

SUBJECT : PHYSICS (SET-I)**Time : 3 Hrs.****M.M.: 70****General Instructions :**

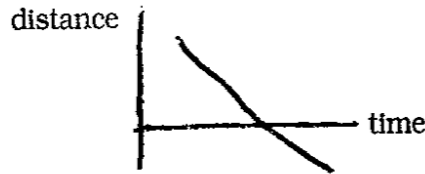
- i) All questions are compulsory.
- ii) Q. no. 1-8 carry 1 mark each, Q. no. 9-16 carry 2 marks each, Q. no. 17-25 carry 3 marks each, Q. no. 26 carries 4 marks and Q. no. 27-29 carry 5 marks each.
- iii) There is no overall choice, but a choice is given in 1 question of 2 marks, 1 question of 3 marks and all questions of 5 marks.
- iv) You may use the following constants :

$$g = 9.8 \text{ m/s}^2$$

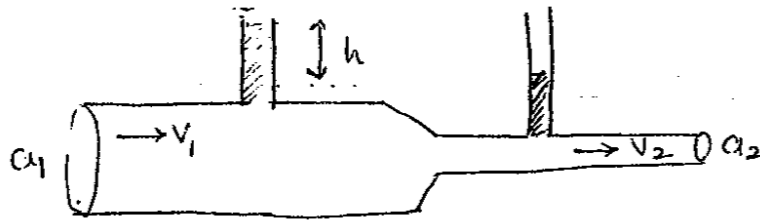
$$G = 6.6 \times 10^{-11} \text{ Nm}^2/\text{Kg}^2$$

- Q1. Two masses M_1 and M_2 are in contact. If a force F acts on any on these masses, then what is the ratio of their acceleration?
- Q2. The material with which two planets are made is same. What is the dependance of 'g' on the radius?
- Q3. A ball of mass 5 Kg strikes a wall normally with speed 5 m/s and is reflected back with same speed. Find the change in momentum.
- Q4. What is the change in internal energy in an isothermal process?
- Q5. If the radius of a sphere has a percentage error of 2%, what is the % error in its volume?
- Q6. Two wires of length l , radius r and length $2l$, radius $2r$ of same material are given. Which will have more Young's modulus?
- Q7. Is $y = \sin 4\omega t$ a simple harmonic motion? Give reason.
- Q8. If the acceleration of a particle is constant in magnitude but not in direction, then what type of path does the body follow?

- Q9. A body travels a distance of 2m in first 2 seconds and 2.8m in next 4 seconds. What will be the speed of the body after 10 seconds from the start?
- Q10. Prove that in a SHM, the total energy will remain constant even though PE and KE interchange.
- Q11. (a) Is the given distance-time graph possible?



- (b) A body covers 1st half of its journey with speed 'u' and 2nd half with speed 'v'. Find the average speed of the body during the entire journey.
- Q12. Find the expression for V_1 in terms of h , g , a_1 and a_2 for the given figure :



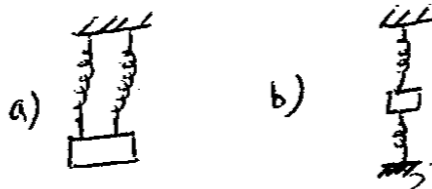
OR

A wooden block floats in water with $\frac{2}{5}$ of its volume above the water surface. Find the density of wood. density of water = 1g/c.c.

- Q13. Two circular discs of same mass and same thickness are made of two different metals whose densities are p_1 and p_2 ($p_1 > p_2$). Which of them has greater moment of inertia about the axis passing through their centres and perpendicular to the plane? Give reasons.
- Q14. A mass of 2 Kg is dropped from a height of 10m. Calculate the height of the point at which its energy is half kinetic and half potential.

Q15. Compare the slope of P-V curves for isothermal and adiabatic processes.

Q16. Two identical springs of constant 'K' each are joined as shown. Find the spring constant of the combination.

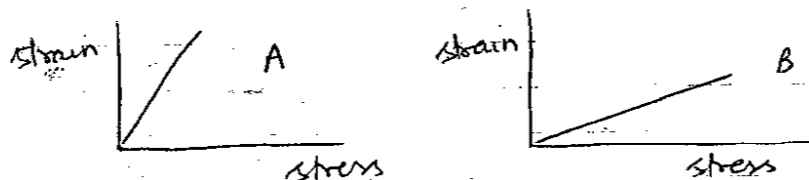


Q17. What do you mean by surface tension? Derive an expression for the excess pressure inside a water drop.

Q18. (i) Calculate the percentage increase in length of a wire of radius 2mm stretched by a force of 100 Kg.wt.

$$Y = 2 \times 10^{11} \text{ N/m}^2.$$

(ii) The stress-strain graphs for two materials A and B are as shown :



Which of them has greater Young's modulus?

Q19. Give reasons :

- A cyclist has to bend a little from his vertical position while turning.
- A horse cannot pull a cart and run in empty space.
- It is easier to catch a table tennis ball than a cricket ball even when both are moving with same velocity.

