दु.क्र ०२०२४४७६९३८

महाराष्ट्र शासन
शालेय शिक्षण व क्रीडा विभाग
राज्य शैक्षणिक संशोधन व प्रशिक्षण परिषद,महाराष्ट्र
७०८ सदाशिव पेठ, कुमठेकर मार्ग, पुणे ४११०३०.

प्रश्नपेढी (Question Bank) 2024

इयत्ता:- बारावी

माध्यम:- इंग्रजी

विषय:- भौतिकशास्त्र (Physics)

सूचना-

1.सदर प्रश्नपेढी ही १००% अभ्यासक्रमावर तयार करण्यात आली आहे.

2.सदर प्रश्नपेढीतील प्रश्न हे अधिकच्या सरावासाठी असून प्रश्नसंचातील प्रश्न बोर्डाच्या प्रश्नपत्रिकेत येतीलच असे नाही, याची नोंद घ्यावी.

Subject -PHYSICS (54)

INDEX

Chapter1. Rotational Dynamics

MCQ's (1 Mark Each)

1. A 500 kg car takes a round turn of radius 50m with a velocity of 36 km/hr. The centripetal force is
   a) 250N
   b) 750N
   c) 1000N
   d) 1200N

   Ans: c) 1000N

2. A string of length ℓ fixed at one end carries a mass m at the other. The string makes 2/π revolutions/sec around the vertical axis through the fixed end. The tension in the string is
   a) 2 ml
   b) 4 ml
   c) 8 ml
   d) 16 ml

   Ans: d) 16 ml

3. A diver in a swimming pool bends his head before diving. It
   a) Increases his linear velocity
   b) Decreases his angular velocity
   c) Increases his moment of inertia
   d) Decreases his moment of inertia

   Ans: d) Decreases his moment of inertia

4. The angular momentum of a system of particles is conserved
   a) When no external force acts upon the system
   b) When no external torque acts upon the system
   c) When no external impulse acts upon the system
   d) When axis of rotation remains the same

   Ans: b) When no external torque acts upon the system

5. A stone is tied to one end of a string. Holding the other end, the string is whirled in a horizontal plane with progressively increasing speed. It breaks at some speed because
   a) Gravitational forces of the earth is greater than the tension in string
   b) The required centripetal force is greater than the tension sustained by the string
   c) The required centripetal force is lesser than the tension in the string
   d) The centripetal force is greater than the weight of the stone

   Ans: b) The required centripetal force is greater than the tension sustained by the string

6. The moment of inertia of a circular loop of radius R, at a distance of R/2 around a rotating axis parallel to horizontal diameter of the loop is
   a) ½ MR^2
   b) ¾ MR^2
   c) MR^2
   d) 2 MR^2

   Ans: b) ¾ MR^2

7. A cyclist riding a bicycle at a speed of $14\sqrt{3}$ m/s takes a turn around a circular road of radius $20\sqrt{3}$ m without skidding. Given g = 9.8 m/s^2, what is his inclination to the vertical
   a) 30^0
   b) 45^0
   c) 60^0
   d) 90^0

   Ans: c) 60^0

Very Short Answer (VSA) (1 MARK Each)

1. A bend in a level road has a radius of 100m. find the maximum speed which a car turning this bend may have without skidding, if the coefficient of friction between the tyres and road is 0.8. (Ans: V_{max}= 28 m/s)
2. State the principle of conservation of angular momentum.
3. Find the radius of gyration of a uniform disc about an axis perpendicular to its plane and passing through its center.
4. Does the angle of banking depend on the mass of the vehicle?

5. During ice ballet, while in the outer rounds, why do the dancers outstretch their arms and legs.
6. Two bodies have their moments of inertia I and 2I respectively about their axis of rotation. If their kinetic energies of rotation are equal, then what is the ratio of their angular velocity.
7. What is meant by the well of death?
8. State the equation for kinetic energy of rolling motion.
9. A hollow sphere has a radius 6.4 m. what is the minimum velocity required by a motorcyclist at bottom to complete the circle. (Ans: V=17.7 m/s)

Short Answer I (SA1) (2 MARKS Each)

1. A bucket containing water is tied to one end of a rope 5 m long and it is rotated in a vertical circle about the other end. Find the number of rotations per minute in order that the water in the bucket may not spill. *(Ans: n=13.37 rpm)*
2. A flywheel is revolving with a constant angular velocity. A chip of its rim breaks and flies away. What will be the effect on its angular velocity?
3. The moment of inertia of a uniform circular disc about a tangent in its own plane is $5/4MR^2$ where M is the mass and R is the radius of the disc. Find its moment of inertia about an axis through its centre and perpendicular to its plane.
4. Derive an expression for maximum safety speed with which a vehicle should move along a curved horizontal road. State the significance of it.
5. Obtain an expression for Total kinetic energy in terms of radius of gyration of the body.
6. The moment of inertia of a body about a given axis is 1.2 kgm^2 . initially the body is at rest. For what duration of angular acceleration of 25 radian/sec^2 must be applied about that axis in order to produce a rotational kinetic energy of 1500 joules? *(Ans: t=2sec)*
7. A body weighing 0.5 kg tied to a string is projected with a velocity of 10 m/s. The body starts whirling in a vertical circle. If the radius of the circle is 0.8 m, find the tension in the string when the body is at the top of the circle. *(Ans: T= 3.8 N)*

Short Answer II (SA2) (3 MARKS Each)

1) A railway track goes around a curve having a radius of curvature of 1 km. The distance between the rails is 1 m. Find the elevation of the outer rail above the inner rail so that there is no side pressure against the rails when a train goes round the curve at 36 km / hr.*(Ans: h = 1.02 cm)*
2) Derive an expression for kinetic energy of a rotating body with uniform angular velocity.
3) Obtain an expression for the torque acting on a rotating body with constant angular acceleration.
4) Derive an expression for the difference in tensions at highest and lowest point for a particle performing vertical circular motion.
5) Obtain an expression for the angular momentum of a body rotating with uniform angular velocity.
6) A flywheel of mass 8 kg and radius 10 cm rotating with a uniform angular speed of 5 rad / sec about its axis of rotation, is subjected to an accelerating torque of 0.01 Nm for 10 seconds. Calculate the change in its angular momentum and change in its kinetic energy. *(Ans.: 0.1kgm^2/s,0.625 J)*
7) Two wheels of moment of inertia 4 kgm^2 rotate side by side at the rate of 120 rev / min and 240 rev / min respectively in the opposite directions. If now both the wheels are coupled by means of a weightless shaft so that both the wheels rotate with a common angular speed. Calculate the new speed of rotation. (Ans: n = 60 rpm)

Long Answer (LA) (4 marks Each)

1) State and explain the theorem of parallel axes.
2) What is a conical pendulum? Obtain an expression for its time period.
3) Obtain an expression for maximum safety speed with which a vehicle can be safely driven along a curved banked road.

OR

Show that the angle of banking is independent of the mass of the vehicle.

Chapter 2. Mechanical Properties of fluids

MCQ's (1 Mark Each)

1) Unit of coefficient of viscosity is
   a) Ns/m
   b) Ns^2/m
   c) Ns^2/m^2
   d) Ns/m^2
   Ans: d) Ns/m^2

2) Insect moves over surface of water because of
   a) Elasticity
   b) Surface tension
   c) Friction
   d) Viscosity
   Ans.: b) Surface tension

3) The water droplets are spherical in free fall due to
   a) gravity
   b) intermolecular attraction
   c) Surface tension
   d) Viscosity
   Ans.: c) Surface tension

4) Surface tension of a liquid at critical temperature is
   a) Infinity
   b) Zero
   c) Same as any other temperature
   d) Cannot be determined
   Ans: b) Zero

5) Two capillary tubes of radii 0.6 cm and 0.3 cm are dipped in the same liquid. The ratio of heights through which the liquid will rise in the tubes is
   a) 2:1
   b) 1:2
   c) 4:1
   d) 1:4
   Ans.: b) 1:2

6) The energy stored in a soap bubble of diameter 6 cm and T = 0.04 N/m is nearly
   a) 0.9×10^{-3} J
   b) 0.4×10^{-3} J
   c) 0.7×10^{-3} J
   d) 0.5×10^{-3} J
   Ans: a) 0.9×10^{-3} J

7) Two stones with radii 1:2 fall from a great height through the atmosphere. Their terminal velocities are in the ratio
   a) 2:1
   b) 1:4
   c) 4:1
   d) 1:2
   Ans.: b) 1:4

Very Short Answer (VSA) (1 MARK Each)

1) A square metal plate of area 100 cm^2 moves parallel to another plate with a velocity of 10 cm/s, both plates immersed in water. If the viscous force is 200 dyne and viscosity of water is 0.01 poise, what is the distance between them? ***(Ans: 0.05 cm)***

2) What is surface film?

3) What are cohesive forces?

4) What will be the shape of liquid meniscus for obtuse angle of contact?

5) What is the net weight of a body when it falls with terminal velocity through a viscous medium?

6) What is the common unit of measuring pressure of a gas?

7) State equation of continuity.

8) The relative velocity between two parallel layers of water is 8 cm/s and perpendicular distance between them is 0.1 cm. Calculate the velocity gradient**. (*Ans:80 per second)***

9) Water rises to a height of 20 mm in a capillary tube. If the radius made 1/3rd of its previous value, to what height will the water now rise in the tube? **(Ans: 60 mm)**

Short Answer I (SA1) (2 MARKS Each)

1) Calculate the rise of water inside a clean glass capillary tube of radius 0.1 mm, when immersed in water of surface tension 7 x 10^{-2} N/m. The angle of contact between water and glass is zero, density of water is 1000 kg/m^3, g = 9.8 m/s^2
   (Ans: h = 0.1428 m)

2) State properties of an ideal fluid.

3) Compare streamline flow and Turbulent flow.

4) Define surface tension and angle of contact.

5) Define pressure of a fluid.

6) State any two applications of pascals law.

7) State Pascal's law of fluid pressure.

8) A rain drop of radius 0.3 mm falls through air with a terminal velocity of 1 m/s. The viscosity of air is 18 x 10^{-6} N-s /m^2. Find the viscous force on the raindrop.
(Ans: F= 1.017 * 10 $^{-7}$ N)

9) Two soap bubbles have radius in the ratio 2:3. Compare the work done in blowing these bubbles. ***(Ans.: 4:9)***

Short Answer II (SA2) (3 MARKS Each)

1) Twenty-seven droplets of water, each of radius 0.1 mm coalesce into a single drop. Find the change in surface energy. Surface tension of water is 0.072 N/m.
(Ans.: W= 1.628 X 10 $^{-7}$ J)

2) Explain the phenomena of surface tension on the basis of molecular theory.

