 0.02 m/s, when it rests on a layer of oil 1.5 x 10^{-3} m thick. Find the coefficient of viscosity of oil.
10. With what velocity does water flow out of an orifice in a tank with a gauge pressure 4 x 10^5 N/m^2 before the flow starts? (Density of water = 1000 kg/m^3)

SHORT ANSWER TYPE QUESTIONS (3 Marks each)

1) Explain surface tension on the basis of molecular theory.
2) Write the relation between surface tension and surface energy.
3) Define angle of contact. And explain the shape of the concave meniscus.
4) Derive an expression for capillary rise or fall by using forces.
5) Derive an expression for capillary rise or fall by using pressure differences.
6) Derive an expression for the terminal velocity.
7) A spherical drop of oil falls at a constant speed of 4 cm/s in steady air. Calculate the radius of the drop. The density of the oil is 0.9 g/cm^3, density of air is 1.0 g/cm^3, and the coefficient of viscosity of air is 1.8 10-4 poise. (g = 980 cm/s^2)

8) A drop of Mercury of radius 0.2 cm is broken into 8 droplets of the same size. Find the work done if the surface tension of mercury is 435.5 dyne/cm.

9) Calculate the rise of water inside a clean glass capillary tube of radius 0.1 mm, when immersed in a water of surface tension 0.07 N/m^2. The angle of contact between water and glass is zero. (Density of water = 1000 kg/m^3, g =9.8 m/s^2)

10) The speed of water is 2 m/s through a pipe of internal diameter 10 cm. What should be the internal diameter of the nozzle of the pipe if the speed of water at the nozzle is 4 m/s?

3 Kinetic Theory of Gases and Radiation

Multiple choice questions (1 mark)

1) The average energy per molecule is proportional to

(A) the pressure of the gas

(B) the volume of the gas

(C) the absolute temperature of the gas

(D) the mass of the gas

2) The number of degrees of freedom, for the vibrational motion of a polyatomic molecule depends on the

(A) geometric structure of the molecule

(B) mass of the molecule

(C) energy of the molecule

(D) absolute temperature of the molecule

3) The power radiated by a perfect blackbody depends only on its

(A) material

(B) nature of surface

(C) colour

(D) temperature

4) If the absolute temperature of a body is doubled, the power radiated will increase by a factor of

(A) 2

(B) 16

(C) 4

(D) 8

5) Calculate the value of λ_{max} for radiation from a body having surface temperature 3000 K. ($b = 2.897 \times 10^{-3}$ m K)

(A) 9656 Å

(B) 9178 Å

(C) 9935 Å

(D) 9421 Å

6) The molar specific heat of a gas at constant volume is 12307.69 J kg^{-1} K^{-1}. If the ratio of the two specific heats is 1.65, calculate the difference between the two molar specific heats of gas.

(A) 7999 J kg^{-1} K^{-1}

(B) 4067 J kg^{-1} K^{-1}

(C) 6890 J kg^{-1} K^{-1}

(D) 7245 J kg^{-1} K^{-1}

7) Calculate the energy radiated in one minute by a blackbody of surface area 200 cm^2 at 127°C. ($\sigma = 5.7 \times 10^{-8}$ J m^{-2} s^{-1} K^{-4})

(A) 1367.04 J

(B) 1751.04 J

(C) 1698.04 J

(D) 1856.04 J

8) If the pressure of an ideal gas is decreased by 10% isothermally, then its volume will

(A) decrease by 9%

(B) increase by 9%

(C) decrease by 10%

(D) increase by 11.11%

9) If a = 0.72 and r = 0.24, then the value of t is

(A) 0.02

(B) 0.04

(C) 0.4

(D) 0.2

10) The ratio of emissive power of perfectly blackbody at 1327 °C and 527 °C is

(A) 4:1

(B) 16:1

(C) 2:1

(D) 8:1

Very Short Answers (1 mark)

1) Under which condition laws of Boyle, Charles, and Gay-Lussac are valid?
2) On what, the values of absorption coefficient, reflection coefficient and transmission coefficient depend, in addition to the material of the object on which the radiation is incident?
3) Why does the temperature of all bodies remain constant at room temperature?
4) Above what temperature do all bodies radiate electromagnetic radiation?
5) If the density of nitrogen is 1.25 kg/m^3 at a pressure of 10^5 Pa, find the root mean square velocity of oxygen molecules.
6) Find kinetic energy of 3 liters of a gas at S.T.P given standard pressure is 1.013×10^5 N/m^2.

7) Determine the pressure of nitrogen at 0 °C if the density of nitrogen at N.T.P. is 1.25 kg/m^3 and R.M.S. The speed of the molecules at N.T.P. is 489 m/s.
8) What is a perfect blackbody?
9) What will happen to the mean square speed of the molecules of a gas if the temperature of the gas increases?
10) State Stefan-Boltzmann law of radiation.

Short Answers (2 marks)

1) State factors on which the amount of heat radiated by a body depends.
2) Show that for monoatomic gas the ratio of the two specific heats is 5:3.
3) Show that for diatomic gas the ratio of the two specific heats is 7:5.
4) Define athermanous substance and diathermanous substance.
5) Draw a neat labeled diagram of Ferry's black body.
6) Compare the rate of radiation of metal bodies at 727 °C and 227 °C.
7) 1000 calories of radiant heat is incident on the body. If the body absorbs 400 calories of heat, find the coefficient of emission of the body.
8) A metal cube of length 4 cm radiates heat at the rate of 10 J/s. Find its emissive power at a given temperature.
9) Draw a neat labeled diagram of spectral distribution of radiant power of a blackbody per unit range of wavelength as a function of wavelength.
10) Calculate the energy radiated in half a minute by a blackbody of surface area 200 cm^2 when it is maintained at 127 °C. (Given: $\sigma = 5.7 \times 10^{-8}$ W/m^2 K^4)
11) 1At 300 K, what is the rms speed of the Helium atom?
(Given: mass of Helium atom = 6.64×10^{-27} kg, KB = 1.38×10^{-23} J/K)
12) Calculate the value of λ_{max} for solar radiation assuming that the surface temperature of the Sun is 5800 K. In which part of the electromagnetic spectrum, does this value lie?
(Given: b = 2.897×10^{-3} m K)
13) Mention the conditions under which a real gas obeys the ideal gas equation.
14) Compare the rms speed of hydrogen molecules at 227 °C with the rms speed of oxygen molecules at 127 °C. Given that molecular masses of hydrogen and oxygen are 2 and 32 respectively.

Short Answers (3 marks each)

1) Show that the root mean square speed of the molecules of gas is directly proportional to the square root of the absolute temperature of the gas.
2) Show that the average energy of the molecules of gas is directly proportional to the absolute temperature of gas.

3) Calculate the ratio of two specific heats of a polyatomic gas molecule.
4) Explain the construction and working of Ferry's black body.
5) Compare the rates of emission of heat by a blackbody maintained at 627 ^{o}C and at 127 ^{o}C, if the blackbodies are surrounded by an enclosure at 27 ^{o}C. What would be the ratio of their rates of loss of heat?
6) Determine the molecular kinetic energy (i) per mole (ii) per gram (iii) per molecule of nitrogen molecules at 227 ^{o}C, (R = 8.310 J mole^{-1} K^{-1}, N_o = 6.03 x 10^{26} molecules Kmole^{-1}. Molecular weight of nitrogen = 28).
7) The velocities of three molecules are 2 km s^{-1}, 4 km s^{-1}, 6 km s^{-1}. Find (i) means square velocity (ii) root means square velocity.
8) State and prove Kirchhoff's law of heat radiation.
9) State the law of equipartition of energy and hence calculate molar specific heat of monatomic gas at constant pressure and constant volume.
10) Derive an expression of total energy for a diatomic molecule due to its translational, rotational and vibrational degrees of freedom.

Very Long Answers (4 marks each)

1) Explain spectral distribution of blackbody radiation.
2) Derive expression for average pressure of an ideal gas.
3) Derive Mayer's relation.

4 Thermodynamics

Multiple choice questions (1 marks each)

1) Which of the following is correct, when the energy is transferred to a system from its environment?
   (A) system gains energy
   (B) system loses energy
   (C) system releases energy
   (D) system do not exchange energy
2) Which of the following systems freely allows exchange of energy and matter with its environment?
   (A) Closed
   (B) Isolated
   (C) Open
   (D) None of these
3) Two systems at same temperature are said to be
   (A) in chemical equilibrium
   (B) in thermal equilibrium
   (C) in mechanical equilibrium
   (D) none of these
4) For work done to be reversible, the process should be
   (A) cyclic
   (B) isobaric
   (C) isochoric
   (D) adiabatic
5) A gas in a closed container is heated with 10 J of energy causing the lid of the container to rise 2 m with 3 N of force. What is the total change in energy of the system?
   (A) 10 J
   (B) 4 J
   (C) -10 J
   (D) -4 J
6) The second law of thermodynamics deals with transfer of
   (A) work done
   (B) energy
   (C) momentum

(D) heat

7) Heating a gas in a constant volume container is an example of which process?

(A) isochoric

(B) adiabatic

(C) isobaric

(D) cyclic

8) The first law of thermodynamics is concerned with the conservation of

(A) momentum

(B) energy

(C) mass

(D) velocity

9) In which thermodynamic process does the pressure of a system remain constant?

(A) isochoric

(B) adiabatic

(C) isobaric

(D) cyclic

10) In a refrigerator, the external work done on the working substance in one cycle is 20% of the energy extracted from the cold reservoir. The coefficient of performance of refrigerator is

(A) 20

(B) 4

(C) 2

(D) 5

Very Short Answers (1 marks each)

1) When two objects are said to be in thermal equilibrium?
2) What is the science of measuring temperatures called as?
3) State zeroth law of thermodynamics.
4) What is the energy associated with the random, disordered motion of the molecules of a system called as?
5) A group of objects that can form a unit which may have the ability to exchange energy with its surrounding is called what?
6) On what basis a thermodynamic system can be classified?
7) What is a thermodynamic process?
8) Define heat.

9) What is the internal energy of the system, when the amount of heat Q is added to the system and the system does not do any work during the process?
10) When does the system lose energy to its surroundings and its internal energy decreases?
11) State first law of thermodynamics.
12) A system releases 100 kJ of heat while 80 kJ of work is done on the system. Calculate the change in internal energy.

Short Answers (2 marks each)

1) Draw a p-V diagram of the reversible process.
2) Draw a p-V diagram of an irreversible process.
3) Draw p-V diagram showing positive work with varying pressure.
4) Draw p-V diagram showing negative work with varying pressure.
5) Draw p-V diagram showing positive work at constant pressure.
6) 3 mole of a gas at temperature 400 K expands isothermally from initial volume of 4 liter to final volume of 8 liter. Find the work done by the gas. ($R = 8.31$ J mol^{-1} K^{-1})
7) An ideal gas of volume 2 L is adiabatically compressed to $(1/10)^{th}$ of its initial volume. Its initial pressure is 1.01×10^5 Pa, calculate the final pressure. (Given $\gamma = 1.4$)
8) Explain the cyclic process.
9) Differentiate between reversible and irreversible processes.
10) State the assumptions made for thermodynamic processes.
11) A gas enclosed in a cylinder is expanded to double its initial volume at a constant pressure of one atmosphere. How much work is done in this process?
12) Explain the change in internal energy of a thermodynamic system (the gas) by heating it.
13) Obtain expression for work done by a gas in an isothermal process.
14) A Carnot refrigerator operates between 250 K and 300 K. Calculate its coefficient of performance.
15) Efficiency of a Carnot cycle is 75%. If the temperature of the hot reservoir is 727 ^oC, calculate its coefficient of performance.

