

# Mock Test-3

Time: 3 Hours

Max. Marks: 70

## General Instructions

- All questions are compulsory.
- 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.
- 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.
- Use of calculators is not permitted.

- Can a vector be zero, if one of its components is not zero?
- A satellite revolving around the Earth loses height. How will its time period change?
- To cut down a tree, we often make a cut on the side facing the direction in which we wish the tree to fall. Why?
- What happens to the coefficient of friction when the weight of a body is doubled?
- Find the mass of a body weighing 100 dyne. Take  $g = 10 \text{ m/s}^2$ .
- Ventilators are provided in rooms just below the roof. Why?
- What is the nature of motion of an object falling freely under the action of gravity?
- If two sound waves have a phase difference of  $60^\circ$ , find the path difference between them.
- The driver of a truck traveling with a velocity  $v$  suddenly notices a brick wall in front of him at a distance  $d$ . Is it better for him to apply brakes or to make a circular turn without applying brakes in order to just avoid crashing into the wall? Explain with reason.
- Polishing beyond a certain limit may increase the friction between surfaces. Why?

OR

State two essential requisites of a geostationary satellite.

- Two gases, A and B, each at temperature  $T$ , pressure  $P$  and volume  $V$ , are mixed. If the mixture is at the same temperature  $T$  and its volume is also  $V$ , then what should be its pressure? Explain.
- Figure 1 shows the strain – stress graph for two materials, A and B. Answer the following questions:
  - Which material has the greater value of Young's modulus?
  - Which material is more ductile?
  - Which material is more brittle?
  - Which material is stronger? Explain your answers.

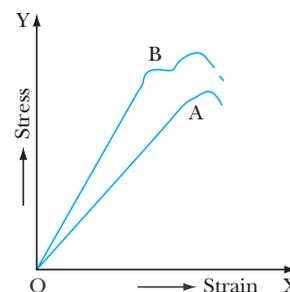


FIGURE 1.

- Why are bridges declared unsafe after long years in operation?
- Refrigerator A works between  $-10^\circ\text{C}$  and  $27^\circ\text{C}$ , while refrigerator B works between  $-27^\circ\text{C}$  and  $17^\circ\text{C}$ , both removing heat equal to  $2000 \text{ J}$  from the freezer. Which of the two is the better refrigerator?
- Can the temperature of a system be increased without heating it?
  - Can heat be added to a system without increasing its temperature?
- If the door of a refrigerator is kept open in a room, will it make the room warm or cool?
- Determine whether or not the following quantities can be in the same direction for a simple harmonic motion:
  - displacement and velocity
  - displacement and acceleration.
- The velocity – time graph of a body moving in a straight line is shown in Fig. 2. Find the displacement and the distance traveled by the body in 6 seconds.

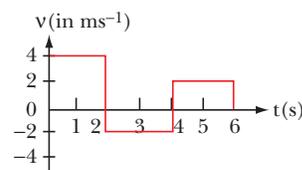


FIGURE 2.

19. A circular ring of diameter 40 cm and mass 1 kg is rotating about an axis normal to its plane and passing through the centre with a frequency of 10 rotations per second. Calculate the angular momentum about its axis of rotation.
20. Explain with a suitable diagram, why it is easier to pull a lawn roller than to push it.
21. A tank filled with fresh water has a hole in its bottom and water is coming out of it. If the hole-size is increased, what will be the change in: (a) volume of water flowing out per second (b) velocity of the water coming out? (c) If, in the above tank, the fresh water is replaced by sea water, will the velocity of the out-coming water change?
22. The frequency  $\nu$  of an oscillating drop may depend upon the radius ( $r$ ) of the drop, density ( $\rho$ ) and surface tension ( $s$ ) of the liquid. Deduce dimensionally the formula for the frequency.
23. Show that the total energy of a body executing simple harmonic motion is independent of time.  
OR
- (a) Define average and root mean square speeds.  
(b) Four molecules of a gas have speeds 2, 4, 6 and 8 km s<sup>-1</sup>. Calculate their average and root mean square speeds.
24. A body of mass 2 kg, initially at rest, moves under the action of an applied force of 7 N on a table with coefficient of kinetic friction equal to 0.1. Calculate the  
(a) work done by the applied force in 10 s  
(b) work done by the friction in 10 s  
(c) work done by the net force on the body in 10 s.
25. Find: (a) time of flight, (b) maximum height, (c) horizontal range of a projectile, projected with speed  $v$  making an angle  $\theta$  with the horizontal direction.
26. (a) Define the term relative velocity.  
(b) Write the expression for relative velocity of a body moving with respect to another body when both the bodies are (i) moving in the same direction, and (ii) moving in opposite directions.  
(c) A jet airplane traveling at the speed of 500 km/hr ejects its products of combustion at the speed of 1500 km/h relative to it. What is the speed of the latter with respect to an observer on the ground?
27. Assuming the length of a chain to be  $L$  and the coefficient of static friction to be  $\mu$ , calculate the maximum length of the chain which can be held hanging outside a table without sliding.
28. (a) State and establish the equation of continuity.  
(b) Eight spherical rain drops of equal size are falling vertically through air with a terminal velocity of 0.10 m/s. What should be the velocity if these drops were to combine to form one large spherical drop?  
OR
- (a) Give an analytical treatment of the formation of standing waves on strings.  
(b) A source of sound emitting a note of frequency 200 Hz moves towards an observer with a velocity  $v$  equal to the velocity of sound. If the observer also moves away from the source with the same velocity  $v$ , what is the apparent frequency heard by the observer?
29. (a) Derive an expression for excess pressure inside a liquid drop.  
(b) In a car lift, compressed air exerts a force  $F_1$  on a small piston having a radius of 5 cm. This pressure is transmitted to a second piston of radius 10 cm. If the mass of the car to be lifted is 1350 kg, calculate  $F_1$ . What is the pressure necessary to accomplish this task?  
OR
- What are standing waves? Explain the formation of standing waves by applying superposition principle to the wave functions of incident and reflected waves in case of a string fixed at both ends. Discuss graphically the various modes of vibration.
30. Explain Doppler effect for sound. Derive an expression for the apparent frequency, when the source and observer are moving in the same direction with velocity  $u_s$  and  $u_o$  respectively, with the source following the observer.  
OR
- Describe stress – strain relationship for a loaded steel wire and hence explain the terms elastic limit, yield point, and tensile strength.