CLASS XI SAMPLE PAPER (2025-26)
SUBJECT- PHYSICS

TIME: 3 HOURS **M.M: 70**

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.

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

(3) All the sections are compulsory.

(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.

(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

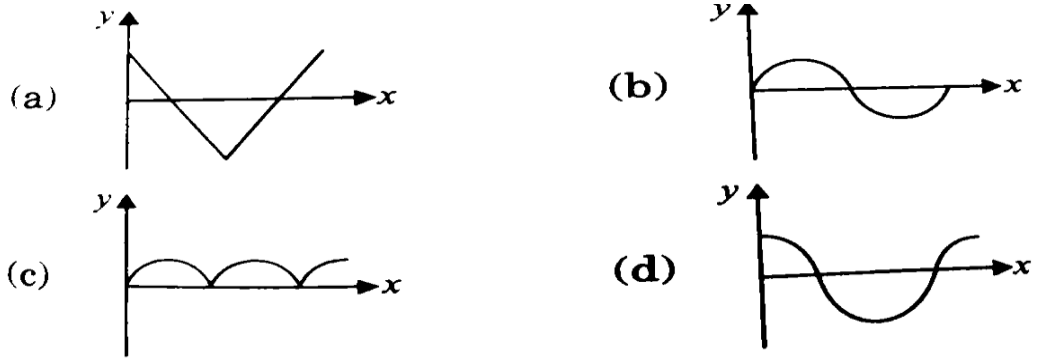
SECTION A

1. If mass is measured in units of α kilogram, length in β metre and time in γ seconds then calorie would be

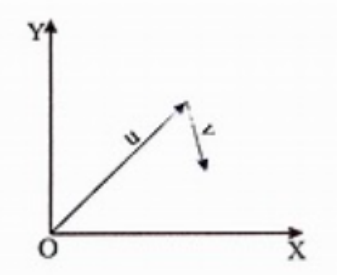
(A) 4.2 $\alpha \beta^2 \gamma^{-2}$ (B) 4.2 $\alpha^{-1} \beta^2 \gamma^2$

(C) 4.2 $\alpha^{-1} \beta^{-2} \gamma^2$ (D) 4.2 $\alpha^{-2} \beta^{-1} \gamma^{-2}$

2. A particle starts moving at t = 0 in x-y plane such that its position (x,y) is given as x = at, y = b sin ωt where a = 2 m/s, b = 5 m, c = 2 s^{-1}. Which of the following figures currently represent the motion of the particle?

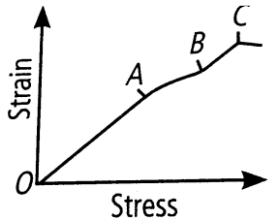


3. Figure shows two vectors $\vec{u}$ and $\vec{v}$ in x-y plane. If $\vec{u}$ = a $\hat{\imath}$ + b $\hat{\jmath}$ and $\vec{v}$ = p $\hat{\imath}$ + q $\hat{\jmath}$, then:



(A) a and p are positive while b and q are negative
(B) a, p and b are positive while q is negative
(C) a, q and b are positive while p is negative
(D) a, b, p and q all positive

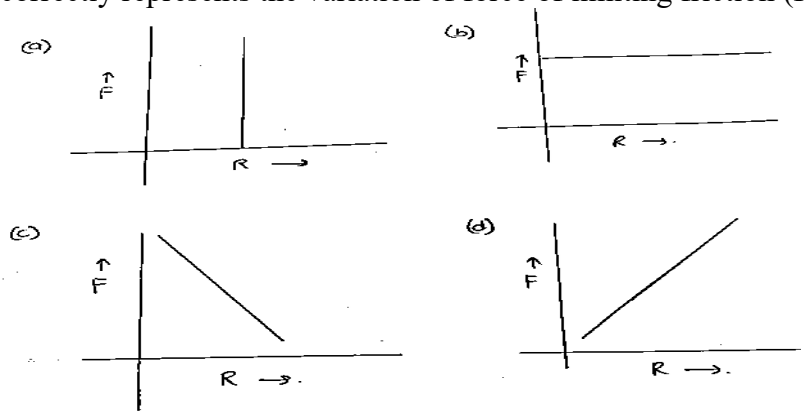
4. The stress- strain graph of a material is shown in the figure. The region in which the material is elastic is:



