Std. XII

PHYSICS

Specimen Question Bank

(Numericals)

Chapter Number 1 To 19

CHAPTER 1 - CIRCULAR MOTION

S. A. I (2 Marks)

1. Calculate the angular velocity and linear velocity of a tip of minute hand of length 10 cm.
2. Propeller blades in aeroplane are 2 m long and rotating with 1800 rpm. What is the tangential velocity at a point on blade midway between tip and axis?
3. A car of mass 2000 kg round a curve of radius 250 m at 90 km/hr. Find centripetal force.
4. A bucket containing water is whirled in a vertical circle at arms length. Find the minimum speed at top to ensure that no water spills out. (Given r = 0.75 m)
5. A motor cyclist at a speed of 5 m/s is describing a circle of radius 25 m. Find his inclination with vertical. What is the value of coefficient of friction between tyre and ground?
6. A small body of mass m = 0.1 kg at the end of a chord of length 1 m swings in a vertical circle. Its speed is 2 m/s when the chord makes an angle $\theta = 30^0$ with the vertical. Find the tension in the chord.
7. A pendulum bob of mass m is held in the horizontal position and then released. Show that the velocity of bob at lowest position is $\sqrt{2gl}$.
8. To stimulate the acceleration of large rockets, astronauts are spun at the end of a long rotating beam of length 9.8 m. What is anglular speed required to generate a centripetal acceleration 8 times the acceleration due to gravity?
9. Find the maximum speed with which a car can be driven safely along a curved path of radius 100 m, if the coefficient of friction between the tyres of the car and road surface is 0.2 ($g = 9.8\ m/s^2$).
10. The radius of curvature of road is 60 m. If the angle of banking is 27^0, find the maximum speed with which a vehicle can turn safely along this curve ($g = 9.8\ m/s^2$).
11. A conical pendulum has length 1 m and the angle subtended by string with the vertical is 8^0. Find its angular speed.
12. A bucket containing water is tied to one end of a rope 8 m long and rotated about the other end in vertical circle. Find the number of rotations per minute in order that water in the bucket may not spill.

13. A stone of mass 10 kg tied with a string of length 0.5 m is rotated in vertical circle. Find the total energy of a stone at the highest position.

14. A motor cycle is travelling at 30 m/s on a circular road of radius 300 m. Its speed is increasing at the rate of 4 m/s^2. Calculate acceleration of the car.

15. A particle moves along the circular path of radius 15 cm with a constant angular acceleration of 4 rad/s^2. If the initial angular speed of the particle is 5 rad/s, find angular displacement of the particle in 5 second.

S. A. II (3 Marks)

1. A body of mass 100 gram is tied to one end of the spring of length 4 m and whirled in a horizontal circle. Find the maximum frequency with which the body can be whirled if the spring breaks under a tension of 45 kg wt.

2. A particle performs U.C.M. in a circle of radius 1 m. If the frequency of revolution is 120 r.p.m. find (1) period of revolution (2) linear speed (3) centripetal acceleration.

3. A bucket containing water is whirled in a vertical circle at arms length. Find the minimum speed at top to ensure that no water spills out. Also find corresponding angular speed (Given r = 0.75 m)

4. The length of hour hand of a wrist watch is 1.5 cm. Find the magnitude of (a) angular velocity (b) linear velocity (c) radial acceleration (d) tangential acceleration.

5. A conical pendulum has length of 0.8 m and angle subtended by the string with the vertical is 12^0. Find (1) angular speed (2) frequency of circular motion of bob.

6. An aeroplane is flying in the sky with a speed of 360 km/hr, in a vertical circle of radius 200 m. The weight of the piolot sitting in it is 75 kg. Compute forces exerted by the seat on pilot when the aeroplane is (A) at highest position (B) at the lowest position of the circle .

7. An aircraft takes a turn along a circular path of radius 600 m. If the linear speed of the aircraft is 300 m/s, find its angular speed and time taken by it to complete $\frac{1}{4}^{th}$ of the circular path.

CHAPTER 2 - GRAVITATION

S.A.I (2 Marks)

1. An astronaut, orbiting in a spaceship round the earth, has a centripetal acceleration of 6.67 m/s^2. Find the height of the spaceship above the surface of the earth. ($G = 6.67 \times 10^{-11}\ Nm^2/kg^2$, Radius of the earth = 6400 km)

2. Calculate the percentage decrease in the weight of a body when it is taken 32 km below the surface of the earth.
(Radius of the earth = 6400 km)

3. At what angular speed should the earth rotate so that a body situated on the equator becomes weightless?
(Acceleration due to gravity = 9.8 m/s^2, Radius of the earth = 6400 km)

4. If the acceleration due to gravity at the surface of the earth is 9.8 m/s^2, find the mean density of the earth.
($G = 6.67 \times 10^{-11}\ Nm^2/kg^2$, Radius of the earth = 6400 km)

5. A communication satellite is at a height of 36000 km from the earth's surface. What will be its new period when it is brought down to a height of 20000 km?
(Radius of the earth = 6400 km)

6. A body is projected from the ground vertically upwards with a speed of 4 km/s. How high will it rise ? Neglect air resistance. (Radius of the earth = 6400 km, Acceleration due to gravity = 9.8 m/s^2)

7. Compare the binding energy of a body at rest on the surface of the earth with the binding energy of a body of the same mass and at rest on the surface of the moon.
(Acceleration due to gravity on the earth's surface = 9.8 m/s^2,
Radius of the earth = 6400 km, Radius of the moon = 1747 km)

8. How much above the surface of the earth does the acceleration due to gravity reduce by 36% of its value on the surface of the earth?
(Radius of the earth = 6400 km)

9. The moon takes 27 days to complete one revolution around the earth. Calculate its linear velocity. (Distance of the moon from the earth is 3.8×10^5 km)

10. A body weighs 72 N on the surface of the earth. Calculate the gravitational force on it due to the earth at a height equal to half of radius of the earth.

