CAREERS 360

PRACTICE Series

Maharashtra HSC

Physics Sample Paper 2025

Std. XII

PHYSICS

Specimen Question Bank

Chapter Number 1 To 20

CHAPTER 1 - CIRCULAR MOTION

V.S.A. (1 Mark)

1. What is angular displacement in radian of a second hand of a clock in 10 second ?
2. Write vector relation between angular velocity $(\vec{\omega})$, tangential velocity $(\vec{v})$ and position vector $(\vec{r})$.
3. A cycle - wheel is rotating with uniform angular velocity $(\vec{\omega})$. What is the nature of the graph between tangential velocities of different points on a spoke and their distances from the axis ?
4. What is the ratio of angular velocities of hour - hand of a clock and the spin motion of the earth?
5. A body of mass 'M' is revolving in a vertical circle of radius 'r'. What is difference in the kinetic energies at the bottom and top position of the circle?
6. Why work done by centripetal force is zero?
7. What is the effect of centripetal force on earth at equator and at poles ?

S.A.I (2 Marks)

1. Write S. I. unit of angular velocity. State the rule concerned with direction of angular velocity.
2. Obtain the relation between linear velocity and angular velocity.
3. Which physical quantities remain constant in U.C.M. ?
4. Define centrifugal force. Explain its any one example.
5. A particle is performing U.C.M. along a circle of radius r. In half period of revolution, what is its displacement and corresponding distance?

S.A.II (3 Marks)

1. Define angular velocity and angular acceleration. Obtain relation between linear velocity and angular velocity.
2. Obtain vector relation between linear velocity and angular velocity. Show that $v \alpha n$ where 'n' is frequency of revolution.
3. Show that acceleration in U.C.M. is $\frac{v^2}{r}$
4. Define conical pendulum. Prove that $T\alpha\sqrt{\ell}$ where 'ℓ' is length of string and T is periodic time.
5. In vertical circular motion, at which point tension is maximum ? Obtain an expression for it at a point midway between the path of vertical circular motion.

CHAPTER 2 - GRAVITATION

V.S.A. (1 Mark)

1. State dimensions of universal gravitational constant 'G'.
2. What do you mean by a satellite ?
3. Define critical velocity of a satellite.
4. Define periodic time of a satellite.
5. State Kepler's law of equal areas.
6. Define binding energy of a satellite.
7. State dimensions of gravitational potential.
8. Define escape velocity of a satellite.
9. What do you mean by geostationary satellite ?
10. State Newton's law of gravitation.

S.A.I (2 Marks)

1. State Newton's law of gravitation. Express it in vector form.
2. State MKS and CGS units of the universal gravitational constant and obtain its dimensions.
3. Obtain the relation between the universal gravitational constant and the gravitational acceleration on the surface of the earth.
4. How is an artificial satellite launched into a circular orbit around the earth?
5. State conditions for various possible orbits of a satellite.
6. Obtain an expression for critical velocity of a satellite.

7. Show that the square of the period of revolution of a satellite is directly proportional to the cube of radius of its orbit .

8. Assuming the expression for critical velocity, obtain an expression for the period of a satellite in a circular orbit.

9. State any four applications of communication satellite.

10. State Kepler's law of orbit and law of period.

11. Obtain an expression for the binding energy of a satellite revolving around the earth at a certain altitude.

12. Derive an expression for the binding energy of a body at rest on the earth's surface.

13. Derive an expression for the escape speed of a body from the surface of the earth. Hence show that it is independent of mass of a satellite.

14. Show that the escape speed of a body from the surface of the earth is $2R\sqrt{\frac{2\pi\rho G}{3}}$ where R is radius of the earth and ρ is the mean density of the earth.

15. Explain why an astronaut in a orbiting satellite has a feeling of weighlessness.

16. Show that acceleration due to gravity at height 'h', $g_h = \frac{g R^2}{(R + h)^2}$

17. What is a communication satellite? State any two uses of communication satellite.

18. Show that the escape velocity of a satellite from the surface of the earth is $\sqrt{2}$ times the critical velocity for a satellite revolving very close to the earth's surface.

19. Show that the period of revolution of an artificial satellite is equal to, $\sqrt{\frac{3\pi}{G\rho}}$ where 'ρ' is the mean density of the planet and R is the radius of the planet.

20. State expressions for acceleration due to gravity at depth 'd' and altitude at height 'h' from the earth's surface. Draw a graph showing the variation of the gravitational acceleration with depth and altitude.

21. Show that escape velocity of a body of mass 'm' from the surface of the earth is equal to $\sqrt{\frac{2FR}{m}}$ where F is gravitational force and R is radius of the earth.

22. Draw a diagram showing different stages of projection for an artificial satellite.

S.A.II (3 Marks)

1. Define critical speed of a satellite and obtain an expression for it. On what factors does it depend ?
2. Define the period of revolution of a satellite. Derive an expression for the period of revolution of a satellite in a circular orbit.
3. State Kepler's laws of planetary motion.
4. Define binding energy of a satellite. Obtain an expression for the binding energy of a satellite revolving around the earth at a certain altitude.
5. Derive an expression for the gravitational acceleration on the earth's surface at a latitude 'φ'.
6. Derive an expression for acceleration due to gravity at a depth 'd' below the earth's surface.
7. State expression for acceleration due to gravity at depth 'd' and altitude 'h'. Hence show that their ratio is equal to $\frac{R-d}{R-2h}$, assuming that h<<<<R, where R is radius of the earth.

CHAPTER 3 - ROTATIONAL MOTION

V.S.A. (1 Mark)

1. What is a rigid body?
2. Define moment of inertia of a rigid body.
3. Why does the grinding wheels have large mass and moderate diameter ?
4. About which axis would a cube of uniform density has its minimum moment of inertia?
5. Define radius of gyration.
6. State the factors on which radius of gyration depends.
7. About which axis of rotation, radius of gyration is the least ?
8. State the formulae for moment of inertia of a solid sphere and hollow sphere about its diameter.
9. Find the ratio of radius of gyration of a solid sphere about its diameter to radius of gyration of hollow sphere about its tangent. (Given - radius of both the spheres is same)
10. State SI unit and dimensions of angular momentum of rotating body.
11. What happens when a ballet dancer stretches her arms while taking turns?
12. If earth suddenly shrinks so as to reduce its volume, mass remaining unchanged, what will be the effect on the duration of the day ?
13. A uniform circular disc is rotating about transverse axis passing through its centre with constant angular speed. A small piece of wax, falls on the disc and sticks to it at some distance from axis. What will happen to moment of inertia of system and its angular speed ?
14. Three point masses M_1, M_2, M_3 are located at the vertices of an equilateral triangle of length 'a'. What is the moment of inertia of a system about an axis along the altitude of the triangle passing through M_1 ?

15. State with reason if the statement is true or false.
A wheel moving down a perfectly frictionless inclined plane will undergo slipping (not rolling) motion.

16. Show that the square of radius of gyration of a hollow cylinder is twice the square of radius of gyration of a solid cylinder, having same radius when rotating about their natural axis of symmetry.

17. Find the ratio of the radii of gyration of a circular disc and a circular ring of the same radii about their tangential axes in their planes.

18. Two discs of moments of inertia I_1 and I_2 about their transverse axes, rotating with angular frequencies ω_1 and ω_2 respectively, are brought into contact with their axes of rotation coincident. Find the angular frequency of their composite disc.

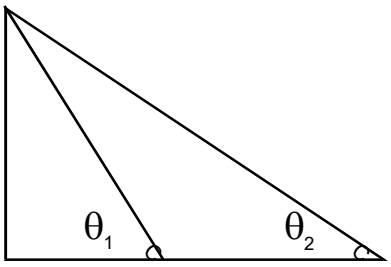
19. Find out the moment of inertia of hydrogen molecule about its centre of mass if mass of each hydrogen atom is 'm' and distance between them is R.

S.A.I (2 Marks)

1. A light rod of length L, with identical point masses situated at the ends, is rotating about an axis through the centre of mass of the system, perpendicular to length of the rod. If the total mass of the system is M, what is the moment of inertia of the system?

2. A boy standing at the centre of turntable with his arms outstretched is set into rotation with angular speed ω rev/min. When the boy folds his arms back, his moment of inertia reduces to $\frac{2}{5}$ times its initial value. Find the ratio of his final kinetic energy of rotation to initial kinetic energy.

3. A solid sphere rolls down, on two different inclined planes from same height, but different angles of inclinations θ_1 and θ_2 . On which plane, sphere will take longer time to roll down?



4. Show that, radius of gyration of disc about a transverse axis through centre of mass is equal to radius of gyration of a ring about an axis coinciding with its diameter, if disc and ring have same radius.

5. Is it possible to distinguish between a raw egg and hard boiled egg, by spinning each, once on a table ? Justify your answer.

6. Explain the physical significance of moment of inertia and the factors on which it depends.

7. Define radius of gyration and explain its physical significance.

8. State and prove, principle of conservation of angular momentum.

9. Derive an expression for total kinetic energy of a rolling body on a horizontal plane without slipping.

10. Fly wheels used in automobiles and steam engines producing rotational motion have discs with large moment of inertia. Explain, why?

11. Show that moment of inertia of a uniform circular lamina about a tangent in its plane is $\frac{5}{4}$ MR^2 where M is its mass and R its radius.

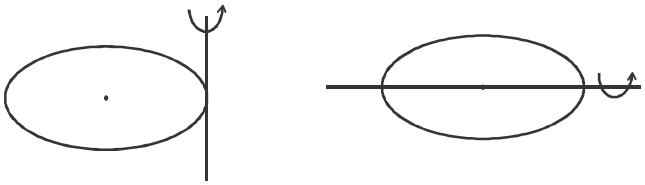
12. A thin uniform rod of length L and area of cross-section A and density ९, is rotating about an axis passing through a point at a disatance of $\frac{L}{4}$ from one end, perpendicular to its length. Derive its moment of inertia in terms of L, A, ९.

13. Find the centre of gravity of an equilateral triangular lamina. Show that it is the same as that of three particles of equal mass, placed at the midpoints of its sides.