Short Answers (3 marks each)

1) Classify and explain the thermodynamic system.
2) Explain given cases related to energy transfer between the system and surrounding –
    a) (i) energy transferred (Q) > 0
    b) (ii) energy transferred (Q) < 0

c) (iii) energy transferred (Q) = 0

3) Explain the different ways through which internal energy of the system can be changed.
4) Write a note on thermodynamic equilibrium.
5) Explain graphically (i) positive work with varying pressure, (ii) negative work with varying pressure and (iii) positive work at constant pressure.
6) Write a note on free expansion.
7) One gram of water (1 cm^3) becomes 1671 cm^3 of steam at a pressure of 1 atm. The latent heat of vaporization at this pressure is 2256 J/g. Calculate the external work and the increase in internal energy.
8) Calculate the fall in temperature of helium initially at 15 ^oC when it is suddenly expanded to 8 times its original volume ($\gamma = 5/3$).
9) A cylinder containing a one-gram molecule of the gas was compressed adiabatically until its temperature rose from 27 ^oC to 97 ^oC. Calculate the work done and heat produced in the gas ($\gamma = 1.5$).
10) Explain the thermal efficiency of a heat engine.

Long Answers (4 marks each)

1) State the first law of thermodynamics and derive the relation between the change in internal energy (ΔU), work done (W) and heat (Q).
2) Explain work done during a thermodynamic process.
3) Explain thermodynamics of isobaric processes.
4) Explain thermodynamics of isochoric processes.
5) Explain thermodynamics of adiabatic processes.

5 Oscillations

Multiple choice questions (1 mark)

1. The equation of S.H.M. is y= a sin (2π n t + $\propto$) then its phase at time t is

a) $\propto$

b) $2\pi nt + \propto$

c) $2\pi nt$

d) $2\pi t$

2. The displacement of a particle in one time period of a linear S.H.M. is _____

(A = Amplitude of S.H.M.)

a) 0

b) A

c) 2A

d) 4A

3. The maximum velocity of a simple harmonic motion represented by

y= 3 sin (100 t + $\frac{\pi}{6}$) is given by _____ unit

a) 300

b) $\frac{3\pi}{6}$

c) $\frac{\pi}{6}$

d) 100

4. In a damped harmonic oscillator, periodic oscillations have _____ amplitude.

a) gradually increasing

b) suddenly increasing

c) suddenly decreasing

d) gradually decreasing

5. Acceleration of particle, executing S.H.M. at its mean position is

a) Infinity

b) Varies

c) Maximum

d) Zero

6. If two S.H.M's of same amplitude 'A' are 90^0 out of phase, then resultant amplitude = _____

a) zero

b) A

c) 2A

d) $\sqrt{2}$A

7. A body of mass 1 kg is executing simple harmonic motion. Its displacement y (cm) at t seconds is given by, y = 4 sin ((100 t + $\frac{\pi}{4}$) .Its maximum kinetic energy is _____

a) 8 J

b) 4 J

c) 2 J

d) 16 J

8. What is the effect on the time period of a simple pendulum if the mass of the bob is doubled

a) Halved

b) Doubled

c) Becomes eight times

d) Remain same

9. The length of a seconds pendulum is _____

a) g π^2

b) g π^2

c) g/π^2

d) g/π

10. The Linear S.H.M. of a particle of mass 4 gm is given by the differential equation $\frac{d^2x}{dt^2}$ + 25x = 0. The force constant of a particle is _____in SI units.

a) 0.1

b) 0.2

c) 0.5

d) 0.8

VERY SHORT ANSWER TYPE - 1 MARK EACH

1. Define Amplitude of linear simple harmonic motion.
2. Write the differential equation of angular S.H.M.
3. How does damping effect period of oscillation?
4. Define linear SHM.
5. At which position the total energy of a particle executing linear simple harmonic motion is purely kinetic?

6. What is the value of the phase difference between displacement and velocity in linear simple harmonic motion?
7. Define second's pendulum.
8. Calculate velocity of a particle performing S.H.M. after 1 sec., if its displacement is given by $x=6 \sin (\pi t/3)$ m.
9. The length of a Seconds pendulum on the surface of the earth is nearly 1m. then what will be its length on the surface of moon

   [Given: acceleration due to gravity (g) on the moon is 1/6 th of that on the earth's surface.]
10. A body of mass 0.2kg performs linear S.H.M. with force constant 5 N/m. Find the magnitude of its acceleration when displaced 4 cm from the mean position

SHORT ANSWER TYPE - I - 2 MARKS EACH

1. State any two laws of simple pendulum.
2. Obtain the differential equation of linear Simple Harmonic motion.
3. Obtain the differential equation of angular Simple harmonic motion.
4. What is a seconds pendulum? Derive a formula for the length of seconds pendulum
5. Draw diagram of damped simple harmonic oscillator.
6. Write the expression for velocity of a particle in linear S.H.M and find its maximum and minimum values
7. Distinguish between simple pendulum and conical pendulum (any two points)
8. Draw the graph showing variation of kinetic energy and potential energy with displacement in linear simple harmonic motion.
9. State any two factors on which the total energy of a particle performing linear Simple Harmonic motion depends.
10. At what distance from the mean position is the speed of the particle performing S.H.M. half its maximum speed. The amplitude of S.H.M. is 5 cm.
11. In SI Units, the differential equation of an SHM is $\frac{d^2x}{dt^2} = -100x$. Find the frequency and period.
12. A particle performing Linear S.H.M. has maximum velocity 16 cm/s and maximum acceleration 64cm/s^2. Find the time period of oscillation.
13. At what distance from the mean position is the K.E. of a particle performing linear S.H.M. of amplitude 16 cm, three times its potential energy?

14. A magnet of moment of inertia 3 x 10-6 kg m2 and magnetic moment 3 Am2 is vibrating with a frequency 2/π Hz in the plane of uniform magnetic field , Find the magnetic field B.
15. A spring is stretched by 5 cm by a force 10 N. Find the time period of oscillation when a mass of 2kg is attached to it.

SHORT ANSWER TYPE - II - 3 MARKS EACH

1. Derive an expression for the period of a simple pendulum performing linear Simple Harmonic motion.
2. Prove that under certain conditions a magnet vibrating in a uniform magnetic field performs angular simple harmonic motion.
3. Show that a linear S.H.M. is the projection of a U C M along any of its diameter
4. Draw the graph of displacement, velocity and acceleration with time when the particle starts performing S.H.M from the mean position, towards positive.
5. Draw the graph of displacement, velocity and acceleration with time when the particle starts performing S.H.M from the positive extreme position.
6. Explain damped oscillation and derive the differential equation of damped harmonic oscillation.
7. The time period of oscillation of a simple pendulum increases by 20 % when its length is increased by 44 cm. Find its initial length and initial period. ($g = 9.8$ m/$\mathbf{s^2}$)
8. The speeds of a particle performing linear S.H.M. are 8 cm/sec and 6 cm/sec at respective displacements of 3cm and 4 cm. Find its period and amplitude.
9. If a particle of mass 100 gm executes linear S.H.M. along a path length of 20 cm with frequency of 10 Hz, find
   (a) Total energy
   (b) P.E and K.E at a point midway between mean and extreme position
10. A bar magnet of mass 240 gm, in the form of a rectangular parallelepiped has dimensions l =5 cm and b=2 cm and h=6 cm. With the dimension h vertical, the magnet performs angular oscillations in the plane of a magnetic field with period $\boldsymbol{\pi}$ s. If its magnetic moment is 5.8 Am^2, determine the influencing magnetic field.

LONG ANSWER TYPE - 4 MARKS EACH

1. State differential equation for linear simple harmonic motion and hence obtain an expression for acceleration, velocity and displacement for linear simple harmonic motion.

2. Discuss analytically the composition of the two linear simple harmonic motions having the same period and along the same path. Obtain the expression for the

resultant amplitude, Find the resultant amplitude when the phase difference is (i) zero radian and (ii) $\frac{\pi}{2}$ radian.

3. Deduce the expressions for the kinetic energy, potential energy and total energy of a particle performing linear Simple Harmonic motion.

6 Superposition of Waves

Multiple choice questions (1 mark)

1. Let n1 and n2 be two slightly different frequencies of two sound waves. Then the time interval between waxing and immediate next waning is _____

(a) $\frac{1}{n1-n2}$ (b) $\frac{2}{n1-n2}$ (c) $\frac{1}{2(n1-n2)}$ (d) $\frac{n1-n2}{2}$

2. When a tuning fork produces a sound wave in the air, which of the following is the same in the material of the tuning fork as well as the air

a) Wavelength

b) Frequency

c) Velocity

d) Amplitude

3. The distance between the nearest node and antinode in a stationary wave is

a) λ

b) $\lambda/2$

c) $\lambda/4$

d) 2λ

4. When an air column in a pipe closed at one end vibrates such that 3 antinodes are formed in it the frequency of its vibration is _____ times the fundamental frequency.

a) 2

b) 3

c) 4

d) 5

5. Velocity of transverse wave along a stretched string is proportional to _____

(T = tension in the string)

a) $\sqrt{T}$

b) T

c) $1/\sqrt{T}$

d) 1/T

6. For a pipe open at both the ends the end correction is _____ times inner diameter.

a) 0.2

b) 0.3

c) 0.6

d) 0.8

7. The equation of a S.H. progressive wave traveling on a string is y=8sin2(0.02x-4t) cm. then the speed of wave is _____ cm/s.
   a)10
   b)20
   c)100
   d)200
8. Ratio of frequencies for a string fixed at both the ends, for second to third harmonic is _____.
   a) 2:3
   b) 1:4
   c) 4:1
   d) 3:2
9. If two open organ pipes of length 50 cm and 51 cm sounded together produce 7 beats per second, the speed of sound is_____
   a) 307m/s
   b) 327 m/s
   c) 350 m/s
   d) 357 m/s

10. A pipe closed at one end can produce overtones at frequencies 384 Hz,640 Hz and 896 Hz. Then the fundamental frequency is _____Hz
    a) 192
    b) 128
    c)320
    d)448

VERY SHORT ANSWER TYPE - 1 MARK EACH

1. What are antinodes?
2. What is the phase change when longitudinal waves travel from a denser media to a rare media?
3. A wave is represented by an equation y= A sin (B x +C t) given constants A, B and C are positive, then in which direction the wave is moving?
4. What is the loudness of sound?
5. How much is the distance between two successive antinodes in terms of wavelength?
6. What is a stationary wave?
7. The fundamental frequency of the air column in a pipe closed at one end is 200 Hz. What is the frequency of the second overtone? (ignore the end correction)
8. Find the distance between two successive nodes in a stationary wave on a string vibrating with frequency 96 Hz. The velocity of progressive wave that resulted in the stationary wave is 48 m/sec.
9. The fundamental frequency of the air column in a pipe open at both ends is 100 Hz. What is the frequency of the third overtone (ignore the end correction)
10. A string of 99 cm long is fixed at one end and is made to vibrate with 3 complete loops Find the wavelength.

SHORT ANSWER TYPE - I - 2 MARKS EACH

1. State any four characteristics of progressive waves.
2. What are harmonics and overtones?
3. State any four properties of stationary waves.
4. Differentiate between free and forced vibrations.
5. What are beats? Write any two applications of beats.
6. Explain the reflection of longitudinal wave from a denser media
7. Explain the reflection of transverse wave from a denser media
8. For a pipe closed at one end, prove that end correction, $e = \frac{n_1 l_1 - n_2 l_2}{(n_2 - n_1)}$
9. For a pipe open at both the ends prove that end correction, $e = \frac{n_1 l_1 - n_2 l_2}{2(n_2 - n_1)}$
10. The fundamental frequency of a pipe closed at one end is in unison with the 3rd overtone of an open pipe. Calculate the ratio of their length of air column.
11. A sonometer wire of length 0.5 m is stretched by a weight of 5 kg. The fundamental frequency of vibration is 100 Hz. Calculate linear density of the wire.
12. A sound wave in a certain fluid media is reflected at an obstacle to form a standing wave. The distance between two successive nodes is 3.5 cm. If the speed of sound is 1400 m/sec, find the frequency.
13. Find the fundamental frequency of an air column vibrating in a pipe closed at one end. The length of the pipe is 34.4 cm and the inner diameter of the pipe is 2 cm. The speed of sound in air at room temperature is 350 m/s.
14. A string 1 m long is fixed at one end, the other end is moved up and down with frequency 18 Hz. Due to this, a stationary wave with four complete loops, gets produced on the string. Find the speed of the progressive wave which produces the stationary wave
15. Two sound waves travel at a speed of 330 m/s. If their frequencies are also identical and are equal to 550 Hz, what will be the phase difference between the waves at points 3.6 m from one source and 3 m from the other if the sources are in phase?