S.A.II (3 Marks)

1. Calculate the escape velocity for a body on the earth's surface. If the earth were made of wood, its mass would be only 10% as much as it is now. Calculate the escape velocity if the earth were wooden.
   ($G = 6.67 \times 10^{-11}$ Nm^2/kg^2, Radius of the earth = 6400 km)

2. Four particles having masses of 2 kg, 3 kg, 2 kg and 4 kg are situated at the corners A, B, C and D of a square whose each side is 4 m long. Find the resultant force of gravitational attraction acting on a particle of mass 1 kg situated at the intersection 'O' of the diagonals.
   ($G = 6.67 \times 10^{-11}$ Nm^2/kg^2)

3. If the earth were a homogeneous sphere of wood of density 800 kg/m^3, what would be (a) the acceleration due to gravity on the earth's surface? (b) the value of critical velocity of a satellite orbiting close to its surface?
   ($G = 6.67 \times 10^{-11}$ Nm^2/kg^2, Radius of the earth = 6400 km)

4. Calculate the workdone in moving a body of mass 1000 kg from a height 2 R to a height 3 R above the surface of the earth.
   ($G = 6.67 \times 10^{-11}$ Nm^2/kg^2, Radius of the earth = 6400 km)

5. A satellite is taken at a height equal to the radius of the earth and then projected horizontally with a speed of 7 km/s. State the nature of its orbit.
   ($G = 6.67 \times 10^{-11}$ Nm^2/kg^2, Radius of the earth = 6400 km)

6. Determine the K.E., P.E., T.E. and B.E. of a satellite of mass 50 kg in a circular orbit around the earth at a height of 600 km above the earth's surface.
   ($G = 6.67 \times 10^{-11}$ Nm^2/kg^2, Re = 6400 km, $Me = 6 \times 10^{24}$ kg)

7. If the earth were to cease rotating about its axis, what will be the change in the value of g at a place of latitude 60^0, assuming the earth to be a sphere of radius 6400 km?

8. At what distance above the earth's surface and at what depth below the earth's surface is the acceleration due to gravity less by 20% of its value at the surface? (Radius of the earth = 6400 km)

9. The mass of saturn is 95.22 times that of the earth and its radius is 9.47 times that of the earth. The acceleration due to gravity at the surface of the earth is 9.8 m/s^2, Find the acceleration due to gravity at the surface of saturn.

10. Venus is orbiting round the sun in 225 days. Calculate the orbital radii and speed of venus. (Mass of the sun = 2×10^{30} kg, G = 6.67×10^{-11} Nm^2/kg^2)

CHAPTER 3 - ROTATIONAL MOTION

S.A.I (2 Marks)

1. A thin rod of uniform cross-section is made up of two sections. The first part is wooden having length of 50 cm and mass 0.6 kg. The second is of steel having length 30 cm and mass 3 kg. Find moment of inertia of the rod, about transverse axis passing through the junction of the two sections.

2. A solid cylinder of mass 2 kg and radius 0.1 m rolls down an inclined plane of height 3m. Calculate its rotational energy when it reaches the foot of the plane.

3. A rope is wound around a hollow cylinder of 3 kg and radius 40 cm. If the rope is pulled downwards with a force of 30 N, find (i) the angular acceleration of the cylinder (ii) the linear acceleration of the rope.

4. A flywheel has a constant angular acceleration of 2 rad/s^2. (a) Find the angle through which the flywheel moves as it comes to rest from an angular speed of 220 rad/s. (b) Find the time required for the flywheel to come to rest.

S.A.II (3 Marks)

1. A torque of 100 Nm is applied to a body, capable of rotating about a given axis. If the body starts from rest and acquires kinetic energy of 10,000 J in 10 second, find (a) its moment of inertia about given axis, (b) angular momentum at the end of 10 second.

2. Two identical metal beads, each of mass M, but negligible width can slide along a thin smooth, uniform horizontal wooden rod of mass M and length L. The rod is capable of rotating about a vertical axis passing through its centre. Initially the beads are almost touching the axis of rotation and rod is rotating at speed of 14 rad/s. Find the angular speed of system, when the beads have moved upto the ends of the rod. (Assume that no external torque is acting on the system)

CHAPTER 4 - OSCILLATIONS

S.A.I (2 Marks)

1. Calculate the time taken by the body performing S.H.M. to cover half the amplitude starting from the extreme position with period two second.

2. Calculate the amplitude of the S.H.M. represented

   by $x = 5\sqrt{2}\ (\sin 2\pi t + \cos 2\pi t)$ m.

3. A 3 kg block is attached to a spring performing S.H.M. and displacement is given by $x = 2\cos(50t)$ m. Find the spring constant of the spring.

4. The amplitude and periodic time of S.H.M. are 5 cm and 6 s respectively. What is the phase at a distance of 2.5 cm away from the mean position ?

5. Find the frequency and maximum velocity of the particle performing S.H.M. represented by $x = 0.3 \sin (220t + 0.64)$m.

6. Mass and diameter of a planet are twice that of the earth. What will be period of oscillation of a pendulum on this planet if it is seconds pendulum on earth?

7. A light spring is stretched by 50 g force through a distance of 10 cm. A mass of 100 g is attached to the spring and set into oscillations. Find the periodic time of its oscillation and spring constant.

8. Find the maximum velocity and maximum acceleration of a particle performing S.H.M. whose displacement is $x = 2\cos (50t)$ cm.

9. A uniform rod of wood floats vertically in water with 14 cm of its length immersed in water. If it is depressed slightly and released, find its period of oscillations.

10. A particle of mass 10 g is performing S.H.M. Its Kinetic energies are 4.7 J and 4.6 J when the displacements are 4 cm and 6 cm respectively. Compute the period of oscillation

S.A.II (3 Marks)

1. A particle is performing S.H.M. with amplitude 2 cm. At what distance from the equilibrium position is its energy half potential and half kinetic? What is its maximum velocity if its frequency is 50 Hz?

2. Simple pendulum of length 2 m has mass of 20 g and oscillates freely with amplitude 3 cm.Find the period and potential energy at extreme position. ($g = 9.8\ m/s^2$)

3. A particle performs linear S.H.M. of amplitude 10 cm with period two second. If it is initially at positive extremity of its path, find the displacement and velocity at the end of $1/6^{th}$ second.

4. The differential equation of S.H.M. of mass 2 g is given by $\frac{d^2x}{dt^2} + 16x = 0$, find the force constant, period and frequency of oscillation.