14. State expression for moment of inertia of uniform solid sphere about its axis passing through centre. How will you increase its moment of inertia, by changing axis of rotation?.

15. The moment of inertia of disc about its diameter is $\frac{MR^2}{4}$. What will be the moment of inertia if the axis of rotation is passing through a point at a distance of $\frac{R}{2}$ from centre, perpendicular to its plane?.

16. Two identical rings are allowed to rotate about different axes of rotation, under the application of torques to create same angular acceleration as shown in diagram. Is It true ?

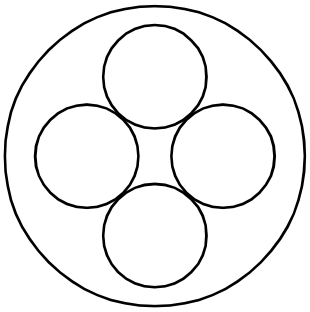


ring 1 ring 2

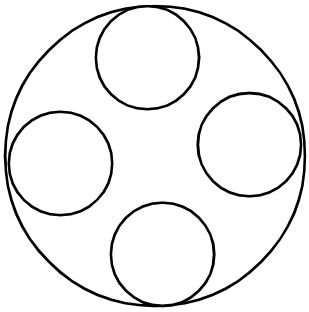
17. Two wheels have same mass. First wheel is in the form of disc with radius R. while second is hollow in centre, with inner radius r and outer radius R. Both are rotating with same angular velocity ω about transverse axes through their centres. If first wheel comes to rest in t_1 seconds and second comes to rest in t_2 seconds, are t_1 and t_2 different ? Why ?

18. Two circular discs A and B having four identical small circular discs placed on them as shown in diagram, have same mass. When the discs are allowed to roll down on an inclined plane at the same instant, which disc will reach the bottom first ?

disc A



disc B



S.A.II (3 Marks)

1. State and explain the theorem on perpendicular axes.

2. State and explain the theorem on parallel axes.

3. Derive an expression for torque acting on a rotating body with constant angular acceleration.

4. Derive an expression for the kinetic energy of a rotating body with uniform angular speed.

5. Obtain an expression for the angular momentum of a rotating body. Express it in vector form.

6. Derive an expression for linear acceleration of a body, rolling down the inclined plane without slipping.

7. Derive an expression for linear velocity of a body at the bottom of an inclined plane, when allowed to roll down the plane without slipping.

8. State and prove the law of conservation of angular momentum. Explain it with one example.

CHAPTER 4 - OSCILLATIONS

V.S.A. (1 Mark)

1. Obtain dimensions of force constant 'K'.
2. What is the displacement of a particle at any position, performing linear S.H.M ?
3. Define path length and amplitude of a particle performing linear S.H.M.
4. State the equation of displacement of a particle performing linear S.H.M. Hence define initial phase.
5. State the equation of displacement of a particle performing linear S.H.M. starting from a) mean position b) extreme position.
6. What is the phase difference between the displacement and velocity, the displacement and acceleration of a particle performing S.H.M. starting from the mean position?
7. What is the phase difference between the displacement and velocity, the displacement and acceleration of a particle performing S.H.M. starting from the extreme position?
8. Define epoch of S.H.M.?
9. State the expression for total energy of S.H.M. in terms of acceleration.
10. What is the ratio of potential energy to kinetic energy of a particle performing S.H.M. at a distance $x = \frac{A}{2}$, where 'A' is amplitude of S.H.M.?
11. Define ideal simple pendulum.
12. Define second's pendulum. State the formulae for its length.
13. State the law of isochronous in case of simple pendulum.
14. State the law of length in case of simple pendulum.
15. State the law of mass in case of simple pendulum.
16. State the law of acceleration due to gravity in case of simple pendulum.

17. Does the variation of radius of the bob affect the period of simple pendulum? Why?

18. What is the length of seconds pendulum at a place where acceleration due to gravity is 9.8 m/s^2 ?

19. What is the effect of mass and amplitude on the period of simple pendulum?

20. For damped harmonic oscillator, show graphically the variation of displacement against time.

21. A simple pendulum is oscillating with certain amplitude at an instant. Does its amplitude remain same after 8 hours ? Why?

22. How the frequency of S.H.M. varies with force constant 'K'?

23. How the frequency of S.H.M. varies with mass of a particle performing S.H.M?

24. Does the period of simple pendulum depend on (1) amplitude of oscillation 2) mass of the bob?

25. Show that total energy of particle performing linear S.H.M. is directly proportional to mass and inversely proportional to square of its period.

26. Show that total energy of a particle performing linear S.H.M. is directly proportional to square of its amplitude.

27. What is the initial phase of a particle starting from extreme position?

S.A.I (2 Marks)

1. Define periodic motion. Write two exmples.

2. Define simple harmonic motion and state its differential equation

3. Derive the differential equation of linear simple harmonic motion.

4. Derive an expression for maximum acceleration of a particle performing simple harmonic motion.

5. Derive an expression for maximum velocity of a particle performing simple harmonic motion.

6. Define phase and epoch of simple harmonic motion.

7. Write the equation for displacement of a particle performing linear simple harmonic motion starting from mean position. Represent graphically displacement versus time. State the conclusion.

8. Write the equation for velocity of a particle performing linear simple harmonic motion starting from mean position. Represent graphically velocity against time state the conclusion.

9. Write the equation for acceleration of a particle performing linear S.H.M. starting from mean position. Represent graphically acceleration against time. State the conclusion.

10. Write the equation for displacement of a particle perofrming linear S.H.M. starting from extreme position. Represent graphically displacement againt time. State the conclusion.

11. Write the equation for velocity of a particle performing linear S.H.M. starting from extreme position. Represent graphically velocity against time. State the conclusion.

12. Write the equation for acceleration of a particle performing linear S.H.M. starting from extreme position. Represent graphically acceleration against time. State the conclusion.

13. Represent graphically variation of potential energy, kintic energy and total energy of particle performing simple harmonic motion with respect to displacement.

14. Define ideal simple pendulum. Why it does not exist in practice?

15. State any two laws of simple pendulum.

16. Using definition of linear S.H.M., derive an expression for angular frequency of the body.

17. A simple pendulum is set into oscillations in a uniformly travelling car along the horizontal road. What happens to its period if the driver takes sudden turn towards left?

18. Derive an expresion for potential energy of a particle performing linear S.H.M.

19. Derive an expression for kinetic energy of a particle performing linear S.H.M.

S.A.II (3 Marks)

1. Obtain differential equation of linear S.H.M. Hence obtain the dimensions of force constant.

2. Show that linear S.H.M. is the projection of uniform circular motion on any diameter.

3. Discuss analytically the composition of two S.H.M.'s having same period, different initial phases, parallel to each other.

4. For a particle performing linear S.H.M. show that total energy is conserved.

5. Show that for a small amplitude, the motion of a simple pendulum is linear S.H.M..

L.A. (5 Marks)

1. State differential equation of linear S.H.M. Hence derive an expression for (a) acceleration (b) velocity and (c) displacement of a particle performing linear S.H.M.

2. Represent graphically displacement, velocity and acceleration against time for a particle performing linear S.H.M. starting from extreme position. State the conclusions.

3. Represent graphically displacement, velocity and acceleration against time for a particle performing linear S.H.M. starting from mean position. State the conclusions.

4. State the expression for the resultant amplitude of composition of two S.H.M.'s. having same period, different initial phases and parallel to each other. Hence obtain the expression for the resultant amplitude when phase difference is 1) zero 2) 90^0 3)180^0

5. State the experssions for kinetic energy, potential energy and total energy of a particle performing linear S.H.M. Show that the total energy is conserved. Hence represent it graphically.

CHAPTER 5 - ELASTICITY

V.S.A. (1 Mark)

1. What is plasticity? Write example of perfect plasticity.
2. What are the factors, which decide ductility and brittleness of the material?
3. Explain the terms in elasticity.

   a) point of proportionality

   b) elastic limit

   c) yield point

   d) breaking stress

   e) perfectly elastic body

   f) perfectly plastic body.
4. State Hooke's law of elasticity and hence define modulus of elasticity.
5. State and define modulus of elasticity applicable to substance in all states of matter.
6. What are linear elastic or Hookean materials?
7. Draw a stress against strain curve for an elastic body.
8. How is flexibility of rope increased ?
9. Which materials are called elastometers?
10. Define stress and strain.
11. Define modulus of elasticity.
12. Stress and pressure have the same dimensions but pressure is not the same as stress. Why?
13. Define compressibility and state its SI unit.

14. In the method for determination of Young's modulus of material of wire, what is the use of reference wire?

15. Which modulii of elasticity are related to jelly cube ?

16. What are the requirments of ultimate stress while designing a rope?

17. Explain the terms ductility and malleability.

18. Why Young's modulus and shear modulus are relevant only for solids and not for fluids?

S.A.I (2 Marks)

1. Derive an expression for modulus of rigidity.

2. Derive an expression for modulus of elasticity related to change in length.

3. Derive an expression for compressibility of fluid.

4. Distinguish between Young's modulus and bulk modulus.

5. Distinguish between modulus of rigidity and bulk modulus.

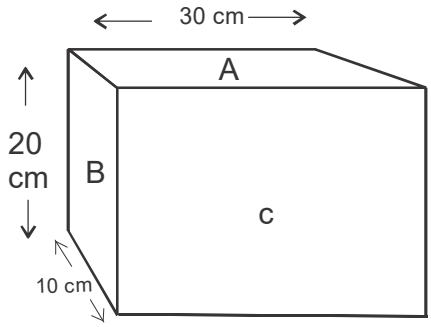
6. Distinguish between plasticity and elasticity.