SHORT ANSWER TYPE - II - 3 MARKS EACH

1. Show that all harmonics are present in the vibration produced on a stretched string.
2. Prove that all harmonics are present in the vibrations of the air column in a pipe open at both ends.
3. Show that only odd harmonics are present in the vibrations of the air column in a pipe closed at one end.
4. Find the amplitude of the resultant wave produced due to interference of two waves given as $\mathbf{y_1 = A_1 \sin \omega t}$ **and** $\mathbf{y_2 = A_2 \sin(\omega t + \phi)}$
5. State the laws of a vibrating string.
6. Explain verification of the first law of a vibrating string using a sonometer.

7. Two sound notes have wavelength 83/170 m and 83/172 m in the air. These nodes when sounded together produce 8 beats per second. Calculate speed of sound in air and frequencies of their two nodes.
8. A pipe open at both the ends has a fundamental frequency of 680 Hz. The first overtone of a pipe closed at one end has the same frequency as the first overtone of the open pipe. How long are the two pipes? Take velocity of sound to be 340 m/s [ignore end correction]
9. The equation of progressive wave is represented by **$y= 4 \sin 4\pi (t/0.04 – x/80)$**, where the length is in cm and time in seconds.

   Find (a) wavelength (b) amplitude (c) frequency (d) time period (e) speed of wave

10. Two wires of the same material and cross-section are stretched on a sonometer. One wire is loaded with 2 kg and another is loaded with 8 kg. The vibrating length of the first wire is 50 cm and its fundamental frequency of vibration is the same as that of the second wire. Calculate vibrating length of the other wire

LONG ANSWER TYPE - 4 MARKS EACH

1. Explain the formation of stationary waves by analytical method. Show that the distance between a node and an adjacent antinode is $\lambda/4$.

2. What are beats? Using analytical method Obtain formula for period of beats.

7. Wave Optics

Multiple choice questions (1 mark)

1. Which property of light does not change when it travels from one medium to another?
    a. velocity
    b. wavelength
    c. amplitude
    d. Frequency
2. A perpendicular drawn to the wavefront at any point in the direction of propagation of light is
    a. wavefront
    b. Asdasd
    c. Asd
    d. Asads
3. When unpolarised light is passed through a polariser, its intensity:
    a. Increase
    b. Decreases
    c. Remains unchanged
    d. Depends on the orientation of the polariser
4. Ratio of intensity of two waves is given by 4:1. Then the ratio of amplitude of the two waves is:
    a. 2:1
    b. 1:2
    c. 4:1
    d. 1:4
5. A ray of light enters from air into glass of refractive index 1.5. The speed of light in glass water will be:
    a. $1.5 X10^8$ m/s
    b. 2×10^8 m/s
    c. $2.25 x10^8$ m/s

d. 3×10^8 m/s

6. The Brewster's angle ib for an interface should be

   a. $0° < ib < 30°$

   b. $30° < ib < 45°$

   c. $5° < ib < 90°$

   d. $ib = 90°$

7. Fringe Width in an interference pattern is 0.4 mm. What is the distance between the 6^{th} bright band and 4^{th} dark band on the same side of the central maxima?

   a. 0.5 mm

   b. 1 mm

   c. 2 mm

   d. 4 mm

8. For constructive interference, the phase difference between the two waves should be

   a. $0, \pi/2, \pi$

   b. $0, 2\pi, 4\pi$

   c. $\pi, 3\pi, 5\pi$

   d. $\pi/4, \pi/2, 3\pi/4$

9. When unpolarised light is passed through a polariser, its intensity:

   a. increase

   b. decreases

   c. Remains unchanged

   d. Depends on the orientation of the polariser

10. In Young's double slit experiment, the two coherent sources have different intensity. The ratio of maximum intensity to the minimum intensity in the interference pattern produced is 25:1. What was the ratio of intensity of the two sources?

    a. 5:1

    b. 25:1

    c. 3:2

    d. 9:4

VERY SHORT ANSWER TYPE - 1 mark

1. What are coherent sources?
2. What is a Polaroid?
3. A point P situated from two coherent sources, such that the optical path difference at P is 167.5 λ will the point P bright or dark?
4. Define wave front.
5. Give two examples of primary source of light.
6. If the source of light is linear, what type of wave front will be?
7. What do you mean by polarisation of light?
8. State Brewster's law
9. What is the condition to get constructive interference of light in terms of path difference?
10. What is diffraction of light?

SHORT ANSWER TYPE – I – 2 marks

1. Draw the diagram of the spherical wavefront using Huygen's principle.
2. Draw the diagram of a plane wavefront using Huygen's principle
3. Distinguish between plane polarised light and unpolarised light.
4. Why are our multiple colours observed over a thin film floating on water?
5. What is optical Path length? How is it different from actual path length?
6. On what factors the resolving power of a microscope depends how it can be increased?
7. If the difference in velocity of light in glass and water is 2.5×10^{8} m/s. Find the velocity of light in air. R.I. of glass is 1.5 and R.I. of water 1.3.
8. A ray of light is incident on the water surface of refractive index 4/3 making an angle of 40° with the surface. Find the angle of refraction.
9. Explain the term plane of polarisation and plane of vibration.
10. A Star is emitting light at the wavelength of 5000 A°, determining the limit of resolution of a telescope having an objective of diameter of 200 inches.
11. What is the minimum distance between two objects which can be resolved by a microscope having the visual angle of 300 when light of wavelength 500 nm is used?

12. For what angle of incidence will light incident on a bucket filled with liquid having refractive index 1.5 be completely polarized after reflection?

SHORT ANSWER TYPE – II (3 marks)

1. Explain with diagram, the construction of a spherical wave front
2. State and explain Rayleigh's criterion.
3. What is Brewster's law? Derive the formula for Brewster angle.
4. A parallel beam of green light of wavelength 546 nm passes through a slit of 0.4 mm. The intensity pattern of the transmitted light is seen on the screen which is 40 cm away. What is the distance between the two first order minima?
5. Describe with a neat diagram, the Fraunhofer diffraction pattern due to a single slit.
6. What is meant by coherent sources? What are the two methods for obtaining coherent sources in the laboratory?
7. Explain what is meant by polarisation of light and derive Malu's law.
8. Derive the laws of refraction of light using Huygen's principle.
9. In Fraunhofer diffraction by a narrow slit, a screen is placed at a distance of 2 *m* from the lens to obtain the diffraction pattern. If the slit width is 0.2 *mm* and the first minimum is 5 *mm* on either side of the central maximum, find the wavelength of light.
10. What is meant by the limit of angular resolution and explain the resolving power of a telescope?
11. Derive the laws of reflection of light using Huygen's principle.
12. The intensity of the light coming from one of the slits in Young's experiment is twice the intensity of the light coming from the other slit. What will be the approximate ratio of the intensities of the bright and dark fringes in the resulting interference pattern?
13. Describe what is Rayleigh's criteria for resolution. Explain it for a microscope.
14. What must be the thickness of a thin film which, when kept near one of the slits, shifts the central fringe by 5 mm for incident light of wavelength 5400 Å in Young's double slit interference experiment? The refractive index of the material of the film is 1.1 and the distance between the slits is 0.5 mm.
15. What are the conditions for obtaining a good interference pattern? Give reasons.

LONG ANSWER TYPE – 4 marks

1. Describe geometry of the Young's double slit experiment with the help of a ray diagram. What is fringe width? Obtain an expression of it. Write the conditions for constructive as well as destructive interference.
2. Derive the laws of reflection of light using Huygen's principle.
3. Explain what is meant by polarization of light? Derive Malu's law.
4. What is meant by coherent sources? What are the two methods for obtaining coherent sources in the laboratory?
5. Derive the conditions for bright and dark fringes produced due to diffraction by a single slit.
6. Describe what is Rayleigh's criteria for resolution, explain it for a telescope and microscope.
7. Monochromatic electromagnetic radiation from a distant source passes through a slit. The diffraction pattern is observed on a screen 2.50 m from the slit. If the width of the central maximum is 6.00 mm, what is the slit width if the wavelength is
   (a) 500 nm (visible light)
   (b) 50 μm (infrared radiation);
   (c) 0.500 nm (X-rays)?
8. In Young's double slit experiment, the difference in optical path lengths between the rays starting from the two slits S1 and S2 and reaching a point A on the screen is 0.0075 mm and reaching another point B on the screen on the other side of the central fringe is 0.0015 mm. How many bright and dark fringes are observed between A and B if the wavelength of light used is 6000 Å?

8 Electrostatics

Multiple choice questions (1 mark)

1. The work done to move a test charge along an equipotential surface is _____
   a. positive
   b. Negative
   c. zero
   d. depends on the path followed by the test charge.

2. Electric field due to a charged sphere at a point outside the sphere decreases with _____
   a. Increases with charge on the sphere.
   b. Increase in dielectric constant.
   c. Decrease in the distance from the centre of the sphere.
   d. Decrease in square of distance from the centre of the sphere

3. An electric dipole of moment *p* initially parallel to an external electric field *E* is rotated through angle Θ. The work done to do this is _____
   a. $W = pE$
   b. $W = pE(1 - cos\,)$
   c. $W = - pEcos$
   d. $W = - pE(1 - sin\,)$

4. $Cp\ and\ Cs$ are the equivalent capacities in parallel and series combinations respectively when n identical capacitors each of capacity C are connected in the combinations. The ratio $Cp: Cs$ =_____
   a. n
   b. $1/n$
   c. $1/n^2$
   d. n^2

5. Capacitance of parallel plate capacitor has dimensions _____
   a. $[M^1L^{-2}T^2]$
   b. $[M^1L^2T^4A^{-2}]$
   c. $[M^{-1}L^{-2}T^4A^2]$
   d. $[M^1L^2T^{-2}]$

6. A dielectric slab of thickness *t (t < d)* Is introduced between the plates of the capacitor this would result in
   a. The increase of capacity
   b. the decrease of capacity
   c. no change in capacity

d. the change in capacity depending on the way the slab is inserted.

7. A 200 μf The capacitor is charged by a 100 volt battery. The terminals of capacitor are then connected to 8 Ω heating coil. The amount of heat generated in the coil is _____

a. $1\ J$
b. $8\ J$
c. $1.25\ kJ$
d. $2.5\ kJ$

8. When 10^8 electrons are transferred from a conductor, it's potential changes by 10 volt. The capacitance of the conductor is _____

a. $1.6\times10^{-8}\ F$
b. $1.6\times10^{-9}\ F$
c. $1.6\times10^{-12}\ F$
d. $1.6\times10^{-10}\ F$

9. A test charge of $2\ nC$, at a distance of $2\ m$ is moved to $1.5\ m$ from a fixed charge of $1\ \mu C$. The work done during this process is _____

a. $2\ \mu J$
b. $3\ \mu J$
c. $1\ \mu J$
d. $4\ \mu J$

10. Capacity of a parallel Capacitor with dielectric constant 5 is $4\mu f$, then _____ will be the capacity of the same capacitor when dielectric material is removed.

a. $1.25\ \mu f$
b. $0.8\ \mu f$
c. $2\ \mu f$
d. $0.5\ \mu f$

VERY SHORT ANSWER TYPE – (1 MARK EACH)

1. What is the shape of an equipotential surface of single point charge?
2. How does the capacity of a parallel plate capacitor vary/ change with the area of each plate of capacitor?
3. State a correct formula giving the relation between electric intensity and electric potential.
4. State the formula for electric field intensity at a point outside and infinitely long charged cylindrical conductor
5. How much is the electric field intensity inside a charged conducting sphere?
6. How much is the Electric potential at an equatorial point of an electric dipole?
7. Calculate the linear charge density of a thin uniform wire of length $200\ cm$ with a positive charge of $3\ \mu C$ on it.