5. A light spring has mass m, suspended at its lower end with upper end fixed to rigid support. The mass is pulled down a short distance and then released. The period of vibration of mass m_1 is T second. When the mass m_2 is added to m_1 and the system is made to oscillate, the period is found to be 2T. Find $\frac{m_1}{m_2}$.

6. A body of mass 0.1 kg performs linear S.H.M. It experiences a restoring force 1 N, when its displacement is 5 cm. Find (a) force constant (b) period of S. H. M (c) acceleration of the body when its displacement from the mean position is 1 cm.

CHAPTER 5 - ELASTICITY

S.A.I (2 Marks)

1. A light uniform rod,105 cm long is supported by wires A and B at the ends of the rod. The length of wires is the same but cross-section of A is 1 mm^2 and that of B is 2 mm^2. From what point on the rod, should a weight be suspended in order to produce equal stress in wires A and B ?
   [$Y_A = 2 \times 10^{11}$ N/m^2, $Y_B = 10^{11}$ N/m^2]

2. A metal plate has dimensions 10 cm x 10 cm x 1mm. One of its faces having largest area is fixed and a tangential force is applied to opposite face. If the lateral displacement between these two faces is 1.2×10^{-3} mm, find shear strain and tangential force.
   [$\eta = 5 \times 10^{10}$ N/m^2]

3. A material breaks under a stress of 10^6 N/m^2. If the density of material is 3×10^3 kg/m^3, what should be the length of a wire of this material so that it breaks by its own weight?

4. A wire of length 1.2 m and diameter 0.26 cm is streched between two fixed supports. If the temperature of wire is decreased by 30^0C, calculate the tension created in wire.
   [$Y = 1.6 \times 10^{11}$ N/m^2, $\alpha = 2.4 \times 10^{-5}$ / ^{0}C]

5. The average depth of Indian Ocean is about 3000 m. If the fractional compression of water at the bottom of the ocean is 1.5 %, find the compressibility of water.

S.A.II (3 Marks)

1. A uniform wire of length 1 m and radius 0.028 cm is employed to raise a stone of density 2500 kg/m^3 immersed in water. Find the change in elongation of wire when the stone is raised out of water.
   [mass of stone = 5 kg, Y of material of wire = 2×10^{11} N/m^2,]

2. When wire is subjected to a suitable load, volume of wire remaining unchanged, show that Poisson's ratio of material of wire is 0.5.

CHAPTER 6 - SURFACE TENSION

S.A.I (2 Marks)

1. A capillary tube of radius' r' can support a liquid of weight 6.284×10^{-4} N. Calculate the radius of capillary if the surface tension of liquid is 4×10^{-2} N /m.

2. Two vertical glass plates are 0.5 mm apart, dipped into water. If the surface tension of water is 70 dyne / cm , calculate the height of water rise between two plates.

3. Find the amount of work done in increasing the size of a soap film 10 cm X 4 cm to 10 cm X 8 cm (surface tension of soap solution is 0.030 N /m.)

4. There is an air bubble of radius 1.0 mm in a liquid of surface tension 0.072 N /m and density 10^3 kg m^{-3} . The bubble is at a depth of 10 cm below the free surface of liquid. By what amount the pressure inside the bubble is greater than the atmospheric pressure ?

5. Calculate the work done in splitting a drop of water of 1 mm radius into 10^6 droplets. (Surface tension of water is 72×10^{-3}N/ m)

S.A.II (3 Marks)

1. Water rises to a height of 10 cm in a capillary tube and mercury falls to a depth of 3.42 cm in the same capillary tube. The densities of water and mercury are 1 g/cm^3 and 13.6 g/ cm^3 respectively and the angles of contact for water and mercury are 0° and 135° respectively. Find the ratio of surface tension for water and mercury.

2. Two soap bubbles A and B are kept in a closed chamber where air is maintained at pressure 8 N /m^2. The radii of bubbles A and B are 2 cm and 4 cm respectively. Surface tension of soap solution is 0.04 N/m . If n_A and n_B are the number of moles of air in bubbles A and B respectively then find the ratio $n_B : n_A$.
[Neglect the effect of gravity]

3. A glass capillary of radius 0.4 mm is inclined at 60° with vertical in water. Find the length (l) of water column in the capillary tube .
[surface tension of water = 7×10^{-2} Nm^{-1} .]

CHAPTER 7 - WAVE MOTION

S.A.I (2 Marks)

1. Find the velocity of the source in terms of 'v' where 'v' is the speed of sound in air for a stationary observer when the frequency appears to be (a) doubled and (b) half of the original frequency.

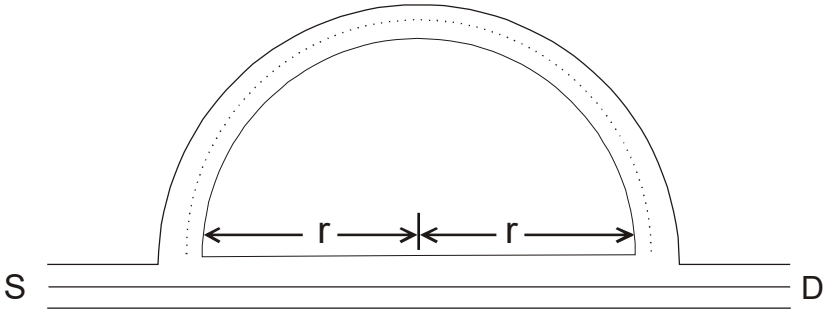
2. Two tuning forks 'C' and 'D' give four beats per second, the frequency of `C' being 480 Hz. When fork 'D' is filed a little again four beats per second are produced. Calculate the frequency of fork 'D' before and after filing.

3. Two interfering sources have an intensity ratio 16:1. Find the ratio of their amplitudes and intensities between constructive and destructive interference.

4. The frequency of vibration of tuning fork is 320 Hz. Calculate the distance through which the sound travels when the tuning fork completes 200 vibrations. Velocity of sound in air is 340 m/s.

5. A set of 33 tuning forks is arranged in descending order of frequencies. Each fork produces 'x' beats per second with preceding one. If the first fork is an octave of the last, find the frequency of first and last fork. The frequency of 10^{th} fork is 440 Hz.

6. A sound wave of wavelength 2.28 m enters the tube at `S' as shown in fig. Find the radius of the circular path to hear minimum sound at D.