7. Explain the origin of elasticity in solids.

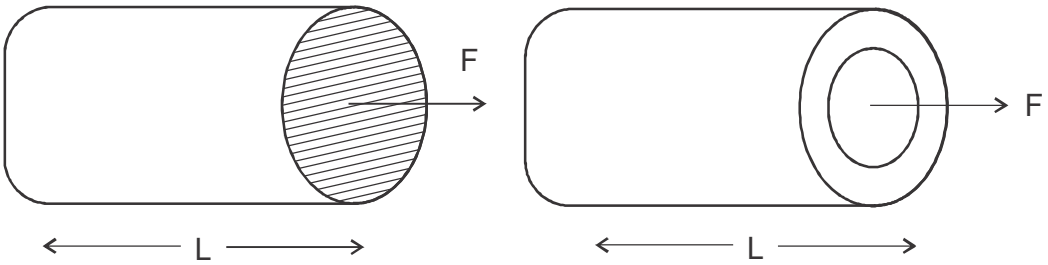
8. The block in the given diagram rests on the ground. Which face A, B or C experiences

   a) the largest stress

   b) the smallest stress when block is resting on it?



9. Two cylinders shown in diagram are identical in all respects except one is hollow. When identical forces are applied to the right end of each cylinder, explain which cylinder streches the most.



10. Discuss the factors on which the bending of beam having rectangular cross-section, depend on, when beam is loaded at the centre.

11. A metallic rod is heated. Show that the thermal stress is directly proportional to its coefficient of linear expansion and Young's modulus of the material of rod.

12. Define Poisson's ratio. What are the limits of Poisson's ratio for a practical isotropic material?

13. Draw stress-strain curve for elastic tissue of Aorta and discuss the conclusions about elastic properties of aorta.

14. What are the advantages of I beam?

15. Why hollow circular pole or tube are preferred over solid circular poles?

S.A.II (3 Marks)

1. What is strain energy? Derive an expression for strain energy per unit volume when wire is loaded.

2. Derive an expression for work done when wire is loaded. What is strain energy?

3. Draw a stress against strain graph for a ductile material under increasing load and hence explain the behaviour of wire.

4. Within elastic limit, prove that Young's modulus of material of wire is the stress required to double its length.

5. Derive an expression for strain energy per unit volume and show that, the strain energy per unit volume is proportinal to Young's modulus of material of wire.

6. Derive the relation between Young's modulus, thermal stress and coefficient of linear expansion.

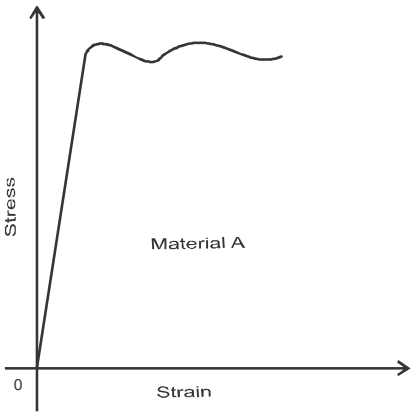
7. Describe an experiment to determine Young's modulus of material of thin wire.

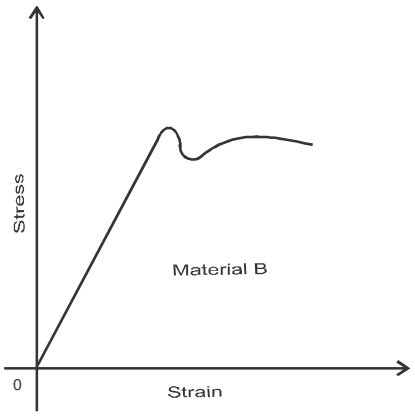
8. Answer the following questions with reference to the graph for material A and B.

   a) Which material has greater Young's modulus?

   b) Which material is more ductile?

   c) Which material is more strong?





CHAPTER 6 - SURFACE TENSION

V.S.A. (1 Mark)

1. Define : a) Cohesive force and Adhesive force

   b) Range of molecular forces (c) Sphere of influence

   (d) Surface tension e) Angle of contact

2. What is capillarity ?

3. What is surface energy ?

4. Water spiders are able to walk on the surface of water, why ?

5. A steel blade floats on the surface of pure water, when detergent is added it sinks . Why ?

6. A small air bubble of radius ' r' in water is at depth 'h', below the water surface. If P is atmospheric pressure , 'd' is density of water and T is surface tension of water then what is the pressure inside the bubble ?

7. Arun says that molecular forces do not obey the inverse square law of distance. Ashok says that molecular forces obey the inverse square law of distance. State your opinion.

8. What is the nature of molecular forces ?

9. What is the effect of temperature on the angle of contact ?

10. "Tents are coated with a thin layer of aluminium hydroxide", why ?

11. "The threads of raincoat are coated with water proofing agents like resin", why ?

S.A.I (2 Marks)

1. Show that surface tension is numerically equal to surface energy per unit area.

2. Obtain the dimensions of surface tension. State its SI unit.

3. State any four applications of capillarity.

4. State the characteristics of angle of contact.

5. The radii of two columns r_1 and r_2 when a liquid of density ρ, angle of contact ($\theta = 0^0$) is filled in it. The level difference of liquid in two arms is 'h'.

   Find the surface tension.

6. Why do molecules of a liquid lying in the surface film possess extra energy ?

7. Draw neat labelled diagram to show angle of contact between ----

   (a) pure water and clean glass (b) mercury and clean glass

S.A.II (3 Marks)

1. Define angle of contact . Explain why it is acute in case of water.

2. Define angle of contact . Explain why it is obtuse in case of liquids which

   do not wet solids.

3. Explain the formation of concave and convex surface of liquid on the basis of molecular theory.

4. Obtain the relation between surface tension and surface energy.

5. Derive Laplace's law for spherical membrane .

6. Describe the capillary tube experiment to determine the height of water rise in the capillary tube. Hence find the surface tension of water. [Given : radius of capillary is 'r' and angle of contact is $\theta = 0°$]

7. Describe the capillary tube experiment to determine the surface tension of a liquid.

8. Explain the surface tension on the basis of molecular theory.

9. Obtain an expression, for the rise of a liquid in a capillary tube.

10. Why there is a rise of liquid inside the capillary tube ?

11. Draw diagram showing force due to surface tension at the liquid - solid,

    air –solid, air – liquid interface, in case of (a) drop of mercury on a plane solid surface and

    b) drop of water on a plane solid surface. Discuss the variation of angle of contact.

CHAPTER 7 - WAVE MOTION

V.S.A. (1 Mark)

1. Define wave motion
2. Wave motion is doubly periodic, explain.
3. How does get constructive intereference in case of sound wave?
4. How does we get destructive interference in case of sound wave?
5. Explain reflection of transverse wave and change of phase from a denser medium.
6. Explain reflection of transverse wave and change of phase from a rarer medium.
7. Explain reflection of longitudinal wave and change of phase from a denser medium.
8. Explain reflection of longtudinal wave and change of phase from a rarer medium.
9. What happens to a particle velocity when a transverse wave is reflected from air medium?
10. What happens to a particle velocity when a transverse wave is reflected from rarer medium?
11. What happens to a particle velocity, when a sound wave is reflected from rarer medium and denser medium?
12. Define waxing and waning in the formation of beats?
13. Define beats.
14. What is Doppler effect ?
15. What is effect of wind on apparent frequency of sound heard by the observer?
16. Which phenomenon is used in superheterodyne oscillator?

S.A.I (2 Marks)

1. Define amplitude and wavelength of the progressive sound wave.

2. Define frequency and velocity of the progressive sound wave.

3. Dervie the relation between velocity and wavelength of the progressive wave.

4. In case of sound wave, explain phase difference and path difference.

5. State any four characteristics of simple harmonic progressive wave.

6. State and explain principle of superposition of waves.

7. What are beats? How are they produced?

8. What are the conditions for formation of beats?

9. State the applications of beat phenomenon.

10. What is the effect on beat frequency if prongs of higher frequency is waxed a little or filed a little?

11. What is the effect on beat frequency if the prongs of lower frequency is waxed a little or filed a little?

12. Write the expression for I_{max} and I_{min} for two interfering waves in beats having amplitude a_1 and a_2.

13. Represent graphically constructive interference when two identical progressive sound waves are superimposed.

14. State the limitations of Doppler effect.

15. State the expression for apparent frequency when source of sound and the observer are

    1. moving towards each other

    2. moving away from each other.

16. State the expression for apparent frequency when source is stationary and observer is

    1. moving towards the source.

    2. moving away from the source.

17. State the expression for apparent frequency when observer is stationary and source is

    1. moving towards the observer.

    2. moving away from the observer.

S.A.II (3 Marks)

1. Derive an expression for one dimensional simple harmonic progressive wave travelling in the direction of positive X-axis. Hence state the expression along negative x- axis direction.

2. Explain how Quincke's tube experiment is used to determine the wavelength of the sound wave.

3. Explain the production of beats and deduce analytically the expression for beat frequency.

4. Show analytically the beat frequency is equal to the difference between the reciprocals of the periods of the two interfering notes.

5. Explain the superposition of two progressive waves. Hence explain how intensity of sound becomes maximum and mimimum.

CHAPTER 8 - STATIONARY WAVES

V.S.A. (1 Mark)

1. When are stationary waves produced?

2. Why are the stationary waves called so?

3. What is the minimum frequency with which a stretched string of length 'L', linear density 'm' can vibrate under tension 'T'?

4. How the frequency of a vibrating wire is affected, when the load attached is immersed in water?

5. What are the frequencies of the notes produced in an open and closed pipe in terms of length 'L' of pipe and velocity 'V' of waves?

6. Explain, why the pitch of an organ pipe on a hot summer day is higher.

7. How sounds of different frequencies are produced by opening or closing the different holes of a flute?

8. State two points of difference between progressive waves and stationary waves.

9. Why are strings of different thickness and materials used in a sitar or some other such instrument?

10. A tuning fork is in resonance with a closed pipe. But the same tuning fork cannot be in resonance with an open pipe of the same length. Why?

11. When we start filling an empty bucket (or cylinder) with water, the pitch of the sound produced goes on changing. Why?

12. If oil of density higher than that of water is used in place of water in a resonance tube, how does the frequency change?

13. Two organ pipes of same length open at both ends produce sound of different frequencies, if their radii are different. Why?

14. State formulae for frequency of tuning fork N in Melde's experiment (i) in parallel position and (ii) in perpendicular position, if L is vibrating length of string having linear density 'm' strecthed under tension T.

