Roll No. _____ **Code : 112017-042-A**

Please check that this question paper contains **26** questions and **7** printed pages.

CLASS-XI
PHYSICS

Time Allowed : 3 Hours **Maximum Marks : 70**

General Instructions :

(i) All questions are compulsory. There are 26 questions in all.

(ii) This question paper has five sections : Section A, Section B, Section C, Section D and Section E.

(iii) Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.

(iv) 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 the three questions of five marks. You have to attempt only one of the choices in such questions.

(v) Fifteen minutes time has been alloted to read this question paper. During this time, the student will only read the question paper and will not write any answers on the answer script.

Section-A

1. Define the term 'systematic errors'.

2. Particles of masses m_1, m_2, ... m_n, are present at points defined by position vectors $\vec{r}_1$, $\vec{r}_2$, ... $\vec{r}_n$. Write the expression for the position of the centre of mass of this n-particle system.

3. Given that Boltzmann's constant = K_B and Absoulute temperature = T, show, on a graph, the dependence of the average translational Kinetic Energy (E) of a gas molecule, on the absolute temperature of the gas.

4. Name the physical quantity that remains constant for a given system during an adiabatic process. For a given gas, the ratio $\frac{C_p}{C_v} = r$. Write the relation, between pressure (p) and volume (v), for this gas, during an adiabatic change.

5. In which liquid water or honey, the terminal velocity, of a given object, has a lower value ?

Section-B

6. A constant force, $\vec{F}$, acting on a body of mass 20 kg, changes its velocity from $(2\hat{i})_{ms^{-1}}$ to $(6\hat{i})_{ms^{-1}}$ in 40s. Find the magnitude and direction of the force.

7. A particle, of mass 0.5 kg, moves along the x-axis, with a velocity $V = kx^{3/2}$ where k = (S)$m^{-1/2}s^{-1}$. Find the work done by the net force, acting on it, during its displacement from x = 0 to x = 2m.

8. How much below the surface of the earth does the acceleration due to gravity becomes 99% of its value at the earth's surface ? (Radius of earth = 6400 km).

9. Show, on a diagram, the fundamental mode of vibration, of the air-column, in (*i*) an open tube (*ii*) a closed tube. If the frequencies of vibration are equal in the two tubes, find the ratio of their lengths.

OR

A source, S, of sound, having a natural frequency n, first approaches, and than moves fast, a stationary observer O. The source moves with a constant velocity V_s of sound, in air, is V.

Find the magnitude of change (Δn) in the apparent frequency of the source, at the instant it goes past O.

10. Two bodies, M and N, of Equal masses, are suspended from two separate mass less springs of spring constants k_1 and k_2 respectively. If these two bodies, when made to oscillate, vertically, have equal values for their maximum velocities find the ratio of their oscillation amplitudes of M to that of N.

Section-C

11. (a) Check the correctness of the relation :

$$V = \sqrt{\frac{2\,GM}{R}}$$

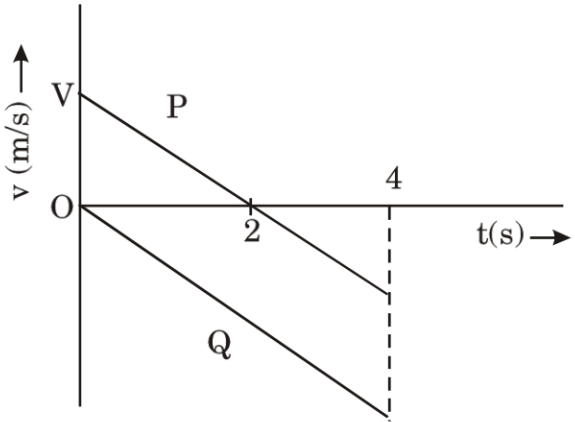
(V = velocity, M = mass R = Radius, G = universal gravitational constant)

(b) A physical quantity P is related to four observables a, b, c and d as follows :–

$$P = \frac{a^3 b^2}{\sqrt{cd}}$$

If the percentage errors of measurement in a, b, c and d are 1%, 3%, 4% and 2% respectively, find the percentage error in the quantity P ?

12. (a) Two particles P and Q move vertically under gravity the graphs, in the figure* show the upward velocity V (in m/s of the particles at time t (in s) for $0 \leq t \leq 4$. P starts with velocity V (in m/s) and Q starts from rest. Taking $g \simeq 10\ ms^{-2}$, find the value of v.



(b) Given that Q reaches the ground, when t = 4s. Find the speed with which Q reaches the ground and its height above the ground, at t = 0.

13. A fighter plane, flying horizontally at an altitude (H) metre, with a speed v (ms^{-1}), passes directly overhead an anti aircraft gun. At what angle from the vertical should the gun be fired so that the shell fired with a muzzle speed (U)ms^{-1}, hits the plane ? At what minimum altitude should the pilot fly the plane to avoid being hit ?