S.A.II (3 Marks)

1. A sound wave has amplitude 20 cm and frequency 1000 Hz and is travelling with velocity 310 m/s. Calculate the displacement of a particle at a distance 3.1m and time 1.004 second and also find the phase difference when

i) two particles in path of the way separated by 0.0775 m

ii) two positions of the particle after time interval of 0.001 second.

2. The wavelengths of two sound notes in air are 85/171 m and 85/173 m. Each of these notes produced 4 beats per second with a third note of fixed frequency. Find the frequency of third note and velocity of sound in air.

3. A whistle emitting a sound of frequency 440 Hz is tied to a string of 1.5 m length and revolved with an angular velocity 20 rad/s in the horizontal plane. Calculate the range of frequencies heard by an observer stationed at a large distance from the whistle. (Velocity of sound = 330 m/s).

4. Two tuning forks with natural frequencies of 340 Hz each, move relative to stationary observer. One fork moves away from the observer while the other moves towards the observer with the same but small speed. The observer hears beats of frequency 3 Hz. Find the speed of the tuning fork. (Velocity of sound in air is 340 m/s).

5. The equation of simple harmonic progressive wave is given by $y = 4 \sin\pi \left(\frac{t}{0.02} - \frac{x}{75} \right)$ cm. Find the displacement and velocity of a particle at a distance of 50 cm from the origin and at the instant 0.1s.(All quantities are in C.G.S. system).

6. Two persons A and B are standing on a road. A third person riding on a cycle between A and B is ringing his bell and moving towards A at 27 km/hr. The frequency of the ring as heard by A is 420 Hz. What will be the frequency of the ring as heard by B? (Speed of sound in air = 350 m/s).

CHAPTER 8 - STATIONARY WAVES

S.A.I (2 Marks)

1. Two tuning forks produce resonance with air columns of lengths 16 cm and 24 cm respectively. If the smaller frequency is 320 Hz, find the frequency of the other fork. (Neglect end correction)

2. Two pipes closed at one end, 51 cm and 52 cm long produce 3 beats per second when they are sounded together with their fundamental notes. Ignoring end correction, calculate the velocity of sound in air.

3. A sound wave of frequency 1000 Hz and travelling with speed 340 m/s is reflected from the closed end of the tube. At what distance from that end will the successive node occur?

4. Two wires have lengths of 30 cm and 40 cm, radii in the ratio 4:5 and densities in the ratio 6 : 5. If they are stretched by loads in the ratio 3:4, compare their frequencies in the fundamental mode.

5. An open pipe is suddenly closed at one end with the result that the frequency of the third harmonic of the closed pipe is found to be higher by 100 Hz than the fundamental frequency of the open pipe. Find the fundamental frequency of the open pipe.

6. Two sitar strings 'A' and 'B' playing the note `Ga' are slightly out of tune and produce beats of frequency 6 Hz. The tension in the string 'A' is slightly reduced so that the beat frequency becomes 3 Hz. If the original frequency of 'A' is 324 Hz, find the frequency of string 'B.

7. A stretched wire emits a fundamental note of 256 Hz. Keeping the stretching force constant and reducing the length of wire by 10 cm, the frequency becomes 320 Hz. Calculate the original length of the wire.

S.A.II (3 Marks)

1. A string of mass 0.5 gram and length 0.5 m is under the tension 19.6 N. Determine the frequency of its fundamental note and third overtone.

2. A stretched wire under a tension of 4 kg wt is in unison with a tuning fork of frequency 512 Hz. How should the tension be altered to make the wire vibrate in unison with a tuning fork of frequency 256 Hz?

3. Two tuning forks when sounded together produce 5 beats per second. A sonometer wire of length 0.24 m is in unison with one of the forks. When the length of wire is increased by 1 cm, it is in unison with the other fork. Find the frequencies of the tuning forks.

4. When the air columns in two pipes closed at one end of lengths 62 cm and 63 cm are vibrating in fundamental mode, 7 beats are heard in 3 second. Neglecting end correction, calculate velocity of sound in air.

5. A pipe 20 cm long is closed at one end. Which harmonic mode of vibration of pipe is resonantly excited by a source of frequency 430 Hz? Will this same source be in resonance with the pipe if both ends are open? (Speed of sound = 344 m/s)

6. A closed pipe and an open pipe sounding together produce 5 beats/s. If the length of the open pipe is 30 cm, find by how much the length of the closed pipe must be changed to bring the vibrations of air columns in two pipes in unison? (Velocity of sound = 330 m/s)

7. The forks A and B, when sounded together, produce 4 beats/s. The fork A is in unison with 30 cm length of a sonometer wire and B is in unison with 25 cm length of the same wire under the same tension. Calculate the frequencies of the forks.

CHAPTER 9 - KINETIC THEORY OF GASES AND RADIATION

S.A.I (2 Marks)

1. A body of surface area 10 cm^2 and temperature 727 °C emits 300 J of energy per minute. Find its emissivity.
   [Given σ = 5.67 x 10^{-8} watt/m^2K^4]

2. Determine the pressure of oxygen at 0 °C, if the density of oxygen at N.T.P. is 1.44 kg/m^3 and R.M.S. speed of the molecules at N.T.P. is 456.4 m/s.

3. Calculate wavelength in Angstrom unit, which is maximum for a black body heated to a temperature of 3727 °C (Wien's constant, b = 2.898 x 10^{-3} mK)

4. A room is to be prepared for a birthday party filled with helium balloons. Some ballons are filled to occupy 0.240 m^3 when the pressure inside them is 0.038 atm. and the constant temperature of the room is 70° F. With what pressure should the larger balloons be filled so that they occupy 0.400 m^3?

S.A.II (3 Marks)

1. A body cools from 80 °C to 70 °C in 5 minutes and to 62 °C in the next 5 minutes. Calculate temperature of the surroundings.

2. A steam engine delivers 5.4 x 10^8 J of work per minute and absorbes 3.6 x 10^9 J of heat per minute from the boiler. What is the efficiency of the engine? How much heat is wasted per minute?

