SAMPLE QUESTION PAPER (2026-2027)

PHYSICS

CLASS – XI

Time Allowed: 3 hours **Maximum Marks: 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.

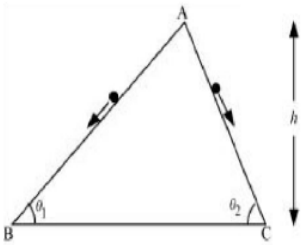
(4) Section A contains sixteen questions, twelve MCQ and four assertion reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study-based questions of four marks each and Section E contains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

(5) There is no overall choice. However, an internal choice has been provided in two questions in Section B, one question in Section C 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. Two inclined frictionless tracks, one gradual and the other steep meet at A from where two stones are allowed to slide down from rest, one on each track (stone I along AB and stone II along AC) as shown in the figure. 1



Which of the following statements is correct?

(A) Both stones reach the bottom at the same time but with different speeds.

(B) Both stones reach the bottom with the same speed, and stone I reaches earlier than stone II**.**

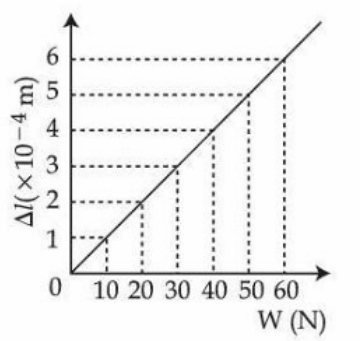
(C) Both stones reach the bottom with the same speed, and stone II reaches earlier than stone I**.**

(D) Both stones reach the bottom at the same time and with the same speed.

2. The dimensions of the product of two physical quantities P and Q are [M L^2 T^{-3}] while those of $\frac{P}{Q}$ are [M T^{-1}]. Then quantities P and Q respectively are **1**

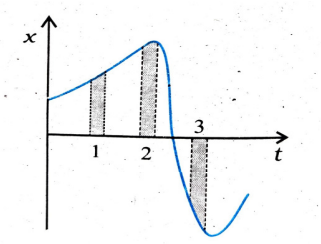
(A) Force and displacement
(B) Momentum and displacement
(C)Work and velocity
(D) Force and velocity

3. Figure represents the extension (Δl) of a wire of length 1 meter, suspended from the ceiling of the room at one end with a load W connected to the other end. If the cross-sectional area of the wire is 10^{-5} m^2 then the Young's modulus of the wire in N/m^2 is: **1**



(A) 1.0 x 10^{11}
(B) 2.0 x 10^{11}
(C) 1.0 x 10^{10}
(D) 2.0 x 10^{10}

4. Figure shows the x-t plot of a particle in one -dimensional motion. Three different equal intervals of time are shown. Which of the following statement is true? **1**



(A) Average speed is least in time interval 3 and average velocity is positive.
(B) Average speed is least in time interval 2 and average velocity is negative.
(C) Average speed is greatest in time interval 3 and average velocity is negative.
(D) Average speed is greatest in time interval 1 and average velocity is positive.

5. When one moves from a point 16 km below the earth's surface to a point 16 km above the earth's surface. The change in g is approximately α %. The value of α is (given: radius of the earth = 6400 km.) 1

(A) 0.12

(B) 0.25

(C) 0.50

(D) 0.75

6. A soap bubble initially has radius 'a'. Its radius is increased to '2a' during expansion. Assuming the surface tension remains constant, the increase in the surface energy of the soap bubble is: **1**

(A) $24\pi a^2\sigma$

(B) $48\pi a^2\sigma$

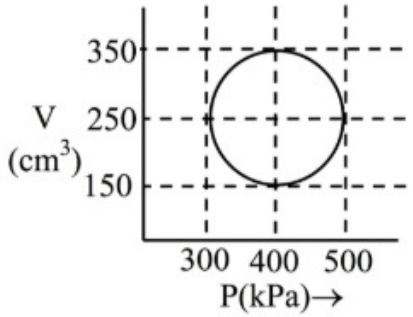
(C) $36\pi a^2\sigma$

(D) $12\pi a^2\sigma$

7. Two balls are projected from the same point in directions 30°and 60°with respect to the horizontal. The ratio of their initial velocities if they attain the same maximum height is- **1**