15. State any two applications of resonance.

16. State any two disadvantages of resonance.

17. What is the cause of end correction?

18. State the formula for end correction for a pipe closed at one end if L_1 and L_2 are the resonating lengths for frequencies n_1 and n_2 respectively.

19. State the formula for end correction for a pipe open at both ends if L_1 and L_2 are the resonating lengths for frequencies n_1 and n_2 respectively.

20. State any two limitations of end correction.

21. Define specific gravity and state its formula.

22. State the mathematical expression for lowest frequency of stretched wire of length 'L' in terms of Young's modulus 'Y', extension 'ℓ', density ρ.

23. If 'α' is coefficient of linear expansion of material of wire of length 'L' and 't' is rise in temperature, 'Y' is Young's modulus and 'ρ' is density, state the formula for fundamental frequency of vibration.

24. What are pressure nodes and pressure antinodes?

S.A.I (2 Marks)

1. What are stationary waves? Why are they called stationary waves?

2. Distinguish between progressive waves and stationary waves.

3. State the characteristics of stationary waves.

4. Distinguish between stationary waves and beats.

5. Distinguish between overtones and harmonics.

6. Distinguish between free vibrations and forced vibrations.

7. Distinguish between free vibrations and resonance.

8. Draw neat diagrams to explain fundamental mode of vibrations of an air column in a pipe when (i) open at both ends and (ii) closed at one end.

9. Draw neat diagrams to explain (i) third harmonic and (ii) second overtone, of an air column in a pipe closed at one end.

10. Draw neat diagrams to explain (i) second harmonic and (ii) second overtone, of an air column in a pipe open at both the ends..

11. What is end correction? If 'L' is the length of the tube, what are the end corrected lengths for (i) a pipe open at both ends and (ii) a pipe closed at one end.

12. State the formula for the velocity of transverse waves on a stretched string and obtain an expression for fundamental frequency of vibrations of stretched string.

13. State and explain law of linear density of stretched string. Hence show that frequency 'n' is inversely proportional to radius of string.

14. Explain the phenomenon of resonance and state one example about its merit and demerit.

15. Two organ pipes, one open at both ends and the other closed at one end, vibrate in unison in fundamental mode. Compare their lengths.

16. An air column in a pipe closed at one end vibrates in unison with a pipe open at both ends in the mode of first overtone. Compare their lengths.

17. Compare the lengths of air column in pipes closed at one end and open at both ends, if they vibrate in unison with each other in second overtone.

18. You are given, 'Y' is Young's modulus, 'ρ' is density and 'α' is coefficient of linear expansion of material of wire. Obtain expression for its fundamental frequency if the rise in temperature is 'dθ' for a wire of length 'L'.

19. In sound waves, a displacement node is a pressure node and vice versa. Explain.

20. State any four advantages of resonance.

21. Prove that a pipe open at both ends of length '2L', has same fundamental frequency as another pipe of same radius, closed at one end of length 'L'.

22. An organ pipe open at both ends vibrate with a frequency 'n' with its 'Pth overtone. When one end of the same pipe is closed, it vibrates with a frequency N which is its qth overtone, show that

$$N = \frac{(2q + 1)\, n}{2\,(P+1)}$$

$$\text{or } n = \frac{2\,(P+1)}{(2q + 1)}\, N$$

23. Define relative density. If 'd' is the relative density, n_1 and n_2 be the frequencies of string in air and liquid respectively, obtain the relation between them.

24. What are stringed instruments? State two suitable examples.

25. What are wind instruments? Explain working of flute..

26. Explain working of bugle and harmonium.

27. State disadvantages of resonance.

28. What are the limitations of end correction?

29. What is end correction? Obtain an expression for velocity of sound in air at room temperature by applying end correction.

30. State any four properties of stationary waves.

31. The fundamental frequency of vibrations of stretched string is $n = \frac{1}{2\ell}\sqrt{\frac{T}{m}}$ where T is tension applied to a wire of resonating length ' ℓ ' having mass per unit length 'm'. Express it in terms of density 'ρ', extension 'x' and Young's modulus 'Y'.

S.A.II (3 Marks)

1. State and explain law of length and law of tension of vibrating string.

2. Show that only odd harmonics are present as overtones in the case of an air column vibrating in a pipe closed at one end.

3. Show that even harmonics are absent in the case of an air column vibrating in a pipe closed at one end.

4. Show that all harmonics are present as overtones in the case of an air column vibrating in a pipe open at both ends.

5. With diagrams show that the fundamental frequency of vibrations of an air column in the tube closed at one end is equal to half the fundamental frequency in a tube of same dimensions but open at both ends.

6. Show that the frequency of vibrations of air column in first overtone for tube closed at one end is equal to $\left(\frac{3}{4}\right)^{th}$ of frequency in the same mode of vibration in a tube of same dimensions and open at both ends.

7. Show that the frequency of vibrations of air column in second overtone in the tube open at both ends is 20% higher than the frequency of vibration in the same mode but in a tube of same dimensions and closed at one end.

8. With neat diagram, explain various modes of vibration on a stretched string between two rigid supports.

9. Show that even as well as odd harmonics are present as overtones on a string stretched between two rigid supports.

10. Explain the formation of stationary waves by analytical method.

11. Explain the terms (i) Free bibrations, (ii) Forced vibrations and (iii) Resonance.

12. Derive formulae for end correction in case of (i) pipe open at both ends (ii) pipe closed at one end.

13. Assuming amplitude of stationary wave $A = 2a \cos \frac{2\pi\chi}{\lambda}$ where the symbols have their usual meanings, obtain conditions for nodes and antinodes.

14. State the formula for velocity of transverse waves on a stretched string and with diagram obtain an expression for fundamental frequency of vibration of stretched string between two rigid supports.

15. State and explain law of linear density. Derive the relationship between fundamental frequency with radius of string and density of material of string.

16. The displacement of the particle of medium when sound wave propagates is represented by $y = A \cos (ax + bt)$ where A, a and b are positive constants. The wave is reflected by an obstacle situated at $x = O$.

a What is the wavelength and frequency of incident wave?

b) Write the equation of the reflected wave.

17. A wire of length 'L' is in unison with a tuning fork of frequency 'n' when stretched by a load of density 'ρ' hanging vertically. The load is then immersed in water of density 'σ'. By how much the length of the wire should be changed to bring it again in unison with the same tuning fork?

18. Prove analyticalty that in case of an open organ pipe of length 'L', the frequencies of the vibrating air column are given by $n = P \frac{V}{2L}$ where 'P' is an integer and V is velocity of sound in air.

19. Prove analytically that in case of an organ pipe of length 'L' closed at one end, the frequencies of the vibrating air column are given by $n = (2P-1) \frac{V}{4L}$ where 'P' is an integer and 'V' is velocity of sound in air.

L.A. (5 Marks)

1. What are stationary waves? Explain the formation of these waves by applying super position principle to the wave functions of incident and reflected waves in case of string fixed at both ends. What are nodes and antinodes? State any two properties of stationary waves.

2. Explain formation of stationary waves by analytical method. What are nodes and antinodes? Show the distance between two successive nodes or antinodes is half the wavelength.

3. Show that all harmonics are present in case of an air column vibrating in a pipe open at both ends and only odd harmonics are present in a pipe closed at one end.

4. Show that only odd harmonics are present in case of an air column vibrating in a pipe closed at one end. Explain resonance with one example about its merit and demerit.

5. Show that all harmonics are present in case of an air column vibrating in a pipe open at both the ends. Define free vibrations and forced vibrations.

6. With suitable diagrams, explain various modes of vibration in a stretched string.

   Write the formulae for frequency of tuning fork in Melde's experiment in (i) parallel position (ii) perpendicular position. What are percussion instruments?

CHAPTER 9 - KINETIC THEORY OF GASES AND RADIATION

V.S.A. (1 Mark)

1. Which type of ideal gas will have the largest value for $[C_P - C_V]$?
2. State the equation of vibrational energy of a diatomic molecule.
3. What is the value of emissivity of perfectly (a) black body and (b) reflecting body?
4. A 'good absorber is also a good emitter of heat. Correct or incorrect? Why`?
5. The top of cloud of smoke holds together for hours. Why?
6 What is the specific heat of gas in isothermal process?
7. What is the specific heat of a substance at its boiling point or melting point?
8. What is the origin of pressure exerted by the gases on the wall of the container?
9. What is the average velocity of molecules of an ideal gas?

S.A.I (2 Marks)

1. State the types of degrees of freedom of rigid diatomic molecules.
2. State the type of degrees of freedom of non-rigid diatomic molecules.
3. Show that for a diatomic gas, the total energy possessed by it is $U = \frac{7}{2} RT$
4. State the characteristics of spectrum of black body radiations in terms of wavelength.
4. State and explain Stefan's law of radiation.
5. State and explain Newton's law of cooling.
6. Assuming the expression for pressure P exerted by ideal gas, prove that the kinetic energy per unit volume is $\frac{3}{2} P$.
7. Show that the r.m.s. velocity of gas molecules is directly proportional to the square root of its absolute temperature.

8. Refrigerator is the reverse of heat engine. Explain.

9. What is athermanous substance? Write two examples.

10. What is diathermanous substance? Write two examples.

11. On what factors does the emissive power of a body depend?

12. Why is it cold at the top of the mountain compared to sea level?

13. What is basic law followed by equipartition of energy ?

14. Equal masses of monoatomic and diatomic gases are supplied heat at the same temperature, pressure and volume. If same amount of heat is supplied to both the gases, which of them will undergo greater temperature rise? Why?

15. A gas is contained in a closed vessel. How pressure due to the gas will be affected if force between the molecules disappear suddenly?

S.A.II (3 Marks)

1. What are degrees of freedom? Explain degrees of freedom of (a) a monoatomic and

   (b) a diatomic molecule.

2. Explain Maxwell's distribution of molecular speeds with suitable graph.

3. What is coefficient of performance of a refrigerator? Derive an expression for it.

4. State the law of equipartition of energy. Obtain an expression for energy per molecule and energy per mole of a monoatomic gas.