3. At what temperature is the r.m.s. speed of an atom in an argon gas cylinder is equal to r.m.s. speed of helium gas atom at -20 °C ? (Atomic mass of Argon = 39.9 a.m.u. and of He = 4.0 a.m.u)

CHAPTER 10 - WAVE THEORY OF LIGHT

S.A.I (2 Marks)

1. The speed of light in air is $3x10^8$ m/s. If the R.I of glass is 1.5, then find the time taken by light to travel a distance of 20 cm in glass.
2. The R.I. of ice and glass are 1.31 and 1.5 respectively. Find the R.I of ice w.r.t. glass.
3. Compare the wavelength of light in glass and in water if the R.I. of glass and the water relative to air are 3/2 and 4/3 respectively.
4. The wavenumber of a beam of light in air is 5×10^6 m^{-1}. If the velocity of light in air is 3×10^8 m/s, find the frequency of the beam.
5. Find the polarising angle for glass with refractive index 1.5166.
6. For a given medium, the polarising angle is 60^0. What will be the critical angle for this medium?

S. A. II (3 Marks)

1. The width of a plane incident wavefront is found to be doubled in a denser mudium. If it makes an angle of 70^0 with the surface, calculate the refractive index of the denser medium.
2. A ray of light travels from water into glass. What should be the angle of incidence, so that the reflected and refracted rays are perpendicular to each other?
   ($n_w = 1.333$, $n_g = 1.542$)
3. The refractive indices of glycerine and diamond with respect to air are 1.4 and 2.4 respectively. Calculate the speed of light in glycerine and in diamond. From these results find refractive index of diamond w.r.t. glycerine.

CHAPTER 11 - INTERFERENCE AND DIFFRACTION

S.A.I (2 Marks)

1. A slit of width 'a' is illuminated by monochromatic light of wavelength 650 nm at normal incidence. Calculate the value of 'a' when first minimum falls at an angle of diffraction 30^0.

2. A central fringe of interference pattern produced by light of wavelength 6000 $\overset{0}{A}$ is shifted to the position of 5^{th} bright fringe by introducing a thin glass plate of refractive index 1.5. Calculate the thickness of the plate.

3. First diffraction minima due to a single slit of width 1.0×10^{-5} cm is 30^0. Calculate the wavelength of light used.

4. In an oil immersion objective microscope, oil of refractive index 1.414 is used. The wavelength of illuminating light is 4850 $\overset{0}{A}$ and the semivertical angle is 45^0. Find the limit of resolution and the resolving power.

5. In a biprism experiment, the distance between the first and eleventh bright fringe formed by a light of wavelength λ is 1.8×10^{-3} m. If the light is replaced by one of wavelength $\lambda/2$, find the distance between first and sixteenth bright fringe.

6. A point P is situated from two coherent sources such that the optical path difference at P is 167.5 λ. Will the point P be bright or dark? If the path difference is 8.375×10^{-5} m, find the wavelength of light.

7. Two sources of light A and B of wavelengths 2000 $\overset{0}{A}$ and 3000 $\overset{0}{A}$ respectively are used in Young's experiment simultaneously. Find the ratio of fringe widths from source A to source B.

8. The intensity of the light coming from one of slits in Young's double slit experiment is double the intensity from the other slit. Find the ratio of maximum intensity to minimum intensity in the interference pattern observed.

9. In a biprism experiment, when a convex lens was placed between the biprism and eyepiece at a distance of 30 cm from the slit, the virtual images of the slit are found to be separated by 7 mm. If the distance between the slit and biprism is 10 cm and between the biprism and eyepiece is 80 cm, find the linear magnification of the image.

10 Diffraction pattern due to single slit of width 1 cm is formed by a lens of focal length 40 cm. Calculate the distance between the first dark and next bright fringe from the axis, wavelength of light used is 4890 $\overset{0}{A}$.

11. Two slits in Young's experiment have widths in the ratio 81:1. What is the ratio of intensities of maxima and minima in fringe pattern?

12. Find the separation of two points on the moon that can be resolved by a 500 cm telescope. The distance of moon is 3.8×10^5 km. Assume that an eye is most sensitive for light of wavelength 5500 $\overset{0}{A}$.

S.A.II (3 Marks)

1. In Young's double slit experiment, the slits are 0.5 mm apart and interference is observed on a screen placed at a distance of 100 cm from the slits. It is found that 9th bright fringe is at a distance of 8.835 mm from the second dark fringe from the centre of the fringe pattern. Find the wavelength of light used.

2. In a biprism experiment, the distance between two coherent sources is 0.5 mm and that between the slit and the eyepiece is 1.2 m. The slit is illuminated by red light of wavelength 6550 $\overset{0}{A}$. It is found that nth red bright band coincides with (n+1)th green bright band. (λ_g = 5240 $\overset{0}{A}$) Calculate the distance of this band from the central bright band.

3. In a biprism experiment, the distance between the second and tenth dark bands on the same side of central birght band is 0.12 cm, that between slit and biprism is 20 cm and distance between the eyepiece and biprism is 80 cm. The magnified and diminished virtual images of the slit for two conjugate positions of a convex lens inserted between the slit and eyepiece are 4.5 mm and 2 mm respectively. Find the wavelength of light used.

4. In biprism experiment, 10th dark band is observed at 2.09 mm from the central bright point on the screen with red light of wavelength 6400 $\overset{0}{A}$. By how much will fringe width change if blue light of wavelength 4800 $\overset{0}{A}$ is used with the same setting?

5. Two sources of intensity I and 4I are used in an interference experiment. Find the intensity at a point where the waves from the two source superimpose with a phase difference of (i) zero (ii) $\pi/2$ (iii) π

6. In Young's experiment, interference bands are produced on the screen placed at 1.5 m from the two slits separated by distance of 0.15 mm and illuminated by a light of wavelength 4500 $\mathring{A}$.

(i) Find the fringe width

(ii) Find the change in fringe width if screen is brought towards the slit by 50 cm.

CHAPTER 12 - ELECTROSTATICS

S.A.I (2 Marks)

1. Find the number of tubes of induction originating from a point charge of 35.4×10^{-8} C kept in the medium of dielectric constant 4.

2. The electric field intensity at a point at a distance of 1 metre, from the centre of a charged sphere of radius 25 cm is 10^4 N/C. Find the surface density of charge on the surface of the sphere. The sphere is situated in air.

