MID-TERM EXAM - NOVEMBER 2024

I PUC - PHYSICS (33)

Time: 3 hours. **No of questions: 45** **Max Marks: 70**

General Instructions:

1. All parts are compulsory.
2. For Part - A questions, first written-answer will be considered for awarding marks.
3. Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.
4. Direct answers to the numerical problems without detailed solutions will not carry any marks.

PART – A

I. Pick the correct option among the four given options for ALL of the following questions: **15 × 1 = 15**

1. The physical quantity having the dimensions [ML-1T -2] is

(A) angular momentum (B) energy (C) pressure (D) force

2. In kinematics, we study

(A) the description of motion and the causes for motion.

(B) the description of motion without considering the causes for motion.

(C) the causes for motion without considering the description of motion.

(D) the bodies at rest.

3. The v-t graph of a particle moving with uniform velocity is

(A) a straight line parallel to time axis. (B) a straight line with positive slope.

(C) a straight line with negative slope. (D) a curve.

4. A vector of magnitude 5 unit is along Y-axis. The magnitude of its X-component is

(A) 5 unit (B) $5\sqrt{3}$unit (C) zero (D) 10 unit

5. Motion in a plane is the superposition of

(A) two separate simultaneous one dimensional motions along same directions.

(B) two separate simultaneous one dimensional motions along opposite directions.

(C) two separate simultaneous one dimensional motions along two perpendicular directions.

(D) two separate simultaneous one dimensional motions along two directions with any directions.

6. The velocity of a particle is along –ve Y-axis. Then the linear momentum of the particle is along

(A) +ve Y-axis (B) –ve Y-axis (C) –ve X-axis (D) –ve Z-axis

7. A body which is under the action of three forces is in equilibrium. Then

(A) the forces must be equal and mutually perpendicular

(B) the forces must be making an angle of 1200 with each other.

(C) the magnitude of any one force must be equal to the sum of the magnitudes of the other two forces.

(D) each force must be equal and opposite to the vector sum of the other two forces.

8. A particle under uniform circular motion possesses constant _____.

(A) velocity vector (B) acceleration vector (C) momentum vector (D) speed

9. The scalar product $\hat{j}.\hat{j}$ =

(A) -1 (B) 1 (C) zero (D) $\hat{i}$

10. A cyclist comes to skidding halt after moving through certain distance. The work done by the road on the cycle is +W. The work done by the cycle on the road is

(A) -W (B) + W (C) zero (D) 2 W

11. The non-conservative force among the following is

(A) gravitational force (B) spring force

(C) frictional force (D) electrostatic force

12. The unit of energy is

(A) J s-1 (B) horse-power (C) kilowatt hour (D) volt

13. According to the principle of conservation of angular momentum, if moment of inertia of a rotating body decreases, then its angular velocity

(A) decreases (B) increases (C) remains constant (D) becomes zero

14. The correct expression for the total energy of a satellite revolving around earth is

(A) $E = \frac{GmM_E}{(R_E + h)}$ (B) $E = \frac{GmM_E}{2(R_E + h)}$ (C) $E = \frac{-GmM_E}{(R_E + h)}$ (D) $E = \frac{-GmM_E}{2(R_E + h)}$

15. The orbital speed of a satellite moving in a circular path around earth is independent of

(A) mass of earth (B) radius of earth

(C) mass of the satellite (D) height at which satellite is revolving

II. Fill in the blanks by choosing appropriate answer given in the brackets for ALL the following questions: **5 × 1 = 5**

(zero, angular momentum, vector, maximum, impulse, scalar)

16. A quantity that has only a magnitude but no direction is called a _____.

17. The product of force acting on a body and time interval gives _____.

18. The work done by a force acting perpendicular to the displacement vector is _____.

19. The moment of force or torque is a _____.

20. The Kepler's law of areas is based on the law of conservation of _____.

PART – B

III. Answer any FIVE of the following questions: **5 × 2 = 10**

21. Define average velocity. How can we find the average velocity from position-time graph?

22. The velocity of a particle moving along a straight path changes from 10 ms-1 to 20 ms-1 while covering a distance of 6 m. Find the acceleration of the particle.

23. State triangle law of vector addition. How many times the triangle law has to be applied for adding three vectors?

24. What is a projectile? What is the nature of trajectory of a projectile?

25. How is centripetal acceleration of a particle related to a) speed of the particle(v) and b) radius of the circular path (r)?

26. Explain the law of moments.

27. State and explain Newton's law of gravitation.

28. Name the natural satellite of Earth. Give its period of revolution.

PART – C

IV. Answer any FIVE of the following questions: **5 × 3 = 15**

29. Mention two advantages and one limitation of dimensional analysis.

30. Define i) unit vector, ii) null vector and iii) negative of a vector.

31. Derive the expression for the magnitude of the resultant of two concurrent coplanar vectors.

32. Explain why a cricket player lowers his hands while catching a fast ball.

33. What is kinetic friction? Mention any two methods of reducing friction.

34. What is meant by potential energy? Mention the expression for potential energy of a spring and explain the terms.

35. Define the term 'radius of gyration'. Using the expression for the moment of inertia of a spherical body about an axis of rotation passing through its diameter find the corresponding radius of gyration.

36. The gravitation force of attraction between Earth and Sun is 35.47×10^{21} N. Calculate the mass of the Sun. Given: The mass of the earth is 5.98×10^{24} kg, the mean distance between Earth and Sun is 1.496×10^{11} m and G = 6.67×10^{-11} Nm^2kg^{-2}.

PART – D

V. Answer any THREE of the following questions: **3 × 5 = 15**

37. What is velocity-time graph? Derive the equation $x = v_0t + 1/2\ at^2$ by graphical method.

38. State and prove the law of conservation of linear momentum

39. (a) What is meant by completely inelastic collision? (1)

(b) Derive an expression for the loss of kinetic energy in a completely inelastic collision in one dimension. (4)

40.(a) What is meant by pure rotational motion? (1)

(b) Obtain an expression for kinetic energy of a rotating body in terms of angular velocity by considering the expression for kinetic energy of a particle in terms of linear velocity. (4)

41. Obtain an expression for acceleration due to gravity at a depth 'd' from the surface of the earth.

VI. Answer any TWO of the following questions: 2 × 5 = 10

42. A person stands on the edge of a cliff 500 m above the ground and throws a stone horizontally with an initial speed of 20 m s^{-1}. Neglecting air resistance, find the time taken by the stone to reach the ground, and the speed with which it hits the ground. (Take g = 10 m s^{-2})

43. A block of mass 4 kg rests on a horizontal plane. The plane is gradually inclined and at an angle of 150 with the horizontal, the block just begins to slide.

Find the coefficient of static friction between the block and the surface by representing all the forces acting on the body in a diagram.

44. In a ballistics demonstration a police officer fires a bullet of mass 50g with speed 200ms^{-1} on soft plywood of thickness 2 cm. The bullet emerges with only 10% of its initial kinetic energy. Calculate

a) the emergent speed of the bullet and

b) the work done by the plywood.

45. The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds.

(i) What is its angular acceleration if it is uniform?

(ii) How many revolutions does the engine make during this time?

****