Most important questions and problems

XI Physics

Sec 'B' (Short-Answer Questions)

Chap 1

1. Find the dimensions of the following:
   - Time period of simple pendulum
   - Time period of spring mass system
   - Tension in a string
   - Pressure
   - Angular momentum
   - Energy
   - Force
   - Torque
   - Gravitational constant

Chap 2

2. Find the value of 'p' for which the following vectors are perpendicular to each other:

$$\vec{\mathbf{A}} = \hat{\mathbf{i}} + p\,\hat{\mathbf{j}} + 3\,\hat{\mathbf{k}} \qquad \vec{\mathbf{B}} = 3\,\hat{\mathbf{i}} + 3\,\hat{\mathbf{j}} - 4\,\hat{\mathbf{k}}$$

3. Two vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are such that $|\vec{\mathbf{A}}| = 4$, $\vec{\mathbf{B}} = 6$ and $\vec{\mathbf{A}}.\vec{\mathbf{B}} = 8$; find:
   (i) The angle between $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ (ii) The magnitude $|\vec{\mathbf{A}} - \vec{\mathbf{B}}|$
4. Two vectors A and B are such that |A|=4, |B|=6 and |A-B|=5.Find |A+B|
5. If $\vec{A} = 3\hat{\mathbf{i}} + \hat{\mathbf{j}} - 2\hat{\mathbf{k}}$; $\vec{\mathbf{B}} = -\hat{\mathbf{i}} + 3\hat{\mathbf{j}} + 4\hat{\mathbf{k}}$. Find $|\vec{\mathbf{A}} + \vec{\mathbf{B}}|$ and angle between $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$.
6. Find the angle between the two vectors, perpendicular unit vector, area of a parallelogram and area of triangle. If its two sides are formed by the vectors. Also find the projection of $\vec{A}$ onto $\vec{B}$

$$\vec{\mathbf{A}} = 2\,\hat{\mathbf{i}} - 3\,\hat{\mathbf{j}} - \hat{\mathbf{k}} \qquad \vec{\mathbf{B}} = \hat{\mathbf{i}} + 4\,\hat{\mathbf{j}} - 2\,\hat{\mathbf{k}}$$

7. Can the magnitude of the resultant of the two vectors of same magnitude be equal to the magnitude of either of the vector?

Chap 3

8. A 100gm bullet is fired into a 12 kg block which is suspended by a long cord, such that it can swing like a pendulum. If the bullet is embedded in the block and the block rises by 5cm, what was the speed of the bullet?
9. A car starts from rest and moves with a constant acceleration. During the 5^{th} second of its motion it covers a distance of 36m; calculate:
   (i) The acceleration of the car. (ii) The total distance covered by the car during this time.
10. A boy throws a ball upward from the top of a tower with a speed of 12m/s. On the way down it just misses the thrower and falls to the ground 50m below. Find how long the ball remains in the air.
11. A ball is thrown vertically upward from the ground with a speed of 25m/s. On the way down it is caught at a point 5m above the ground. How long did the trip take?
12. State and prove law of conservation of momentum.
13. Both cases of pulley.

Chap 4

14. A boy standing 10m from a building can just barely reach the roof 12m above him when he throws a ball at the optimum angle with respect to the ground. Find the initial horizontal velocity of the ball.
15. Prove $s=r\theta$, $v=r\omega$, $a=r\alpha$.

16. A machine gun is pointed upward at an angle of 30^o with respect to the horizontal and fires a projectile with a velocity of 200 m/s; calculate the range of the projectile and the height of the projectile.
17. A mortar shell is fired at a target 800m away with the velocity of 100m/sec. calculate the maximum possible value of the launch angle and the minimum time.
18. Tarzan swings on a vine of length 5m in a vertical circle under the influence of gravity. When the vine makes an angle of 30 degree with the vertical, Tarzan has a speed of 4m/sec. Find (a) centripetal acceleration at this instant (b) the tangential acceleration.
19. At what suitable angle is the maximum height of the projectile 1/3 of its range?
20. Find the initial velocity of a rocket if it hits maximum target 100 km away.
21. The turntable of a record player rotates initially at a rate of 33rev/min and takes 20 s to come to rest. **(a)** What is the angular acceleration is constant? **(b)**How many rotations does the turntable make before coming to rest? **(c)**If the radius of the turntable is 0.14 m. what is the initial linear speed of a bug riding on the rim? **(d)** What is the magnitude of the tangential of the bug at time t=0?