3. A metal surface of area 5 m^2 is charged with $\sqrt{8.85}$ μC. The dielectric contant of the medium is 10. Find the surface density and the mechanical force acting on the surface.

4. A cube of marble of each side 4 metre is placed in an electric field of intensity 200 V/m. Determine the energy stored in the marble if its dielectric contant is 6.

5. The energy density in an electric field in vacuum is 8.91×10^{-7} J/m^3. Calculate the intensity of the field.

6. A metal sphere of radius 4.5 cm is charged to a potential of 200 V. Calculate the charge on it if it is situated in a medium of dielectric constant 4.

7. Calculate the charge and energy stored in a capacitor of capacitance 32 μF, when it is charged to a potential of 600 V.

8. A 100 V battery is connected across the combination of capacitors of capacities 4 μF and 8 μF in parallel and then in series. Calculate the charge on each capacitor in parallel and in series combination.

9. The capacity of a parallel plate condenser with dielectric constant 10 is 12 μF. What will be its capacity if the dielectric is removed?

S.A.II (3 Marks)

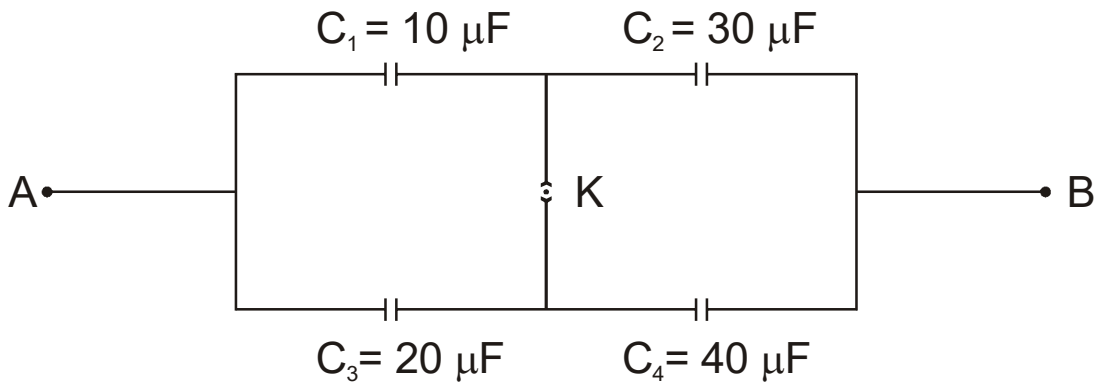
1. A condenser having a capacity of 50 μF is charged to a potential of 200 volt. If the area of each plate of the condenser is 10 cm^2 and the distance between the plates is 0.1 mm, find the energy per unit volume of the field between the plates.

2. A battery of e.m.f. 240 V is connected across the combination of capacitors 5 μF each. What arrangement (series or parallel) using the condensers would give minimum energy? What is its value?

3. Two condensers of capacities C_1 and C_2 are joined in series and this combination is joined in parallel with a condenser of capacity C_3. Show that the capacity of the system is $C = \frac{C_1 (C_2 + C_3) + C_2 C_3}{C_1 + C_2}$.

4. Four condensers are of same capacity. When three of them are connected in parallel and the remaining one is connected in series with this combination, the resultant capacity is 3.75 μF. Find the capacity of each condenser.

5. In figure $C_1 = 10$ μF, $C_2 = 30$ μF, $C_3 = 20$ μF, $C_4 = 40$ μF. Find the capacitance between points A and B when (a) the key k is closed (b) the key k is open.



6) Three condensers, having capacitances of 5 μF, 10 μF and 15 μF respectively are connected in series. A potential difference of 110 V is applied across the combination. Find the potential drop across each condenser.

CHAPTER 13 - CURRENT ELECTRICITY

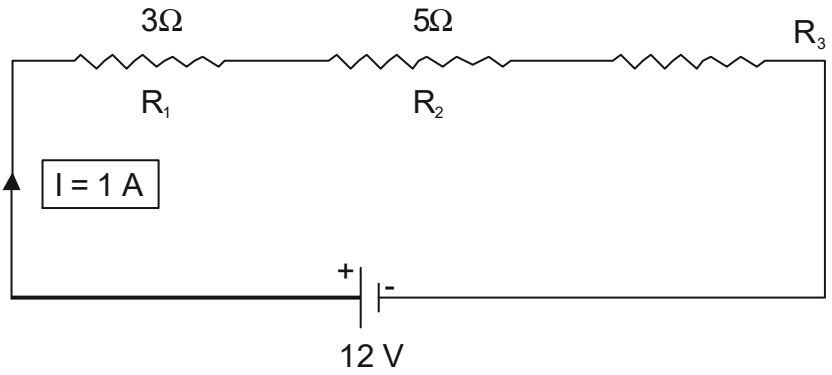
S.A.I (2 Marks)

1. An unknown resistance is connected in the left gap of a meter bridge and a resistance R is connected in the right gap. The null point is obtained at a distance of 35 cm from the left end. When a resistance of 15 Ω is connected in series with the unknown resistance and the same resistance R in the right gap, the null point is obtained at the centre of the wire. Calculate the unknown resistance.

2. Find the length of the wire of diameter 2 mm needed to prepare a coil of resistance 35 Ω. The specific resistance of the material = 5.4×10^{-5} Ω m.

3. The resistance of a potentiometer wire is one ohm per metre. A Daniell cell of e.m.f. 1.08 V balances at 216 cm on this potentiometer wire. Calculate the current through the wire. Also calculate the balancing length for another cell of e.m.f. 1.5 V.

4.



Find the value of unknown resistance R_3 in the above circuit using Kirchhoff's voltage law.

S.A.II (3 Marks)

1. A potentiometer wire of length 2 m and resistance 5 ohm is connected in series with a resistance of 998 ohm and a cell of e.m.f. 2 V and internal resistance 2 Ω. Find the potential drop along the wire and the length required to balance a potential difference of 4 mV.

CHAPTER 14

MAGNETIC EFFECT OF ELECTRIC CURRENT

S.A.I (2 Marks)

1. When current of 300 μ A is passed through the coil of galvanometer, the coil is deflected through 30^0. The twist constant of the suspension fibre is 5×10^{-9} Nm per degree. Calculate the deflecting toque acting on coil.