(A) √3: 1
(B) 1: √3
(C) 1: 1
(D) 3: 1

8. An ideal gas has undergone through the cyclic process as shown in the figure. Work done by the gas in the entire cycle is: (given π = 3.14) **1**



(A) 3.14 J

(B) 31.4 J
(C) 1.256 J
(D) 12.56 J

9. Two blocks of masses 5 kg and 2 kg are placed on **a** frictionless horizontal surface and connected by a light spring. An external kick gives a velocity of 14 m/s to the heavier block in the direction of the lighter one. The velocity gained by the centre of mass immediately after the kick is: **1**

(A) 10 m/s in the direction of kick.
(B) 10 m/s opposite to the direction of kick.
(C) 70 m/s in the direction of kick.
(D) 70 m/s opposite to the direction of kick.

10. A travelling harmonic wave is represented by

$y(x, t) = 2.0 \sin [20\pi t - 0.01\pi x + 0.4\pi]$

where x and y are in cm and time in s. The phase difference between oscillatory motion of two points separated by distance of 50 cm is **1**

(A) $\frac{\pi}{2}$ rad
(B) $\frac{\pi}{4}$ rad
(C) $\frac{\pi}{5}$ rad
(D) $\frac{\pi}{10}$ rad

11. Which of the following relationships between the acceleration 'a' and the displacement 'x' of a particle involve simple harmonic motion? **1**

a) $a = 0.1x$
b) $a = -0.1\ x^2$
c) $a = -0.1x$
d) $a = 0.1\ x^2$

12. If μ_s, μ_k and μ_r are coefficients of static friction, kinetic friction and rolling friction then, choose the correct option. **1**

a) $\mu_s = \mu_k = \mu_r$
b) $\mu_r < \mu_k < \mu_s$
c) $\mu_s < \mu_k < \mu_r$
d) $\mu_k < \mu_r < \mu_s$

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) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. (B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. (C) Assertion is true but Reason is false. (D) Both Assertion and Reason are false.

13**. Assertion (A):** The work–energy theorem is valid for a variable force.

Reason (R): The work done by a variable force is equal to the area under the force–displacement graph**.** **1**

14. **Assertion (A):** A large spherical drop when breaks into smaller spherical drops, the temperature of these drops decreases**.**

Reason (R): The surface energy of the smaller spherical drop increases at the cost of internal energy. **1**

15. **Assertion (A):** In an oscillating table fan, the blades rotate about their own fixed axis, while the axis of rotation oscillates about a fixed pivot.

Reason (R): A body can undergo rotation about an axis that is itself changing direction with time. **1**

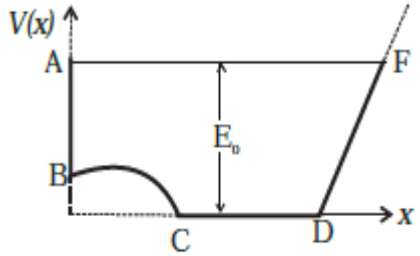
16. **Assertion (A):** The bulk modulus for a perfect rigid body is infinite.

Reason (R): The compressibility of the perfect rigid body is infinite. **1**

SECTION-B

17. If energy E, velocity V and time T are chosen as fundamental quantities, deduce the dimensional formula of surface tension.
2

18. A graph of potential energy V(x) vs. position x is as shown. A particle of energy E_0 is executing motion in it. Draw graph of kinetic energy K(x) versus position x for one complete cycle, AFA. Give reason for your answer. **2**

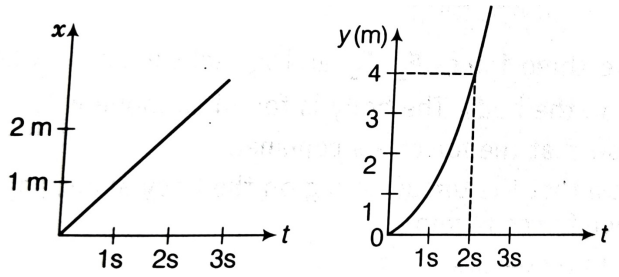


OR

18. Consider the one-dimensional motion of a particle with total mechanical energy E. Four different regions A, B, C, and D are characterized by different relations among the total energy E, potential energy V, and kinetic energy K. For each of the following cases, state whether the particle can be found in that region or not. Give reason for your answer.

