Mock Test-1

Time: 3 Hours **Max. Marks: 70**

General Instructions

(a) All questions are compulsory.
(b) There are 30 questions in total. Questions 1–8 carry one mark each, questions 9–18 carry two marks each, questions 19–27 carry three marks each and questions 28–30 carry five marks each.
(c) 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 three questions of five marks each. You have to attempt only one of the given choices in such questions.
(d) Use of calculators is not permitted.

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1. If an electric fan is switched on in a closed room, will the air in the room be cooled? If not, why do we feel cold?

2. You are given four tuning forks: the lowest frequency fork is of 300 Hz. By striking two tuning forks at a time, 1, 2, 3, 5, 7 and 8 Hz beat frequencies are heard. What are the possible frequencies of the other three forks?

3. A car and a truck are moving on a level road so that their linear momenta are equal. Which one is moving faster?

4. A body is traveling with a constant speed in on the circumference of a circle. Of the following quantities: (a) linear velocity (b) linear acceleration (c) acceleration toward the centre and (d) centripetal force, which remains constant?

5. State Newton's law of cooling.

6. Why is the work done by centripetal force zero?

7. What is Reynolds's number? Give any one factor on which it depends?

8. At what temperature (in °C) will the speed of sound in air be 3 times its value at 0 °C?

9. Define torque. Give its unit and dimension.

10. Why do fruits fall down from a tree when its branches are shaken?

OR

Two masses of 8 kg and 12 kg are connected at the two ends of a light inextensible string that passes over a frictional-less pulley. Find the acceleration of the masses and the tension in the string when the masses are released.

11. Two straight lines drawn on the same displacement – time graph make angles of 30° and 60° with the time axis. Which line represents greater velocity? What is the ratio of the two velocities?

12. Show that angular momentum of a particle about a given axis is twice the product of the mass of the particle and areal velocity of the position vector of the particle.

13. At what temperature is the rms speed of a hydrogen molecule equal to that of an oxygen molecule at 47 °C? Given: atomic mass of hydrogen is 1 u and that of oxygen is 16 u.

14. What is simple harmonic motion? State its characteristics.

15. Define angle of friction and angle of repose and find the relation between them.

16. Derive an expression for work done in an adiabatic process.

17. The time period of oscillation of a simple pendulum is given by $t = 2\pi\sqrt{l/g}$. What is the accuracy in the determination of g if a 10 cm length is known to an accuracy of 1 mm and the 0.5 s time period is measured from the time taken for 100 oscillations with a watch of 1 s resolution?

18. State and derive work energy principle.

19. Assume that the mass M of the largest stone that can be moved by a flowing river depends upon 'v' the velocity, 'ρ' the density of water and 'g' the acceleration due to gravity. Using dimensional analysis, show that M varies with the sixth power of the velocity of flow.

20. Define acceleration due to gravity and show that its value decreases with altitude.

21. Derive an expression for the maximum velocity of a vehicle on a banked road, when the coefficient of friction is also taken into consideration.

OR

Deduce the expression for work done in moving a body up a rough inclined plane.

22. What is meant by elastic collision? Show that in the case of one-dimensional elastic collision of two bodies, the relative velocity of separation after the collision is equal to the relative velocity of approach before the collision.

23. Obtain an expression for the minimum velocity of projection of a body at the lowest point for looping a vertical loop.

24. Define Kepler's law of periods and hence deduce Newton's law of gravitation using it.

25. The pressure of a given mass of a gas is halved at constant temperature. What will be the volume of the gas in comparison to its initial volume? Explain on the basis of kinetic theory.

26. (a) What is Pascal's law for transmission of pressure in a liquid?

(b) Explain why the blood pressure in human beings is greater at the feet than at the brain.

(c) Why is hydrostatic pressure a scalar quantity even though pressure is force divided by area and force is a vector?

27. Show that Newton's second law of motion is the real law of motion.

28. (a) Find the magnitude and direction of the resultant of two vectors $\vec{A}$ and $\vec{B}$ in terms of their magnitude and angle θ between them.

(b) Define the law of sines and the law of cosines.

OR

Derive an expression for: (a) maximum height (H), (b) horizontal range (R), (c) time of flight (T) of an oblique projectile. Also mention what should be the angle of projection in order to obtain maximum range, maximum height, and maximum time of flight?

29. (a) Discuss rolling without slipping of a cylinder down a rough inclined plane and obtain an expression for the coefficient of friction necessary for the same.

(b) Three mass points 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 the system about an axis along the altitude of the triangle passing through m_1?

OR

(a) Prove that $\vec{A}=\hat{i}+2\hat{j}+3\hat{k}$ and $\vec{B}=2\hat{i}-\hat{j}$ are perpendicular to each other.

(b) Find the component of $\vec{A}=3\hat{i}+2\hat{j}$ along the direction of $(\hat{i}+\hat{j})$ and $(\hat{i}-\hat{j})$.

30. State and prove Bernoulli's theorem. Explain any two of its applications briefly.

OR

(a) Show that for a perfectly elastic collision in one dimension, the coefficient of restitution is equal to unity.

(b) Two ball-bearings of mass m moving in opposite directions with equal speed v collide head-on with each other. Predict the outcome of the collision, assuming it to be perfectly elastic.