8. The capacity of a condenser is 5 μF and its potential is 200 V. Find the magnitude of charge on the condenser.
9. Four capacitors, each of capacity 4 μF, are connected in series. Find the equivalent capacitance.
10. A charge of 2 C moves between two plates maintained at a potential difference of 2 V. What is the energy acquired by the charge?

SHORT ANSWER TYPE - I – (2 MARKS EACH)

1. Explain the principle of parallel plate capacitors.
2. Derive an expression for the equivalent capacity of two capacitors connected in series combination.
3. The series equivalent capacity of two capacitors is $6\ \mu F$ and when the same two capacitors are connected in parallel, its equivalent capacity is $25\ \mu F$. Calculate capacity of each capacitor.
4. Show graphical variation of electric field and electric potential due to a single charge at a distance r.
5. What do you mean by polar and non-polar molecules? Give one example each.
6. Define capacity of a capacitor and write the mathematical expression and state its SI unit.
7. Draw a neat labeled diagram of van de Graff generator.
8. In a parallel plate capacitor with air between the plates, each plate has an area of 9×10^{-3} m^2 and the separation between the plates is 3 mm. Calculate the capacitance of the capacitor.
9. A metal sphere of radius 1 cm is charged with 3.142 μC. find the electric intensity at a distance 1 m from the centre of the metal sphere.
10. A plane surface element of area 2 mm^2 is situated in a uniform electric field of intensity 4.5×10^6 N/C such that the angle between the area vector and the electric field is 60°. Determine the electric flux over the surface.

SHORT ANSWER TYPE - II – (3 MARKS EACH)

1. With the help of neat diagrams explain how the non-polar dielectric material is polarised in an external field of increasing intensity. Define polarisation in dielectrics.
2. Obtain an expression for energy of a charged capacitor and express it in different forms.
3. Obtain an expression for the capacitance of a parallel plate capacitor without a dielectric.
4. Obtain an expression for potential energy of a dipole in an external field.
5. Derive an expression for the electric potential due to a point charge.
6. Obtain an expression for electric field intensity at a point outside an infinitely long charged conducting cylinder.
7. An electric dipole consists of two opposite charges each of magnitude 1 μC, are separated by 2 cm. The dipole is placed in an external field of 10^5 N/C. Calculate a)

maximum torque experienced by the dipole and b) work done by the external field to turn the dipole through 180^{O}.

8. A small particle carrying a negative charge of 1.6×10^{-19} C is suspended in equilibrium between two horizontal metal plates 5 cm apart, having a potential difference of 2000 V across them. Find the mass of the particle.
9. A parallel plate air capacitor has a capacitance of 3×10^{-9} F. A slab of dielectric constant 3 and thickness 3 cm completely fills the space between the plates. The potential difference between the plates is maintained constant at 400 V. What is the change in the energy of the capacitor if the slab is removed?
10. Two charges of magnitude 5 nC and -2 nC are placed at points (2 cm, 0, 0) and (20 cm, 0, 0) in a region of a space where there is no external field. Find electrostatic potential energy of the system.

LONG ANSWER TYPE – (4 MARKS EACH)

1. With a neat labeled diagram, describe the construction and working of van de Graff generator
2. Derive an expression for electric field potential due to an electric dipole.
3. Obtain an expression for the capacitance of a parallel plate capacitor with a dielectric slab between the plates

9. CURRENT ELECTRICITY

Multiple choice questions (1 mark)

1. The current, which is assumed to be flowing in a circuit from positive terminal to negative, is called

a) electronic current

b) conventional current

c) alternating current

d) pulsating current

2. Kirchhoff's first law, i.e., $\Sigma I = 0$ at a junction, deals with the conservation of

a) charge

b) energy

c) momentum

d) mass

3. Four resistances 10 Ω, 10 Ω, 10 Ω and 15 Ω form a Wheatstone's network. What shunt is required across 15 Ω resistor to balance the bridge

a)10 Ω

b) 15 Ω

c) 20 Ω

d) 30 Ω

4. No current flows between two charged bodies when connected, if they have the same

a) capacity

b) potential

c) charge

d) none of these

5. The rate of flow of electric charge is

a) electric current

b) voltage

c) power

d) resistance

6. Which of the following instruments is generally used with a galvanometer to show nil reading?

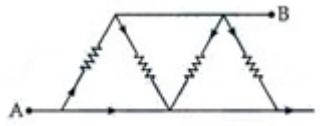
a) an ammeter

b) a voltmeter

c) a voltmeter

d) a meter bridge

7. In the diagram below each resistance is of 1Ω. The total resistance between A and B is



a) 3/8 Ω

b) 3/5 Ω

c) 2/8 Ω

d) 5/7 Ω

8. The e.m.f. of two cells can be compared by

a) potentiometer

b) ammeter

c) luxmeter

d) speedometer

9. In a potentiometer experiment the balancing length is found to be 1.80 m for a cell of emf 1.5 V. The balancing length for a cell of emf 1 V is

a) 1.2 m

b) 0.5 m

c) 2.2 m

d) 0.2 m

10. The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10 Ω is

a) 0.5 Ω

b) 0.8 Ω

c) 1.0 Ω

d) 0.2 Ω

VERY SHORT ANSWER TYPE QUESTION

1. State Kirchhoff's first law (Current law / Junction law)

2. State Kirchhoff’s Voltage law.

3. Define potential gradients.

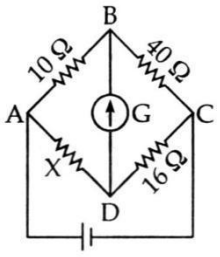
4. Write the equation to find the internal resistance of the cell.

5. What is the demerit of potentiometer?

6. What is the use of a galvanometer?

7. Two resistors when connected in series have an equivalent resistance of 9 Ω and when connected in parallel have an equivalent resistance of 2 Ω. What are the values of two resistors?

8. A Wheatstone's bridge shown in figure, is to be balanced. Find the value of X.



9. If the balancing point is obtained at 35th cm on a meter bridge, what is the ratio of resistances in the gaps?

10. A cell of e.m.f. 2 V and internal resistance 0.5 Ω. is connected across a resistor R. The current that flows is the same as that, when a cell of e.m.f. 1.5 V and internal resistance 0.3 Ω is connected across the same resistor. Find the value of R.

SHORT ANSWER TYPE QUESTIONS (2 Marks each)

1. Define (i) Junction (ii) Loop for electrical circuit.
2. What are the advantages of Potentiometer over voltmeter?
3. Distinguish between ammeter and voltmeter.
4. State the uses of Potentiometer.
5. State any two sources of errors in the meter bridge experiment.
6. Explain how errors in meter bridges can be minimized.
7. In an experiment to determine the internal resistance of a cell of emf 1.5 V, the balance point in the open cell condition is at 76.3 cm. When a resistor of 9.5 ohm is used in the external circuit of the cell the balance point shifts to 64.8 cm of the potentiometer wire. Determine the internal resistance of the cell.
8. A voltmeter has a resistance of 30 Ω. What will be its reading, when it is connected across a cell of emf 2 V having internal resistance 10 Ω.
9. A potential drop per unit length along a wire is 5×10^{-3} V/m. If the emf of a cell balances against length 216 cm of this potentiometer wire, find the emf of the cell.
10. A Galvanometer has a resistance of 25 Ω and its full-scale deflection the current is 25 μA. What resistance should be added to it to have a range of 0 -10 V?

SHORT ANSWER TYPE QUESTION (3 Marks each)

1) Obtain the balancing condition in case of Wheatstone's network.
2) Describe Kelvin's method to determine the resistance of a galvanometer by using a metre bridge.

3) Describe how a potentiometer is used to compare the emfs of two cells by connecting the cells individually.
4) Describe with the help of a neat circuit diagram how you will determine the internal resistance of a cell by using potentiometer. Derive the necessary formula.
5) Explain with the neat circuit diagram how you will determine the unknown resistance by using metre bridge.
6) Explain how to convert a moving coil galvanometer into a voltmeter.
7) Two batteries of 7 volt and 13 volt and internal resistances 1 ohm and 2 ohm respectively are connected in parallel with a resistance of 12 ohm. Find the current through each branch of the circuit and the potential difference across 12-ohm resistance.
8) A Galvanometer has a resistance of 40 Ω and a current of 4 mA is needed for a full scale deflection. What is the resistance and how is it to be connected to convert the galvanometer (a) into an ammeter of 0.4 A range and (b) into a voltmeter of 0.5 V range?
9) Two resistances 2 ohm and 3 ohm are connected across the two gaps of the metre bridge as shown in figure. Calculate the current through the cell when the bridge is balanced and the specific resistance of the material of the metre bridge wire. Given the resistance of the bridge wire is 1.49 ohm and its diameter is 0.12 cm.
10) A set of three coils having resistances 10 Ω, 12 Ω and 15 Ω are connected in parallel. This combination is connected in series with a series combination of three coils of the same resistances. Calculate the total resistance and current through the circuit, if a battery of emf 4.1 Volt is used for drawing current.

10 Magnetic Fields due to Electric Current

Multiple choice questions (1 mark)

1. Ampere's law is analogous to

a) Kirchoff's law in current electricity b) Lenz's law

c) Gauss's law of electrostatics d) Faraday's law

2. Maximum kinetic energy of the positive ion in the cyclotron is

a) $\frac{q^2B^2R}{2m}$ b) $\frac{q^2BR}{2m}$ c) $\frac{qB^2R^2}{2m}$ d) $\frac{q^2B^2R^2}{2m}$

3. A conductor of length l and carrying current I kept in uniform magnetic field B experiences a force

a) in the direction of the magnetic field

b) in the direction opposite to the magnetic field

c) in the direction perpendicular to both field and its length

d) in the direction parallel to both field and its length

4. In a moving coil galvanometer, radial magnetic field is produced due to the

a) rectangular coil b) iron core

c) concave pole pieces of magnet d) mirror

5. In a moving coil galvanometer, the deflection of the coil θ is related to the electric current I by the relation

a) $I \propto \tan\theta$ b) $I \propto \theta$ c) $I \propto \theta^2$ d) $I \propto \sqrt{\theta}$

6. Maximum force acts on a current-carrying conductor in the magnetic field, when angle between the current and magnetic field is

a) 90^O b) 45^O c) 0 d) 60^O

7. A current loop of area 0.01 m^2 and carrying a current of 10 A is held perpendicular to a magnetic field of induction 0.1 T, the torque (in Nm) acting on the loop is

a) 0 b) 0.001 c) 0.01 d) 1.1

8. A moving coil galvanometer shows a deflection of 50^o for a current of 0.3 mA. What current will produce a deflection of 40^o?

a) 0.5 mA b) 2 mA c) 0.24 mA d) 1.0 mA

9. An electron (mass = 9×10^{-11} kg, charge = 1.6×10^{-19} C) moving with a very high velocity of 10^6 m/s enters a magnetic field. If it describes a circle of radius 0.1 m, then the strength of the magnetic field will be

a) 4.5×10^{-5} T b) 1.4×10^{-5} T c) 2.6×10^{-5} T d) 5.6×10^{-5} T

10. What is the magnetic field at a point 80 mm from a wire carrying a current of 6A?

a) 0.15×10^5 T b) 1.5×10^{-5} T c) 0.15×10^{-5} T d) 0.51×10^{-5} T

VERY SHORT ANSWER TYPE QUESTIONS (1 Mark)

1) What is the value of force on a closed circuit in a magnetic field?
2) What is the force acting on a current-carrying wire kept in the uniform magnetic field?
3) If a charge of 50 μC is moving with the speed of 50 m/s parallel to the direction of the magnetic field, find the mechanical force acting on a charged particle.
4) What is the unit of permeability constant?
5) Write Biot-Savart Law in vector form.
6) What is the relation between Tesla and Gauss?
7) Write the mathematical statement of Ampere's Law.
8) A circular coil of conducting wire has 250 turns and an area of 1.26×10^{-4} m^2 is enclosed by the coil. A current 200 μA is passed through the coil. Calculate the magnetic moment of the coil.
9) Consider a closely wound 500-turn coil, having a radius of 2 m. If a current of 20 A passes through the coil, what will be the magnitude of the magnetic field at the center?
10) A solenoid of length πm has an inner radius of 2.5 cm and is made up of 1000 turns of copper wire. For a current of 5 A in it, what will be the magnitude of the magnetic field at its center along the axis?