Region A: V > E Region B: V < E Region C: K > E Region D: V > K **2**

19. Figure i) and ii) graphically show x-t and y-t variation of a body moving in two dimensions. If the body has a mass of 1 kg, find the magnitude and direction of the force acting on the body. **2**

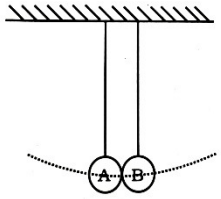


OR

19.A body of mass 1 kg travels according to the relation $x(t) = \alpha t + \beta t^2 + \gamma t^3$, where $\alpha = 3ms^{-1}$, $\beta = 4ms^{-2}$, $\gamma = 5ms^{-3}$

Find the force acting on the body at t = 2s. **2**

20. Two pendulums with identical bobs and lengths are suspended from a common support such that in rest position the two bobs are in contact. One of the bobs is released after being displaced by 30º so that it collides elastically head on with the other bob. **2**



(a) Describe the motion of the two bobs.

(b) Draw a graph showing variation in energy of either pendulum with time for $0 \leq t \leq 2T$, where T is the time period of each pendulum.

21. Explain why- **2**

(a) Two bodies are at different temperatures T_1 and T_2, if brought in thermal contact, then they do not necessarily attain the mean temperature.

(b) Bicycle pump gets heated up, when the piston is pushed down very fast.

SECTION-C

22.(i) In a two-dimensional motion, instantaneous speed is a positive constant.
In this context, state whether the given statement 'Displacements in equal time intervals are equal',
is True or False. Give reason for your answer.

(ii) An object moving with the speed of 6.25 m/s is decelerated at a rate given by-
$\frac{dv}{dt}$ = - 2.5 $\sqrt{v}$, where v is the instantaneous speed.
Calculate the time taken by the object to come to rest. **1+2**

23. Infinite bodies, each of mass 3kg are situated at distances 1m, 2m, 4m, 8m..... respectively on x-axis. What will be the resultant intensity of gravitational field at the origin? **3**

24. A mercury barometer kept inside a stationary elevator reads 76 cm of Hg. The elevator now starts accelerating upward with acceleration a.

(a) How will the reading of the barometer change? Explain with reason.

(b) Derive the relation between atmospheric pressure and the height of the mercury column for an elevator accelerating upward. **3**

OR

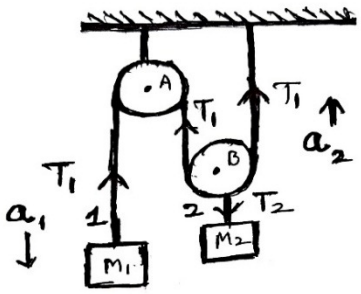
24. A small solid ball bearing is dropped into a tall vertical column of height h containing a viscous liquid.

(a) Sketch the graph showing the variation of the velocity (**v**) of the ball with time (**t**) as it falls through the liquid. Explain shape of the graph.

(b) What will happen if instead of ball bearing, a cricket ball is dropped in same vertical column?

3

25. Consider two blocks of masses m_1 and m_2 connected as shown in the given figure with massless pulleys using inextensible and massless strings 1 and 2. Find the tension produced in the two strings. **3**



26. The work of 146 kJ is performed in order to compress one kilo mole of a gas adiabatically and in this process the temperature of the gas increases by 7°C. Find the nature of the gas (monoatomic/diatomic/mixture of both) by showing necessary calculations.