3) Obtain an expression for the capillary rise or fall using the forces method.

4) State Stoke's law and give two factors affecting angle of contact.

5) Explain: Hydrostatic paradox.

6) Explain: Gauge pressure.

7) State Bernoulli's principle. Derive Bernoulli's equation.

8) State any two applications of Bernoulli's equation.

9) Explain the working of the Venturi tube.

10) Explain the working of an atomizer.

11) A u-tube is made up of capillaries of bore 1 mm and 2 mm respectively. The tube is held vertically and partially filled with a liquid of surface tension 49 dyne/cm and zero angle of contact. Calculate the density of liquid, if the difference in the levels of the meniscus is 1.25 cm. take g = 980 cm/s^2 ***(Ans.: density of liquid = 0.8 g/ cm^3)***

12) A rectangular wire frame of size 2 cm x 2 cm is dipped in a soap solution and taken out. A soap film is formed, it the size of the film is changed to 3 cm x 3 cm, Calculate the work done in the process. The surface tension of soap film is 3 x 10^{-2} N/m.
(Ans: W= 3x 10^{-5} J)

Long Answer (LA) (4 marks Each)

1) Derive the relation between surface energy & surface tension.

2) Obtain Laplace's law of spherical membrane.

3) Derive an expression for terminal velocity of the sphere falling under gravity through a viscous medium.

Chapter 3. Kinetic Theory of gases and Radiation

MCQ's (1 Mark Each)

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

Ans: c) the absolute temperature 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

Ans: a) geometric structure 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

Ans: d) temperature

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

(a) 2 (b) 4 (c) 8 (d) 16

Ans: d) 16

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

(a) 9935 Å (b) 9656 Å (c) 9421 Å (d) 9178 Å

Ans: b) 9656 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) 7245 J kg^{-1} K^{-1}

(c) 6890 J kg^{-1} K^{-1} (d) 4067 J kg^{-1} K^{-1}

Ans: a) 7999 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) 1698.04 J (c) 1751.04 J (d) 1856.04 J

Ans: c) 1751.04 J

Very Short Answer (VSA) (1 MARK Each)

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) State the formula for the mean free path.
6) 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. (Ans: Vrms = $489.89\ m/s$)
7) Find kinetic energy of 3 liters of a gas at S.T.P given standard pressure is 1.013 x 10^5 N/m^2.
   (Ans: K.E.= $455.8\ J$ **)**
8) Determine the pressure of nitrogen at 0^{o}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.
   (Ans: $P =$ **99633.75 N/m)**

Short Answer I (SA1) (2 MARKS Each)

1) 1000 calories of radiant heat are incident on a body. If the body absorbs 400 calories of heat, find the coefficient of emission of the body. ***(Ans: a=e=0.4)***
2) State factors on which the amount of heat radiated by a body depends.
3) Show that for monoatomic gas the ratio of the two specific heats is 5:3.
4) Show that for diatomic gas the ratio of the two specific heats is 7:5.
5) Show the graphical representation of radiant power of a black body per unit range of wavelength as a function of wavelength.
6) Draw a neat, labeled diagram of Ferry's black body.
7) Explain the mean free path of a gas molecule.
8) State and explain law of equipartition of energy.
9) Define degrees of freedom of a system.
10) Compare the rate of radiation of metal bodies at 727 ^{o}C and 227 ^{o}C.
    (Ans: 16)
11) A metal cube of length 4 cm radiates heat at the rate of 10 J/s. Find its emissive power at a given temperature.

(Ans: E = 1041.66 $J/s\,m^2$)

Short Answer II (SA2) (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 polyatomic gas molecules.
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°C and at 127°C, if the blackbodies are surrounded by an enclosure at 27°C. What would be the ratio of their rates of loss of heat?

   (*Ans* $\frac{R_1}{R_2} = \frac{10.28}{1}$)
6) Determine the molecular kinetic energy (i) per mole (ii) per gram (iii) per molecule of nitrogen molecules at 227°C, R = 8.310 J $mole^{-1}$ K^{-1}, No = 6.03 x 10^{26} moleculesKmole^{-1}. Molecular weight of nitrogen = 28.

   (Ans

   (i) ***K.E. per mole*** = 6.232×10^3 ***J/mole***

   (ii) ***K.E. per kilogram*** = 0.225×10^3 ***J/kg***

   (iii) ***K.E. per kmole*** = 1.048×10^{-23} ***J)***
7) The velocity of three molecules are 2 km s^{-1}, 4 km s^{-1}, 6 km s^{-1}. Find (i) mean square velocity (ii) root means square velocity.

   (Ans: i) mean square velocity, $\underline{V^2} = 18.66$ ***km*** s^{-1} ***ii) root mean square velocity,*** $V_{rms} = 4.319$ ***km*** s^{-1}***)***

Long Answer (LA) (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.

Chapter 4. Thermodynamics

MCQ's (1 Mark 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 does not exchange energy

Ans.: a) System gains energy

2) Which of the following systems freely allows exchange of energy and matter with its environment?

(a) Closed (b) Isolated (c) Open (d) partially closed

Ans.: c) Open

3) Two systems at same temperature are said to be in

(a) chemical equilibrium (b) thermal equilibrium

(c) mechanical equilibrium (d) electrical equilibrium

Ans: b) thermal equilibrium

4) For work done to be reversible, the process should be

(a) cyclic (b) isobaric (c) isochoric (d) adiabatic

Ans: 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) -4 J (d) - 10 J

Ans: b) 4 J

6) The second law of thermodynamics deals with transfer of

(a) work done (b) energy (c) momentum (d) heat

Ans.: 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

Ans: c) isobaric

Very Short Answer (VSA) (1 MARK Each)

1) A system releases 100 kJ of heat while 80 kJ of work is done on the system. Calculate the change in internal energy**.** **(Ans: ΔU = 20 kJ)**
2) When two objects are said to be in thermal equilibrium?
3) The science of measuring temperatures is called as?
4) State zeroth law of thermodynamics.
5) What is energy associated with the random, disordered motion of the molecules of a system called as?
6) A group of objects that can form a unit which may have the ability to exchange energy with its surrounding is called what?
7) On what basis a thermodynamic system can be classified?
8) What is a thermodynamic process?
9) Define heat.
10) 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?
11) When does a system lose energy to its surroundings and its internal energy decreases?
12) State first law of thermodynamics.
13) What are heat engines?
14) write an equation for the efficiency of the Carnot engine.

Short Answer I (SA1) (2 MARKS Each)

1) Draw p-V diagram of reversible process.
2) Draw p-V diagram of 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) Explain the cyclic process.
7) Differentiate between reversible and irreversible processes.
8) State the assumptions made for thermodynamic processes.
9) Define efficiency of a heat engine.
10) write a short note on Refrigerator.

11) Draw a neat, labeled diagram of energy flow of a refrigerator.

12) Write a short note on the Air Conditioner.

13) Write a short note on Heat pumps.

14) Write a Kelvin-Planck statement.

15) 3 moles of a gas at temperature 400 K expands isothermally from initial volume of 4 litre to final volume of 8 liter. Find the work done by the gas. ($R = 8.31$ J mol^{-1} K^{-1})

(Ans.: W = 6.919 kJ)

16) An ideal gas of volume 2 L is adiabatically compressed to $(1/10)^{th}$ of its initial volume. Its initial pressure is 1.01 x 105 Pa, calculate the final pressure. (Given $\gamma = 1.4$)

(Ans: $P_f = 25.37 \times 10^5\ Pa$)

Short Answer II (SA2) (3 MARKS Each)

1) Classify and explain the thermodynamic system.
2) Explain given cases related to energy transfer between the system and surrounding –
    1) energy transferred (Q) > 0
    2) energy transferred (Q) < 0
    3) 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) Explain the Stirling cycle using a diagram.
8) Explain: 1) A working substance of a heat engine.
    2) Hot and cold reservoir of a heat engine.
    3) Cylinder of a heat engine.
9) State and explain the limitations of the first law of thermodynamics.
10) 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. ***(Ans. W = 169 J, ΔU = 2087 J)***
11) Calculate the fall in temperature of helium initially at 15^{o}C when it is suddenly expanded to 8 times its original volume ($\gamma = 5/3$). ***(Ans. – 216.0 ^{o}C)***

12) A cylinder containing one gram molecule of the gas was compressed adiabatically until its temperature rose from 27°C to 97°C. Calculate the work done and heat produced in the gas ($\gamma = 1.5$). ***(Ans. W =*** -11.63×10^2 ***J and Q = 277 cal)***

Long Answer (LA) (4 marks Each)

1) State 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.

Chapter 5. Oscillations

MCQ's (1 Mark Each)

1) A particle is moving in a circle with uniform speed. Its motion is
   a) Periodic and simple harmonic
   b) Non periodic
   c) Periodic but not simple harmonic
   d) Non periodic but simple harmonic

   Ans: c) Periodic but not simple harmonic

2) A particle is performing simple harmonic motion with amplitude A and angular velocity ω . the ratio of maximum velocity to maximum acceleration is

   a) ω

   b) $1 / \omega$

   c) ω^2

   d) A / ω

   Ans: b) $1 / \omega$

3) Acceleration of a particle executing S.H.M. at its mean position.
   a) Is infinity
   b) Varies
   c) Is maximum
   d) Is zero

   Ans: d) Is zero

4) In a second's pendulum, the mass of Bob is 50 g. If it is replaced by 100 g mass, then its period will be.
   a) 1 s b) 2 s c) 3 s d) 4 s

   Ans: b) 2 s

5) The maximum speed of a particle executing S.H.M. is 10 m/s and maximum acceleration is 31.4 m/s^2. Its periodic time is

a) 1 s b) 2 s c) 4 s d) 6 s

Ans: b) 2 s

6) When the displacement of a simple harmonic oscillator is half of its amplitude, its P.E. is 3 J. Its total energy is

a) 6 J b) 12 J c) 15 J d) 20 J

Ans: b) 12 J

7) Two S.H.M.'s have zero phase difference and equal amplitudes A. The resultant amplitude on their composition will be

a) 2 A b) zero c) $\sqrt{2}$ A d) $\sqrt{2\,A}$

Ans: a) 2 A

Very Short Answer (VSA) (1 MARK Each)

1) What is a seconds pendulum?
2) A simple pendulum moves from one end to the other in ¼ second. What is its frequency?***(Ans: 2 Hz)***
3) A particle executes S.H.M. of 2 cm. At the extreme position, the force is 4 N. What is the force at a point midway between mean and extreme positions? ***(Ans: F = 2 N)***
4) A simple pendulum is inside a spacecraft. What will be its periodic time? ***(Ans: infinite)***
5) What is the amplitude of S.H.M.
6) State the formula for frequency of S.H.M in terms of force constant.
7) What does the phase of π/2 indicate in linear S.H.M.?