5. State the law of equipartition of energy. Obtain an expression for energy per molecule and energy per mole of a rigid diatomic gas.

6. State the law of equipartition of energy. Obtain an expression for energy per molecule and energy per mole of a non-rigid diatomic gas.

7. Explain Ferry's perfectly black body with the help of neat labelled diagram.

8. Derive theoretically the Kirchhoff's law of radiation.

9. Derive on expression for pressure exerted by an ideal gas on any one wall of a container.

CHAPTER 10 - WAVE THEORY OF LIGHT

V.S.A. (1 Mark)

1. In air, three media water, turpentine and glass are separated by parallel plane boundaries. They have refractive indices μ_w, μ_t and μ_g with respect to air. What is refractive index of glass with respect to turpentine?

2. How does the wave normals travel in (a) plane wavefront (b) spherical wavefront?

3. What is the angle of incidence when a ray of light passes from vacuum into a medium of refractive index μ if the angle of incidence 'i' is found to be twice the angle of refraction 'r' ?

4. A ray of light is incident on a medium at an angle 'i'. It is found that the reflected ray and refracted ray are perpendicular. What is the refractive index of the medium?

5. Why polaroid glass is used in sunglasses?

S.A.I (2 Marks)

1. Define wavefront and wave normal.

2. Draw a neat labelled diagram of

   a) Spherical wavefront with wavenormal.

   b) Plane wavefront with wavenormal.

3. Draw a neat labelled diagram of reflection of light from a plane reflecting surface using plane wavefront.

4. Define angle of polarisation and state Brewster's law.

5. Using Huygens' principle, explain the construction of a plane wavefront.

S.A.II (3 Marks)

1. State Huygens' principle and explain the construction of spherical wavefront.
2. Write merits and demerits of Huygens' wave theory of light.
3. Explain the phenomenon of polarisation of light by reflection.
4. State and prove Brewster's law.
5. What are different types of wavefronts? How are they produced?
6. Explain the concept of wavefront and wavenormal.

CHAPTER 11 - INTERFERENCE AND DIFFRACTION

V.S.A. (1 Mark)

1. Why are coherent sources required for producing a steady interference pattern of light?

2. Is the speed of light in glass independent of the colour of light? Why?

3. Which of the two colours, red and violet travel slower in a glass prism? Why?

4. What is the difference between light waves and matter waves?

5. Unpolarised light is incident on a plane glass surface. What should be the angle of incidence so that the reflected and refracted rays are perpendicular to each other?

6. What is the nature of interference fringes observed in Young's double slit experiment?

7. In Young's double slit experiment, does interference pattern also produce diffraction?

8. What happens when monochromatic source is replaced by a source of white light in biprism experiment?

9. State the limit of resolution for circular aperture, according to Airy.

10. How can Young's experiment be performed by using a single source of light?

11. State the importance of Young's double slit experiment.

12. When a tiny circular obstacle is placed in the path of light from a distant monochromatic source, a bright spot is seen at the centre of the shadow of the obstacle. Explain, why?

13. State conditions of path difference for constructive and destructive interference pattern?

14. State the factors on which resolving power of microscope depends.

15. How can the resolving power of telescope be increased?

16. Show graphically the variation of intensity (I) against angular separation for images well resolved by an optical instrument.

17. State Abbe's condition for the least distance between two objects so that they are just resolved.

18. What should be the order of size of obstacle or aperture to produce diffraction of light?

19. In the interference pattern, if the intensities of both sources are I, then what is the intensity of maxima and minima?

20. If the two interfering waves having unequal amplitudes interfere, then what will be the nature of interference pattern?

S.A.I (2 Marks)

1. When a low flying aircraft passes overhead, then light shaking of the picture on T.V. screen is noticed. Why?

2. The two sources of light should be close to each other for the production of steady interference pattern. Why?

3. How will the interference pattern in Young's experiment gets affected, when

   i) distance between the slits is reduced and

   ii) the entire set up is immersed in water?

4. When the whole apparatus of Young's experiment is kept in a liquid of refractive index 1.3 instead of air, how does the fringewidth of interference fringe changes?

5. In a single slit diffraction experiment, the width of the slit is made double. How does this affect the size and intensity of diffraction pattern?

6. Two students are separated by a 3 m partition wall in a room 5 m high. If both light and sound waves can bend around obstacles, why the students are unable to see each other even though they can converse easily?

7. State any four conditions to get steady interference pattern.

8. State the difference between interference and diffraction.

9. Draw a neat labelled ray diagram to get magnified and diminished images of the two virtual sources when convex lens is used in biprism experiment.

10. State the formula for limit of resolution and resolving power of an oil immersion microscope. On which factors resolving power depends?

11. State the formula for angular separation and resolving power of telescope. State the factors on which resolving power depends.

12. Why microscopes of high magnifying power have oil immersion objectives?

13. Draw a ray diagram showing position of virtual sources with region of interference in biprism experiment.

14. Represent graphically the intensity distribution in the case of diffraction due to single slit.

15. Assuming the expression for path difference between two light waves, obtain an expression for the fringewidth in case of bright bands.

S.A.II (3 Marks)

1. In Young's experiment, describe briefly how bright and dark fringes are obtained on the screen kept in front of the double slit.

2. Using analytical method, obtain an expression for path difference between two light waves.

3. Assuming the expression for path difference between two light waves, show that the bright and dark bands are equally spaced.

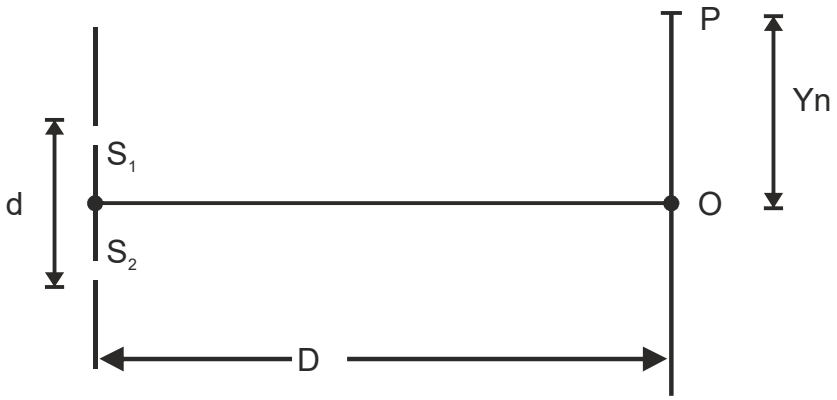
4. Describe how the distance between the two virtual sources in the biprism experiment is measured. Derive the necessary formula.

5. Explain Rayleigh's criterion about limit of resolution with necessary diagrams.

6. Explain Fraunhofer's diffraction due to single slit to get diffraction pattern with necessary ray diagram.

7. Deduce an expression for path difference between two light waves.

8. The intensity at the central maxima (O) in a Young's double slit experiment is I_O. If the distance OP equals one-third of the fringe width of the pattern, then show that the intensity at point P would be $\frac{I_O}{4}$



CHAPTER 12 - ELECTROSTATICS

V.S.A. (1 Mark)

1. Does the electic flux due to a point charge enclosed by a spherical Gaussian surface get affected when its radius is increased?

2. A charge Q μC is placed at the centre of a cube. What would be the flux through one face?

3. An arbitrary surface encloses a dipole. What is the electric flux through this surface?

4. The capacitance of a charged capacitor is C and the energy stored in it is U. What is the value of charge on the capacitor?

5. Express dielectric constant in terms of capacitance with and without medium. What is its unit?

6. What is the function of a dielectric in a capacitor?

7. How does the electric field inside a dielectric decrease when it is placed in an external electric field?

8. How does the energy stored in a capacitor change (a) if the battery is disconnected b) if the plates of a charged capacitor are moved farther?

9. How does the energy stored in a capacitor change, if the plates of a charged capacitor are moved farther, the battery remains connected?

10. When a capacitor is charged by a battery; is the energy stored in the capacitor same as energy supplied by the battery? why?

S.A.I (2 Marks)

1. Derive an expression for the electric field intensity at a point outside a charged conducting sphere.

2. Derive an expression for the electric field intersity at a point outside an infinitely long charged cylindrical conductor.

3. Derive an expression for the electric field intensity at a point near a uniformly charged infinite plane sheet.

4. Assuming the equation for mechanical force per unit area of a charged conductor, obtain an expression for energy density of a medium.

5. Explain concept of a capacitor.

6. Draw a neat labelled diagram of

   i) Cylindrical capacitor ii) Spherical capacitor.

7. Draw a neat labelled diagram of van de Graaff generator.

8. Two isolated metal spheres A and B have radius R and 2R respectively, and same charge q. Find which of the two spheres has greater energy density just outside the surface of the spheres.

9. An infinitely long positively charged straight wire has a linear charge density λ Cm^{-1}. An electron is revolving around the wire as its centre with a constant velocity in a circular plane perpendicular to the wire. Deduce the expression for its kinetic energy.

10. What do you mean by polar molecules and non polar molecules?

11. Derive an expression for electric field intensity at a point near and outside the surface of a charged conductor of any shape.

S.A.II (3 Marks)

1. State and prove Gauss' theorem in electrostatics.

2. Derive an expression for mechanical force per unit area of a charged conductor.

3. Derive an expression for the capacitance of a parallel plate capacitor completely filled with a dielectric.

4. Derive an expression for the energy stored in a charged capacitor.

   Express it in different forms.

5. Derive an expression for the effective capacitance when three capacitors are connected in series.

6. Obtain an expression for the equivalent capacitance when three capacitors are connected in parallel.

7. Explain polarisation of a dielectric in an external electric field.

8. Describe the working and state the uses of van de Graaff generator.

CHAPTER 13 - CURRENT ELECTRICITY

V.S.A. (1 Mark)

1. What is null point in a Wheatstone's network?
2. What is a junction in a circuit?
3. What is a potentiometer?
4. Why is no power consumed from the circuit containing unknown e.m.f. when potentiometer is used to measure the unknown e.m.f.?
5. Define potential gradient.
6. What is terminal P.D. of a cell?

