

Mock Test-4

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.

1. Which of the two, kilowatt hour or electron volt, is a bigger unit of energy and by what factor?
2. Why are wheels made circular?
3. Which component of a force does not contribute towards torque?
4. A stone tied to one end of a string is whirled in a circle. If the string breaks, the stone flies off tangentially. Why?
5. What is the weight of a body at the centre of the Earth?
6. The length of the second hand of a clock is 5 cm. Find the speed of the tip of the second hand.
7. In a tug of war, the team that pushes harder against the ground wins. Why?
8. Define the radius of gyration.
9. If angular momentum is conserved in a system whose moment of inertia is decreased, will its rotational kinetic energy be also conserved? Explain.
10. State and explain Stefan's law.
11. The angular velocity of the revolution of the Earth around the Sun increases when it comes closer to the Sun. Why?
12. What are the factors on which moment of inertia of a body depends?
17. What is Stokes' law? Derive the relation by the method of dimensional analysis.
18. A transverse harmonic wave on a string is described by
$$y(x, t) = 4 \sin(36t + 0.018x + \pi/4)$$
where x and y are in cm and t in s. The positive direction of x is from left to right.
 - (a) Is this a travelling wave or a stationary wave? If it is travelling, what are the speed and direction of its propagation?
 - (b) What are its amplitude and frequency?
19. Prove that the distance we have to cover into the Earth below its surface is two times the distance we have to cover above the surface to get the same change in the value of g .
20. Represent graphically the variation of extension with load in an elastic body. On the graph, mark:
 - (a) Hooke's law region, (b) elastic limit, (c) yield point, (d) breaking point.
22. What do you understand by the terms mean speed, root mean square speed, and most probable speed? Write expressions for each of them.
23. Calculate the work done (in joules) in expanding isothermally 5 moles of an ideal gas from 1 to 20 liters at 0°C .
24. Two capillaries of the same length but of radii in the ratio 1:2 are connected in series and a liquid flows through this system under streamline conditions. If the pressure across the two extreme ends of the combination of tubes is 1 m of water column, what is the pressure difference across the first and second capillary tubes?
25. By applying the gas laws, derive the ideal gas equation.
26. A block of mass 10 kg is sliding on a surface inclined at an angle of 30° with the horizontal. Find acceleration of the block ($\mu = 0.5$).

OR

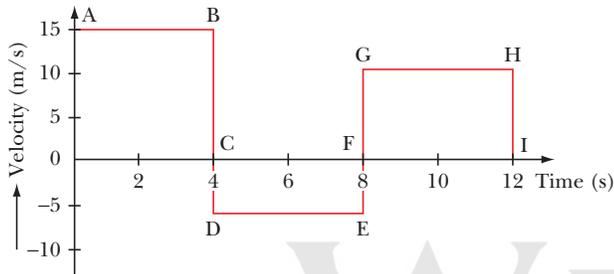
Water rises in a capillary tube but mercury falls in the same tube. Why?

13. The distances of two planets from the sun are 10^{11} and 10^{10} meters respectively. What is the ratio of the velocities of these two planets?
14. Two balls are thrown simultaneously: ball A vertically upwards with a speed of 20 m/s from the ground and ball B vertically downwards from a height of 40 m with the same speed and along the same line of action. At what point do the balls collide? ($g = 9.8 \text{ m/s}^2$)
15. The ratio of radii of two wires of the same material is 2:1. If these wires are stretched by equal forces, find the ratio of the stresses produced in them.
16. Write down Newton's formula for the speed of sound in air. What correction was made by Laplace in this formula?
- OR
 - (a) A light body and a heavy body have same momentum. Which one has greater linear kinetic energy?
 - (b) The momentum of a body of mass 5 kg is 100 kg m/s. Find its kinetic energy.

27. Four spheres, each of diameter $2a$ and mass M , are placed with their centers on the four corners of a square of side b . Calculate moment of inertia of the system about one side of the square taken as the axis.
28. A car accelerates from rest at a constant rate α for some time, after which it decelerates at a constant rate β to come to rest. If the total time elapsed is t seconds, then calculate:
- The maximum velocity attained by the car and
 - The total distance travelled by the car in terms of α , β , and t

OR

The velocity – time graph of a moving particle is shown. Find the displacement for the time ranges (a) (0–4) s, (b) (0–8) s, and (c) (0–12) s from the graph. Also write the differences between distance and displacement for each of these ranges.



29. What is Bernoulli's theorem? Show that the sum of pressure, potential and kinetic energies in the streamline flow is constant.

OR

- Which physical quantities are represented by the (i) rate of change of angular momentum (ii) product of l and ω .
 - Show that angular momentum of a satellite of mass M_s revolving around the earth having mass M_e in an orbit of radius r is equal to $\sqrt{GM_e M_s^2 r}$.
30. What is a simple pendulum? Find an expression for the time period and frequency of a simple pendulum.

OR

What is Doppler's effect in sound? Obtain an expression for apparent frequency of sound when

- listener moves towards the stationary source.
- source and listener are approaching each other.