(Ans: particle is at the positive extreme position during first oscillation)

Short Answer I (SA1) (2 MARKS Each)

1) Derive differential equation of linear S.H.M.
2) Define linear S.H.M.
3) State any two laws of simple pendulum.
4) State formula for angular frequency and time period of damped oscillations.
5) A particle is performing S.H.M. of amplitude 5 cm and period of 2s. Find the speed of the particle at a point where its acceleration is half of its maximum value.

(Ans: V = 13.6 X 10 $^{-2}$ m/s)

6) The acceleration due to gravity on the surface of the moon is 1.7 m/s^2. What is the time period of a simple pendulum on the surface of moon if its time period on the surface of earth is 3.5 s? (g on the surface of earth = 9.8 m/s^2) ***(Ans.: 8.40 sec)***

7) The total energy of a body of mass 2 kg performing S.H.M. is 40 J. Find its speed while crossing the center of the path**.** ***(Ans.: V = 6.324 m/s)***

Short Answer II (SA2) (3 MARKS Each)

1) The period of oscillation of a simple pendulum increases by 20% , when its length is increased by 44 cm. Find its initial length**.** ***(Ans.: L_1 = 1 m)***

2) A particle performing S.H.M. has velocities of 8 cm/s and 6 cm/s at displacements of 3 cm and 4 cm respectively. Calculate the amplitude and period of S.H.M.
(Ans: Amplitude = 5 cm, T= 3.14 sec)

3) A particle performs linear S.H.M. of period 4 seconds and amplitude 4 cm. Find the time taken by it to travel a distance of 1 cm from the positive extreme position.
(Ans: t = 0.46 sec)

Long Answer (LA) (4 marks Each)

1) Obtain an expression for the resultant amplitude of, composition of two S.H.M. 's having the same period along the same path.

2) Define angular S.H.M. and obtain its differential equation.

3) Obtain the expression for the period of a magnet vibrating in a uniform magnetic field and performing S.H.M.

4) Explain damped oscillation.

5) Derive differential equation of damped harmonic oscillations.

6) Explain the reference circle method for projection of a rotating rod.

7) Explain 1) Free Oscillations 2) Force Oscillations 3) Resonance

8) Using a differential equation of linear S.H.M., obtain an expression for acceleration, velocity and displacement of simple harmonic motion.

9) Define an ideal simple pendulum and obtain an expression for its periodic time.

10) Deduce the expression for kinetic energy, potential energy and total energy of a particle performing S.H.M. State the factors on which total energy depends.

Chapter 6. Superposition of Waves

MCQ's (1 Mark Each)

1) A standing wave is produced on a string fixed at one end with the other end free. The length of the string
   a. must be an odd integral multiple of λ
   b. must be an odd integral multiple of λ/2
   c. must be an odd integral multiple of λ/4
   d. must be an even integral multiple of λ

   Ans: c) must be an odd integral multiple of λ/4

2) The equation of a simple harmonic progressive wave is given by, $y = 5 \cos \pi [200t - x/150]$, where x and y are in cm and 't' is in second. Then the velocity of the wave is
   a) 2 m/s b) 150 m/s c) 200 m/s d) 300 m/s

   Ans: c) 200 m/s

3) A man standing in an unsymmetrical position between two mountains fires a gun. He hears the first echo after 1.5 s and the second echo after 2.5 s. If the speed of sound in air is 340 m/s, then the distance between the mountains will be
   a. 400 m
   b. 520 m
   c. 640 m
   d. 680 m

   Ans: d) 680 m

4) A set of tuning forks is arranged in ascending order of frequencies each tuning fork gives 8 beats/s with the preceding one. If frequency of the first tuning fork is 120 Hz and the last fork is 200 Hz, then the number of tuning forks arranged will be,
   a. 8
   b. 9
   c. 10
   d. 11

   Ans.: d) 11

5) In law of tension, the fundamental frequency of vibrating string is,
   a. inversely proportional to square root of tension
   b. directly proportional to the square of tension
   c. directly proportional to the square root of tension
   d. inversely proportional to density

Ans: c) directly proportional to the square root of tension

6) The integral multiple of fundamental frequencies are
   a. beats
   b. resonance
   c. overtones
   d. harmonics

Ans: d) harmonics

7) An organ pipe of length 0.4 m is open at both ends. The speed of sound in air is 340 m/s. The fundamental frequency is,
   a. 405 Hz
   b. 415 Hz
   c. 425 Hz
   d. 435 Hz

Ans: c) 425 Hz

Very Short Answer (VSA) (1 MARK Each)

1) A wave is represented by an equation y = A Sin (Bx + Ct). Given that the constants A, B and C are positive, can you tell in which direction the wave is moving?
2) Why is wave motion doubly periodic?
3) What is interference of sound waves?
4) What are beats?
5) What are harmonics?
6) What are overtones?
7) State law of length.
8) State law of tension.
9) State law of linear density.
10) What is the resonance?

11) What are forced vibrations?

12) State any one characteristic of sound.

13) A violin string vibrates with a fundamental frequency of 510 Hz. What is the frequency of the first overtone? **(Ans*: $n_1 = 1020$ Hz)***

14) A string 1 m long is fixed at one end. The other end is moved up and down with frequency 20 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. [Note: Remember that the moving end is an antinode**.]** **(Ans*: V = 10 m/s)***

Short Answer I (SA1) (2 MARKS Each)

1) For a stationary wave set up in a string having both ends fixed, what is the ratio of the fundamental frequency to the third harmonic?

2) What are stationary waves? Why are they called stationary waves?

3) Distinguish between overtone and harmonic.

4) State any four applications of beats.

5) Prove that a pipe opens at both ends of length of 2L, has the same fundamental frequency as another pipe closed at one end of length L.

6) How is the frequency of vibrating wire affected if the load is fully immersed in water?

7) A sonometer wire of length 1 m is stretched by a weight of 10 kg. The fundamental frequency of vibration is 100 Hz. Determine the linear density of material of wire.

(Ans: $m = 0.0025 \times 10^{-4}$ kg/m)

Short Answer II (SA2) (3 MARKS Each)

1) Find the amplitude of the resultant wave produced due to interference of two waves given as,

$y_1 = A_1 \sin \omega t$, $y_2 = A_2 \sin (\omega t + \phi)$

2) Show that even as well as odd harmonics are present as overtone in modes of vibration of string.

3) State and explain laws of vibrating strings.

4) Write a short note on Quality or timbre.

5) Two wires of the same material and same cross section are stretched on a sonometer. One wire is loaded with 1 kg and another is loaded with 9 kg. The vibrating length of the first wire is 60 cm and its fundamental frequency of vibration is the same as that of the second wire. Calculate vibrating length of the other wire. *(Ans: 3)*

6) The equation of simple harmonic progressive wave is, $y = \sin \pi/2\ (4t/0.025 - x/0.25)$. Where all quantities are in the S.I. system. Find amplitude, frequency, wavelength and velocity of the wave. ***(Ans: Amplitude, A = 1 m Frequency n = 40 Hz Wavelength λ = 1 m, v = 40 m/sec)***

7) A stretched sonometer wire is in unison with a tuning fork. When the length is increased by 4%, the number of beats heard per second is 6. Find the frequency of the fork. ***(Ans: n_1 = 156 Hz)***

Long Answer (LA) (4 marks Each)

1) Explain the formulation of stationary waves by analytical method. What are nodes and antinodes? Show that the distance between two successive nodes or antinodes is $\lambda/2$.
2) Explain the production of beats and deduce analytically the expression for beats frequency.
3) State and verify the laws of vibrating strings using a sonometer.
4) Explain the reflection of transverse waves from a denser medium.
5) Explain the reflection of Longitudinal waves from a rarer medium.
6) Waves produced by two vibrators in a medium have wavelength 2 m and 2.1 m respectively. When sounded together they produce 8 beats/second. Calculate wave velocity and frequencies of the vibrators. ***(Ans: n_1 = 168 Hz)***

Chapter 7. WAVE OPTICS

MCQ's (1 Mark Each)

1) When light travels from an optically rarer medium to an optically denser medium, the speed decreases because of change in:

a) Wavelength
b) Frequency
c) Amplitude
d) Phase

Ans – a) Wavelength

2) Light of wavelength 5000 A.U. falls on a plane reflecting surface. The frequency of reflected light is…

a) 6×10^{14}Hz
b) 5×10^{14}Hz
c) 2×10^{14}Hz
d) 1.666×10^{14}Hz

Ans – a) 6×10^{14}Hz

3) Light follows wave nature because…

a) Light rays travel in a straight line
b) Light exhibits the phenomenon of reflection and refraction.
c) Light exhibits the phenomenon of interference.
d) Light causes the phenomenon of photoelectric effect.

Ans – c) Light exhibits the phenomenon of interference.

4) Young's double slit experiment is carried out using green, red and blue light, one colour at a time. The fringe widths recorded are W_G, W_R, and W_B respectively then…

a) $W_G > W_B > W_R$
b) $W_B > W_G > W_R$
c) $W_R > W_B > W_G$
d) $W_R > W_G > W_B$

Ans – d) $W_R > W_G > W_B$

5) The path difference between two waves meeting at a point is (11/4) λ. The phase difference between the two waves is…

a) 11 π/4
b) 11 π/2
c) 11 π
d) 22 π

Ans – b) 11 π/2

6) Which of the following cannot produce two coherent sources?

a) Lloyd's mirror
b) Fresnel biprism
c) Young's double slit
d) Prism

Ans. – d) Prism

7) The bending of beams of light around corners of obstacles is called…

a) Reflection
b) Diffraction
c) Refraction
d) Interference

Ans. – b) Diffraction

8) In a single slit diffraction pattern, first minima obtained with red light of wavelength 6600 A.U. coincides with first maxima f some other wavelength λ then is…

a) 5500 A.U.
b) 5000 A.U.
c) 4800 A.U.
d) 4400 A.U.

Ans. – d) 4400 A.U.

Very Short Answer (VSA) (1 MARK Each)

1) What is the shape of the wave front on Earth for Sunlight?
2) In Young's double slit experiment if there is no initial phase difference between the light from the two slits, a point on the screen corresponds to the 5^{th} minimum. What is the path difference?
3) Two coherent sources whose intensity ratio is 25:1 produce interference fringes. Calculate the ratio of amplitudes of light waves coming from them.
4) Why must two light sources must be of equal intensity to obtain a well-defined interference pattern?
5) What is the relation between phase difference and Optical path in terms of speed of light in vacuum?
6) What should be the slit width to obtain pronounced diffraction with a single slit illuminated by light of wavelength λ?
7) What must be the ratio of the slit width to the wavelength for a single slit, to have the first diffraction minimum at 45˚?