14. (a) State the triangle law of vector addition.

(b) Two vectors $\vec{A}$ and $\vec{B}$ are inclined to each other at an angle Q. Using triangle law of vector addition, find the magnitude of their resultant.

15. Check the correctness, or otherwise of the following statements :

(a) It is comparitively difficult to put an object into motion than to maintain its motion.

(b) Friction is a conservative force.

(c) A single isolated force can exist in nature.

16. Find the potential energy of a system of four particles placed at the vertices of a square of side L. Also obtain the potential at the centre of the square.

OR

The radius of a planet is double that of the earth but their average densities are the same. If the escape velocities at the planet and at the earth are V_P and V_E, respectively, show that $V_P = 2V_E$

17. A brass rod, of length 50 cm and diameter 3.0 mm, is joined to a steel rod of same length and same diameter. Find is the change in length of the combined rod at 250°C, if the original lengths have been measured at 40.0°C. Is there a 'Thermal Stress' developed at the junction when the ends of the rod are free to expand ? (Coefficient of linear expansion of brass = $2.0 \times 10^{-5}°C^{-1}$ and that of steel = $1.2 \times 10^{-5}°C$.

18. The Young's moduling, of the material of a given wire is Y. It is observed that the length of a given wire of this material is L_1, when the tension becomes T_2. Find the original length of the wire.

19. (a) Define the term "isothermal process".

    (b) Derive an expression, for the work done, when an ideal gas undergoes a change in its state, isothermally, from (P_1V_1) to (P_2,V_2).

20. On the basis of kinetic theory, derive an expression, for the pressure exerted by an ideal gas, on the walls of the container, in terms of the root mean square velocity.

21. A particle, in SHM, is described by the displacement function.

$$x\ (t) = A \cos\ (wt + \phi),\ w = \frac{2\pi}{T}$$

    If the initial ($t = 0$) position of the particle is at $x = 1$ cm and its initial velocity is π cm/s, find its amplitude and its initial phase angle ?

    The angular frequency of the particle is $(\pi)\ s^{-1}$.]

22. Justify (in brief) the correctness, or otherwise, of the following statements :

    (a) Solid can support both longitudinal and transverse waves, but-only longitudinal waves can propagate-through gases.

    (b) The shape of a pulse does not get distorted during its propagation in a dispersive medium.

    (c) A violin note and a sitar note may have the same frequency and amplitude; yet we can distinguish between two such notes.

23. A manufacturer wanted to display his products at a fare. He wanted to use a rotating turn table on which his products, as well as one of his sales person, could be present together. He also wanted that his sales person should be able to adjust the speed of rotation without having to step down from the table.

When he told his problem to his school day teacher, the teacher suggested him a very simple method for this purpose. The manufacturer checked the suggested method and found it working. He thanked his teacher profusely.

(a) Write the likely simple suggestion that could have been given by the teacher.

(b) Name the principle on which this suggestion is based.

(c) State the values displayed by the (i) teacher (ii) manufacturer.

Section-F

24. State the meaning of the term 'banking of roads'. Give the reason for 'banking a (curved) road. Obtain an expression for maximum speed with which a vehicle can safety negotiate a curved road, banked out an angle θ. The coefficient of friction between the wheels and the road is μ.

OR

Give the meaning of the term 'friction' ? Distinguish between static friction, limiting friction and kinetic friction. Draw the relevant graph, showing how the force of friction, *f*, varies with the (externally) aplied, force, F.

25. When is a collision, between two objects, said to be an elastic collision ? Prove that in an elastic one-dimensional collision between two bodies, of masses m_1, and m_2, moving with velocities u_1, and u_2, the relative velocity of approach (before the collision), equals their relative velocity of recession, (after the collision).

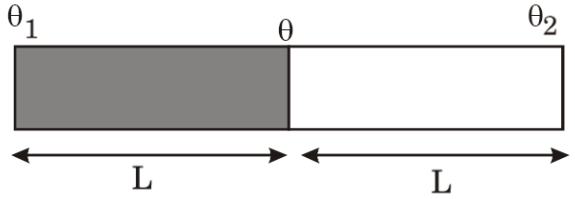
OR

State and demonstrate the Principle of conservation of total mechanical energy. Show that the total mechanical energy of a freely falling body remains constant throughout its fall.

26. State, and prove, Berroull's Principle for the flow of a non-viscous, incompressible fluid in a combined flow through a pipe of non-uniform cross-section.

OR

State the factors on which the rate of flow of heat, through a bar of uniform cross section, depends. Hence define the 'coefficient of thermal conductivity' for a given material. The two parts, of a composite rod, made up of two metals, have equal lengths and equal areas of cross section. The thermal conductivities, of the two materials, are k_1 and k_2, respectively. Find an expression for the steady state temperature, θ, of the function when the two ends are maintained at temperatures θ_1 and θ_2 $(\theta_1 > \theta_2)$



Area of cross section = A