(A) OA (B) OB (C) OC (D) AC

5. A car of mass m moves with a constant speed v over (1) horizontal flat surface (2) convex bridge (3) concave bridge. Let R_1, R_2 and R_3 be the forces exerted by surfaces in cases (1), (2) and (3) respectively on the car as it passes the middle point of the bridge. Which of the following relations is correct?
(A) $R_1 = mg$; $R_2 < mg$; $R_3 = mg$
(B) $R_1 = mg$; $R_2 > mg$; $R_3 < mg$
(C) $R_1 = mg$; $R_2 < mg$; $R_3 > mg$
(D) $R_1 = mg$; $R_2 = mg$; $R_3 = mg$

6. A block of Mass m is lying on a horizontal rough surface. Which of the following graph correctly represents the variation of force of limiting friction (F) with normal reaction (R)?



7. A binary system of stars of equal mass is moving along a circle of radius r under the action of mutual attraction. The speed of each star is:
(A) $\sqrt{Gm/4r}$ (B) $\sqrt{Gm/2r}$ (C) $\sqrt{Gm/r}$ (D) $\sqrt{Gmr}$

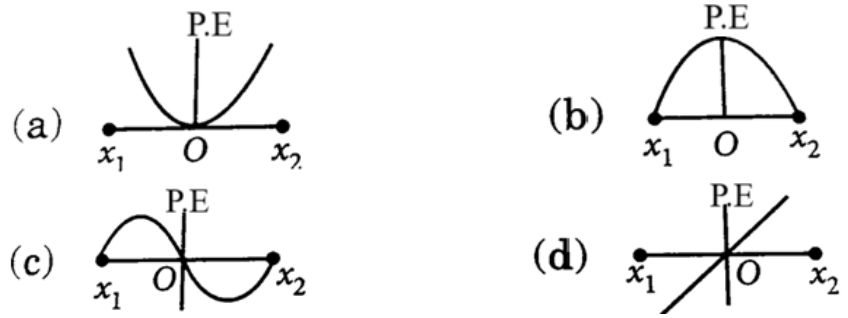
8. The radius of a spherical metal ball at room temperature T is R, and the coefficient of linear expansion of the material is α. The sphere is heated a little through a temperature ΔT so that its new temperature is (T + ΔT). The increase in the volume of the sphere is approximately:
(A) $2\pi R\alpha\Delta T$ (B) $\pi R^2\alpha\Delta T$ (C) $4\pi R^3\alpha\Delta T/3$ (D) $4\pi R^3\alpha\Delta T$

9. Average velocity of a particle executing SHM of amplitude A with angular frequency ω in one complete oscillation is:
(A) Zero (B) $A\omega/2$ (C) $A\omega$ (D) $A\omega^2/2$

10. The ratio of specific heats (C_p / C_v) of monoatomic and rigid diatomic gases are respectively:
(A) 9/7, 5/3 (B) 9/5, 7/3 (C) 5/3, 7/5 (D) 3/5, 7/9

11. Consider two containers A and B containing identical gases at the same temperature, pressure and volume. The gas in container A is compressed to one- third of its original volume isothermally while the gas in container B is compressed one- third of its original value adiabatically. The ratio of final pressure of gas in B to that of gas in A is:
(A) $(3)^{\gamma - 1}$ (B) $(1/3)^{\gamma - 1}$ (C) $(1/1-\gamma)^2$ (D) $(1/\gamma - 1)^2$

12. A particle of mass m oscillates in simple harmonic motion between points x_1 and x_2, the equilibrium position being O. Which of the following graph correctly shows variation of potential energy with x.



For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.
(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

13. Assertion (A): A restoring force acting on a body, executing simple harmonic motion is proportional to the displacement of the body from the mean position.
Reason (R): Restoring force is always directed towards the centre of motion during simple harmonic motion.

14. Assertion (A): Metals have larger values of Young's modulus than alloys.
Reason (R): A wire made of material with large value of Young's modulus requires a small force to produce small changes in its length.

15. Assertion (A): An astronaut experiences weightlessness in a space satellite.
Reason (R): Both the astronaut and the satellite are in free fall towards the Earth.

16. Assertion (A): The direction of resultant acceleration of an object in uniform circular

motion is away from the centre.
Reason (R): The speed of an object in uniform circular motion is not constant.