(Given R=8.3 J mol $^{-1}K^{-1}$) **3**

27. Explain why-

(a) The speed of sound waves in air increases with increase in humidity.

(b) Change in temperature of the medium changes the wavelength of sound waves.

(c) Solids can support both longitudinal and transverse waves but only longitudinal waves can propagate in gases. **3**

28.(i) A gas mixture at thermal equilibrium consists of molecules of type P, Q and R with masses in the order of $m_P > m_Q > m_R$. Arrange the three types of molecules in increasing order of their

a) average kinetic energy.

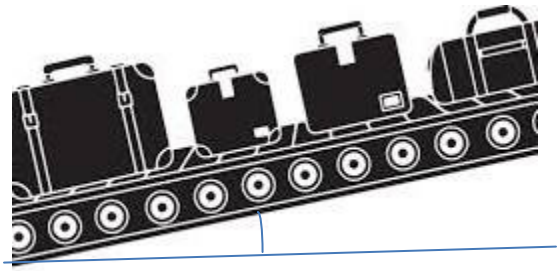
b) r.m.s speed.

(ii) Calculate the number of degrees of freedom of molecules of hydrogen in 1cc of hydrogen gas at NTP. **3**

SECTION-D

29. Conveyor belts are widely used at airports, shopping malls, mining, warehouses etc to transport material from one place to another with minimum human effort. Conveyor belt improve efficiency, reduce effort and ensure continuous movement of goods.

At an airport, trolley bag of mass *m* is placed on a moving rough inclined conveyor belt making an angle θ with the horizontal. The coefficient of friction between the conveyor belt and the trolley bag is μ. The frictional force between the belt and the trolley bag helps it accelerate until it attains the same speed as the belt. If friction is insufficient, the object slips on the belt. **(1x4=4)**



Figure

(I)**.** Which force is primarily responsible for making a trolley bag move along with a conveyor belt?

(A) Gravitational force
(B) Static frictional force
(C) Tension
(D) Normal reaction

(II) If the friction between the conveyor belt and the trolley bag becomes very small, the bag will

(A) move faster than the belt.
(B) remain at rest relative to the belt.
(C) move upward.
(D) slip backward relative to the moving belt.

(III) If a conveyor belt moves with constant speed, then trolley bag placed on it also moves with the same speed without slipping. Choose the correct statement.

(A) No friction acts on the trolley bag.
(B) Kinetic friction acts on the trolley bag.
(C) Static friction acts opposite to motion.
(D) Static friction acts in the direction of motion.

(IV) To transport heavier loads on a conveyor belt without the load slipping, which of the following is the most effective way?

(A) Decrease friction between the belt and the load.
(B) Increase the weight of the belt.
(C) Increase the coefficient of friction between the belt and the load.
(D) Reduce the speed of the belt to zero.

OR

(IV) What minimum force F, applied parallel to the incline in the upward direction, is required to keep the trolley bag at rest or move it upward with uniform speed?

(A) $mg(\sin\theta + \mu\cos\theta)$

(B) $mg(\sin\theta - \mu\cos\theta)$

(C) $mg / (\sin\theta + \mu\cos\theta)$

(D) $(\sin\theta - \mu\cos\theta)/mg$

30. Do you know, how food in restaurants, vaccines and blood samples in laboratories and other temperature-sensitive materials are preserved? Have you seen a deep freezer? A deep freezer, is a specialized appliance designed to store items at extremely low temperatures. Unlike regular refrigerators, deep freezers can maintain temperatures as low as -40°F (-40°C), making them ideal for long-term storage. Most deep freezers come with a thermostat that allows users to set and maintain the desired temperature. Advanced models may also include digital displays and alarms to alert users of temperature fluctuations.

A standard domestic or commercial chest deep freezer measures roughly 28 to 65 inches wide, 27 to 31 inches deep, and 33 to 35 inches tall. Its insulated walls typically range from 60 mm to 80 mm (2.4 to 3.1 inches) in thickness, utilizing high-density Polyurethane Foam (PUF) to minimize conductive heat transfer.

