

## SUBJECT : PHYSICS (SET-I)

Time : 3 Hrs.

M.M.: 70

## General Instructions :

- (i) All questions are compulsory.
- (ii) Q.no. 1-5 are very short answer type questions carrying 1 mark each
- (iii) Q.no. 6-10 are short answer type questions carrying 2 marks each.
- (iv) Q.no. 11-22 are also short answer type questions carrying 3 marks each.
- (v) Q.no. 23 is a value based question carrying 4 marks.
- (vi) Q.no. 24-26 are long answer type questions carrying 5 marks each.
- (vii) You may use the following constants :

Radius of earth,  $R = 6.4 \times 10^6 \text{ m}$

Mass of earth,  $M = 6 \times 10^{24} \text{ Kg}$

1 atm =  $1.01 \times 10^5 \text{ Pa}$

- Q1. What will be the effect on the horizontal range of a projectile when its initial speed is doubled, keeping the angle of projection same?
- Q2. Is it possible to increase the temperature of a body without adding heat to it? Explain.
- Q3. In which position, during a SHM, is the velocity of particle (i) maximum (ii) minimum.
- Q4. Which of the following observation is more accurate and why? 0.001m , 0.0010m
- Q5. Give reason - a hot liquid cools faster if the surface of the container is blackened.
- Q6. The time period (T) of an oscillating star depends on its radius (R), density (P) and the universal gravitational constant (G). Using dimensions, find the expression for the time period.

- Q7. Calculate the value of  $x$  so that vectors  $\vec{A}$  and  $\vec{B}$  are perpendicular to each other.

$$\vec{A} = x\hat{i} + 2\hat{j} - \hat{k}$$

$$\vec{B} = 3\hat{i} - 4\hat{j} - 2\hat{k}$$

Q8.

Derive an expression for variation of 'g' with height from surface of earth.

- Q9. An object of mass 0.4kg moving with 4m/s collides with another object of mass 0.6kg moving in same direction with a velocity of 2m/s. If the collision is perfectly inelastic, then find the (i) final velocity (ii) final KE of the system of masses.

OR

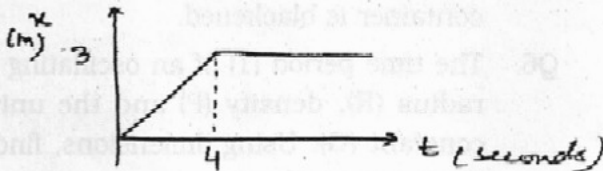
Find an expression for work done against friction when a body is made to slide up an inclined plane.

- Q10. A particle covers 16m during 4th second of its motion and 24m during the 6th second of its motion. Determine its initial velocity and acceleration.

- Q11. Obtain an expression for the work done in an isothermal process. Give an example of isothermal process.

- Q12. A 2kg particle undergoes SHM according to the following equation:  $x = 1.5 \sin \frac{\pi t}{4}$  cm. Find the (i) time period, (ii) total energy of the oscillator, (iii) maximum acceleration of the oscillator.

- Q13. Figure shows position-time graph of a particle of mass 4kg. What is the force on the particle for (i)  $0 < t < 4s$  (ii)  $t > 4s$ , (iii)  $t = 4s$ .



(2)

Q14. (a) If the earth is supposed to be a hollow sphere, then what is the weight of an object just below the surface of earth?

(b) Compare the escape velocities of two planets A & B having same masses but radius of planet 'A' is double the radius of planet 'B'

Q15. Two wires of same material having same length are suspended from a rigid support. The radii of the wires are different. Both wires carry equal load. Will, in the two wires, (i) stress, (ii) strain, (iii) extension be same or different? Why?

OR

(a) What is the significance of Reynold's number?

(b) State and prove Bernoulli's theorem.

Q16. (a) Write the SI units of angular momentum.

(b) State the law of conservation of angular momentum.

(c) Why do ice-skaters fold their hands to change their speed?