SHORT ANSWER TYPE QUESTIONS (2 Marks each)

1) State and explain Ampere's law
2) Derive the cyclotron equation.

3) Draw a neat labeled diagram of suspended coil type moving coil galvanometer
4) Draw a neat labeled diagram for the construction of 'cyclotron'
5) Explain what you mean by magnetic dipole moment.
6) Derive the equation for Lorentz force.
7) For proton acceleration, a cyclotron is used in which a magnetic field of 1.4 Wb/m^2 is applied. Find the time period for reversing the electric field between the two D's. Given that mass of the proton = 1.67×10^{-27} kg, charge of proton = 1.6×10^{-19} C.
8) 8. A current of 10 A passes through a coil. The coil has 5 turns and produces magnetic field at the center of the coil of magnitude 0.5×10^{-4} T. Calculate diameter of the coil ($\mu_0 = 4\pi \times 10^{-7}$ Wb/Am)
9) 9. A rectangular coil of effective area 0.05 m^2 is suspended freely in a radial field of 0.01 Wb/m^2. If the torsional constant of suspension fibre is 5×10^{-9} N/m per degree, find the angle through which the coil rotates when a current of 300 μA is passed through it.
10) 10. State when magnetic potential energy is maximum and minimum. Also state which is the most stable/unstable position

SHORT ANSWER TYPE QUESTIONS (3 Marks each)

1) Derive an expression for a magnetic field produced by a current in a circular arc of a wire.
2) Show that the current flowing through a moving coil galvanometer is directly proportional to the angle of deflection of the coil.
3) Derive an expression for force experienced by a current carrying straight wire in a uniform magnetic field B.
4) Calculate the current flowing through two long parallel wires carrying equal currents and separated by a distance of 1.35 cm experiencing a force per unit length of 4.76×10^{-2} N/m.
5) Derive an expression for torque acting on a rectangular current-carrying loop in a uniform magnetic Field.
6) State and explain Biot-Savart Law
7) Explain the working of a cyclotron and hence find the expression for the time of revolution of the charged particle.
8) A small cyclotron of a maximum radius of 0.5 m accelerates protons in a magnetic field of 1.7 T. Calculate the kinetic energy (maximum) of protons when they leave the cyclotron.

9) The magnetic field at the center of a circular current carrying loop of radius 12.3 cm is 6.4×10^{-6} T. What will be the magnetic moment of the loop?

10) A moving coil galvanometer has been fitted with a rectangular coil having 50 turns and dimensions 5 cm x 3 cm. The radial magnetic field in which the coil is suspended is of 0.05 Wb/m^2. The torsional constant of the spring is 1.5×10^{-9} Nm/degree. Obtain the current required to be passed through the galvanometer so as to produce a deflection of 30^0.

LONG ANSWER TYPE QUESTIONS (4 Marks each)

1) State Ampere's circuital law. Using Ampere's circuital law, obtain an expression for magnetic induction at any point due to a straight conductor carrying current.
2) Find an expression for the axial magnetic field produced by current in a circular loop.
3) Find the expression for the magnetic field produced by a current carrying solenoid.
4) What is toroid? Obtain an expression for magnetic induction at a point along the axis of toroid.
5) With the help of a neat labeled diagram, describe the construction theory and working of a moving coil galvanometer.
6) Derive an expression for the magnetic field due to an infinitely long straight wire carrying current I.
7) Derive an expression for the force acting per unit length of the wire in case of two long parallel wires carrying currents in the same direction.

11 Magnetic Materials

Multiple choice questions (1 marks each)

1. Magnetic susceptibility for diamagnetic material is
   a. Infinite
   b. Negative
   c. Positive
   d. Zero

2. Magnetic susceptibility is
   a. Directly proportional to temperature
   b. Independent of temperature
   c. Inversely proportional to temperature
   d. Directly proportional to square root of temperature

3. Soft iron is used to make the core of transformer because of its
   a. Low coercivity and low retentivity
   b. Low coercivity and high retentivity
   c. high coercivity and high retentivity
   d. high coercivity and low retentivity

4. Permanent magnets are prepared by using a hard
   a. Diamagnetic rod
   b. Ferromagnetic rod
   c. Paramagnetic rod
   d. Nonmagnetic material

5. A rectangular magnet suspended freely has a period of oscillation equal to T. Now it is broken into two equal halves (each having half of the original length) and one piece is made to oscillate freely. Its period of oscillation is T′, the ratio of T′ / T is.
   a. $\frac{1}{2\sqrt{2}}$
   b. $\frac{1}{2}$
   c. 2
   d. $\frac{1}{4}$

6. A magnetizing field of 360 Am^{-1} produces a magnetic flux density B=0.6 T in a ferromagnetic material. What is its permeability in TmA^{-1}.

   a. $\frac{1}{300}$

   b. 300

   c. $\frac{1}{600}$

   d. 600

7. The relation between relative permeability and magnetic susceptibility is given by

   a. $\chi = \mu_r + 1$

   b. $\chi = -\mu_r - 1$

   c. $\mu_r = 1 - \chi$

   d. $\mu_r = 1 + \chi$

8. A magnetic material of susceptibility 3×10^{-4}, and magnetic intensity is 4×10^{-4} Am^2. Then The magnetization in the units of Am^{-1} is

   a. 12×10^{-8}

   b. 1.33×10^{8}

   c. 0.75×10^{-8}

   d. 14×10^{-8}

9. Relative permeability of iron 5500, then its magnetic susceptibility will be

   a. 5500×10^{7}

   b. 5501

   c. 5499

   d. 5500×10^{-7}

10. If an electron of charge (-e) and mass m_e revolves around the nucleus of an atom having orbital magnetic moment m_o, then angular momentum of electron is

    a. $L = \frac{m_0 e}{2m_e}$

    b. $L = \frac{e}{2m_0 m_e}$

    c. $L = \frac{2m_e m_0}{e}$

    d. $L = \frac{2e}{m_0 m_e}$

Very Short Answers (1 marks each)

1. Which property of soft iron makes it useful for preparing electromagnet?
2. Define magnetization..
3. What is hysteresis cycle?
4. What does the hysteresis loop represent?
5. What does the ratio of magnetization to magnetic intensity indicate?
6. The relative permeability of a medium is 0.075. Find its magnetic susceptibility?
7. Write down the equation for the torque acting on a bar magnet.
8. Give a few examples of diamagnetic materials
9. What is the use of electromagnet?
10. The moment of a magnet (15 cm× 2cm × 1cm) is 1.2 A-m^{-1}. What is its intensity of magnetization?

11 Give a gyromagnetic ratio.

Short Answers (2 marks each)

1. What are soft and hard magnetic materials?
2. Discuss the curie law for paramagnetic material.
3. Derive the quantity for Bohr magneton and also state its value.
4. State any four properties of a diamagnetic substance.
5. A solenoid has core of a material with relative permeability 500 and its windings carry current of 1 A. The number of turns of the solenoid is 500 per metre . Calculate the magnetization of the material.
6. Show that the orbital magnetic dipole moment of a revolving electron is $\frac{evr}{2}$
7. Derive the quantity for Bohr magneton and also state its value.
8. A bar magnet of moment of inertia of 500 g cm^2 makes 10 oscillations per minute in a horizontal plane. What is its magnetic moment, if the horizontal component of earth's magnetic field is 0.36 gauss?

9 The susceptibility of a paramagnetic material is χ at 27^o C. At what temperature its susceptibility will be $\chi/3$

10 The work done for rotating a magnet with a magnetic dipole moment M through 90° from its magnetic meridian is N times the work done to rotate it through 60°. Find the value of N.

Short Answers (3 marks each)

1. Obtain an expression for the orbital magnetic moment of an electron rotating about the nucleus in an atom.
2. A magnet of magnetic moment $3Am^2$ weighs 75 g. The density of the material of the magnet is 7500 kg/m^2. What is magnetization?
3. Define gyromagnetic ratio. Find relation for Bohr magneton.
4. When a plate of magnetic material of size 10 $cm \times 0.5\ cm \times 0.2\ cm$ (length, breadth and thickness respectively) is located in magnetizing field of 0.5×10^4 Am then magnetic moment of 5 Am^2 is induced in it. Find out magnetic induction in the plate.
5. What is magnetization, magnetic intensity, and magnetic susceptibility?
6. The region inside a current carrying toroid winding is filled with aluminium having susceptibility, $\chi = 2.3 \times 10^{-5}$. What is the percentage increase in the magnetic field in the presence of aluminium over that without it?
7. An electron in an atom is revolving around the nucleus in a circular orbit of radius 5.3×10^{-11} m with a speed of 2×10^6 m/s. Find the resultant orbital magnetic moment and orbital angular momentum of the electron.
   (e = 1.6×10^{-19} C, mass of electron = 9.1×10^{-31} kg.
8. State Curie's law for paramagnetic material. Using the law derives the relation between magnetic susceptibility and temperature.
9. Explain the behaviour of a ferromagnetic material in an external magnetic field with the help of a hysteresis is a cycle.
10. Give a reason why the rod of a diamagnetic material when suspended freely aligns itself in the direction perpendicular to the direction of external magnetic field.

Long Answers (4 marks each)

1. Define magnetization. State its SI unit and dimensions. Derive the relation between magnetic field intensity(H) and magnetization(M) for a magnetic material placed in a magnetic field.
2. Explain origin of magnetism in material, hence find magnetic moment of electron revolving around the nucleus of an atom.
3. Explain the different properties of diamagnetic substance and paramagnetic substance.
4. Write a note on electromagnet. Explain applications of electromagnet.

5. A magnetic needle placed in a uniform magnetic field has a magnetic moment of 2×10^{-2} Am^2, and moment of inertia of 7.2×10^{-2} kg/m^2. It performs 10 complete oscillations in 6 s. What is the magnitude of the magnetic field?