Short Answer I (SA1) (2 MARKS Each)

1) What are Secondary sources? State Huygens' Principle.
2) A Plane Wavefront of light of wavelength 5500 A.U. is incident on two slits in a screen perpendicular to the direction of light rays. If the total separation of 10 bright fringes on a screen 2 m away is 2 cm. Find the distance between the slits.
   (Answer: d =5.5 x 10^{-4}m)
3) State any four Conditions for Obtaining a well – defined and Steady Interference Pattern.
4) Draw a neat, labeled ray diagram of Fresnel Biprism experiment showing the region of interference.
5) What is Optical Path length? How is it different from actual Path length?
6) What is the difference between Fresnel and Fraunhofer diffraction?
7) Compare Young's Double Slit Interference Pattern and Single Slit Diffraction Pattern.
8) Define unpolarised light.
9) Define the plane of polarisation.
10) Define the plane of vibration.
11) State any two postulates of Newton's corpuscular theory.
12) White light consists of wavelengths from 400 nm to 700 nm. What will be the wavelength range seen, When white light is passed through glass of refractive index 1.55 ? ***(Ans: (258.1 to 451 nm)***

13) The Optical Path of a ray of light of a given wavelength traveling a distance of 3 cm in flint glass having refractive index 1.6 is same as that on traveling a distance x cm through a medium having refractive index 1.25. Determine the value of x. ***(Ans: 3.84 cm)***

Short Answer II (SA2) (3 MARKS Each)

1) Explain reflection of light at a plane surface with the help of a neat ray diagram.
2) Describe Young's double slit experiment with a neat diagram showing points of maximum and minimum intensity.
3) Explain experimental setup for Fraunhofer diffraction with neat diagram.
4) The distance between two bright fringes in a biprism experiment using light of wavelength 6000 A.U. 0.32 mm. By how much will the distance change, if light of wavelength 4800 A.U. is used? **(Ans: Change in distance x = 0.06 mm)**
5) A parallel beam of green light of wavelength 546 nm passes through a slit of width 0.4mm. The intensity pattern of the transmitted light is seen on a screen which is 40 cm away. What is the distance between the two first order minima? **(Ans: We = 1mm)**
6) 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 0.2mm and the first minimum is 5mm on either side of the central maximum. Find the wavelength of light **(Ans.: 5000 A.U.)**

Long Answer (LA) (4 marks Each)

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) Explain Fraunhofer diffraction at a single slit with a neat ray diagram. Obtain expression for width of the central bright fringe.
3) What is interference? Explain constructive and destructive interference with the help of a diagram. What are coherent sources of light?

Chapter 8. Electrostatics

MCQ's (1 Mark Each)

1) A metal foil of negligible thickness is introduced between two plates of a capacitor at the centre. The capacitance of capacitor will be
   a) Half
   b) Double
   c) Same
   d) K times

   Ans: c) Same

2) Capacitance (in F) of a spherical conductor of radius 1m is
   a) 1.1×10^{-10}
   b) 9×10^{-9}
   c) 10^{-6}
   d) 10^{-3}

   Ans: a) 1.1×10^{-10}

3) A dipole is placed in a uniform electric field, its potential energy will be minimum when the angle between its axis and field is
   a) 2π
   b) π
   c) $\frac{\pi}{2}$
   d) Zero

   Ans: d) Zero

4) If an electron is brought towards another electron, the electric potential energy of the system.
   a) decreases
   b) increases
   c) Becomes zero
   d) Remains same

   Ans: b) increases.

5) The work done in carrying a charge Q once round a circle of radius r with charge q at the centre of the circle is

a) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{r}$

b) $\frac{Q.q}{4\pi\varepsilon_0 r}$

c) Zero

d) $\frac{Q.q}{2r}$

Ans: c) Zero

6) You are given a number of capacitors labeled as 8μF - 250V. Find the number of capacitors needed to get an arrangement equivalent of 16μF - 1000V.

a) 4

b) 16

c) 32

d) 64

Ans: c) 32

7) A parallel plate capacitor with oil between the plates (dielectric constant of oil, k = 2) has a capacitance C. If the oil is removed, then the capacitance of the capacitor becomes

a) 2C

b) $C\sqrt{2}$

c) $\frac{C}{\sqrt{2}}$

d) $\frac{C}{2}$

Ans: d) $\frac{C}{2}$

Very Short Answer (VSA) (1 MARK Each)

1. What do you mean by dielectric polarization?
2. Which physical quantity has its unit as J/C? Is it a scalar or vector?
3. What are linear isotropic dielectrics?
4. What happens to the energy stored in a capacitor, if the plates of a charged capacitor are drawn apart, the battery remaining connected?
5. What is an equipotential surface?
6. The mean free path of electrons in a metal is 4 x 10^{-8}m. Find the electric field, in units of V/m, which can give on an average 2 eV energy to an electron in the metal.

(Ans: E = V / d = 5 x 10^7 V/m)

7. Find the electric potential at the surface of an atomic nucleus(Z=50) of radius 9×10^{-13} cm. ***(Ans: $V = 8 \times 10^6$ V)***

8. The capacity of a parallel plate capacitor is 10 μF when the distance between its plates is 9 cm. What will be its capacity if the distance between the plates is reduced by 6 cm.

(Ans: $C_2 = 30\mu F$)

Short Answer I (SA1) (2 MARKS Each)

1) Explain the principle of a capacitor.
2) Obtain an expression for the electric field intensity at a point outside a uniformly charged infinite plane sheet.
3) What are polar and non-polar dielectrics?
4) State the principle of working of the van de Graaff generator.
5) Draw a neat, labeled diagram of the Van de Graaff generator.
6) Draw neat, labeled diagram for equipotential surfaces for a dipole.
7) Two capacitors each of capacity 2 μF are connected in parallel. This system is connected in series with a third capacitor of 12μF capacity. Find the equivalent capacity of the system. ***(Ans: 3μF)***
8) Two spheres A and B of radius a and b respectively are at the same potential. Find the ratio of the surface charge densities of A and B**.** ***(Ans: $\frac{\sigma_1}{\sigma_2} = b/a$)***
9) A molecule with a dipole moment p is placed in an electric field of strength E. Initially the dipole is aligned parallel to the field. If the dipole is to be rotated to be anti-parallel to the field, find the work required to be done by an external agent ***(Ans.: $W = 2pE$)***

Short Answer II (SA2) (3 MARKS Each)

1) Derive an expression for the effective capacitance of three parallel plate capacitors connected in series.
2) Obtain an expression for the energy stored in a charged condenser. Express it in different forms.
3) Obtain an expression for the capacitance of a parallel plate capacitor without a dielectric.
4) State properties of conductors in electrostatic conditions.
5) Write principle and explain construction of Van de Graaff generator.
6) Two parallel plate capacitors X and Y have the same area of the plates and same separation between them, are connected in series to a battery of 15 V. X has air between the plates while Y contains a dielectric of constant k = 2.

i) Calculate the capacitance of each capacitor if equivalent capacitance of the combination is 2 μF. ii) Calculate the potential difference between the plates of X and Y. iii) What is the ratio of the electrostatic energy stored in X and Y?

(Ans.: i) $C_x = 3\mu F$ $C_y = 6\mu F$, ii) $V_x = 10$ $V_y = 5$ V iii) Energy stored $_{(x)}$ / Energy stored $_{(y)} = 2 : 1$)

7) Find the amount of work done in rotating an electric dipole of dipole moment 3.2 x 10^{-8} Cm from its position of stable equilibrium to the position of unstable equilibrium in a uniform electric field if intensity 10^4 N / C. ***(Ans: 6.4 x 10^{-4} J)***

8) Three-point charges +q, +2q and Q are placed at the three vertices of an equilateral triangle. Find the value of charge Q (in terms of q), so that electric potential energy of the system is zero**. (Ans.: *Q = -2q / 3)***

Long Answer (LA) (4 marks Each)

1) Obtain an expression for the potential energy of a dipole in an external field.
2) Find the capacitance of a parallel plate capacitor with dielectric slab between the plates.
3) Derive an expression for the electric potential due to an electric dipole.

Chapter 9. CURRENT ELECTRICITY

MCQ'S (1 Mark Each)

1) Kirchhoff's second law (voltage law) is based on

a) conservation of charge

b) conservation of mass

c) conservation of energy

d) conservation of momentum

Ans: c) conservation of energy

2) When unknown resistance is determined by meter bridge, the error due to contact resistance is minimised by

a) connecting both the resistances only in one gap

b) interchanging the position of known and unknown resistances

c) using uniform wire

d) obtaining the null point near the ends of the wire

Ans: b) interchanging the position of known and unknown resistances.

3) The SI unit of potential gradient is

a) V/cm b) V-m

c) V/m d) V-cm

Ans: c) V/m

4) Instrument which can measure terminal potential difference as well as electromotive force (emf) is

a) Wheatstone's meter bridge

b) voltmeter

c) potentiometer

d) galvanometer

Ans.: c) potentiometer

5) When null point is obtained in the potentiometer, the current is drawn from the

a) main battery

b) cell battery

c) both main and cell battery

d) neither main nor cell battery

Ans.: a) main battery

6) If potential gradient of a wire decreases, then its length

a) remains constant

b) decreases

c) increases

d) none of the above

Ans.: c) increases

7) Four resistances 4 Ω,8Ω, XΩ and 12Ω are connected in a series to form Wheatstone's network. If the network is balanced, the value of X is

a) 24 b) 18

c) 12 d) 8

Ans: a) 24

Very Short Answer (VSA) (1 MARK Each)

1) State Kirchhoff's first (current) law.
2) State Kirchhoff's second (voltage) law.
3) What is the basis of Kirchhoff's current law and voltage law?
4) Are Kirchhoff's laws applicable to both AC and DC circuits?
5) Define potential gradients.
6) On what factors does the potential gradient of the wire depend?
7) What is the SI unit of potential gradient?
8) State any one use of a potentiometer.
9) A voltmeter has resistance of 100 Ω. What will be its reading when it is connected across a cell of emf 6 V and internal resistance 20 Ω? ***(Ans: 5 V)***

10) In a meter bridge, two unknown resistances R and S, when connected between the two gaps, gives a null point is 60 cm from one end. What is the ratio of R and S*?*

(Ans: 3/2)

Short Answer I (SA1) (2 MARKS Each)