Chap 5

22. A particle of mass 500 gm rotates in circular orbit of radius 25 cm at a constant rate of 1.5 revolutions per second. Find the angular momentum with respect to centre of the orbit.
23. A particle of mass 0.5kg moves along xy-plane. At that instant, the coordinates are (3,4)m and its velocity is $(4i+5j)$m/sec. Determine the angular momentum relative to origin at that time.
24. A uniform ladder having length 'l' and weighing 50N, rests against a smooth vertical wall. If the coefficient of friction between the ladder and the ground is 0.40, find the maximum angle such that the ladder may not slip.
25. A 15 m ladder weighing 350 N rests against a smooth vertical wall at a point 12 m above the ground. The centre of gravity is one-third the way up. A body of mass 47 kg climbs half way up the ladder. Calculate the reaction exerted by the wall and the ground.
26. Define couple and derive its expression. Show that $L=mr^2\omega$.
27. State and prove law of conservation of angular momentum.

Chap 6

28. The planet Jupiter of mass 314 times than that of the earth. Its radius is 11.3 times large than that of the Earth. Find the acceleration due to gravity on the surface on the surface of Jupiter.
29. The radius of moon is 27% of the earth's radius and its mass is 1.2% of the earth's mass. Calculate the acceleration due to gravity on the surface of the moon.
30. Show the variation of 'g' with depth and altitude.
31. At what distance from the center of the earth does the gravitational acceleration have one third of the value it has on the surface of the earth? (Re= 6.4×10^6m).

Chap 7

32. Derive work energy equation.
33. Water is falling over a height of 30m at a rate of 4500gm/min. determine the power generated.
34. Define conservative field. Prove gravitational field is conservative field.
35. State and prove law of conservation of energy.
36. A water pump of how much minimum horse power is needed to lift water through a height of 2.5m at the rate of 500g/min.
37. A horse pulls a cart horizontally with a force of 40N at an angle of 25 degree above the horizontal and moves along at a speed of 15m/sec.How much work will the horse do in 5 minutes. What is the power output of the horse? Give your answer in horse power.
38. An object weighing 98N is dropped from a height of 10m.it is found to be moving with a velocity 12m/sec just before it hits the ground. How large was the frictional force acting upon it.

39. An object moves along a straight line from (3, 2, –6) to (14, 13, 9) when a uniform force $\vec{\mathbf{F}} = 4\,\hat{\mathbf{i}} + \hat{\mathbf{j}} + 3\,\hat{\mathbf{k}}$ acts on it. Find the work done and the angle between force and displacement.

Chap 8

40. Simple pendulum complete one vibration in one second, calculate its length when g = 980 cm/s.

41. A body of mass 32gm attached to a spring performing SHM. Its velocity is 0.4m/s when the displacement is 8cm towards right. If the spring constant is 0.4Nm^{-1}; calculate (i) total energy (ii) the amplitude of the motion.

42. A mass at the end of a spring oscillates with simple harmonic motion with a period of 0.20 sec; find the acceleration when the displacement is 2.0cm.

43. A guitar string has a linear density of 7.16g/m and is under tension of 152N. The fixed supports of the string are 89.4cm apart. If it vibrates in three segments, calculate the speed, the wavelength and the frequency of the standing wave.

44. A stationary wave is set in a 1.5m long string fixed at both ends. The string vibrates in five segments when driven by a frequency of 100Hz. Calculate the wavelength and the fundamental frequency?