2. A moving coil galvanometer has coil of area 10 cm^2 and 100 turns. It is suspended by a fibre of torque constant 10^{-8} Nm per degree in radial magnetic field of induction 0.05 Wb/m^2. Find the angle through which the coil will be deflected when a current of 16 μ A passes through it.

3. A galvanometer has a resistance of 98 Ω. It is shunted by 2 Ω resistance. Calculate the fraction of the total current that can pass through the galvanometer.

4. A moving coil galvanometer has resistance of 9.8 Ω and gives full scale deflection when a current of 10 mA passes through it. How will you convert it into a milliammeter to measure current up to 500 mA?

5. A galvanometer of resistance 100 Ω gives full scale diflection with a current of 2 mA. How will you use it to measure the voltage up to 5 volt?

S.A.II (3 Marks)

1. A galvanometer when shunted with a resistance of 2.5 Ω gives full scale deflection for 5 A. When it is connected in series with a resistance of 140 Ω, it gives a full scale deflection for 150 volt. Compute the resistance of the galvanometer.

2. A moving coil galvanometer of resistance 200 Ω gives full scale deflection of 100 divisions for a current of 50 mA. How will you convert it into ammeter to read 2 A for 20 divisions?

3. A moving coil galvanometer requires a current of 100 μA for a full scale deflection of 50 divisions. If galvanometer resistance is 1000 Ω, find the current and voltage sensitivity.

4. A solenoid 1.5 m long and 4 cm in diameter possesses 10 turns/cm. A current of 5 A is flowing through it. Calculate the magnetic induction i) inside and ii) at one end on the axis of the solenoid.

CHAPTER 15 - MAGNETISM

S.A.I (2 Marks)

1. If the magnetic moment of the revolving electron in an orbit of radias 0.5 $\overset{0}{A}$ is

   9×10^{-24} Am^2 then find the linear momentum of electron in that orbit

   $(e/m = 1.76 \times 10^{11}$ C/kg)

2. The magnetic moment of electron revolving in circular orbit of radius 2.2 $\overset{0}{A}$ is

   5.024×10^{-24} Am^2. Calculate the frequency of revolution of electron in that orbit.

3. A circular coil having radius 2 cm carries a current of 3 A. Compute the magnitude of magnetic induction at an axial point 30 cm away from centre of coil.

S.A.II (3 Marks)

1. The electron in hydrogen atom is revolving in an orbit of radius 0.5 $\overset{0}{A}$ and produces current of 1.1 mA. Calculate the magnetic induction at an axial point at distance of 100 $\overset{0}{A}$ from nucleus of an atom.

2. The magnetic induction at an axial point 20 cm away from centre of bar magnet is

   4×10^{-4} T. If the dimensions of magnet are 5 cm in length and 2 cm^2 in cross - sectional area then find the magnetization of a bar magnet.

3. The permeability of the substance at temperature 300 K is 6.284×10^{-3} SI unit. At what temperature will the susceptibility of that substance increase to 9.998×10^{3}?

CHAPTER 16- ELECTROMAGNETIC INDUCTION

S.A.I (2 Marks)

1. A coil of effective area 2.5 m^2 is at right angles to a magnetic field of induction $0.04 \frac{Wb}{m^2}$ If the field is reduced to 10% of its initial value in 2.5 s, how much is the e.m.f. induced in the coil?

2. In a closed circuit magnetic flux $\phi = 15 t^2 - t + 5$ weber changes in time 't'. If the resistance of circuit is 10 Ω, calculate the magnitude of the induced current in 0.2 s.

3. A conducting wire 40 cm long, bent in to rectangular loop 12 cm x 8 cm is placed perpendicular to the magnetic field of induction 0.5 T. Within 0.1 s, the loop is changed to a square and magnetic induction is increased to 1 T. Compute the e.m.f. induced in the wire.

4. The wing span of an aeroplane is 40 m. The plane is flying due north, horizontally with a speed of 360 km/hr. What is the potential difference developed between the wing-tips if horizontal component of earth's magnetic feld $B_H = 3.2 \times 10^{-5}$ T and the angle of dip at the place is 60^o?

5. A coil of 100 turns each of area 0.02 m^2 is rotated so as to cut magnetic induction 3.5×10^{-5} T at 100 revolutions per second. How much will be the maximum e.m.f. induced in the coil?

6. A 25 W lamp is connected to a A. C. source of peak value 100 V. Compute the r.m.s. current flowing in a lamp.

7. An inductor, capacitor and pure resistance 10 Ω are connected in series across 100 V, a. c. supply. If inductive reactance is 31 Ω and capacitive reactance is 64 Ω, find the phase angle between inductive e.m.f. and capacitive e.m.f.

8. A step down transformer works on 220 V a. c. mains. What is the efficiency of the transformer, when a bulb of 100 watt, 20 volt connected to A. C. mains, and 0.5 A current flows through it?

S.A.II (3 Marks)

1. What is mutual inductance between two coils, when a current changes from 4 A to 12 A in 0.5 s in primary coil, the induced e.m.f. of 50 mV is generated in secondary coil. What will be e.m.f. induced in secondary, if the current in primary changes from 3 A to 9 A in 0.02 s?

2. A transformer converts 400 volt A. C. to 100 volt A.C. The secondary of a transformer has 50 turns and load across it draws a current 600 mA. How much is the current in primary, power consumed and number of turns in primary?

3. A radio can tune over frquency range of medium wave band 400 kHz to 600 kHz. If LC circuit has an effective inductance of 0.2 mH, what must be the range of its variable capacitance of the capacitor?

4. An A.C. circuit of resistance 10 Ω, inductor of 0.1 henry and capacitor of 25 μF are connected in series across 230 V, 50 Hz supply. How much is the value of r.m.s. current and power factor in a circuit?

5. An A.C. supply e = 300 sin [314.2 t] volt is connected across a resistance of 60 Ω. How much will be the r.m.s. values of e.m.f. and current in the circuit?

6. A circular alluminium disc of radius 10 m rotates at 3600 rev/min, with its axis passing through centre and parallel to a uniform magnetic field of induction 2 tesla. How much will be the e.m.f. induced between the centre and the edge (rim) of the disc?

7. A capacitor of 25 μF, inductor of 0.1 H and resistor of resistance 25 Ω are connected in series with an A. C. source of e.m.f. e = 310 sin (314 t) volt.

