

APEEJAY SCHOOL, SCHOOL, SHEIKH SARAI-I

Time allowed : 3 Hrs.

Physics
Class – XI

Maximum Marks : 70

General Instructions

- (i) All questions are compulsory.
- (ii) There are 30 questions in total.
- (iii) Question 1 to 8 carry one marks each.
Question 9 to 18 carry two marks each.
Question 19 to 27 carry three marks each.
Question 28 to 30 are five marks question.
- (iv) There is no overall choice.
However an internal choice has been provided in one question of two marks.
One question of three marks and all the three questions of five marks.
- (v) Use of calculators is not permitted.
- (vi) "Log table" are allowed for calculating.

1. How does numerical value of a physical quantity depend on the size of the unit selected?
2. What are polar vectors? Give one example.
3. When are the two given bodies said to have same inertial mass ?
4. In a game of tug of war, what is the network done and by whom ?
5. Under what condition is torque of a force zero ?
6. Why are space rockets usually launched from west to east in the equatorial plane.
7. Which component of a force does not contribute towards torque?
8. Why is gravitational potential energy always negative ?
9. Two particles begin to fall freely from rest from the top of a tower within a gap of 1 sec. How long after the first particle begins to fall, the two particles be 15 m apart ? ($g = 10 \text{ m/sec}^2$).
10. Find the number of significant figures in the following :
 - (a) .00427g
 - (b) 7.0030C
 - (c) $3.24 \times 10^{-31} \text{ kg}$
 - (d) 0.25 Å
11. Define angle of friction. How is it related to coefficient of friction?

12. A body of mass 0.5 kg travels in straight line with velocity $v = ax^{3/2}$, where $a = 2 \cdot 5^{-1} \text{ m/sec}^2$. What is the work done by the net force during its displacement from $X = 0$ to $X = 3\text{m}$?
13. Can you associate vectors with
 (a) the length of a wire bent into a loop.
 (b) a sphere? Explain.
14. Obtain an expression for escape velocity from energy consideration.
15. Define moment of inertia of a rigid body and give a mathematical expression for it.
16. A projectile is fired with a certain velocity V at an angle ' θ ' with horizontal. Find expression for its trajectory.
17. In what direction should a swimmer swim across a river so as to cross it along the shortest path? What time is taken by him to swim across?
18. Briefly explain Static friction, Kinetic friction and Limiting friction. How do they vary with the applied force? Draw the diagram.

OR

State three basic laws of motion. Show that first law of motion gives the definition of force and the second law of motion gives the measure of force.

19. Centrifugal force ' F ' acting on a particle of mass ' m ' moving along a circular path of radius ' r ' with a constant angular velocity ' ω ' is given by $\vec{F} = m\omega^2 r$. Show that the equation is dimensionally correct.
20. \hat{i} and \hat{j} are unit vectors along x and y-axis. What is the magnitude and direction of vectors $(\hat{i} + \hat{j})$ and $(\hat{i} - \hat{j})$? What are the components of a vector $\vec{A} = 2\hat{i} + 3\hat{j}$ along the directions of $(\hat{i} + \hat{j})$ and $(\hat{i} - \hat{j})$?
21. With the help of a neat diagram explain how banking of a curved road provides necessary centripetal force for a vehicle to run on it. Find expression for angle of banking.
22. Prove that in an elastic collision in one dimension the relative velocity of approach before impact is equal to the relative velocity of separation after impact.
23. An object of mass 0.4 kg moving with a velocity of 4 m/sec. collides with another object of mass 0.6 kg moving in same direction with a velocity of 2 m/sec. If the collision is perfectly in elastic, what is the loss of K.E. due to impact?

OR

A stone is thrown at an angle of 60° to the horizontal with an initial velocity of 15 m/sec. Find the kinetic, potential and total energy of the stone at the highest point of its trajectory. Given that mass of the stone is 0.2 kg.

24. State and prove work-energy theorem.
25. Establish a relation between torque and angular momentum for a system of particles.
26. Find an expression for gravitational potential due to the Earth at any point near its surface.
27. State and prove parallelogram law of vector addition.
28. From a uniform disk of radius ' R ' a circular hole of radius $R/2$ is cut out. The centre of the hole is at $R/2$ from the centre of the original disc. Locate the centre of gravity of the resulting flat body.

OR

A rope of negligible mass is wound round a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N? What is the linear acceleration of the rope? Assume that there is no slipping.

29. Two heavy spheres each of mass 100 kg and radius 0.10 m are placed 1.0 m apart on a horizontal table. What is the gravitational force and potential at the mid point of the line joining the centres of the spheres? Is an object placed at that point in equilibrium? If, so, is the equilibrium stable or unstable?

OR

A rocket is fired vertically from the surface of Mars with a speed of 2 km s^{-1} . If 20% of its initial energy is lost due to Martian atmospheric resistance, how far will the rocket go from the surface of Mars before returning to it?

Mass of Mars = $6.4 \times 10^{23} \text{ kg}$, Radius of Mars = 3395 km

30. A thin circular loop of radius ' R ' rotates about its vertical diameter with an angular frequency ' ω '. Show that a small bead on the wire loop remains at its lowermost point for $\omega \leq \sqrt{g/R}$. What is the angle made by the radius vector joining the centre to the bead with the vertical downward direction for $\omega = \sqrt{\frac{2g}{R}}$.

Neglect friction.

OR

A '70' kg man stands in contact against the inner wall of a hollow cylindrical drum of radius '3m' rotating about its vertical axis with 200 rev/minute. The coefficient of friction between the wall and his clothing is 0.15. What is minimum rotational speed of the cylinder to enable the man to remain stuck to the wall (without falling) when the floor is suddenly removed?