12 Electromagnetic Induction

Multiple choice questions (1 mark)

1. The polarity of induced EMF is defined by
   a) Ampere's circuital law
   b) Boit-Savart law
   c) Lenz's law
   d) Fleming's left-hand rule
2. The magnitude of induced EMF is directly proportional to the rate of change of….
   a) electric flux
   b) magnetic flux
   c) electric intensity
   d) magnetic potential
3. Lenz's law conforms with the principle of conservation of….
   a) Charge
   b) momentum
   c) energy
   d) Angular momentum
4. The circulating currents induced in a metal block are.
   a) Eddy currents
   b) Steady currents
   c) rms current
   d) Joule's current
5. The efficiency of an Ideal transformer is…
   a) 1%
   b) 10%
   c) 100%
   d) 89%
6. SI unit of $\frac{d\emptyset}{dt}$ is
   a) Weber/s
   b) Weber/s^2
   c) s/Weber

d) s^2/Weber

7. The energy stored in the 100mH inductor carrying a current of 5A is

a) 0.25J

b) 125J

c) 0.0025J

d) 1.25J

8. Two inductor coils 10mH and 40mH are connected in parallel. What is the result the inductance of the combination of these two coils?

a) 50 mH

b) 30 mH

c) 8 mH

d) 0.8 mH

9. A transformer converts 60-volt AC to 240-volt AC. The number of turns of primary is 60. The number of turns of secondary are….

a) 60

b) 120

c) 240

d) 180

10 In the equation Ø = LI the 'L' stands for

a) Mutual inductance

b) Self-inductance

c) conductance

d) impedance

11 L, C, and R represent the physical quantities inductance, capacitance, and resistance respectively. Which of the following combinations does not have dimensions of frequency?

a) 1/ RC

b) R/ L

c) 1/ √ LC

d) C/L

12 A current through a coil of self-inductance 20 mH increases from 1A to 2A in 0.2 second. What is the induced emf in the coil?

a) 0.1 V

b) 0.2 V

c) 0.01 V

d) 0.02 V

13 When a magnet is moved towards a coil with a south pole near the coil then the nearer face of the coil behaves as a

a) Positive charge

b) Negative charge

c) South pole

d) North pole

14 The working of the transformer is based on the.

a) Self-inductance

b) Mutual inductance

c) Coupling of the coils

d) Generator

15 The basic construction of an electric generator is same as

a) Transformer

b) Motor

c) Coil

d) Motion of magnet in a loop

B. VERY SHORT ANSWER TYPE - 1 MARK EACH

1. State Faraday's laws of electromagnetic induction
2. State Lenz's law in electromagnetic induction.
3. What is induced emf.
4. What is meant by an induced electric field.?
5. What is motional emf
6. What is back emf.
7. What is the magnitude of induced emf in a conductor moving in the magnetic field?
8. What is the emf developed between the two ends of the rod rotating at its one end in a perpendicular magnetic field.?
9. State unit for induced emf.
10. Magnetic flux is scalar or vector quantity.
11. State unit of mutual inductance.
12. Define 1 henry.
13. What is the value of coefficient of coupling (K) for radio coils?

14. If K=1, what does it indicate?
15. If K> 0.5 and K< 0.5 then what are predictions about couplings.
16. What is the principle of a transformer?
17. What is the turn ratio?
18. What is the condition for an ideal transformer?
19. What is meant by step up transformer
20. What is meant by a step down transformer?
21. Why the core of transformer is laminated
22. What is the minimum value of inductance that can be obtained with the help of three inductances of 2H,3H and 6H
23. How much is the inductance of a coil carrying current 0.1A and yields energy storage of 0.05J
24. What is the value of induced emf when the flux associated with it, at the rate of 1Wb/min.

C. SHORT ANSWER TYPE - I - 2 MARKS EACH

1. State laws of electromagnetic induction.
2. State the condition when two coils kept close are perfectly coupled.
3. Why eddy currents are produced.
4. How eddy currents are minimized.
5. What is the unit of self-inductance and define it?
6. Which quantity has unit henry/meter (H/m)
7. What is the value of inductance per unit length near the middle of the solenoid?
8. What is the value of the magnetic field inside the toroid?
9. What is the significance of a series arrangement of inductances?
10. What is the significance of the parallel arrangement of inductances?
11. What is the difference between self and mutual inductance,
12. A coil having 400 turns and self-inductance 20 mH carries a current of 8 mA. Find magnetic flux linked with each turn of the coil.
13. What is self-inductance in a coil having a magnetic flux of 20 milliweber when a current of 4 A flows through it?
14. Write a dimensional formula of magnetic flux.
15. A coil of metal wire is held in a stationary and non uniform magnetic field. Is any emf induced in the coil?

16. A wire cuts across a flux of 0.2 x 10^{-2} Wb in 0.12 s. What is the emf induced in the wire?
17. When current in a coil changes with time, how is the back emf induced in the coil changes.
18. Give two applications of eddy currents.
19. What is Flemings's right-hand rule?
20. Distinguish between step up and step-down transformers.
21. Give the dimension and unit for self and mutual inductance.
22. What is the relation between induced charge and change in magnetic flux?
23. Write the mathematical form of electromagnetic induction.

D. SHORT ANSWER TYPE - II - 3 MARKS EACH

1. Derive an expression for the total emf induced in a conducting rotating rod.
2. Explain the working of an electric generator and derive the equation for induced emf.
3. Explain self-inductance and mutual inductance
4. Explain the principle, construction, and working of the transformer.
5. The magnetic flux passes perpendicular to the plane of the circuit and is directed into the paper. If the magnetic flux varies with respect to time as per the following relation: $\Phi = (2t^3 + 3t^2 + 8t + 5)$ mWb. What is the magnitude of the induced emf in the loop when t = 3 s?
6. An ideal transformer has 460 and 40,000 turns in the primary and secondary coils respectively. Find the voltage developed per turn of the secondary if the transformer is connected to 230 V AC mains.
7. The mutual inductance of two coils is 1.5 H. The self-inductance of the coils is 5 H and 4 H respectively. Find the coefficient of coupling between the coils.

13 AC Circuits

Multiple choice questions (1 mark)

1. The electric current which has fixed polarity of voltage is known as….
   a) Alternating current
   b) Direct current
   c) Instantaneous current
   d) Induced current

2. The current for which the polarity of the voltage keeps changing periodically is ..
   a) Alternating current
   b) Direct current
   c) Instantaneous current
   d) eddy current

3. The average value of alternating current over a complete cycle is
   a) $I_o/2$
   b) $I_o/\sqrt{2}$
   c) $2I_o$
   d) Zero

4. Alternating currents cannot be measured by D.C. ammeter, because
   a) AC is virtual
   b) AC changes its direction
   c) AC cannot pass through D.C. ammeter
   d) Average value of AC over complete cycle is zero

5. The domestic AC supply is 230 V, 50 Hz. It is the RMS or effective value. Its peak value will be
   a) 325 V
   b) 360 V
   c) 460 V
   d) 230 V

6. The diagram which shows various phasors and their phase relations is called
   a) Indicator graph

b) Resonance graph
c) Phasor diagram
d) Inductor diagram

7. In a simple AC circuit with resistance…
a) Current leads emf by 90 degrees
b) Emf leads current by 90 degrees
c) Emf and current both are in the same phase
d) Emf and current both are in the opposite phase

8. In a simple AC circuit with capacitor...
a) Current leads emf by 90 degrees
b) Emf leads current by 90 degrees
c) Emf and current both are in the same phase
d) Emf and current both are in the opposite phase

9. In a simple AC circuit with an inductor ….
a) Current leads emf by 90 degrees
b) Emf leads current by 90 degrees
c) Emf and current both are in the same phase
d) Emf and current both are in the opposite phase

10. The value of reactance changes with...
a) Current
b) Voltage
c) Frequency
d) Amplitude

11. Among which has constant value …
a) Impedance
b) Reactance
c) Resistance
d) Admittance

12. The total effective resistance in the LCR circuit is called as….
a) Conductance
b) Admittance

c) Impedance

d) Reactance

13. Direct currents cannot pass through ….

a) Resistance

b) Inductor

c) Capacitor

d) Straight wire

14. Power factor for purely resistive circuit is

a) Infinity

b) Zero

c) One

d) Not known value

15. At resonance

a) $X_L > X_C$

b) $X_L < X_C$

c) X_L not equal to X_C

d) $X_L = X_C$

16. In parallel resonant circuit impedance is maximum but

a) Current is also maximum

b) Current is minimum

c) Power is maximum

d) Power is infinity

17. In series resonant circuit, current is maximum but

a) Impedance is maximum

b) Impedance is minimum

c) Conductance is zero

d) Specific resistance is maximum

18. The equation of alternating current is i= 77 sin 314t then frequency of AC is

a) 100Hz

b) 50Hz

c) 220Hz

d) 60Hz

19. Apparent power is calculated by the formula P =
    a) e i
    b) e_{rms} x i_{rms}
    c) $e_o i_o \sin^2 \omega t$
    d) $e_o i_o \sin \omega t$

20. Peak value of A C is
    a) 220 V
    b) 440 V
    c) 311 V
    d) 120 V

21. What is the rms value of current for a 100-ohm resistor and a voltage of 350 V
    a) 10 A
    b) 3.3 A
    c) 3.5 A
    d) 1.5 A

VERY SHORT ANSWER TYPE - 1 MARK EACH

1. What is an alternating current? Write an expression for its instantaneous value.
2. What is the average value of voltage or current?
3. Define the RMS value of alternating current
4. What is a phasor diagram?
5. What is the phase difference between current and emf for a resistive circuit?
6. What is the phase difference between current and emf for a capacitive circuit?
7. What is the phase difference between current and emf for an inductive circuit?
8. What is the value of inductive reactance?
9. What is the value of capacitive reactance?
10. What is meant by reactance?
11. What is impedance?
12. What is admittance?
13. What is the unit for admittance?
14. Give a unit for reactance.
15. Mention the unit for impedance.

16. What is the phase difference between emf and current for the LCR series circuit?
17. What is the apparent power?
18. What is meant by true power?
19. What is the average power dissipated in an LCR series circuit?
20. What is the average power associated with a resistive circuit?
21. What is the average power associated with an inductor?
22. What is the average power associated with a capacitor?
23. What is the resonance condition for a series LCR circuit?
24. What is the resonance condition for the parallel resonant circuit?
25. What is the value of resonant frequency?
26. Define Q- factor.
27. What are the maximum and minimum values of the power factor of an AC circuit?
28. What is the peak value of voltage for 220 V ac?
29. What is the relation between the peak value and the root mean square value of an alternating emf?
30. What is wattless power?
31. What is the significance of the quality factor in an AC circuit?
32. What are the factors on which the power factor depends?
33. What is the dimension of RC?
34. What are the dimensions of $\sqrt{RC}$
35. What is the phase difference in a series LCR circuit, X_L=9Ω, X_C=5Ω, and Z=6Ω?
36. In a series LCR circuit the phase difference between the voltage and current is 45^0, then what is the value of the power factor?
37. Find the power factor for the LCR circuit if R= 20Ω and Z= 30Ω

SHORT ANSWER TYPE - I - 2 MARKS EACH

1. What is the relation between true power and apparent power?
2. When the current in the AC circuit is wattles?
3. What is the average value of a.c. over a cycle and why?
4. When an alternating current is passed through a moving coil galvanometer, it shows no deflection. Why?
5. Why a DC voltmeter and DC ammeter cannot read ac?
6. On which effect of current ac ammeters are based, give a reason.
7. Which value of current do you read with an ac ammeter?

8. A 110 V DC heater is used on a source such that the heat produced is the same. What would be the rms value of alternating voltage?
9. Why is 220 V ac more dangerous than 220 V dc?
10. What is the reactance of an inductor in a DC circuit?
11. Why in a series LCR circuit, at resonance the current reaches its maximum value?
12. What is the maximum value of the power factor when it occurs?
13. What is the minimum value of the power factor when it occurs?
14. Can we use a capacitor instead of an inductor for reducing current in an AC circuit?
15. What is the ratio of impedance to resistance in a circuit that has a phase difference between voltage and current is 60 degrees?
16. Show that (L/R) has the dimension of time.
17. What is the natural frequency of the LC circuit?
18. At resonance, what is the value of the power factor?
19. What is a rejector circuit?
20. What is an acceptor circuit?
21. If the effective current in a 50-cycle AC circuit is 5 A, what is the peak value of the current?
22. A light bulb is rated 100 W for 220 V AC supply of 50 Hz. Calculate the resistance of the bulb.
23. What is the value of the capacitor which makes 101.4 microhenry inductance oscillate with a frequency of one megahertz?
24. A 60-watt lamp is connected to an alternating emf of peak value 240 volts. Find the peak value of the current flowing through the lamp.
25. Find the reactance of a coil of inductance 50 mH at frequency 100 Hz.