S.A.I (2 Marks)

1. State and explain Kirchhoff's current law.
2. State and explain Kirchhoff's voltage law.
3. State any one probable error while using meter bridge and explain how this error can be minimized.
4. What is balance point in Kelvin's method to measure resistance of a galvanometer?
5. The Kelvin's method is called equal deflection method, why? Explain.
6. Explain the principle of potentiometer.
7. Draw a neat labelled circuit diagram for using the potentiometer for comparison of e.m.f.s of two cells by individual cell method.
8. Draw a neat labelled circuit diagram for using the potentiometer for comparison two cells by sum and difference method.
9. Draw a neat labelled circuit diagram for using the potentiometer to determine internal resistance of a cell.

10. Explain two precautions to be taken while using a potentiometer with respect to the e.m.f. of the primary cell and the two cells whose e.m.f. is to be measured.

11. State any two disadvantages of a potentiometer.

S.A.II (3 Marks)

1. Obtain balancing condition in case of Wheatstone's network using Kirchhoff's law.

2. Obtain balancing condition in case of Wheatstone's network using Ohm's law.

3. With a neat circuit diagram, explain the use of meter bridge to determine unknown resistance.

4. With a neat circuit diagram, explain the use of meter bridge to determine the resistance of a galvanometer.

5. Describe how a potentiometer can be used to find the e.m.f. of one cell when e.m.f. of other cell is known, using direct method.

6. Describe how a potentiometer can be used to find the e.m.f. of one cell when e.m.f. of other cell is known, using combination method.

7. With neat circuit diagram explain the use of potentiometer to determine the internal resistance of a cell.

8. State any three advantages of potentiometer over voltmeter.

CHAPTER 14 - MAGNETIC EFFECT OF ELECTRIC CURRENT

V.S.A. (1 Mark)

1. What will be the magnetic field i) outside ii) inside a long current carrying air-cored solenoid?

2. What is function of i) electric field ii) magnetic field in a cyclotron?

3. Can cyclotron accelerate uncharged particles? Why?

4. What is meant by cyclotron frequency?

5. Does the time spent by proton inside the dee of cyclotron depend upon the radius of path and velocity of proton? Why?

6. The frequency of charged particle circulating inside the dees of cyclotron does not depend upon speed of particle. Why?

7. Why the earth's magnetic field does not affect the working of a moving coil galvanometer?

8. Is the resistance of an ammeter greater or less than that of the galvanometer of which it is formed? Why?

9. Why should an ammeter have a low resistance?

10. Why should an voltmeter have a very high resistance?

11. State two properties of the material of the wire used for suspension of the coil in a moving coil galvanometer.

12. How accuracy of pivoted coil type of galvanometer can be increased?

13. A galvanometer having a resistance of 80 Ω is shunted by a wire of resistance 20 Ω. If the total current is 10 A, find the current through the shunt.

14. A galvanometer having a resistance of 120 Ω is shunted by 5 Ω resistance. What is the ratio of current in shunt to the current in galvanometer?

15. There are two identical galvanometers. One is converted into voltmeter and the other into millivoltmeter. Which meter will have smaller resistance !

S.A.I (2 Marks)

1. By using Ampere's law, obtain an expression for magnetic induction at a point near infinitely long straight conductor carrying current.

2. Derive an expression for magnetic induction along the axis of toroid.

3. Draw a neat lebelled diagram of suspended coil type moving coil galvanometer.

4. What is shunt? State the functions of shunt in convertion of galvanometer into an ammeter.

5. Define sensitivity of moving coil galvanometer. Can the sensitivity of moving coil galvanometer be increased to any extent? Why?

6. Show that radius of circle traced by positive ion in cyclotron is directly proportional to its velocity.

7. What are the limitations of cyclotron?

S.A.II (3 Marks)

1. State Ampere's circuital law. Obtain an expression for magnetic induction at a point near infinitely long straight conductor carrying an electric current.

2. Derive an expression for magnetic induction at point along the axis of long straight solenoid.

3. State the principle of moving coil galvanometer. Show that the torque acting on a coil of galvanometer is constant at any position of coil.

4. Derive an expression for sensitivity and accuracy of moving coil galvanometer.

5. Explain construction of cyclotron. Obtain an expression for magnetic resonance frequency in cyclotron.

CHAPTER 15 - MAGNETISM

V.S.A. (1 Mark)

1. What is the magnetic moment of electron due to its orbital motion?
2. Which magnetic materials have i) relative permeability > 1 ii) relative permeability < 1?
3. Why do magnetic lines of force prefer to pass through iron than air?
4. Are the i) diamagnetic materials ii) paramagnetic malerials iii) ferromagnetic materials attracted or repelled by the magnet?
5. Write the relation between relative permeability and magnetic susceptibility.
6. Can there be a material which is non-magnetic?
7. Name two materials which have i) positive susceptibility ii) negative susceptibility.
8. The relative permeability of a material is i) 0.999 ii) 1.001. Identify the material.
9. Is the magnetic susceptibility dimensionless quantity? Why?
10. What is a Curie temperature?
11. What is a ferromagnetic substance?
12. What is gyromagnetic ratio?
13. What is the effect of temperature on magnetization of paramagnetic material?

S.A.I (2 Marks)

1. Explain an analogy between magnetic dipole moment M of circular current loop and electric dipole moment P of electric dipole.
2. Define magnetization. Obtain relation between magnetization, external magnetic field and absolute temperature for paramagnetic material.

3. Distinguisn between diamagnetic and paramagnetic substances.

4. Write any four properties of paramagnetic substance.

5. What are domains in ferromagnetic material? What is the effect of temperature on domain structure of ferromagnetic material ?

6. Write any four properties of diamagnetic substance.

S.A.II (3 Marks)

1. Explain magnetization of ferromagnetic material with the help of toroid. Hence obtain relation between relative permeability and magnetic susceptibility.

2. Explain ferromagnetism on the basis of domain theory.

3. What is diamagnetism? Why the diamagnetic substance remains perpendicular, when it is suspended freely in uniform magnetic field? What is Meissner effect?

4. What is magnetization? State Curie's law of magnetization? Under what condition you can apply Curie's law for ferromagnetic materials?

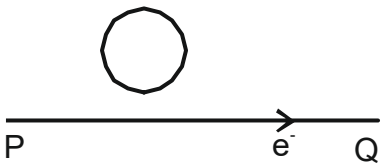
CHAPTER 16 - ELECTROMAGNETIC INDUCTION

V.S.A. (1 Mark)

1. The north pole of a bar magnet is moved towards a coil along the axis passing through the centre of the coil and perpendicular to the plane of the coil. What is the direction of the induced current in the coil, when viewed in the direction of the motion of the magnet ?

2. According to which law, the relative motion between the coil and magnet, produces change in magnetic flux and an induced emf in coil?

3. An electron moves along the line PQ which lies in the same plane as a circular loop of conducting wire PQ as shown in figure. What will be the direction of the induced current in the loop?



4. Why displacement current is induced in a coil by change in magnetic flux produced by another coil in its vicinity?

5. Which quantity plays the role of inertia for current flowing in a coil?

6. State the general equation of Ampere's is circuital law. State the modified Ampere's circuital law.

7. Which concept is used in order to show phase relationship between voltage and current ? In what type of circuit it is used?

8. What will be the phase angle between the voltage and the current in resistive and capacitive A.C. circuit?

9. How alternating current can be measured ?

10. What do you mean by capacitive reactance ?

11. State the relation between capacitive reactance and frequency.

12. At resonant frequency, what is the amplitude of current ? What is the value of current, for resonance in (i) series (ii) parallel ?

13. Which device, uses the principle of mutual induction.?

14. Using turns ratio, how will you decide step down and step-up transformer? Explain the principle used in transformer.

15. What happens to the current in the coil, when a magnet is accelerated in the coil?

16. Why is Lenz's law a consequence of the law of consevation of energy?

17. When average power consumed in circuit is zero, will that current perform work ? What is it called?

18. When a current is passed through the suspended coil, it starts oscillating. The coil stops its oscillations, if an aluminium plate is placed near the oscillating coil, why?

19. Is the magnetic flux through any coil proportional to the displacement current produced in it? Why?

20. What is magnetic line of force ?

21. What is magnetic flux ? Is magnetic flux a scalar or vector quantity ?

22. State SI unit of magnetic flux. State its dimensions.

23. Distinguish between eddy current and displacement current?

S.A.I (2 Marks)

1. State the SI unit of I) magnetic flux II) magnetic induction.

2. What is electromagnetic induction?

3. State Faraday's laws of electomagnatic induction.State Fleming's right hand rule.

4. What are eddy currents?

5. State Faraday's second law and Lenz's law of electromagnetic induction ?

6. State two applications of eddy currents and explain any one application of eddy currents.

7. Explain the phenomenon of self induction.

8. Define self - inductance. State its SI unit and dimensions.

9. A glowing lamp is connected in parallel with an inductor. When it is switched off what happens to the lamp? Why?

10. Define mutual induction. State formula for coefficient of mutual induction.

11. What is a transformer? State the principle of working of a transformer.

12. What is step-up transformer and step down transformer?

13. Derive the relation Es/Ep = Ns/Np for a transformer. What is a step up and a step-down transformer?

14. What is the turns ratio of a transformer? What can you say about its value for (1) step up transformer (II) step-down transformer?

15. State any two factors on which the value of alternating emf induced in the secondary coil of a transformer depends.

16. Distinguish between a step-up and step-down transformer.

17. State the principle of an A.C. generator. Draw the graph of induced e.m.f. versus phase.

18. For a rectangular coil rotating in a uniform magnetic field, in which position of the coil the emf induced is maximum? What is minimum amount of the magnetic flux through the coil in this position ?