45. A sound wave of frequency 500Hz in air enters from a region of temperature 25 degree Celsius to a region of temperature 5 degree Celsius. Calculate the percent fractional change in wavelength.

46. A standing wave is established in a 2.4 m long string fixed at both ends. The string vibrates in four segments when driven at 200 Hz. Determine (i) the wavelength (ii) the fundamental frequency.

Chap 9

47. What is diffraction of light and what is diffraction grating. Derive an expression for the wavelength of light by diffraction grating.

48. Derive an expression for wavelength of X-rays by rock salt. (X-ray diffraction or Bragg's law).

49. Interference fringes were produced by two slits 0.25mm apart on a screen 150mm from the slits. If ten fringes occupy 3.75mm what is the wavelength of the light produces fringes?

50. How many fringes will pass a reference point if the moveable mirror of the Michelson's Interferometer is moved by 0.08mm? The wavelength of light used is 5800A^{o}.

51. A diffraction grating produces a deviation of 12^{o} in the second order with the light of wavelength 4160A^{o}. Find the grating element and the number of lines per centimeter of the grating.

52. What is the difference between deviation and diffraction?

53. Why the fringes in Newton's rings circular?

54. Why is the central spot black?

55. Discuss Michelson's interferometer.

Chap 10

56. Discuss the aberration of lenses. How can they remove?

57. A compound microscope has an objective of a focal length of 10 mm and a tube 232 mm long. The final image is produced at 250 mm from the eyepiece when the object is 10.5 mm from the objective. What is the angular magnification?

58. An astronomical telescope has a length of 105cm, and its magnification is 6.Determine the power of objective and eye piece.

59. Derive the formula for combination of two thin lenses.

60. What is the magnification of an astronomical telescope, focused for infinity, when the powers of its objective and the eye-piece lenses are 2 dioptre and 20 dioptre respectively?

Section 'C' (Detailed questions)

Chap 2

1. What are the two kinds of product of two vectors? Define vector product and show that cross product does not obey commutative property, prove that

$\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$

$\vec{\mathbf{A}} . (\vec{\mathbf{B}} + \vec{C}) = \vec{\mathbf{A}} . \vec{\mathbf{B}} + \vec{\mathbf{A}} . \vec{C}$

$\vec{A} . \vec{B} = \vec{B} . \vec{A}$

Chap 3

2. Define elastic and inelastic collision. Two spheres of unequal masses A and B moving with initial velocities U_1 and U_2 in the same direction collide elastically. Derive the relations for their final velocities V_1 and V_2.

Chap 4

3. Define centripetal acceleration and centripetal force. Also derive an expression for centripetal acceleration in terms of period.
4. Define projectile motion. Give assumptions to study projectile motion. Derive expressions for range and maximum height of projectile.

Chap 5

5. Define angular momentum. State and prove law of conservation of angular momentum.

Chap 6

6. Show the variation of 'g' with depth and altitude.
7. Discuss weightlessness in satellite. How can this problem be overcome?

Chap 8

8. Define simple harmonic motion. Prove that the motion of the projection of a particle in uniform circular motion (UCM) is simple harmonic motion (SHM). Also derive the velocity.
9. Discuss the Newton formula for the speed of sound and the flaw in it. In what way did the Laplace correct the formula? How do the pressure and temperature affect the speed of sound?
10. What is Doppler's effect? Write its three applications. Derive the expressions for the apparent frequency when
    1. An observer moves towards and away from stationary source.
    2. When source moves towards or away from stationary observer.
    3. When source and observer both move towards or away from each other.

Chap 9

11. What is Newton's Ring? Derive an expression for the radius of nth bright ring.
12. What is Diffraction of light and what is diffraction grating? Derive an expression for the wavelength of light by diffraction grating.

Chap 10

13. What is the difference between astronomical and Galilean telescope. Give the construction and working of a Compound Microscope or astronomical telescope. Derive a relation for its magnifying power.