SHORT ANSWER TYPE - II - 3 MARKS EACH

1. Derive an expression for the average power associated with an inductor.
2. Distinguish between resistance and reactance.
3. Distinguish between series and parallel resonant circuit
4. Draw the graph of ac emf $e = e_o \sin\omega t$ versus time.
5. Derive an expression for the impedance of the LCR circuit connected to the AC power supply.
6. State the characteristics of series and parallel resonant circuits with a proper diagram.
7. Obtain an expression for a series LCR resonant circuit.
8. What is a parallel resonant circuit? Obtain an equation for its resonant frequency.

9. Obtain the equation for the power dissipated in the LCR circuit with the Q- factor.
10. An ac circuit consists of a resistor of 10Ω, inductor of 0.1 H and capacitor of 50 microfarad in series across a 100 V, 50 Hz supply. Find its inductive reactance, capacitive reactance, impedance, current, power factor, and power dissipated in the circuit
11. An alternating emf e = 300sin(100t) volts is applied to a pure resistance of 100 Ω. Calculate the rms current through the resistance.
12. Find the impedance of a series LCR circuit if the inductive reactance, capacitive reactance, and resistance are 184 Ω, 144 Ω, and 30 Ω respectively. Also, calculate the phase angle between voltage and current.
13. A 500 μ H inductor, $80/\pi^2$ pF capacitor, and a 628 Ω resistor are connected to form a series LCR circuit. Calculate the resonant frequency and Q-factor of this circuit at resonance.

14. Dual Nature of Radiation and Matter

Multiple choice questions (1 mark)

1. The concept of quantization of energy was proposed by _____
   (a) Planck
   (b) Einstein
   (c) Maxwell
   (d) Newton
2. Photoelectrons are emitted when _____ radiation will hit metal.
   (a) UV
   (b) micro-wave
   (c) infra red
   (d) all of them
3. The value of Planck's constant is _____
   (a) 6.6×10^{-24}
   (b) 6.6×10^{-54}
   (c) 6.626×10^{-34}
   (d) 6.6×10^{-15}
4. Einstein's photoelectric equation is given by:
   (a) $E_{max} = h\nu$
   (b) $K.E._{max} = h\nu$
   (c) $K.E._{max} = h\nu - \phi_0$
   (d) $K.E._{max} = \phi$
5. In an LED _____ energy is converted to _____
   (a) Electrical, light
   (b) ight, electrical
   (c) mechanical, light
   (d) chemical, light
6. The de-Broglie wavelength for an electron accelerated by a potential of 150 V is;
   (a) 0.112 nm
   (b) 0.15 nm
   (c) 0.3 nm
   (d) 0.1 nm

7. Particle nature of radiation is observed in _____
   (a) Interference
   (b) Diffraction
   (c) Compton effect
   (d) Photoelectric effect
8. The AM radio station has a broadcast frequency of 550 kHz. What is the energy of an AM photo?
   (a) 36.4×10^{-30} eV
   (b) 3.64×10^{-31} eV
   (c) 3646×10^{-30} eV
   (d) 36.46×10^{-3} eV
9. The energy of photon for wavelength of 10^{-24} m is _____
   (a) 15000 SI
   (b) 19.8×10^{29} J
   (c) 11×10^{29} J
   (d) 10^{23} J
10. De-Broglie wavelength for a material, with momentum of 10 kg/m is _____
   (a) 6.626×10^{-33} m
   (b) 6.626×10^{-33} cm
   (c) 6.626×10^{-34} m
   (d) 6.626 m

Very Short answer type questions. (1 Mark each)

1. Is it always necessary to use red light to get a photoelectric effect?
2. In a relation, $E = h\nu$; what is ν?
3. What is the de-Broglie hypothesis?
4. What is the photosensitive surface?
5. What is the photoelectric effect?
6. The threshold wavelength of Tungsten is 2.76×10^{-5} cm. Explain why no photoelectrons are emitted when the wavelength is more than 2.76×10^{-5} cm.
7. What is the de Broglie wavelength associated with a particle having momentum 10^{-26} kg.m/s? [$h = 6.63 \times 10^{-34}$ J.s]
8. Find the momentum of the electron having de Broglie wavelength of 0.5 Å.

Short answer question. (2 Marks each)

1. Describe the construction of a photocell.
2. Draw a neat labeled circuit diagram of experimental arrangement for study of photoelectric effect.
3. Define: (a) Threshold frequency (b) Photoelectric work function.
4. Explain de Broglie wavelength. Obtain an expression for de Broglie wavelength of wave associated with the material particles.
5. How does the wave theory of light fail to explain the observations from experiments on photoelectric effect?
6. Find the wave number of a photon having an energy of 2.072 eV. [Given: Charge on electron = 1.6×10^{-19} C, Velocity of light air = 3×10^{8} m/s, Planck's constant = 6.63×10^{-34} J-s]
7. The threshold wavelength of silver is 3800 Å. Calculate the maximum kinetic energy in eV of photoelectrons emitted, when ultraviolet light of wavelength 2600 Å falls on it. [Planck's constant, h = 6.63×10^{-34} J-s, Velocity of light in air, c = 3×10^{8} m/s]
8. If the total energy of radiation of frequency 10^{14} Hz is 6.63 J, calculate the number of photons in the radiation. [Planck's constant, h = 6.63×10^{-34} J-s]
9. If the work function of a metal is 3 eV, calculate the threshold wavelength of that metal.
10. The photoelectric work function for a metal surface is 3.84×10^{-19} J. If the light of wavelength 5000 Å is incident on the surface of the metal, will there be photoelectric emission? [υ_o = 5.792 x 1014 Hz; v = 6 x 1014 Hz; as $\upsilon > \upsilon_o$ emission is possible]
11. The photoelectric work function for a metal is 5 eV. Calculate the threshold frequency for the metal.

Short answer question. (3 Marks each)

1. State Einstein's photoelectric equation. Explain two characteristics of photoelectric effect on the basis of Einstein photoelectric equation.
2. Draw a well labeled diagram of a photoelectric cell. Explain the observations made by Hertz and Lenard about the phenomenon of photoelectric emission.
3. What is the photoelectric effect? Define: (i) Stopping potential (ii) Photoelectric work function.
4. Describe an experiment for the study of characteristics of photoelectric effect.
5. With a neat, labeled schematic diagram, explain the experimental set-up for photoelectric effect.

6. What is de-Broglie hypothesis? Obtain the relation for de-Broglie wavelength.
7. The photoelectric work function for a metal is 4.2 eV. If the stopping potential is 3 V, find the threshold wavelength and maximum kinetic energy of emitted electrons. [Velocity of light, c = 3 x 10^{8} m/s, Planck's constant, h = 6.63 x 10^{-34} J-s, Charge on electron = 1.6 x 10^{-19} C]
8. The photoelectric threshold wavelength of a metal is 230 nm. Determine the maximum kinetic energy in joule and in eV of the ejected electron for the metal surface when it is exposed to a radiation of wavelength 180 nm. [Velocity of light, c = 3 x 10^{8} m/s, Planck's constant, h = 6.63 x 10^{-34} J-s]
9. The photoelectric current in a photoelectric cell can be reduced to zero by a stopping potential of 1.8 volt. Monochromatic light of wavelength 2200 Å is incident on the cathode. Find the maximum kinetic energy of the photoelectrons in joules. [Charge on electron = 1.6 x 10^{-19} C]
10. The photoelectric work function for a metal surface is 2.3 eV. If the light of wavelength 6800 Å is incident on the surface of metal, find threshold frequency and incident frequency. Will there be an emission of photoelectrons or not? [Velocity of light, c = 3 x 10^{8} m/s, Planck's constant, h = 6.63 x 10^{-34} J-s]
11. Light of wavelength 3000 Å falls on a metal surface having work function 2.3 eV. Calculate the maximum velocity of ejected electrons. [Velocity of light, c = 3 x 10^{8} m/s, Planck's constant, h = 6.63 x 10^{-34} J-s, Mass of electron = 9.1 x 10^{-31} kg]
12. The work function for potassium and cesium are 2.25 eV and 2.14 eV respectively. Is the photoelectric effect possible for either of them if the incident wavelength is 5180? [Velocity of light, c = 3 x 10^{8} m/s, Planck's constant, h = 6.63 x 10^{-34} J-s, Charge on electron = 1.6 x 10^{-19} C]
13. The work function for a metal surface is 2.2 eV. If light of wavelength 5000 Å is incident on the surface of the metal, find the threshold frequency and incident frequency. Will there be an emission of photoelectrons or not? [c = 3 x 10^{8} m/s, h = 6.63 x 10^{-34} J-s, 1 eV = 1.6 x 10^{-19} C]

Long answer questions. (4 Marks each)

1. With a neatly labeled diagram, describe the Davison and Germer experiment in support of the concept of matter waves.
2. What is a photocell? Describe its construction and working with a neat labeled diagram.
3. What is the Compton effect? State the formula for the Compton shift and obtain its maximum value.

4. Radiation of wavelength 4500 Å is incident on a metal having work function 2 eV. Due to the presence of a magnetic field B, the most energetic photoelectrons emitted in a direction perpendicular to the field move along a circular path of radius 20 cm. What is the value of the magnetic field B?
5. Write Einstein's photoelectric equation and explain its various terms. How does the equation explain the various features of the photoelectric effect?

15 Structure of Atoms and Nuclei

Multiple choice questions (1 mark)

1. Visible range has wavelength ranging from _____ in hydrogen spectrum,

   a) 200 – 410 nm

   b) (b) 410 – 434 nm

   c) 486 – 656 nm

   d) (d) 656 nm onwards

2. According to Bohr's atomic model, angular momentum of the electron is integral multiple of _____

   a) h/π

   b) 2π.h

   c) h/2π

   d) (d) 4π.h

3. Bohr's radius for an atom can be calculated by using the formula,

   a) $\frac{nh\varepsilon_0}{m_e e^2}$

   b) $\frac{h\varepsilon_0}{m_e e}$

   c) $\frac{h\varepsilon_0}{\pi e^2}$

   d) $\frac{h^2\varepsilon_0}{\pi m_e e^2}$

4. In the ground state of a hydrogen atom, energy is _____ eV.

   a) – 0.6

   b) -13.6

   c) -3.4

   d) 0

5. To remove an electron in the ground state from a hydrogen atom, the energy required is _____.

   a) -13.6 eV

   b) -10.9 eV

   c) +12.38 eV

   d) +13.6 eV

6. The second postulate of Bohr's atomic model, helps to calculate _____.

   a) angular velocity

b) energy of an electron

(c) angular momentum

(d) quantum number

7. Isotones have the same number of _____

a) electrons

b) neutrons

c) protons

d) deuterons

8. Density of a nucleus does not depend on _____

a) mass

b) Radius

c) Atomic number

d) 4π

9. Gamma rays are (high energy) _____

a) electrons

b) UV rays

c) photons

d) neutrons

10. In the equation: $A = A_0e^{-bt}$, 'b'; represents _____.

a) Oscillation constant

b) electron density

c) damping factor

d) time constant

Very Short answer type questions. (1 Mark each)

1. What is the expression for the minimum angular momentum of the electron in a hydrogen atom?

2. State the name of the visible series in the hydrogen spectrum.

3. Write the mathematical formula for Bohr magneton for an electron revolving in n^{th} orbital.

4. What is the mathematical formula for the third postulate of Bohr's atomic model?

5. Calculate the minimum energy required to take an electron from the ground state to the first excited state in a hydrogen atom.