1. What are the disadvantages of a potentiometer over a voltmeter?
2. Distinguish between a potentiometer and a voltmeter.
3. Distinguish between an ammeter and a voltmeter.
4. How do you calculate the shunt required to increase the length small n times?
5. Define: a) electrical circuit b) Junction
6. Calculate the value of the shunt resistance when connected across a galvanometer of resistance 18Ω will allow 1/10th of the current to pass through the galvanometer. ***(Ans: S = 2Ω)***
7. Four resistances 6Ω,6Ω,6Ω and 18Ω form a Wheatstone bridge. Find the resistance which connected across the 18Ω resistance will balance the network. ***(Ans: 9 Ω)***
8. The maximum safe voltage that can be measured using a galvanometer of resistance G is V_m . Find the resistance to be connected in series with the galvanometer so that it becomes a voltmeter of range nV_m. **[Ans: (n-1) G]**

Short Answer II (SA2) (3 MARKS Each)

1) Explain with a neat circuit diagram. How you will determine the unknown resistances using a meter bridge.
2) State any two sources of errors in the meter bridge experiment. Explain how they can be minimised.
3) What is the potential gradient? How is it measured? Explain.
4) Describe how a potentiometer is used to compare the emf's of two cells by connecting the cells individually.
5) A cell of E.M.F 1.5V and negligible internal resistance is connected in series with a potential meter of length 10 m and total resistance 20 Ω. What resistance should be introduced in the resistance box such that the potential drop across the potentiometer is one microvolt per cm of the wire? 3 ***(Ans: 29980 Ω)***
6) In a meter bridge, the balance point is found to be at 39.5 cm from the end A when the resistor R is of 12.5 Ω (right gap).
   a) Determine the resistance of X (left gap).
   b) Determine the balance point of the bridge if X and R are interchanged?

c) What happens if the galvanometer and cell are interchanged at the balance point of the bridge? ***(Ans: a) 8.16 Ω b) 60.5 cm)***

7) The emf of a standard cell is 1.5V and is balanced by a length of 300 cm of a potentiometer with 10 m long wire. Find the percentage error in a voltmeter which balances at 350 cm when its reading is 1.8 V. 3 ***(Ans: 2.8571 %)***

Long Answer (LA) (4 marks Each)

1) Describe with the help of a neat circuit diagram how you will determine the internal resistance of a cell by using a potentiometer. Derive the necessary formula.

2) Describe how a potentiometer is used to compare the emf's of two cells by the combination method.

3) State the uses of a potentiometer. Why is a potentiometer preferred over a voltmeter for measuring emf?

Chapter 10. Magnetic Field Due to Electric Current

MCQ'S (1 Mark Each)

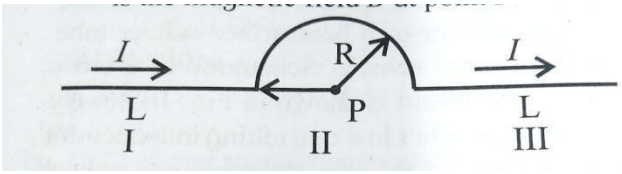
1) According to right hand rule, the direction of magnetic induction if the current is directed in anticlockwise direction is

(a) perpendicular and inwards (b) perpendicular and outwards

(c) same as current (d) opposite to that of current

Ans: b) perpendicular and outwards

2) A conductor has three segments; two straights of length L and a semicircular with radius R. It carries a current I What is the magnetic field B at point P?



(a) $\frac{\mu_0 I}{4\pi R}$ (b) $\frac{\mu_0}{4\pi}\ \frac{I}{R^2}$ (c) $\frac{\mu_0 I}{4R}$ (d) $\frac{\mu_0 I}{4\pi}$

Ans: a) $\frac{\mu_0 I}{4\pi R}$

3) A strong magnetic field is applied on a stationary electron. Then the electron

(a) moves in the direction of the field (b) remained stationary

(c) moves perpendicular to the direction of the field (d) moves opposite to the direction of the field

Ans: b) remained stationary.

4) The force between two parallel current carrying conductors is F. If the current in each conductor is doubled, then the force between them becomes

(a) 4F (b) 2F (c) F (d) F/4

Ans: a) 4F

5) Which of the following is not a unit of magnetic induction?

(a) gauss (b) tesla (c) oersted (d) Wb/m^2

Ans.: c) oersted

6) The magnetic dipole moment of current loop is independent of

(a) number of turns (b) area of loop

(c) current in the loop (d) magnetic field in which it is lying

Ans: d) magnetic field in which it is lying

7) Circular loop of radius 0.0157 m carries a current 2 A. The magnetic field at the centre of the loop is

(a) 1.57×10^{-3} Wb/m² (b) 8.0×10^{-5} Wb/m² (c) 2.0×10^{-3} Wb/m² (d) 3.14×10^{-1} Wb/m²

Ans: (b) 8.0×10^{-5} Wb/m²

Very Short Answer (VSA) (1 MARK Each)

1) What is Lorentz force?

2) What is Solenoid?

3) What is Toroid?

4) Calculate the value of magnetic field at a distance of 2 cm from a very long straight wire carrying a current 5 A

5) What happens to the magnetic field at the centre of a circular current carrying coil if we double the radius of the coil keeping the current unchanged?

6) A solenoid of length 50 cm of inner radius of 1 cm and is made up of 500 turns of copper wire for a current of 5 A in it. What will be the magnitude of the magnetic field inside the solenoid?

7) State the orientation of magnetic dipole with respect to magnetic field, which possess maximum magnetic potential energy

Short Answer I (SA1) (2 MARKS Each)

1) A toroid of 4000 turns has an outer radius of 26 cm and inner radius of 25 cm. If the current in the wire is 10 A. Calculate the magnetic field of the toroid. [Ans: 3.137×10^{-2} T]

2) Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?

3) A solenoid of length π m and 5 cm in diameter has winding of 1000 turns and carries a current of 5 A. Calculate the magnetic field at its centre along the radius. **[Ans : 2 x 10^{-3} T]**

4) Currents of equal magnitude pass through two long parallel wires having separation of 1.35 cm. If the force per unit length on each wire is 4.76 x 10^{-2} N/m, what is *I* ? **[Ans: 56.68 A]**

5) Explain " Magnetic force never does any work on moving charges".

6) State the conditions when magnetic potential energy of a magnetic dipole (current carrying coil) kept in uniform magnetic field be minimum and maximum.

7) Derive the expression for the magnetic field produced by a current in a circular arc of wire.

8) Explain the condition under which a charged particle will travel through a uniform magnetic field in a helical path.

9) What is a cyclotron? State its principle of working.

10) What are the factors on which the cyclotron frequency depends?

Short Answer II (SA2) (3 MARKS Each)

1) Explain Construction and working of Moving coil Galvanometer.
2) Explain Biot Savart's Law.
3) Explain cyclotron motion and cyclotron formula.
4) State under what conditions will a charged particle moving through a uniform magnetic field travel in 1) a straight line 2) a circular path 3) a helical path.
5) A Rectangular coil of 10 turns, each of area 0.05 m^2, is suspended freely in a uniform magnetic field of induction 0.01 T. A current of 30 μA is passed through it. (i) What is the magnetic moment of the coil (ii) What is the maximum torque experienced by the coil? ***[Ans: 15 μA.m^2, 1.5 x10^{-7} N.m]***
6) Using Ampere's Law, derive an expression for the magnetic induction inside an ideal solenoid carrying a steady current.
7) Derive an expression for the net torque on a rectangular current carrying loop placed in a uniform magnetic field with its rotational axis perpendicular to the field.
8) A circular loop of radius 9.7 cm carries a current 2.3 A. Obtain the magnitude of the magnetic field (i) at the centre of the loop (ii) at a distance of 9.7 cm from the centre of the loop but on the axis. ***[Ans: 14.9 μT, 5.267 μT]***
9) The magnetic field at the centre of a circular loop of radius 12.3 cm is 6.4 x 10^{-6} T. What will be the magnetic moment of the loop? ***[Ans: 5.954 x 10^{-2} A m^2]***

Long Answer (LA) (4 marks Each)

1) Show that currents in two long, straight, parallel wires exert forces on each other. Derive the expression for the force per unit length on each conductor.
2) Using Biot Savart's law, obtain the expression for the magnetic induction near a straight infinitely long current carrying wire.
3) Derive an expression for the axial magnetic field produced by current in a circular loop.

Chapter 11. Magnetic materials

MCQ'S (1 Mark Each)

1) The magnetic susceptibility is given by

a) $\chi = \frac{1}{H}$ b) $\chi = \frac{B}{H}$ c) $\chi = \frac{M_{net}}{V}$ d) $\chi = \frac{M}{H}$

Ans : d) $\chi = \frac{M}{H}$

2) 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) $\mu_r = 1 + \chi$

Ans : d) $\mu_r = 1 + \chi$

3) 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) $L = \frac{m_o e}{2m_e}$ b) $L = \frac{e}{2m_o m_e}$ c) $L = \frac{2m_o m_e}{e}$ d) $L = \frac{2e}{m_o m_e}$

Ans : c) $L = \frac{2m_o m_e}{e}$

4) If m_o and L denote the orbital angular moment and the angular momentum of the electron due to its orbital motion, then the gyromagnetic ratio is given by

a) $\frac{L}{m_o}$ b) $\frac{m_o}{L}$ c) Lm_o d) $\sqrt{\frac{m_o}{L}}$

Ans : b) $\frac{m_o}{L}$

5) Relative permeability of iron 5500, then its magnetic susceptibility will be

a) 5500×10^7 b) 5501 c) 5499 d) 5500×10^{-7}

Ans : c) 5499 , hint : $\chi = \mu_r - 1$

6) What is magnetization of a bar magnet having length 6 cm and area of cross section 5 cm^2 ?

(m_{net}= 1)

$a)1.2\times10^{-4}$ A/m b) 3.3×10^{4} A/m c) 1.25×10^{-4} A/m d) 3.3×10^{-4} A/m

Ans : b) 3.3× 10^{4} A/m , M = $\frac{m_{net}}{V} = \frac{m_{net}}{AL}$

7) A magnetic material of susceptibility 3×10^{-4}, and magnetic intensity is 4×10^{-4} Am^{-1} .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}

Ans : a) 12×10^{8} , M = χ H

Very Short Answer (VSA) (1 MARK Each)

1. Give a gyromagnetic ratio.
2. What is stated in terms of Bohr magneton.
3. Define magnetization.
4. What does the ratio of magnetization to magnetic intensity indicate?
5. What is diamagnetism?
6. State the formula for the periodic time of angular oscillations of the bar magnet, in terms of moment of inertia.
7. The relative permeability of a medium is 0.075. What is its magnetic susceptibility?