SECTION B

17. A body of mass 1 kg is moving in x-y plane under the action of two forces 5 $\hat{\imath}$ and 5 $\hat{\jmath}$. Calculate the work done by these forces in moving the body from initial position (0,0) to final position (2m, 2m).

18. A metal bar of length 1 m and mass 2 kg is supported at the mid- point with the help of a knife edge. A 20 kg load is suspended at 20 cm from one end of the bar. Where should be the mass of 50 g be placed from the other end, so that the bar remains in equilibrium?

19. (a) Define coefficient of thermal conductivity. Write its unit.
(b) Write the basic requirement of a cooking utensil in respect of (i) specific heat and (ii) thermal conductivity of the material of the utensil.

OR

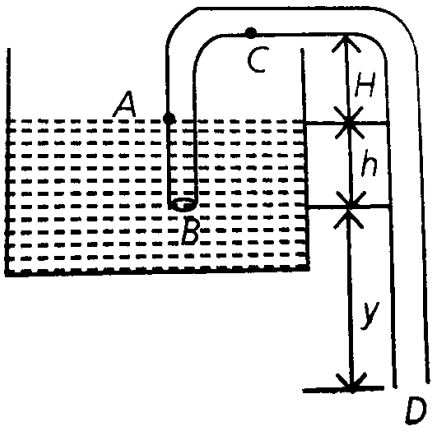
(a) Absolute zero temperature is not the temperature of zero energy. Explain.
(b) What happens to the change in internal energy of a gas during (i) isothermal change and (ii) adiabatic change.

20. When white light travels through glass the refractive index (n) is found to vary with wavelength (λ) as $n = P + (Q / \lambda^2)$, where P and Q are constant. Using the principle of homogeneity of dimensions, determine the dimensional formula of 'P' and 'Q'.

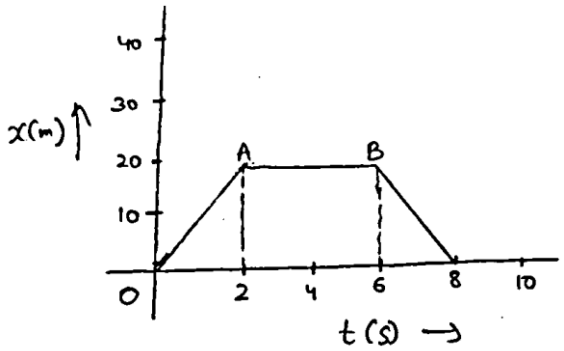
21. (a) Write the factors on which mean free path of a ideal gas molecules depends.
(b) Calculate the mean free path of a gas molecule, if number of molecules per cm^3 is 3×10^{19} and diameter of each molecule is 2 A°.

SECTION C

22. A siphon tube is used to remove liquid from a container as shown in figure. In order to operate the siphon tube it must initially be filled with the liquid. Find the pressure difference between points D and C. (Given H = 10 cm, h = 20 cm and y = 30 cm)



23. Figure shows the position- time graph of a particle of mass 4 kg. (a) What is the impulse at t = 2 s and t = 6 s. (b) What is the velocity of particle at point B. Give reason for your answer.

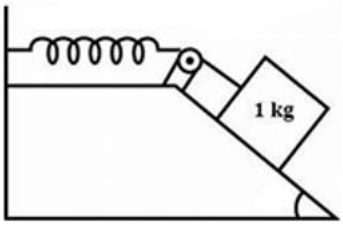


24. Galileo's law of odd numbers is "The distances traversed during equal intervals of time, by a body falling from rest, stand to one another in the same ratio as the odd numbers beginning with unity (namely 1:3:5…….)". Prove it for first three intervals of time.

OR

An object is moving along a straight line with acceleration 'a' starting with velocity 'u'. Find the expression for distance travelled by it in n^{th} second by calculus method.

25. A 1 kg block situated on a rough plane inclined at 30° is connected to a spring of spring constant 50 N/m as shown in the figure. The block is released from rest with the spring in unstretched position. The block moves 10 cm down the incline before coming to rest. Find the coefficient of friction between the block and the incline. Assume that the spring has a negligible mass and the pulley is frictionless. (Given g = 10 m/s^2)



26. (a) Show that moment of a couple does not depend on the point about which you take the moments.