Q20. By the method of dimensions, derive an expression for the time period of oscillations of a small liquid drop (T) which depends on surface tension of the liquid (S), density (d) and radius of drop (r).

OR

Using dimensions, check the accuracy of the following equation :

(3)

$f = \frac{K}{l} \sqrt{\frac{T}{m}}$ where f is the frequency of transverse waves in a string under tension T . M is the mass of the string l is the length of string and K is a dimensionless constant.

Correct the equation if required.

- Q21. (a) Discuss the variation of 'g' with depth below the surface of earth; both mathematically and graphically.
 (b) How far above the surface of earth, does the value of 'g' becomes 20% of its value at the surface?

- Q22. Two particles of masses 1 Kg and 3 Kg are located at $(2\hat{i} + 5\hat{j} + 13\hat{k})$ and $(-6\hat{i} + 4\hat{j} - 2\hat{k})$ meter respectively.

Find the position of their centre of mass.

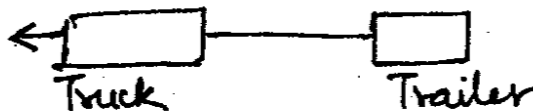
- Q23. A standing train blows whistle of frequency 400Hz in still air.

- (a) What is the frequency of the whistle for an observer moving away from the platform at 10 M/s?
 (b) What is the speed of sound as observed by the observer?
 (c) What is the frequency of the whistle for a stationary observer if the train starts to move away from the platform at 10 M/s?

Take the speed of sound as 300 M/S.

- Q24. Derive an expression for pressure of a gas in a container. Using it, relate KE with pressure.

- Q25. A truck of mass 1000 Kg pulls a trailer of mass 2000 Kg as shown. The engine of truck exerts a force of 6000N. The retarding force on the truck is 500N and on the trailer is 1000N. Calculate the acceleration of the system and tension in the connecting rope.



Q26. A boy observed that the water pipe used by the firemen to put off fire is broad from the back and narrow from the front. He was surprised and asked his father that if they want to put off the fire quickly then the pipe should be broad so that more water can come.

- (a) What explanation do you think that the father had given to his son?
- (b) Water flows through a pipe at the rate of 20 lt/minute. Determine the velocity of water at a point where diameter is 4 cm.
- (c) What values does the boy represent?

Q27. (a) A projectile is fired with initial speed 'u' at an angle 'θ' with horizontal. Find the expression for the range of projectile.

- (b) A stone tied to the end of a string 80 cm long is whirled in a circle with constant speed. The stone makes 15 revolutions in 25 sec. Find the magnitude and direction of the acceleration of the stone.

OR

- (a) Prove that the vectors $\hat{i} + 2\hat{j} + 3\hat{k}$ and $2\hat{i} - \hat{j}$ are perpendicular to each other.
- (b) If $\vec{A} = -2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{B} = 3\hat{i} - 4\hat{j} + 5\hat{k}$ find $\vec{A} \times \vec{B}$.
- (c) Rain is falling vertically with a speed of 30 M/s. A man rides a bicycle with a speed of 10 M/s from north to south. In which direction should he hold the umbrella?

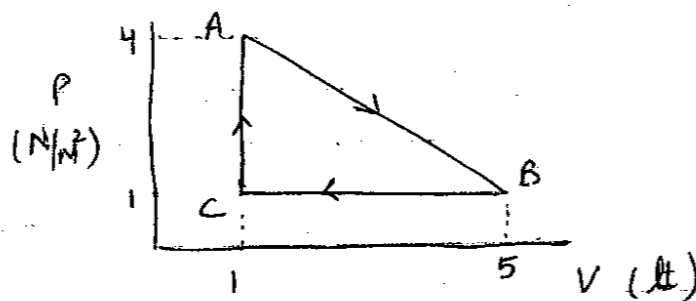
Q28. What are stationary waves? Derive an expression for the stationary waves formed in strings. Draw the three normal modes of vibration.

OR

The displacement of a particle under SHM is

$$x = 10 \sin \left[10t + \frac{1}{4} \right] \text{ m. Find}$$

- (a) amplitude
 - (b) angular frequency
 - (c) time period
 - (d) maximum velocity and maximum acceleration
 - (e) displacement at $t = 0$.
- Q29. (a) Derive an expression for the work done during an adiabatic expansion of an ideal gas when its temperature falls from T_1 to T_2 .
- (b) Calculate the work done during the cyclic process represented by the following P-V curve :



OR

Explain how a carnot's cycle works with the help of heat flow diagram. Hence show that its efficiency is $\eta = 1 - \frac{T_2}{T_1}$.

Where T_2 is the temperature of sink and T_1 is the temperature of source.

A carnot engine absorbs 1000J of heat from a source at 127°C and rejects 6000J of heat during each cycle. Find its efficiency and temperature of sink.