(Ans: 0.925 , hint : $\chi = \mu_r - 1$***)***

8. The moment of a magnet (15 cm×2cm×1cm) is 1.2 A-m^2.What is its intensity of magnetization? **(*Ans :*** $M = 4\times10^{4}\,Am^{-1}$ **)**

9. The electron in hydrogen atom is moving with a speed of 2.5×10^{6} m/s in an orbit of radius 0.5 $\mathring{A}$. What is the Magnetic moment of the revolving electron? ***(Ans:*** $m_o = \frac{evr}{2}$ $= 10^{-23}\,Am^2$***).***

Short Answer I (SA1) (2 MARKS Each)

1. Show that the orbital magnetic dipole moment of a revolving electron is $\frac{evr}{2}$.

2. Derive the quantity for Bohr magneton and also state its value.

3. Define magnetization. State its SI unit and dimensions.

4. What is magnetic hysteresis?

5. Define: 1) retentivity 2) coercivity.

6. Explain magnetic shielding.

7. Calculate the gyromagnetic ratio of electrons. (given e =1.6×10^{-19} C, $m_c = 9.1\times10^{-31}$ kg)

Ans.: hint: gyromagnetic ratio = $\frac{e}{2m_e} = 8.8\times10^{10}$ **C** kg^{-1}

8. An iron rod of area of cross-section $0.1m^2$ is subjected to a magnetizing field of 1000 A/m.

Calculate the magnetic permeability of the iron rod.(χ for iron = 599 , $\mu_0 = 4\pi\times10^{-7}$SI unit)

Ans.: 7.54$\times 10^{-4}$ **, hint:** $\mu_r = \chi + 1$, $\mu = \mu_r\mu_o$

9. 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 meter. Calculate the magnetization of the

material.

Ans.: 2.495×10^5 **A**m^{-1}**,** $\mathbf{H = Ni}$, $\chi = \mu_r - 1$, $\mathbf{M = XH} = (\mu_r - 1)\mathbf{H}$

Short Answer II (SA2) (3 MARKS Each

1) Define magnetic intensity. Explain magnetization of a material.
2) Obtain an expression for the orbital magnetic moment of an electron rotating about the nucleus in an atom.
3) Define gyromagnetic ratio. Find relation for Bohr magneton.
4) What is a paramagnetic material? Give two examples.
5) State any four properties of a paramagnetic material.
6) State Curie's law of Paramagnetic material.

7) What is a ferromagnetic material? Give two examples.
8) Explain magnetic hysteresis in a ferromagnetic material.
9) 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^{-1} then magnetic moment of 5 Am^2 is induced in it. Find out magnetic induction in the plate. *(Ans : $M = 5 \times 10^6\ Am^{-1}$, B = 6.29 T)*
10) A magnet of magnetic moment $3Am^2$ weighs 75 g. The density of the material of the magnet is 7500 kg/m^3 What is the magnetization.? (Ans: M= 3×10^5 A/m)
11) Find the relative permeability, if the permeability of a metal is 0.1256 TmA^{-1}

(Ans: 10^5 ***)***

Long Answer (LA) (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 the origin of magnetism in material, hence find the magnetic moment of an electron revolving around the nucleus of an atom.
3) Derive an expression for a torque acting on a magnetic dipole in a region of uniform magnetic induction. Express it in vector form.
4) State any four properties of a diamagnetic material.
5) An electron in an atom is revolving round the nucleus in a circular orbit of radius 5.3×10^{-11} m, with a speed of 2×10^6 ms^{-1} .Find resultant orbital magnetic moment and angular momentum of electron.
(e = 1.6×10^{-19} C , m = 9.1×10^{-31} kg)

(Ans: $m_o = 8.48 \times 10^{-24}\ Am^2$ **,** $L = 9.646 \times 10^{-35}\ kg.m^2/s$

Chapter 12. Electromagnetic Induction

MCQ'S (1 Mark Each)

1) In which of the following devices, the eddy current is not used

(a) Electromagnet (b) Induction furnace (c) Electric heater (d) Magnetic braking in train

Ans: c) electric heater

2) An ideal transformer has 100 turns in the primary and 250 turns in the secondary. The peak value of the AC is 28 V. The rms secondary voltage is nearest to

(a) 100 V (b) 70 V (c) 50 V (d) 40 V`

Ans: c) 50 V

3) The role of inductance is equivalent to

(a) inertia (b) force (c) energy (d) momentum

Ans: a) inertia

4) The energy stored in a 50 mH inductor carrying a current of 4 A is

(a) 0.4 J (b) 0.1 J (c) 0.04 J (d) 0.01 J

Ans: a) 0.4 J

5) In the expression $e = -d\emptyset/dt$, the -ve sign signifies

(a) The induced emf is produced only when magnetic flux decreases

(b) The induced emf opposes the change in the magnetic flux

(c) The induced emf is opposite to the direction of the flux.

(d) The induced emf is independent of change in magnetic flux.

Ans: b) The induced emf opposes the change in the magnetic flux

6) Two pure inductors each of self-inductance L are connected in series, the net inductance is

(a) 2L (b) L (c) L/2 (d) L/4

Ans: a) 2L

7) A magnet is moved towards a coil (i) quickly (ii) slowly, then the induced e.m.f. is

(a) larger in case (i) (b) smaller in case (i)

(c) equal to both the cases (d) larger or smaller depending upon the radius of the coil

Ans: a) larger in case (i)

Very Short Answer (VSA) (1 MARK Each)

1. State Faraday's Law of electromagnetic Induction.
2. State the mathematical relation between number of turns in primary coil to secondary coil in step up transformer.
3. State the condition at which we say the two coils kept close to each other are perfectly coupled with each other.
4. State Lenz's Law.

5. A pair of adjacent coil has a mutual inductance of 1.5 H. If the current in one coil varies from 0 to 20 A in 0.5 s, what is the change of flux linked with the other coil.**(Ans:15 Wb)**

6. An aircraft with a wing span of 50 m flies horizontally in earth's magnetic field of 6 x 10^{-5} T at a speed of 400 m/s. Calculate the emf generated between the tips of the wings of the aircraft**. (Ans: 1.2 V)**

7. A coil of self-inductance 3 H carries a steady current of 2 A. What is the energy stored in the magnetic field of the coil? [Ans: 6 J]

Short Answer I (SA1) (2 MARKS Each)

1) Why and where eddy currents are undesirable? How are they minimized?

2) Define Self Inductance, Mutual Inductance

3) Explain why the inductance of two coils connected in parallel is less than the inductance of neither coil.

4) An emf of 96 mV is induced in the windings of a coil when a current in a nearby coil is increasing at

the rate of 1.20 A/s. What is the mutual inductance of the two coils? **[Ans: 80 mH]**

5) Calculate the induced emf between the ends of an axle of a railway carriage 1.75 m long

traveling on level ground with a uniform velocity 50 kmph. The vertical component of

Earth's magnetic field (B_v) is 5 x 10^{-5} T. **[Ans: 1.215 mV]**

6) The magnetic flux through a loop varies according to the relation $\emptyset = 8t^2 + 6t + 2$, $\emptyset$ is in milliweber and t is in second. What is the magnitude of the induced emf in the loop at t = 2 seconds?

[38 mV]

7) Distinguish between Step up and Step-Down Transformer.

8) Explain back emf in a motor.

9) What is an ac generator? State the principle of an ac generator.

Short Answer II (SA2) (3 MARKS Each)

1) What is a Transformer? Explain step up and step-down transformers?
2) Determine the motional emf induced in a straight conductor moving in a uniform magnetic field with constant velocity on the basis of Lorentz force.

3) Describe the construction of a simple ac generator and explain its working.
4) Determine the magnetic energy stored per unit length of a coaxial cable, represented by two coaxial cylindrical shells of inner radii a, Outer radii b and carrying current I.
5) Obtain an expression for the self-inductance of a solenoid.
6) The primary of a transformer has 40 turns and works on 100 V and 100 W. Find a number of turns in the secondary to step up the voltage to 400 V. Also calculate the current in the secondary and primary. *[160, 0.25 A, 1 A]*
7) The primary and secondary coil of a transformer each have an inductance of 200 x 10^{-6} H. The mutual inductance (M) between the windings is 4 x 10^{-6} H. What percentage of the flux from one coil reaches the other? ***[Ans: 2 %]***
8) A plane of coil of 10 turns is tightly wound around a solenoid of diameter 2 cm having 400 turns per centimeter. The relative permeability of the core is 800. Calculate the inductance of solenoid. ***[Ans: 0.1264 H]***

Long Answer (LA) (4 marks Each)

1) Find an expression for the power expended in pulling a conducting loop out of a magnetic field.
2) Using Ampere's law, obtain an expression for the magnetic induction near a current carrying straight infinitely long wire.
3) Describe the construction and working of a transformer with a neat, labeled diagram.

Chapter 13. A.C CIRCUITS

MCQ'S (1 Mark Each)

1) An electric current in an LC – circuit at resonance is called -

a) The wattless current
b) The displacement current.
c) The idle current
d) The apparent current

Ans: a) The wattless current

2) In a series LCR circuit at resonance, the applied emf and current are -

a) Out of phase
b) Differ in phase by $\pi/4$ radian.
c) Differ in phase by $\pi/2$ radian.
d) In phase

Ans: d) In phase

3) A series LCR resonant circuit is used as

a) A potential divider circuit.
b) A radio wave transmitter
c) A source of displacement current
d) A tuning circuit in a television receiver set.

Ans: d) A tuning circuit in a television receiver set.

4) If AC voltage is applied to pure capacitor, then voltage across the capacitor

a) Leads the current by phase angle π rad.
b) Leads the current by phase $\pi/2$ rad.
c) Lags the current by phase angle π rad.
d) Lags the current by phase angle $\pi/2$ rad.

Ans: d) Lags the current by phase angle $\pi/2$ rad.

5) A parallel *LC* resonant circuit is used as ….

a) a tuning circuit in a television receiver set.
b) a transformer
c) a rectifier

d) a filter circuit.