(b) A particle is moving along positive X-axis. At some instant its position is x and its velocity is $\vec{v}$. Prove that the angular momentum of the particle about the origin at that instant is zero.

27. (a) State first law of thermodynamics.

(b) Suppose 300 J of work is done on a system and 10 calorie of heat is extracted from the system. What are the values of dW, dQ and dU with proper signs?

28. A cylindrical piece of cork of base area A and height h floats in a liquid of density ρ_1. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period

$$T = 2\pi\sqrt{\frac{h\rho}{\rho_1 g}}$$

where ρ is the density of cork. (Ignore damping due to viscosity of liquid)

SECTION-D
Case Study Based Questions

29. Read the following paragraph and answer the questions that follow.

The interference of two identical waves moving in opposite directions produces standing waves. Standing waves are characterized by fixed locations of zero displacement called nodes and fixed locations of maximum displacements called antinodes. The most significant feature of stationary waves is that the boundary conditions constrain the possible wavelengths or frequencies of vibration of the system. The system cannot oscillate with any arbitrary frequency, but is characterized by a set of natural frequencies or normal modes of oscillation. The transverse displacement of a string clamped at its both ends under the tension 'T' is given by:

$$y(x,t) = 0.08 \sin(2\pi/3)x \cos(60\,\pi t)$$

where x and y are in metre and t in second. The length of the string is 1.5 m and its mass is 15 x 10^{-2} kg.

(i) The wavelength of the wave is:
(A) 1 m (B) 2 m (C) 3 m (D) 4 m

(ii) The time period of the wave is:
(A) 0.034 s (B) 0.34 s (C) 3.4 s (D) 34 m

(iii) The tension produced in the string is:
(A) 410 N (B) 640 N (C) 720 N (D) 810 N

OR

The speed of the wave is:
(A) 30 m/s (B) 90 m/s (C) 120 m/s (D) 150 m/s

(iv) Which of the following equations represent progressive harmonic wave?
(A) $y = 20\sqrt{x - vt}$
(B) $y = \cos x \sin t + \cos 2x \sin 2t$
(C) $y = 4 \cos(6x) \sin(20t)$
(D) $y = 3 \sin(5x - 0.5t) + 4 \cos(5x - 0.5t)$

30. Read the following paragraph and answer the questions that follow.

On an unbanked road, frictional force alone can provide the centripetal force needed to keep a vehicle moving on a circular turn without slipping. If the speed is too large or if the turn is too sharp or both, the friction force is not sufficient to provide the necessary centripetal force and the cyclist slips. To avoid this, the curved road is given an inclination sloping upwards towards the outer circumference. This reduces wearing out of the tyres because the horizontal component of normal reaction provides the necessary centripetal force. The system of raising the outer edge of a curved road above its inner edge is called banking of the curved road. The angle through which the outer edge of the curved road is raised above the inner edge is called angle of banking. The maximum speed that a vehicle can move with is determined by angle of banking, acceleration due to gravity and radius of curve path. If the surface is rough then this speed also depends on coefficient of friction.

(i) The F_{net} acting on a body moving on a banked road to maintain circular path is:
(A) N sin θ + F cos θ
(B) N cos θ + F sin θ
(C) N sin θ
(D) F cos θ

(ii) If θ_1 is the optimum angle of banking of cyclist and θ_2 is the angle of banking of road for a particular speed 'v' and radius 'r' then
(A) $\theta_1 = \theta_2$ (B) $\theta_1 > \theta_2$ (C) $\theta_2 > \theta_1$ (D) $\theta_2 > 2\theta_1$

(iii) The maximum speed with which a vehicle can move safely while negotiating a curved track of radius R on a road banked by angle θ is given by`
(μ_s = coefficient of friction between road and tyre of the vehicle)
(A) $v_{max} = R\, g\, [(\mu_s + \tan\theta) / (1+ \mu_s \tan\theta]^{1/2}$
(B) $v_{max} = R\, g\, [(\mu_s + \tan\theta) / (1- \mu_s \tan\theta]^{1/2}$
(C) $v_{max} = R\, g\, [(\mu_s - \tan\theta) / (1+ \mu_s \tan\theta]^{1/2}$
(D) $v_{max} = R\, g\, [(1 - \mu_s \tan\theta) / (\mu_s + \tan\theta]^{1/2}$