Q17. Write the number of degrees of freedom in a monoatomic gas. Hence obtain the values of  $C_p$  and  $C_v$  for a monoatomic gas.

Q18. (a) Why does mercury fall in a capillary tube while water rises?

(b) Derive the expression for the height upto which a liquid rises in a thin capillary tube.

Q19. What is the difference between conservative and non-conservative forces? An elastic spring of constant 'K' is compressed by an amount  $x$  by a force  $F = Kx$ . Show that its PE =  $\frac{1}{2} Kx^2$ .

Q20. Give reasons:

(a) a cyclist has to bend a little from his vertical position while taking a turn.

(b) it is easier to catch a tennis ball than a cricket ball even when both are moving with same velocity.

(c) sparks coming out of grinding stone are tangential.

Q21. What do you mean by the term regelation? Explain its cause.

Q22. Estimate the mass of sun, given that the average distance between sun and earth is  $1.5 \times 10^8$  km and time period of revolution of earth around the sun is 365 days.

Q23. Sunita's aunty had a history of high blood pressure but she did not care. When Sunita come to know of this, she explained to her aunty the cause of high blood pressure. She told her aunty that an artery may get blocked reducing the area through which blood flows and hence pressure on the heart increases.

(a) What values are shown by Sunita?

(b) Write the equation of continuity.

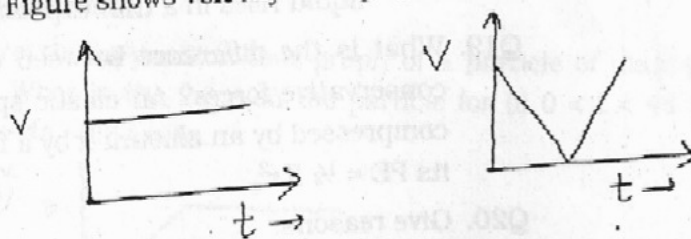
(c) If blood flows with a speed ' $v$ ' in an artery of radius ' $r$ ' then what should be the radius of an artery in which the speed of blood flow is  $v/2$ ?

Q24. (a) Derive an expression for the height of a projectile given an angular projection.

(b) Find the angle of projection for which its range is equal to its height.

OR

Figure shows velocity-time graphs for two situations:



(a) Give an example of each situation.

(b) Draw corresponding acceleration-time graphs.

(c) Find the angle between  $\hat{i} + \hat{j}$  and  $\hat{i} - \hat{j}$ .

Q25. An incident and a reflected wave are given as:

$$y_1 = a \sin \frac{2\pi}{\lambda} (vt - x) \text{ and } y_2 = a \sin \frac{2\pi}{\lambda} (vt + x).$$

Derive the equation of the stationary wave and calculate the position of nodes and antinodes.

OR

(a) The displacement of a particle executing SHM is represented by the equation:

$$y = 9.5 \sin \left( 0.08 + 3t + \frac{\pi}{4} \right) \text{ cm.}$$

Find the (i) amplitude, (ii) frequency, (iii) wave velocity, (iv) maximum particle velocity.

(b) The apparent frequency of the whistle of an engine changes in the ratio 5:3 as the engine approaches and recedes away from a stationary observer. Calculate the velocity of the engine if the speed of sound is 300 m/s.

Q26. Derive an expression for the maximum permissible speed with which a car can negotiate a circular track of radius 'r' banked at an angle 'θ'. The coefficient of friction between the car tyres and the road is 'μ'.

A circular race track of radius 300m is banked at an angle of 15°. If the coefficient of friction between the wheels of race-car and the road is 0.2. What is the maximum speed of the race-car to avoid wear and tear on its tyres?

OR

Derive the relation between Impulse and Momentum. How will you measure impulse from F-t graph?

A ball of mass 20g hits a horizontal hard surface with speed of 10m/s along 45° with horizontal and rebounds with the same speed. The ball is in contact with the surface

for  $\frac{1}{100}$  s. What is the average force on the ball?