Ans: d) a filter circuit

6) An electric bulb operates 10 V d.c. If this bulb is connected to an a.c. source and gives normal brightness, then peak value of the source is …….

a) 141.4 V
b) 14.14 V
c) 1.414 V
d) 0.1414 V

Ans: b) 14.14 V

7) A coil of resistance 300Ω and inductance 1.0 H is connected across an alternating voltage of frequency $\frac{300}{2\pi}$ Hz, therefore phase difference between the voltage and current in the circuit is

a) 180^0
b) 90^0
c) 45^0
d) 0^0

Ans : c) 45^0

Very Short Answer (VSA) (1 MARK Each)

1. Define capacitive reactance.
2. A charged 10 microfarad capacitor is connected to a 81 mH inductor. What is the angular frequency of free oscillations of the circuit**?** ***(Ans: 1.1 X 10^3 rad per sec)***
3. State the equation for impedance Z in an A.C. circuit.
4. In an LCR series circuit, what is the condition for current resonance?
5. State any one characteristic of a parallel LC AC resonance circuit.
6. State the expression for an average power consumed over one cycle in the case of a series LCR AC circuit.
7. What is the relation between average current and rms current over half cycle.

(Ans: $\frac{2\sqrt{2}}{\pi} i_{rms}$ ***)***

8. If the peak value of an alternating emf is 15V, what is its mean value over half cycle?

(Ans: 9.548 V)

Short Answer I (SA1) (2 MARKS Each)

1. State the average or mean value of an alternating emf? Obtain the expression for it.
2. Explain term impedance and state the formula for it in the case of an LCR series circuit.
3. State any two characteristics of a series LCR AC resonance circuit.
4. In an LCR series circuit, what is the (a) impedance and (b) reactance at current resonance?
5. A series LCR circuit has resistance 10Ω and reactance is $7\sqrt{2}$ Ω. What is the impedance of the circuit? ***(Ans: 14.07Ω)***
6. A coil of resistance 10 Ω and inductance 100mH and a capacitor of variable capacitance are connected across a 20V,50Hz A.C. supply. At what capacitance will resonance occur? ***(Ans: 318.5μF)***
7. Find the current in a circuit consisting of a coil and a capacitor in series with an A.C source of 110V (r.m.s.), 60Hz.The inductance of a coil in 0.80 H and its resistance is 50Ω.The capacitance of a capacitor is 8μF**. (Ans:** $I_{rms} = 1.88A$)
8. A 0.5μF capacitor is discharged through a 10 millihenry inductor. Find the frequency of discharge. **(Ans:** $2.25\times10^{3}\ Hz$***)***
9. What is the capacitive reactance of a capacitor of 5μF at a frequency (1) 50 Hz and (2) 20KHZ? ***(Ans: 636.94Ω, 1.59Ω)***

Short Answer II (SA2) (3 MARKS Each)

1) State the rms value of an alternating current? Write the relation between the rms value and peak value of an alternating current that varies with time.
2) Explain the term inductive reactance. State its unit and dimensions.
3) Explain the term capacitive reactance. State its unit and dimensions.
4) Define power and obtain an expression for the average power (cover one cycle) in an ac circuit containing a pure (an ideal) resistor.
5) Explain the terms sharpness of resonance and Q factor (quality factor).
6) What is the inductive reactance of a coil of inductance 10mH at a frequency (1) 50Hz (2) 1000Hz (3) 20kHz? ***(Ans: 3.14Ω,62.8Ω,1256Ω)***
7) An alternating emf of 230V,50Hz is connected across a pure ohmic resistance of 50Ω. Find (1) the current (2) equations for instantaneous values of current and voltage.
(Ans: $I_{rms} = 4.6A$ **,** $E_0 = 325.27\ V$, $I_0 = 6.5A$, $I = 6.5\sin sin\ 100\pi t$,
$E = 325.27\sin sin\ 100\pi t$ ***)***

8) A radio can tune over the frequency range of a portion of MW broadcast-band (800 kHz-1200kHz). If its LC circuit has an effective inductance of 200mH, what must be the range of its variable condenser? ***(Ans: 88pF to 198pF)***

Long Answer (LA) (4 marks Each)

1) Obtain the expression for the applied emf and the effective resistance of the circuit when alternating emf is applied to an LR circuit.
2) Obtain the expression for the applied emf and the effective resistance of the circuit when alternating emf is applied to an CR circuit.
3) Obtain the expression for the resonant frequency of the LCR series circuit and explain electrical resonance in an LCR series circuit.

Chapter14. Dual Nature of Radiation and Matter.

MCQ'S (1 Mark Each)

1) The electrons are emitted in the photoelectric effect from a metal surface.

a) only if the frequency of radiation is above a certain threshold value.

b) only if the temperature of the surface is high.

c) that is independent of the nature of metal.

d) with a maximum velocity proportional to the frequency of incident radiation

Ans: a) only if the frequency of radiation is above a certain threshold value

2) As the intensity of incident light increases

a) photoelectric current increases

b) photoelectric current decreases.

c) kinetic energy of emitted photoelectrons increases

d) kinetic energy of emitted photoelectrons decreases.

Ans: a) photoelectric current increases.

3) The maximum kinetic energy of the photoelectrons depends only on

a) potential b) frequency c) incident angle d) pressure

Ans : b) frequency .

4) According to De-Broglie, the waves are associated with

a) moving neutral particles only.

b) moving charged particles only.

c) electrons only

d) all moving matter particles

Ans : d) all moving matter particles

5) The work function of a metal is 4.2 Ev.Its threshold wavelength will be

a) 4000 $\mathring{A}$ b) 3500 $\mathring{A}$ c) 2959 $\mathring{A}$ d) 2500 $\mathring{A}$

Ans : c) 2959 $\mathring{A}$ **,** $\lambda = \frac{hc}{\emptyset_\circ}$

6) Ultraviolet radiation of 6.2 eV falls on an Aluminum surface (work function 4.2 eV).

The kinetic energy in joules of the fastest electron emitted is

a) 3.2×10^{-21} b) 3.2×10^{-19} c) 3.2×10^{-17} d) 3.2×10^{-15}

Ans: b) 3.2×10^{-19} **,**$K.E_{max} = h\nu - \emptyset_\circ$

7) Planck's constant is 6.6×10^{-34} Js. The momentum of each photon in a given radiation is 3.3×10^{-29} kg/s. The λ of radiation is

a) 2×10^{10} m b) 2×10^{7} m c) 2×10^{5} m d) 2×10^{-5}m

Ans: d) 2×10^{-5} **m ,** $\lambda = \frac{h}{p}$

Very Short Answer (VSA) (1 MARK Each)

1 Define photoelectric effect.

2 Define threshold frequency.

3 What is the cut off or stopping potential?

4 Define the work function of the metal.

5 The minimum frequency for photoelectric effect on a metal is 7×10^{14} Hz, Find the work function of the metal. (Ans: $\emptyset_{\circ} = h\nu_{\circ} = 4.62\times10^{-19}$ J)

6 Find the kinetic energy of an emitted electron, if in a photoelectric effect the energy of the incident Photon is 4 eV and the work function is 2.4 eV. **(Ans:** $K.E._{max}$ **=1.6 eV.)**

7 Find energy of photon which have momentum 2×10^{-16} gm-cm/sec.

(Ans : E = 6×10^{-6} **erg)**

Short Answer I (SA1) (2 MARKS Each)

1 Explain the term 'wave particle duality' of matter.

2 Draw a neat labeled diagram of schematic of experimental set up for photoelectric effect.

3 What is meant by the dual nature of matter.

4 Explain the concept of photoelectric effect.

5 If the total energy of radiation of frequency 10^{14}Hz is 6.63 J , Calculate the number of photons in the radiation**.** ***(Ans n=*** $\frac{E}{h\nu} = 10^{20}$***)***

6 An electron is accelerated through a potential of 120 V. Find its de Broglie wavelength**.**

(Ans : $\lambda = \frac{1.228}{\sqrt{V}}$ ***= 0.112 nm)***

7 Calculate the stopping potential when the metal with the work function 0.6 eV is illuminated with the light of 2 eV. **(***Ans* $V_0 = \frac{E - \emptyset_\circ}{e}$ ***= 1.4 V)***

Short Answer II (SA2) (3 MARKS Each)

1) State Einstein photoelectric equation. Explain 2 characteristics of photoelectric effect on the basis of Einstein's photoelectric equation.
2) With the help of circuit diagrams describe an experiment to study photoelectric effect.
3) What is the photoelectric effect? Define stopping potential and photoelectric work function.
4) Describe photocell construction and working with a neat, labeled diagram.
5) With a neat, labeled diagram, describe the Davisson and Germer experiment in support of the concept of matter waves.
6) Calculate De Broglie wavelength of bullet moving with speed 90m/sec and having a mass 5 gm**.** ***(Ans.*** $\lambda = 1.472 \times 10^{-31}$ ***m,*** $\lambda = \frac{h}{mv}$***)***
7) The energy of a photon is 2 eV. Find its frequency and wavelength.

(Ans. Frequency, $v = \frac{E}{h} = 4.826 \times 10^{14}$ ***Hz., Wavelength*** $\lambda = \frac{c}{\nu} = 6229\ \mathring{A}$***)***

8) The work function of a surface is 3.1 eV. A photon of frequency 1 x 10^{15} Hz. There is an incident on it. Calculate the incident wavelength if photoelectric emission occurs or not.

(Ans $\lambda_\circ = \frac{hc}{\emptyset_\circ} = 4000\ \mathring{A}$ ***photoelectric emission occur.)***

Long Answer (LA) (4 marks Each)

1) With the help of a circuit diagram describing the experiment to study the characteristics of photoelectric effect, Hence discuss any 2 characteristics of photoelectric effect.
2) State Einstein's photoelectric equation. Explain all characteristics of photoelectric effect, on the basis of Einstein's photoelectric equation.
3) Explain De Broglie's Hypothesis.

Chapter 15. Structure of Atoms and Nuclei

MCQ'S (1 Mark Each)

1). When an electron jumps from higher energy orbit to lower energy orbit, the difference in the energies in the two orbits is radiated as a quantum (photon) of….

(a) $E = mc^2$ (b) $E = \frac{h}{\upsilon}$ (c) $E = \frac{hc}{\lambda}$ (d) $E = \frac{\lambda}{hc}$

Ans : (c) $E = \frac{hc}{\lambda}$

2). The radii of Bohr orbit are directly proportional to….

(a) Principal quantum number

(b) Square of principal quantum number

(c) Cube of principal quantum number

(d) Independent of principal quantum number

Ans : (b) square of principal quantum number

3). According to Bohr second postulate, the angular momentum of electron is the integral multiple of $\frac{h}{2\pi}$. The S.I unit of Planck constant *h* is the same as……

(a) Linear momentum (b) angular momentum (c) Energy (d) Centripetal force

Ans : (b) angular momentum

4). The ionization energy of Hydrogen atoms in its ground state is……

(a) 3.4 e V (b) 10.2 eV (c) 13.6 eV (d) – 13.6 eV

Ans : (c) 13.6 eV

5). For hydrogen atoms, the minimum excitation energy (of n =2) is….