   Compute the, i) reactance ii) impedance and the current of the circuit iii) phase angle between current and applied e.m.f. and iv) write an expression for instantaneous value of current.

CHAPTER 17- ELECTRONS AND PHOTONS

DATA

1. Mass of electron (m) = 9.1×10^{-31} kg
2. Charge of electron (e) = 1.6×10^{-19} C
3. Planck's constant (h) = 6.63×10^{-34} Js.
4. Velocity of light in air (c) = 3×10^{8} m/s
5. I eV = 1.6×10^{-19} J
6. $\frac{1}{4\pi\in_o} = 9 \times 10^{9} \ \frac{Nm^2}{C^2}$
7. Permittivity of free space ($\in_o$) = $8.85 \times 10^{-12} \ \frac{C^2}{Nm^2}$

S.A.I (2 Marks)

1. Photoelectric work function of metal is 3.2 eV. Find the threshold wavelength.
2. The work function of caesium is 2.14 eV. Find the wavelength of the incident light if the photocurrent is brought to zero by stopping potential of 0.6 V.
3. Find the wave number of photon having an energy 2.09 eV.
4. Find the momentum and frequency of a photon of energy 3 eV.

S.A.II (3 Marks)

1. The photoelectric work function of a metal is 5.5 eV. Calculate the maximum speed of photoelectrons when electromagnetic radiation with photon energy 5.8 eV is incident on the surface of metal.
2. The work function of metal is 2.4 eV. Find the (i) threshold frequency for metal (ii) wavelength of incident light if a stopping potential is 0.5 V.

3. The work functions for potassium and caesium are 2.25 eV and 2.15 eV respectively. Will photoelectric effect occur for either of these elements with light of wavelength 5180 $\overset{0}{A}$?

4. The threshold wavelength for silver is 3800 $\overset{0}{A}$. Calculate maximum kinetic energy in eV of photoelectrons emitted when ultraviolet light of wavelength 2600 $\overset{0}{A}$ falls on silver plate.

5. Maximum energy required to remove an electron from sodium atom is 2.4 eV. Does sodium show photoelectric effect for a light of wavelength 6800 $\overset{0}{A}$.

6. When a surface is irradiated with light of wavelength 4950 $\overset{0}{A}$, a photocurrent appears which vanishes if a retardirg potential greater than 0.6 V is applied across the phototube. Find the work function of emitted surface.

CHAPTER 18 - ATOMS, MOLECULES AND NUCLEI

DATA

1. Mass of electron (m) = 9.1×10^{-31} kg
2. Charge of electron (e) = 1.6×10^{-19} C
3. Planck's constant (h) = 6.63×10^{-34} Js
4. Velocity of light in air (c) = 3×10^{8} m/s
5. Permittivity of free space ($\in_0$) = 8.85×10^{-12} $\frac{C^2}{Nm^2}$
6. 1 eV = 1.6×10^{-19} J
7. $\frac{1}{4\pi\in_0} = 9 \times 10^{9}$ $\frac{Nm^2}{C^2}$
8. Rydberg's constant (R) = 1.097×10^{7} m^{-1}

S.A.I (2 Marks)

1. Radius of the first orbit of the electron in a hydrogen atom is 0.53 $\overset{0}{A}$. Find the centripetal force acting on the electron.
2. Calculate the angular momentum of the electron in the third Bohr orbit of hydrogen atom.
3. Calculate the potential energy of the electron in the second Bohr orbit of hydrogen atom in electron volt. The radius of Bohr orbit is 2.12 $\overset{0}{A}$.
4. Find the momentum of the electron having de Broglie wavelength 0.6 $\overset{0}{A}$
5. A photon of energy 12.75 eV is absorbed by an electron in the ground state of hydrogen atom and rises it to an excited state. Find the quantum number of this state.
6. Find the value of Rydberg's constant if the energy of electron in the second orbit in hydrogen atom is - 3.4 eV.
7. Calculate de Broglie wavelength of an electron moving with $(\frac{1}{3})^{rd}$ of the velocity of light in vacuum. Neglect the relativistic effect.

8. The half life period of a radioactive element is 4 days. Find the decay constant in SI unit.

S.A.II (3 Marks)

1. Find the radius of the first Bohr orbit of the hydrogen atom. Hence determine the radius of the second Bohr orbit.
2. Determine the linear momentum of electron in the second Bohr orbit in the hydrogen atom. Hence determine the linear momentum in third Bohr orbit.
3. Calculate the wavelength of first two lines of Balmer series in the hydrogen spectrum.
4. Compute the shortest and the longest wavelength in Lyman series of hydrogen atom.
5. The wavelength of first line of the Balmer series is 6563 $\overset{0}{A}$. Calculate the wavelenth of first line of (a) Lyman series (b) Paschen series.

CHAPTER 19 - SEMICONDUCTORS

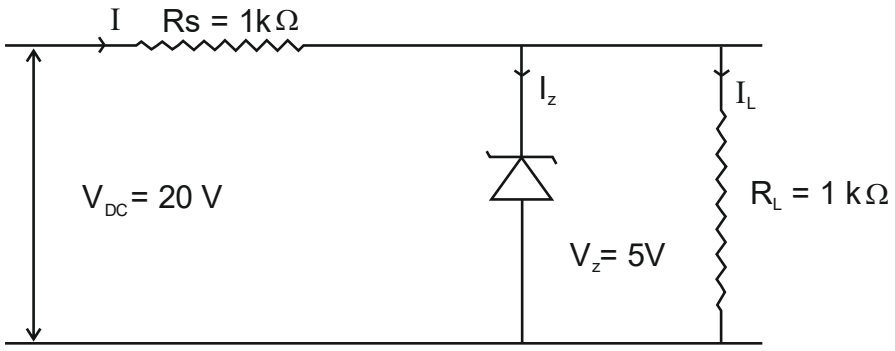
S.A.I (2 Marks)

1. Calculate the current gain β of a transistor if the current gain $\propto$ = 0.98.

2. In a transistor, 1 mA change in emitter current, changes collector current by 0.99 mA. Determine the a.c. current gain.

S.A.II (3 Marks)

1.



In the above circuit calculate the value of I_z.