6. The half-life of a nuclear species is 1.386 years. Calculate its decay constant per year.
7. The radius of the first Bohr orbit in the hydrogen atom is 0.5315 Å. What is the radius of the second Bohr orbit in the hydrogen atom?

Short answer question. (2 Marks each)

1. In a hydrogen atom, an electron carrying charge 'e' revolves in an orbit of radius 'r' with speed 'v'. Obtain an expression for the magnitude of magnetic moment of a revolving electron.
2. State any two postulates of Bohr's theory of hydrogen atoms.
3. State any two limitations of Bohr's atomic model.
4. Derive an expression for the radius of the nth Bohr orbit of the electron in the hydrogen atom.
5. State the first and second postulate of Bohr's atomic model.
6. Find the value of energy of an electron in eV in the third Bohr orbit of the hydrogen atom. [Rydberg's constant (R) = 1.097×10^{7} m^{-1}, Planck's constant (h) = 6.63×10^{-34} J-s, Velocity of light in air (c) = 3×10^{8} m/s.]
7. The velocity of electrons in the 1^{st} Bohr-orbit having radius 0.53 Å is 2200 km/s. Calculate the frequency of revolution of electrons in the same orbit.
8. An electron is orbiting in 5^{th} Bohr orbit. Calculate ionization energy for this atom, if the ground state energy is -13.6 eV.
9. The decay constant of radioactive substances is 4.33×10^{-4} per year. Calculate its half-life period.
10. Find the frequency of revolution of an electron in Bohr's 2^{nd} orbit; if the radius and speed of the electron in that orbit is 2.14×10^{-10} m and 1.09×10^{6} m/s respectively. [$\pi = 3.142$]
11. Thorium $_{90}Th^{232}$ is disintegrated into lead $_{82}Pb^{200}$. Find the number of α and β particles emitted in disintegration.
12. Find the ratio of the longest wavelength in the Paschen series to the shortest wavelength in Balmer series.
13. The electron in the hydrogen atom is moving with a speed of 2.3×10^{6} m/s in an orbit of radius 0.53. Calculate the period of revolution of electrons. [$\pi = 3.142$]
14. The energy of an excited hydrogen atom is -0.85 eV. Find the angular momentum of the electron. [Planck's constant, h = 6.63×10^{-34} J-s, $\pi = 3.142$, $E_1 = -13.6$ eV]

15. Energy of an electron in the school Bohr orbit is -3.4 eV. Calculate the energy of an electron in the first Bohr orbit.
16. The half-life of a radioactive species is 3.2 days. Calculate decay constant (per day).
17. The photoelectric work function for a metal surface is 3.84×10^{-19} J. If the light of wavelength 5000 Å is incident on the surface of the metal, will there be photoelectric emission?
18. Compute the ratio of the longest wavelength of the Lyman and Balmer series in hydrogen atoms.
19. Disintegration rate of the radio-active sample is 10^{10} per hour at 20 hours from the start. It reduces to 5×10^{9} per hour after 30 hours. Calculate the decay constant.

Short answer question. (3 Marks each)

1. State law of radioactive decay. Hence derive the relation $N = N_0 e^{-\lambda t}$. Represent it graphically.
2. State Bohr's third postulate for hydrogen (H_2) atoms. Derive Bohr's formula for the wave number.
3. Using an expression for the energy of electrons, obtain the Bohr's formula for hydrogen spectral lines.
4. State postulates of Bohr's atomic model.
5. Calculate the radius of the second Bohr orbit in a hydrogen atom from the given data. [Planck's constant, $h = 6.63 \times 10^{-34}$ J-s, mass of electron $= 9.1 \times 10^{-31}$ Kg, Charge on electron $= 1.6 \times 10^{-19}$ C, Permittivity of free space $= 8.85 \times 10^{-12}$ C^2/Nm^2]
6. An electron in an atom revolves around the nucleus in an orbit of radius 0.53. If the frequency of revolution of an electron is 9×10^{9} MHz. Calculate the orbital angular momentum. [Charge on electron $= 1.6 \times 10^{-19}$ C, Gyromagnetic ratio $= 8.8 \times 10^{10}$ C/kg, $\pi = 3.142$]
7. Calculate the wavelength of H_γ line and series limit for Brackett series.
8. Determine the shortest wavelengths of the Balmer and Paschen series. Given limit for the Lyman series is 912 Å.

Long answer questions. (4 Marks each)

1. Obtain the ratio of the longest wavelength of spectral line in the Paschen series to the longest wavelength of spectral line in the Brackett series.The speed of the

electron in the first Bohr orbit (in H atom) of radius 0.5 Å is 2.3 x 10^6 m/s. Calculate the period of revolution of the electron in this orbit.

2. Write notes on: (a) Nuclear fission (b) Nuclear Fusion.
3. With the help of a neat labeled diagram, describe the Geiger-Marsden experiment. What is a mass defect?
4. State any two limitations of Bohr's atomic model. The radius of the first orbit of the electron in a hydrogen atom is 0.53 Å. Find the centripetal force on the electron.
5. Draw a neat and labeled energy level diagram and explain Balmer series and Brackett series of spectral lines for hydrogen atoms.
6. Obtain an expression for energy of an electron in Bohr orbit. Hence obtain the expression for its binding energy.

16 Semiconductor Devices

Multiple choice questions (1 mark)

1. Conversion of AC to DC voltage is called _____.

a) Rectification

b) Transformation

c) Filtration

d) Reversion

2. Y = $\overline{A + B}$ is the Boolean expression for _____

a) OR-gate

b) AND-gate

c) NOR-gate

d) NAND-gate

3. In a common emitter amplifier, current gain is 80 and emitter current is 9 mA. The base current is _____

a) $\frac{1}{81}$ mA

b) 8 mA

c) $\frac{1}{8}$ mA

d) $\frac{1}{9}$ mA

4. If the frequency of the input voltage 50 Hz is applied to a full wave rectifier, what will be the output frequency?

a) 25 Hz

b) 50 Hz

c) 100 Hz

d) 150 Hz

5. A photodiode is used in _____.

a) a brake indicator

b) a regulated power supply

c) an optocoupler

d) a logic gate

6. When the load resistance across a solar cell is zero, the current in the external circuit passed by the solar cell is called _____.

a) The open-circuit current

b) the photocurrent

c) the short-circuit current

d) the reverse saturation current

7. For a transistor if $\beta = 99$ then $\propto$ is _____.

a) 0.9

b) 0.99

c) 1

d) 9

8. In n-p-n transistor, if emitter current is 12 mA, collector current is 11 mA, then base current is_____

a) 12 mA

b) -1 mA

c) 2 mA

d) 1 mA

9. In the p-n-p transistor, the arrow on the emitter is directed _____.

a) towards right

b) downwards

c) from emitter to base

d) from base to emitter

10. LEDs used for giving infrared radiations are prepared from _____.

a) SiO_2

b) GaAs

c) GaP

d) GaAsP

VERY SHORT ANSWER TYPE QUESTIONS (1 Mark each)

1) What is the Dark resistance of a photodiode?
2) Write a Boolean expression for Exclusive – OR (X – OR) gate.
3) What is the phase difference between input signal voltage and output signal voltage in CE amplifiers?
4) State any two applications of photodiode.
5) In a common base connection, the emitter current is 6.28 mA and collector current is 6.20 mA. Determine the common base DC current gain.
6) The common-base DC current gain of a transistor is 0.96. What is the current gain in common emitter configuration?

7) For a transistor circuit, in common emitter configuration, the voltage gain is 150. Find the output voltage, if the input voltage is 10 mV.
8) What is an unregulated power supply?
9) In common emitter amplifier $\frac{I_C}{I_E}$ =0.98. Find the value of current gain.
10) What is the function of the anti-reflection coating on the n-side of a solar cell?

SHORT ANSWER TYPE QUESTION (2 Marks each)

1) What is a Light Emitting Diode? Draw its circuit symbol.
2) What is a filter circuit?
3) Draw the schematic symbols for AND, OR, NOT and NAND gate.
4) What is the ripple factor of a rectifier?
5) What are the two major types of devices converting solar energy in usable form?
6) What is the colour of light emitted by GaAsP and ZnSe LEDs?
7) The common-base current gain of a p-n-p transistor is 0.95 and emitter current is 7.2 mA. What is the value of base current?
8) The collector current in the n-p-n transistor is 24 mA. If 80% of the electrons emitted by the emitter reach the collector, what is the base current?
9) For a transistor β is 50. If input resistance (R_i) is = 200 Ω, output resistance (R_o) is 2000 Ω, what is the voltage gain?
10) If the frequency of the input voltage 100 Hz is applied to a (a) half wave rectifier and (b) full wave rectifier, what is the output frequency in both cases?

SHORT ANSWER TYPE QUESTIONS (3 Marks each)

1) Explain the working of n-p-n transistors in common base configuration.
2) Define $\propto_{dc\ and}$ β_{dc}. Obtain the relation between them.
3) What is a light emitted diode? Explain working of a LED.
4) With a neat circuit diagram, explain the working of a p-n junction diode as a half wave rectifier.
5) Distinguish between light emitting diode and photo-diode.
6) Explain working of a transistor as an amplifier in detail with the help of a proper circuit diagram.
7) In a voltage regulator, with input unregulated supply of 10 V, a series resistor R_S of 500 Ω and a Zener diode of breakdown voltage 5 V is connected to design voltage

regulator circuit. If a load resistor R_L of 1 KΩ is connected, calculate (a) load current and (b) Zener current.

8) A 8.0 V stabilized power supply is required to be designed using a 15 V DC power supply as input source. The maximum power rating P_Z of the Zener diode is 4.0 W. Using the Zener regulator circuit calculate (a) the maximum current flowing through the Zener diode (b) the minimum value of the series resistor, R_S (c) the load current I_L if a load resistor of 400 Ω is connected across the Zener diode (d) the Zener current I_Z at full load.
9) What is a logic gate? Write down the truth table and Boolean expression for 'AND' gate.
10) A p-n photodiode is fabricated from a semiconductor with a band gap of 2.8 eV. Can it detect a wavelength of 6000 nm?

LONG ANSWER TYPE QUESTIONS (4 Marks each)

1) What is a Zener diode? Explain how a Zener diode maintains constant voltage across a load.
2) What is a rectifier? With the help of a neat circuit diagram explain the working of a full wave rectifier.
3) With the help of a neat labeled schematic diagram of a solar cell, explain the construction and working on a solar cell.
4) What is an amplifier? Explain the working of a typical transistor amplifier.
5) What is a photodiode? Explain the working principle of a photodiode.
6) State the advantages, disadvantages and applications of (a) LED (b) Photodiode
7) What are analog and digital circuits? Write a short note on X-OR gate.

CREDIT NAMES

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2	DINESH M JOSHI	SATISH PRADHAN DNYANASADHANA COLLEGE,THANE
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4	DR. GAJANAN B PATIL	SECONDARY SCHOOL AND JR. COLLEGE, BHILAWADI.TAL-PALUS,DIST -SANGLI
5	SWAPNIL SUNIL JOSHI	NOOTAN KANNYA SHALA AND JUNIOR COLLEGE, AMRAVATI
6	SMITHA MENON	SATHAYE COLLEGE,MUMBAI
7	NEELAM SHINDE	D.B.J. COLLEGE, CHIPLUN
8	JAGDISHKUMAR S PRAJAPATI	BHAVAN'S COLLEGE, ANDHERI WEST
9	MR. HEMANT DONGRE	VARTAK COLLEGE,VASAI
10	MR. SUNIL BABU BHUSARA	VPM'S BN BANDODKAR COLLEGE OF SCIENCE THANE WEST
11	MRS.SUJATA KHOT	D.B.J. COLLEGE, CHIPLUN
12	BEENA SURESH	ST LAWRENCE HIGH SCHOOL AND JR. COLLEGE, THANE,(WEST)