(iv) At what angle must a racing track of radius of curvature 40 m be banked so as to be suitable for a maximum speed of 17 km/h? (Take g= 10 m/s^2)
(A) 30° (B) 45° (C) 90° (D) 60°

OR

(a) A cyclist while negotiating a circular path with the speed of 30 m/s found that she has to bend at an angle of 30° with vertical to avoid skidding. What is the radius of circular path?
(A) 90√3 m (B) 900√3 m (C) 90/√3 m (D) 900/√3 m

SECTION E

31. (a) A sphere of mass m_1 moving with velocity u $\hat{\imath}$ collides another stationary sphere of masss m_2 placed at the origin. The collision is perfectly inelastic. Calculate the final velocity $\vec{v}$ of the spheres after collision and the loss of kinetic energy during collision.
(b) A ball of mass 500 g is moving along a parabolic path in XY plane under gravity. At some instant its velocity is $\vec{v} = (10\, i + 20\, j)$ m/s. Calculate the power delivered to the ball at that instant. (Given that g = 10 m/s^2)

OR

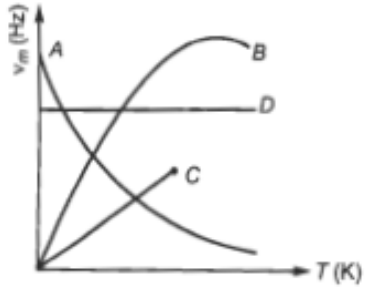
(a) A rocket of mass m is fired vertically with a speed v from the surface of Earth (radius R). Show that the maximum height h attained by the rocket from the Earth surface before returning to the Earth is h = [R v ^{2} / (2gR- v)^2], where g = acceleration due to gravity.
(b) Two bodies of masses 9 kg and16 kg are placed at two points A and B, distance 5 m apart. Find the magnitude of the gravitational force experienced by a mass of 1 kg placed at a point P such that AP = 3 m and BP = 4 m. (Given G = 6.66 x 10^{-11} N m^2 kg^{-2})

32. (a) If the maximum height obtained by a projectile under gravity is H, show that the maximum range achieved would be 2H.
(b) For an object thrown under gravity with initial velocity u at t = 0 and at an angle θ with x-axis, derive equation for the path described by the object.
(c) A ball is projected from origin at initial velocity (30 i + 40 j) m/s in xy plane at t = 0. Find the angle that it makes with x axis at time t = 3 seconds. (Given g = 10 m/s^2)

OR

(a) A boy started rotating a stone of mass m with constant speed u in horizontal plane with help of a string of length *l*. Derive an expression for the centripetal acceleration acting on the stone.
(b) A cyclist is riding with a speed 36 km/h. As he approaches a circular turn on the road of radius 80 m, he applies brakes and reduces his speed at constant rate of 0.5 m/s every second. What is the magnitude and direction of net acceleration of the cyclist in circular turn?

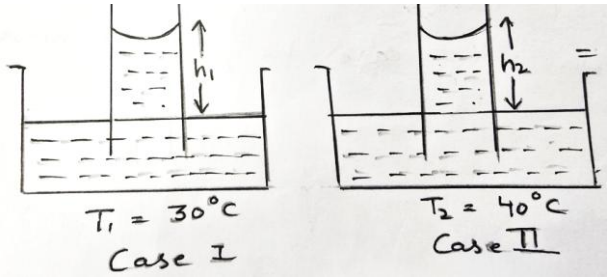
33. (a) Draw experimental curve between wavelength λ and intensity of radiation E_λ emitted by a black body maintained at different constant temperatures.
(b) Which one of the following is the $\nu_m - T$ graph for a perfectly black body?
Here ν_m is the frequency of radiation with maximum intensity and T is the absolute temperature. Give reason for your choice.



(c) The temperature of a hot black body is raised by 5%. Calculate the percentage increase in the rate of heat energy emitted per unit area.

OR

(a) A drop of mercury of radius 'R' and surface tension 'T' is split into 'n' similar drops of radius 'r'. Show that the change in surface energy is given by $4\pi R^2 (1 - n^{1/3}) T$
(b) Calculate the amount of work done in blowing a soap bubble of surface tension 0.07 N/m from diameter 4 mm to a diameter 6 mm.
(c) Two identical capillary tubes are dipped in the same liquid maintained at different temperatures as shown in the figure.



In which case the height attained by the liquid is more?