19. Define I) peak value II) rms value ,of an alternating current.

20. Define inductive reactance. State its SI unit and dimensions.

21. Define capacitive reactance. State its SI unit and dimensions.

22. Explain the terms I) reactance II) impedance.

23. Explain the term impedance. State its equation for LCR series circuit

24. Explain the term inductive reactance. Write an expression for it.

25. Explain the term capacitive reactance . Write an expression for it.

26. Distinguish between resistance and reactance.

27. What is the power factor of an LCR series circuit.?

28. What is an acceptor circuit and rejector circuit? State its use.

29. What is sinusoidal emf? Explain its variation in a coil rotating in uniform magnetic field.

30. Explain phasor diagram for emf and current in A. C. circuit with an inductor.

31. State the modified Ampere's circuital law**.** Explain each term involved in it.

32. What is a choke? Explain its use in the functioning of a fluorescent tube.

33. State and explain Lenz's law of electromagnetic induction in accordance with the principle of conservation of energy.

S.A.II (3 Marks)

1. What is electromagnetic induction? State Faraday's laws of electromagnetic induction.

2. Prove theoretically the relation between the emf induced and the rate of change of magnetic flux in a coil moving in a uniform magnetic field.

3. State and explain two applications where eddy currents are useful.

4. What are eddy currents? State any four applications of eddy currents.

5. Define mutual induction.Explain it and hence define mutual inductance.

6. What is displacement current? Explain the need for displacement current.

7. Describe the construction and working of transformer with neat labelled diagram.

8. Derive the relation Es/Ep = Ns/Np for a transformer. Hence, explain a step up and step down transformer.

9. Obtain an expression for the emf induced in a coil rotating with a uniform angular velocity in a uniform magnetic field. Show graphically the variation of the emf with time.

10. A sinusoidally alternating emf is applied to a resistor. Discuss the behavior of the current in this case with a resistor.Draw the phasor diagram of voltage and current.

11. Explain rms values of an alternating emf and an alternating current. How are they related to the respective peak values in the case of sinusoidal waveforms?

12. Explain the theory of a.c. circuit with a pure inductor. Draw the phasor diagram of voltage and current.

13. A sinusoidally alternating emf is applied to an inductor of large self inductance and negligible resistance. Obtain an expression for the inductive reactance. Define inductive reactace and state its SI unit.

14 Explain the theory of a.c. circuit with a capacitor. Draw phasor diagram of voltage and current.

15 A sinusoidal alternating emf is applied to a capacitor. Obtain an expression for the capacitive reactance, Define capacitive reactance and state its SI unit.

16 How are oscillations produced using an inductor and a capacitor?

17 Explain electrical oscillations produced in a circuit that contains both a capacitor and an inductor.

18 Obtain an expression for power consumed in an LCR series circuit. Hence obtain an expression for the power factor of the circuit.

19 Obtain an expression for the impedance of a resistor, pure inductor and capacitor connected in series across a source of alternating emf. State the formula for the phase difference.

20. Explain electrical resonance in an LCR series circuit. Deduce the expression for the resonant frequency of the circuit.

21. What is a parallel resonant circuit? State the condition for parallel resonance. Obtain an expression for the resonant frequency of the circuit.

22. What is electomagnetic induction? Theoretically prove the relation, $e = -\frac{d\Phi}{dt}$

CHAPTER 17 - ELECTRONS AND PHOTONS

V.S.A. (1 Mark)

1. Why alkali metals are the most suitable as photosensitive surfaces?
2. Which is the best material for photoelectric emission? Why?
3. Why there is no effect of intensity of light on the kinetic energy of emitted photoelectrons?
4. How the stopping potential in volt is related with maximum kinetic energy of photoelectrons in electron volt?
5. Explain the utilization of energy absorbed by electron during its collision with photon.
6. Why more photoelectrons are emitted when intense beam is incident on a metal surface?
7. How photoelectric effect is an instantaneous process?
8. Why photon energy is independent of intensity of radiation?

S.A.I (2 Marks)

1. State any four characteristics of photoelectric effect.
2. What is photoelectric effect? State any two applications of photoelectric cell.
3. Explain the term 'stopping potential. Define threshold wavelength.
4. Write Einstein's photoelectric equation. State physical significance of terms involved in it.
5. Explain graphically a variation of stopping potential with frequency of incident radiation.
6. Explain graphically a variation of photoelectric current with intensity of incident light.
7. Explain graphically a variation of photoelectric current with frequency of incident radiation.

8. What is photoelectric cell? Draw the labelled digram of photoelectric cell.

9. Explain any two applications of photoelectric cell.

10. Explain photon picture of electromagnetic radiation.

S.A.II (3 Marks)

1. State and explain the characteristics of photoelectric effect.

2. With neat and labelled circuit diagram, describe an experiment to study any one characteristic of photoelectric effect.

3. State Einstein's equation of photoelectric effect and hence explain any two characteristics of photoelectric effect.

4. Describe the construction and working of photoelectric cell.

5. State the characteristics of photoelectric effect. Explain any one application of photoelectric cell.

6. Explain graphically a variation of photoelectric current with frequency and with intensity of incident vadiation.

7. Define saturation current and stopping potential. Hence explain graphically a variation of stopping potential with frequency of incident radiation.

8. Explain Planck's quantum theory of radiation. Hence state Einstein's equation of photoelectric effect?

9. Explain the particle nature of light on the basis of photon. Hence explain the photon picture of electromagnetic radiation.

CHAPTER 18 - ATOMS, MOLECULES AND NUCLEI

V.S.A. (1 Mark)

1. How emitted spectra of an element depends on structure of an atom of element?
2. Obtain an expression for kinetic energy of electron by using Bohr's first postulate.
3. Explain the mass energy relation.
4. Obtain the dimensions of Planck's constant.
5. Why Bohr's orbits are known as 'stationary orbits?
6. Obtain the dimensions of Rydberg's constant.
7. What is wave number? What is its use?
9. What are the matter waves?
10. How stability of nucleus depends upon binding energy per nucleon?
11. Define radioactivity and radioactive substance.
12. Define isotopes and isobars.
13. Define atomic number and mass number.
14. Define binding energy of nucleus. Hence write a formula of average energy per nucleon.
15. State the radioactive decay law. Hence write an exponential equation of radioactive decay.
16. Define radioactive decay constant and write the formula for it.
17. Using Bohr's formula obtain an expression for wavelength of Hα line in Balmer series in hydrogen spectrum.

S.A.I (2 Marks)

1. Explain Rutherford's atomic model.
2. Draw neat labelled diagram of Geiger Marsden experiment.
3. Why Rutherford's atomic model can not explain the stability of atomic structure and spectrum of hydrogen atom.
4. Show that linear speed of electron in Bohr's orbit is inversely proportional to the principal quantum number.
5. Show that angular speed (ω) of electron in n^{th} Bohr's orbit is equal to $\frac{\pi me^4}{2\epsilon_o^2 h^3 n^3}$ where all symbols have their usual meanings.
6. Show that angular speed of electron in Bohr's orbit is inversely proportional to the cube of the principal quantum number.
7. Show that frequency (f) of revolution of an electran in n^{th} Bohr's orbit is equal to $\frac{me^4}{4\epsilon_o^2 h^3 n^3}$ where symbols have their usual meanings.
8. Show that frequency of revolution of an electron in Bohr's orbit is inversely priportional to the cube of principal quantum number.
9. Show that period of revolution of an electron in Bohr's orbit is directly proportional to the cube of principal quantum number.
10. Show that centripetal acceleration of electron in Bohr's orbit is inversely proportional to the fourth power of principal quantum number.
11. Draw a neat labelled diagram which shows energy levels of electron in different Bohr's orbits of hydrogen atom.
12. Explain the concept of de-Broglie wave.
13. On the basis of de-Broglie hypothesis, obtain Bohr's quantization condition of angular momentum.
14. Draw neat labelled diagram of Davisson and Germer experiment.
15. State the importance of Davisson and Germer experiment.

16. Define mass defect. State its formula.

17. Define binding energy per nucleon and obtain an expression for it in terms of mass defect.

18. Define Half life period of radioactive substance and obtain an expression for it.

19. Define nuclear fusion and nuclear fission.

20. Obtain an equation for radioactive decay.

21. Distinguish between α and β particles in radioactive disintegration.

22. Distinguish between β particles and γ rays in radioactive disintegration.

23. Explain radioactive disintegration. Hence state the radioactive decay law.

24. Explain the term decay constant.

25. Explain graphically the K_α and K_B wavelengths of X-rays.

26. Explain classical electromagnetic theory.

27. What are the shortest and longest wavelengths present in the Paschen series of spectral lines?

28. Obtain the ratio of shortest wavelength of spectral line in Lyman series to the longest wavelength of spectral line in Balmer series.

29. Obtain the ratio of longest wavelength of spectral line in Paschen series to the longest wavelength of spectral line in Brackett series.

30. Obtain the ratio of wavelength of Hα line to the wavelength of Hγ line in Balmer series.

S.A.II (3 Marks)

1. State the three postulates of Bohr's theory of hydrogen atom.

2. Obtain an expression for radius of n^{th} Bohr's orbit and show that radius is directly proportional to the square of principal quantum number.

3. Obtain an expression for energy of electron in Bohr's orbit and show that energy is inversely proportional to the square of principal quantum number.

4. Using an expression for energy of electron, obtain the Bohr's formula for hydrogen spectral line.

5. State the law of radioactive decay. Deduce the relation $N = N_O e^{-\lambda t}$ where symbols have their usual meanings.

6. On the basis of de-Broglie's hypothesis, obtain the relation for wavelength of an electron accelerated by a p.d. of V volt.

7. State any six properties of α particles.

8. State any six properties of β particles.

9. State any six properties of γ rays.

10. Explain the origin of spectral lines in hydrogen spectrum.

11. Explain the different series of spectral lines in hydrogen spectrum.

12. Explain the nuclear fusion and nuclear fission.

13. Obtain an exponential equation of radioactive decay and show graphically that number of nuclei of radioactive substance decreses exponentially with time.

14. Describe Davisson and Germer experiment for the wavelength of electron.

CHAPTER 19 - SEMICONDUCTORS

V.S.A. (1 Mark)

1. What is energy band?
2. What is breakdown of a PN junction diode?
3. State any two applications of solar cell.
4. How are LED's of different colours obtained?
5. Explain the doping levels of the three regions of a transistor.
6. What is a binary number system?
7. State the three basic gates used to perform logic functions.
8. What is a truth table?
9. What is an intrinsic semiconductor?
10. What is an extrinsic semiconductor?
11. In what region should a transistor be operated to be used as a switch?
12. What is an oscillator?
13. What is a solar cell?
14. What is feedback in a transistor oscillator?
15. What is positive feedback in a transistor oscillator?
16. What is negative feedback in a transistor oscillator?

