

**I. Choose The Correct Answer:****[15 x 1 = 15]**

- The velocity of a particle v at an instant t is given by $v = at + bt^2$. The dimensions of b is
(a) $[L]$ (b) $[LT^{-1}]$ (c) $[LT^{-2}]$ (d) $[LT^{-3}]$
- If the length and time period of an oscillating pendulum have errors of 1% and 3% respectively then the error in measurement of acceleration due to gravity is
(a) 4% (b) 5% (c) 6% (d) 7%
- The dimension of $(\mu_o \epsilon_o)^{-\frac{1}{2}}$
(a) length (b) time (c) velocity (d) force
- Identify the unit vector in the following.
(a) $\hat{i} + \hat{j}$ (b) $\frac{\hat{i}}{\sqrt{2}}$ (c) $\hat{k} - \frac{\hat{j}}{\sqrt{2}}$ (d) $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$
- If an object is thrown vertically up with the initial speed u from the ground, then the time taken by the object to return back to ground is
(a) $\frac{u^2}{2g}$ (b) $\frac{u^2}{g}$ (c) $\frac{u}{2g}$ (d) $\frac{2u}{g}$
- Two objects are projected at angles 30° and 60° respectively with respect to the horizontal direction. The range of two objects are denoted as R_{30° and R_{60° . Choose the correct relation from the following
(a) $R_{30^\circ} = R_{60^\circ}$ (b) $R_{30^\circ} = 4 R_{60^\circ}$ (c) $R_{30^\circ} = \frac{R_{60^\circ}}{2}$ (d) $R_{30^\circ} = 2 R_{60^\circ}$
- When a car takes a sudden left turn in the curved road, passengers are pushed towards the right due to
(a) inertia of direction (b) inertia of motion (c) inertia of rest (d) absence of inertia
- Two masses m_1 and m_2 are experiencing the same force where $m_1 < m_2$. The ratio of their acceleration
(a) 1 (b) less than 1 (c) greater than 1 (d) all the three cases
- An object of mass m begins to move on the plane inclined at an angle θ . The coefficient of static friction of inclined surface is μ_s . The maximum static friction experienced by the mass is
(a) mg (b) $\mu_s mg$ (c) $\mu_s mg \sin\theta$ (d) $\mu_s mg \cos\theta$
- A uniform force of $(2\hat{i} + \hat{j})$ N acts on a particle of mass 1 kg. The particle displaces from position $(3\hat{j} + \hat{k})$ m to $(5\hat{i} + 3\hat{j})$ m. The work done by the force on the particle is
(a) 9 J (b) 6 J (c) 10 J (d) 12 J
- The potential energy of a system increases, if work is done
(a) by the system against a conservative force (b) by the system against a non-conservative force
(c) upon the system by a conservative force (d) upon the system by a non-conservative force
- Two equal masses m_1 and m_2 are moving along the same straight line with velocities 5ms^{-1} and -9ms^{-1} respectively. If the collision is elastic, then calculate the velocities after the collision of m_1 and m_2 , respectively
(a) -4ms^{-1} and 10ms^{-1} (b) 10ms^{-1} and 0ms^{-1} (c) -9ms^{-1} and 5ms^{-1} (d) 5ms^{-1} and 1ms^{-1}
- A couple produces,
(a) pure rotation (b) pure translation (c) rotation and translation (d) no motion
- A rigid body rotates with an angular momentum L . If its kinetic energy is halved, the angular momentum becomes,
(a) L (b) $L/2$ (c) $2L$ (d) $L/\sqrt{2}$
- When a mass is rotating in a plane about a fixed point, its angular momentum is directed along,
(a) a line perpendicular to the plane of rotation
(b) the line making an angle of 45° to the plane of rotation
(c) the radius (d) tangent to the path

II. Answer any 6 of the following questions:**[6 x 2 = 12]****Question number 20 is compulsory**

- What are the limitations of dimensional analysis?
- Write a short note on the scalar product between two vectors.
- What is the difference between velocity and average velocity?

19. State Newton's second law.
20. Using free body diagram, show that it is easy to pull an object than to push it.
21. Define work. Write its unit.
22. Define centre of mass.
23. Define couple.
24. Define centre of gravity.

III. Answer any 6 of the following questions:

[6 x 3 = 18]

Question number 29 is compulsory

25. Write the rules for determining significant figures.
26. Define precision and accuracy. Explain with one example.
27. Write down the kinematic equations for angular motion.
28. Explain various types of friction. Suggest a few methods to reduce friction.
29. State the empirical laws of static and kinetic friction.
30. Write the various types of potential energy. Explain the formulae.
31. Define the following
 - a) Coefficient of restitution
 - b) Power
 - c) Law of conservation of energy
 - d) loss of kinetic energy in inelastic collision.
32. What is the relation between torque and angular momentum?
33. Mention any two physical significance of moment of inertia.

IV. Answer the following questions:

[5 x 5 = 25]

34. a) Explain in detail the various types of errors.
[OR]
 - b) Assuming that the frequency γ of a vibrating string may depend upon
 - i) applied force (F)
 - ii) length (l)
 - iii) mass per unit length (m), prove that $\gamma \propto \frac{1}{l} \sqrt{\frac{F}{m}}$ using dimensional analysis.
35. a) Derive the kinematic equations of motion for constant acceleration.
[OR]
 - b) Derive the expression for centripetal acceleration.
36. a) Briefly explain the origin of friction. Show that in an inclined plane, angle of friction is equal to angle of repose.
[OR]
 - b) Explain the need for banking of tracks.
37. a) State and explain work energy principle. Mention any three examples for it.
[OR]
 - b) Arrive at an expression for elastic collision in one dimension.
38. a) Explain why a cyclist bends while negotiating a curve road? Arrive at the expression for angle of bending for a given velocity.
[OR]
 - b) Explain in detail in triangular law of addition.