(a) 3.4 e V (b) 10.2 eV (c) 13.6 eV (d) – 10.2 eV

Ans : (b) 10.2 eV

6). The dimensions of Rydberg's constant are…..

(a) $[M^0 L^1 T^0]$ (b) $[M^0 L^{-1} T^0]$ (c) $[M^0 L^1 T^1]$ (d) $[M^0 L^{-1} T^{-1}]$

Ans : (b) $[M^0 L^{-1} T^0]$

7). In a Hydrogen, an electron jumps from fourth orbit to second orbit. The wave number of the radiations emitted by electron is

(a) $\frac{R}{16}$ (b) $\frac{3R}{16}$ (c) $\frac{5R}{16}$ (d) $\frac{7R}{16}$

Ans : (b) $\frac{3R}{16}$

8). The speed of electron having de Broglie wavelength of 10^{-10} m is

($m_e = 9.1 \times 10^{-31}$ kg, $h = 6.63 \times 10^{-34}$ J-s)

(a) 7.28×10^{6} m/s (b) 4×10^{6} m/s (c) 8×10^{5} m/s (d) 5.25×10^{5} m/s

Ans: (a) 7.28×10^{6} m/s

9). The decay constant λ of a certain radioactive material is 0.2166 per day. The average life τ of the radioactive material is….

(a) 5.332 days (b) 4.617days (c) 2.166 days (d) 1.083 days

Ans : (b) 4.617 days

10). The ratio of areas of the circular orbit of an electron in the ground state to that of the first excited state of an electron in a hydrogen atom is…

(a) 16 : 1 (b) 4 :1 (c) 1 :4 (d) 1 :16

Ans : (d) 1 :16

Very Short Answer (VSA) (1 MARK Each)

1. What is the angular momentum of an electron in the first excited state for a hydrogen atom?

2. If a_O is the Bohr radius and n is the principal quantum number then, state the relation for the radius of n^{th} orbit of electron in terms of Bohr radius and principal quantum number.

3. In which region of the electromagnetic spectrum for Hydrogen, does the Lyman series lie?

4. How much energy must be supplied to hydrogen atom, to free (remove) the electron in the ground state?

5. State the value of minimum excitation energy for Hydrogen atoms.

6. What is the energy of an electron in a hydrogen atom for $n = \infty$.

7. What is nuclear energy?

8. What is Radioactivity?

9. The radius of the smallest orbit of the electron (a_O) in a hydrogen atom is 0.053 nm. What is the radius of the 4th orbit of the electron in a hydrogen atom?

(Hint: $r_4 = a_O\, n^2 = 0.053 \times 16 = 0.848$ nm)

10. The half-life of a certain radioactive species is 6.93×10^5 seconds. What is the decay constant?

(Hint: $\lambda = \frac{0.693}{T_{1/2}} = 10^{-6}\, sec$)

11. The linear momentum of the particle is 6.63 kg m/s. Calculate the de Broglie wavelength.

(Hint: $\lambda = \frac{h}{p} = 10^{-34}\, m$)

Short Answer I (SA1) (2 MARKS Each)

1. Starting with $r = \frac{\epsilon_o h^2 n^2}{\pi m Z e^2}$ Show that the speed of electrons in n^{th} orbit varies inversely to principal quantum number.

2. State Bohr second postulate for atomic model. Express it in its mathematical form.

3. State any two limitations of Bohr's model for hydrogen atoms.

4. Using de Broglie's hypothesis, obtain the mathematical form of Bohr's second postulate.

5. Show that the half-life period of radioactive material varies inversely to decay constant λ.

6. Define (i) Excitation energy (ii) Ionization energy

7. Define 1) atomic number 2) mass number.

8. What are isotopes? Give one example.

9. What are isotones? Give one example.

10. Define mass defect and state an expression for it.

11. What are the quantities conserved in a nuclear reaction?

12. Give one application of 1) nuclear fission 2) nuclear fusion.

13. Explain: Nuclear binding energy.

14. What is alpha decay? Give its expression.

15. Calculate the longest wavelength in the Paschen series.

(Given $R_H = 1.097 \times 10^7\ m^{-1}$)

16. The angular momentum of electrons in 3rd Bohr orbit of Hydrogen atoms is 3.165×10^{-34} kg m^2/s. Calculate Plank's constant *h*. ***(Ans: h= 6.63 × 10^{-34} Js)***

17. The half-life of a certain radioactive nucleus is 3.2 days. Calculate (i) decay constant (ii) average life of radioactive nucleus. ***(Ans: λ = 0.2166 per day, τ = 4.617 days)***

18. Draw a neat, labeled diagram showing energy levels and transition between them for hydrogen atoms.

Short Answer II (SA2) (3 MARKS Each)

1) Derive an expression for the radius of the n^{th} Bohr orbit for hydrogen atoms.
2) Using the expression for energy of electron in the n^{th} orbit, Show that

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n^2} - \frac{1}{m^2}\right)$$, Where symbols have their usual meaning.

3) Show that for radioactive decay $N(t) = N_O\, e^{-\lambda t}$, where symbols have their usual meaning.
4) Obtain an expression for half life time of radioactive material. Hence state the relation between average life and half life time of radioactive material.
5) State three properties of alpha particles.
6) Calculate the wavelength for the first three lines in the Paschen series. (Given $R_H = 1.097 \times 10^7\ m^{-1}$) ***(Ans: $\lambda_1 = 1.876 \times 10^{-6}$ m, $\lambda_2 = 1.282 \times 10^{-6}$ m, $\lambda_3 = 1.094 \times 10^{-6}$ m)***
7) Calculate the shortest wavelength in Paschen series if the longest wavelength in Balmar series is 6563 A°. ***(Ans: λ_B =6563 A, λ_p = 8203.75 A)***
8) A radioactive substance decays to (1/10)th of its original value in 56 days. Calculate its decay constant. ***(Ans: λ =4.112 ×10^{-2} per day)***

Long Answer (LA) (4 marks Each)

1) State the postulates of Bohr's atomic model. Hence show energy of electrons varies inversely to the square of principal quantum number.

2) Obtain an expression for wavenumber, when electron jumps from higher energy orbit to lower energy orbit. Hence show that the shortest wavelength for Balmar series is $4/R_H$.
3) Obtain an expression for decay law of radioactivity. Hence show that the activity $A(t) = \lambda N_O e^{-\lambda t}$.
4) Using the expression for the radius of orbit for Hydrogen atoms, show that the linear speed varies inversely to principal quantum number *n* the angular speed varies inversely to the cube of principal quantum number *n*.

Chapter 16. Semiconductors Devices

MCQ'S (1 Mark Each)

1). In a Bipolar junction transistor, the largest current flows through

(a) in the emitter (b) in the collector (c) in the base (d) through CB junction

Ans: (a) in the emitter

2). A LED emits visible white light when it's

(a) junction is reversed biased (b) depletion layer widens

(c) holes and electrons recombine (d) junction becomes hot

Ans: (c) holes and electrons recombine.

3). Solar cell operates on a principle of

(a) diffusion (b) recombination (c) photovoltaic action (d) carrier flow

Ans: (c) photovoltaic action

4). The Boolean expression for Exclusive OR gate (X-OR gate) is

(a) A+B (b) $A \oplus B$ (c) $\overline{A + B}$ (d) A.B

Ans: (b) $A \oplus B$

5). In a common base configuration, the transistor has emitter current of 10 mA and collector current of 9.8 mA. The value of base current is….

(a) 0.1 mA (b) 0.2 mA (c) 0.3 mA (d) 0.4 mA

Ans: (b) 0.2 mA

6). For a transistor $\beta = 75$ and $I_E = 7.5$ mA. The value of α is….

(a) 0.1 (b) 0.66 (c) 0.75 (d) 0.98

Ans: (d) 0.98

7). In a transistor amplifier, $I_C = 5.5$ mA , $I_E = 5.6$ mA. The current amplification factor β is…

(a) 45 (b) 50 (c) 55 (d) 60

Ans : (c) 55

8). For which logic gate the following statement is true

The output is low, if and only if all inputs are low

(a) AND (b) NOR (c) NAND (d) OR

Ans : (d) OR

Very Short Answer (VSA) (1 MARK Each)

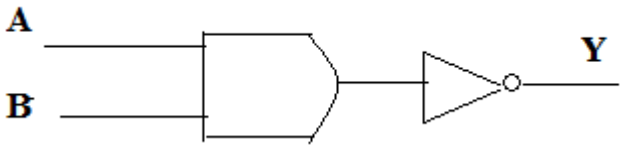
1. State any two special purpose diodes
2. What is the purpose of a capacitor filter in regulated power supply?
3. State the logical expression for NAND gate.
4. Which method of biasing is used for operating transistors as amplifiers?
5. Draw the circuit symbol of the PNP transistor.
6. For a transistor I_C = 15 mA, I_B = 0.5 mA. What is the current amplification factor?

(Hint: $\beta = \frac{I_C}{I_B}$)

7. Give the truth table for NOR gate.
8. What is the need of rectification in regulated power supply?
9. Give a circuit symbol of a Zener diode.
10. State any two applications of Zener diode

Short Answer I (SA1) (2 MARKS Each)

1. Draw a neat labeled circuit diagram of a full wave rectifier using a semiconductor diode.
2. Draw a neat labeled circuit diagram for the transistor as a common emitter amplifier.
3. State any two advantages and disadvantages of a photodiode.
4. State the advantages of full wave rectifier
5. Define current amplification factor α_{DC} and β_{DC} Obtain the relation between them.
6. Draw the block diagram of a simple rectifier circuit with respective output waveform
7. Give the truth table and Boolean expression for



Short Answer II (SA2) (3 MARKS Each)

1) Draw the circuit diagram of a half wave rectifier. Hence explain its working.
2) Explain the construction and working of solar cells.
3) Explain the working of LEDs.

4) Explain the principle of operation of a photodiode.
5) What is a logic gate? Draw the symbol and give the truth table for NOT gate. Why NOT the gate is called an inverter?
6) Explain the working of PNP transistors?
7) Draw the circuit symbol for NPN and PNP transistors. What is the difference in Emitter, Base and Collector regions of a transistor?
8) A neat circuit diagram explains the use of a Zener diode as a voltage regulator.

Long Answer (LA) (4 marks Each)

1) With the help of a neat diagram, explain the working of npn transistors?
2) With the help of a neat circuit diagram, explain the transistor as an amplifier?
3) Define dark current of photodiodes. What are the advantages and disadvantages of photodiode?
4) Draw the circuit diagram to study the characteristics of transistors in common emitter mode. Draw the input and output characteristics.