S.A.I (2 Marks)

1. Explain the concept of donor impurity and acceptor impurity.
2. Explain formation of depletion layer in a PN junction diode.
3. Explain the formation of P-type semiconductor with suitable diagram.

4. Explain the formation of N-type semiconductor with suitable diagram.

5. Distinguish between intrinsic and extrinsic semiconductor.

6. Explain working of forward biased PN junction diode.

7. Explain working of reverse biased PN junction diode.

8. Draw and explain I-V characteristics of P-N junction diode.

9. Draw the characteristics of zener diode. Hence explain why it is used as regulator in the break down region.

10. Draw a neat labelled diagram of solar cell.

11. Explain V- I characteristics of solar cell.

12. Draw the energy band diagram for LED.

13. Draw and explain the V-I characteristics of LED.

14. Give any four advantages of LEDs.

15. Explain the arrangement of LED for formation of seven- segment display unit.

16. Draw the circuit diagram to study NPN transistor characteristics in C-E mode.

17. Draw the circuit diagram to study PNP transistor characteristics in C-E mode

18. With the help of graph explain input characteristics of NPN transistor in C-E-mode.

19. Draw the block diagram of an oscillator.

20. Draw the logic diagram and write truth table for the Boolean equation Y= $\overline{A. \cdot B.}$

21. Draw the logic diagram and write truth table for the Boolean equation Y = $\overline{A + B}$.

22. Using truth table show that $\overline{A + B} = \bar{A} \, . \, \bar{B}$

23. Using truth table show that $\overline{A. \, B} = \bar{A} + \bar{B}$

24. Draw the logic diagram and write truth table for the Boolean equation $\bar{A} \, . \, \bar{B}$.

25. Draw the logic diagram and write truth table for the Boolean equation $\bar{A} + \bar{B}$.

26. What is feedback in an oscillator? What is negative feedback and positive feedback?

S.A.II (3 Marks)

1. Explain with suitable diagram the concept of valence band and conduction band.
2. With necessary circuit diagram explain the working of zener diode as a voltage regulator.
3. With necessary diagram explain working of photo diode.
4. Define the two current ratios of a transistor. Obtain the relation between them.
5. With the help of graph explain output characteristics of NPN transistor in CE mode.
6. Write the formula for the voltage gain of an oscillator system. Explain the different quantities. Hence explain the Barkhausen criterion for sustained oscillations.
7. Draw the schematic symbol of a NOT gate. Explain its working with the help of Boolean equation and truth table.
8. Draw the schematic symbol of a AND gate. Explain its working with the help of Boolean equation and truth table.
9. Draw the schematic symbol of a OR gate. Explain its working with the help of Boolean equation and truth table.
10. Draw the schematic symbol of a NAND gate. Explain its working with the help of Boolean equation and truth table.
11. Draw the schematic symbol of a NOR gate. Explain its working with the help of Boolean equation and truth table.
12. Explain with suitable diagram extrinsic semiconductor.
13. Draw and explain I-V characteristics of P-N junction diode.
14. With the help of neat circuit diagram explain the working of half-wave rectifier. Draw necessary waveforms.
15. With the help of neat circuit diagram explain the working of full-wave rectifier. Draw necessary waveforms.
16. Explain the working of LED.
17. Explain with diagram action of N - P - N transistor.
18. Explain with diagram action of P - N - P transistor.
19. With suitable diagram explain the working of transistor as a switch.

20 Write the truth table for the Boolean equation $Y = \bar{A} - B + A - \bar{B}$

21. With the help of a diagram, explain construction of solar cell.

CHAPTER 20 - COMMUNICATION SYSTEMS

V.S.A. (1 Mark)

1. Video signals require higher bandwidth for transmission. Why?
2. We do not choose to transmit an audio signal by just directly converting it to an e.m. wave of the same frequency. Write two reasons for the same.
3. Draw a plot of the variation of amplitude versus angular velocity (ω) for an amplitude modulated wave.
4. What is meant by critical frequency, for sky wave propagation?
5. What would be the modulation index for an A.M. wave for which the maximum amplitude is 'a', while the minimum amplitude is 'b'?
6. Why are the message signals also called baseband signals?
7. Why short wave communication over long distance is not possible via ground waves?
8. Draw a block diagram of a generalized communication system.
9. Explain why sky wave transmission of electromagnetic waves cannot be used for T.V. transmission.
10. A carrier wave of peak 6 V used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75%?
11. State two factors by which the range of transmission of T.V. signals can be increased.

S.A.I (2 Marks)

1. Draw a neat labelled block diagram of a detector of amplitude modulation wave. Show the waveforms at various stages.
2. What are the drawbacks of amplitude modulation?
3. Explain the need of modulation related to the size of antenna.
4. Explain the terms.

a) Transmitter and b) Receiver in a communication system.

5. Write a note on bandwidth of signals.

6. Describe sky wave propagation in brief.

7. What do you mean by space communication?

8. Explain in brief idea of structure of atmosphere.

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.

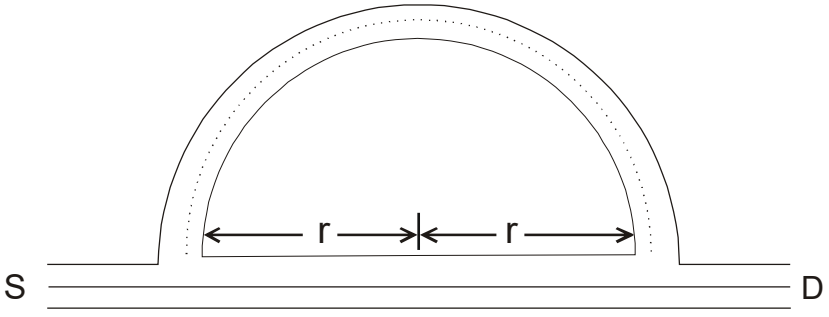
2. Two tuning forks 'C' and 'D' give four beats per second, the frequency of `C' being 480 Hz. When fork 'D' is filed a little again four beats per second are produced. Calculate the frequency of fork 'D' before and after filing.

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)

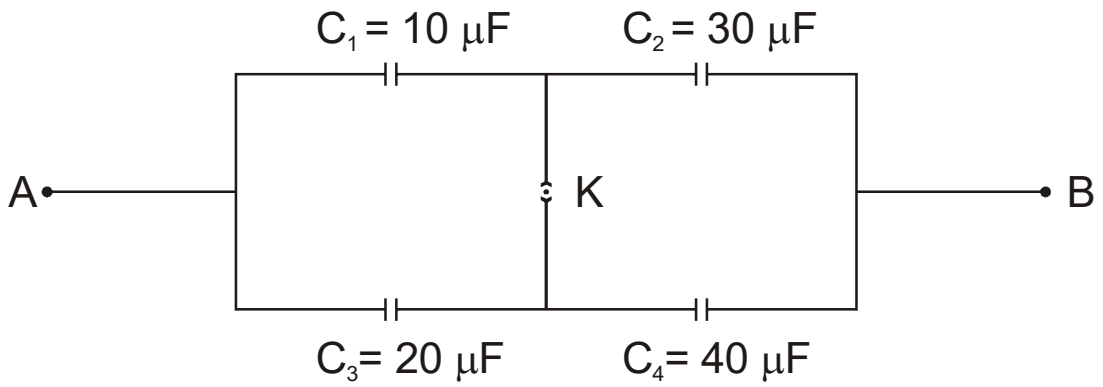
1. A condenser having a capacity of 50 μF is charged to a potential of 200 volt. If the area of each plate of the condenser is 10 cm^2 and the distance between the plates is 0.1 mm, find the energy per unit volume of the field between the plates.

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

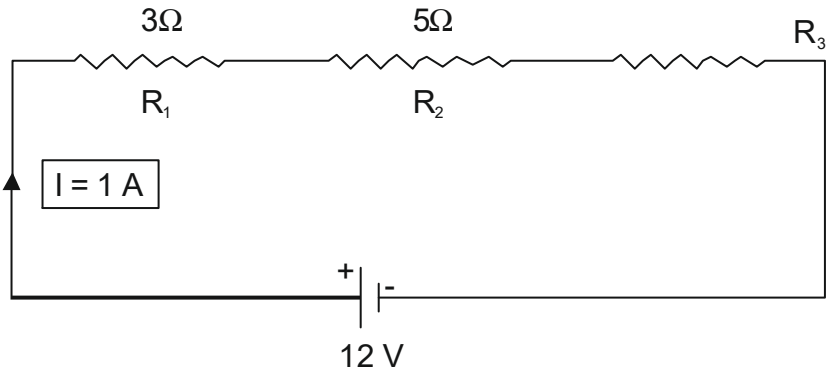
S.A.I (2 Marks)

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

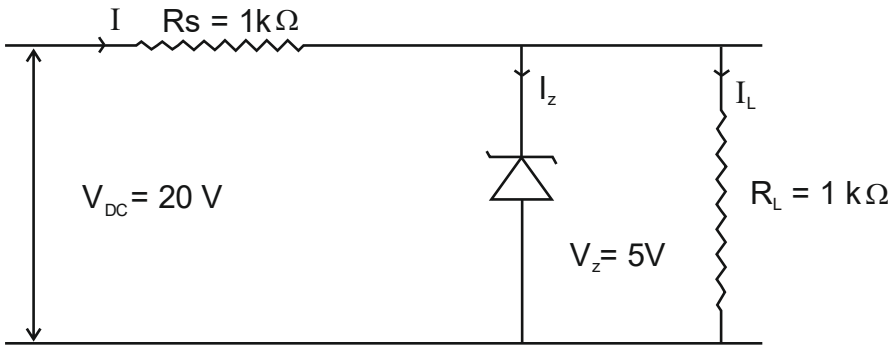
S.A.I (2 Marks)

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.