Based on the above information answer the following questions:

(I) Write one characteristic quality that PUF has in order to minimize heat transfer? **1**

(II) If the thickness of the insulating foam wall of a deep freezer is doubled, what happens to the rate of heat leakage into the freezer, assuming inside and outside temperatures remain constant? **1**

(III) Let the walls of deep freezer have an area of 2.5 square meters and a thickness of 60mm separates it from the surrounding. If the thermal conductivity of the PUF is 0.022 W/mK, calculate the rate of heat transfer by the material used in walls of deep freezer? (Given temperature of inside is -15^0C and outside is 35^0C)? **2**

OR

(III) A deep freezer wall of area A is made of two layers of thickness d_1 and d_2 and thermal conductivities K_1 and K_2. Find the effective thermal conductivity K_{eff} for a composite slab of total thickness $d_1 + d_2$? (Given that thermal resistance is R=d / KA) 2

SECTION-E

31.(i) A cricket fielder can throw the cricket ball with a speed v_0. If he throws the ball while running with speed u at an angle θ to the horizontal, find the
(a) effective angle to the horizontal at which the ball is projected in air as seen by an observer.
(b) time of flight of the ball

(ii) A gun can fire shells with maximum speed V_0 and the maximum horizontal range that can be achieved as $R = \frac{{V_0}^2}{g}$. If a target father away by distance Δx (beyond R) has to be hit with the same gun, show that it could be achieved by raising the gun to a height at least $h = \Delta x \left[1 + \frac{\Delta x}{R}\right]$ **2+3**

OR

31.(i) The speed of a particle moving along a circular path is increasing at a constant rate. Sketch the graph showing the variation of
(a) tangential acceleration with time.
(b) centripetal force with time.
(ii) A particle with velocity $u = -2\,\hat{\imath} + 4\,\hat{\jmath}$ m/s at t = 0 undergoes a constant acceleration of magnitude $3 m/s^2$ at an angle 120° from the positive direction of the x-axis. Find the magnitude and the direction (with respect to + x axis) of the particle velocity at t = 2 s. **2+ 3**

32. Two discs of moments of inertia I_1 and I_2 about their respective axes (normal to the disc and passing through the centre), and rotating with angular speeds ω_1 and ω_2, are brought into contact face to face with their axes of rotation coincident.

(i) Explain why the total angular momentum of the two-disc system remains conserved, when the rotating discs are brought into contact.

(ii) Derive an expression for the common angular speed attained by the two discs after they start rotating together with the same angular velocity.

(iii) Sketch the variation of the total rotational kinetic energy (K) of the system with time (t) from the instant the discs are brought into contact till they attain a common angular speed. Indicate the region where energy is dissipated. **1+2+2**

OR

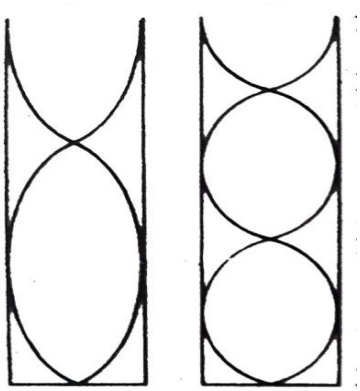
32. (i) Draw the vector diagram showing the relation of torque 'τ' with position vector 'r', applied force 'f 'and the angle 'θ' between the position vector and the applied force.

(ii) Resolve the applied force into its radial and tangential (transverse) components. Hence, prove that only the tangential component contributes to torque, while the radial component produces no torque.

(iii) A door is hinged along a vertical axis and can rotate freely about it. The weight of the door acts vertically downward through its centre of mass. Will the weight of the door produce any torque about the hinge axis? Justify your answer using the direction of the torque vector and the concept of the axis of rotation. **1+2+2**

33.(i) All harmonics are overtones but all over tones are not harmonic. Why?

(ii) Figures A and B show 2 vibrating modes of an air column having length 'L'. Find the ratio of frequencies of the two modes.



(A) **(B)**

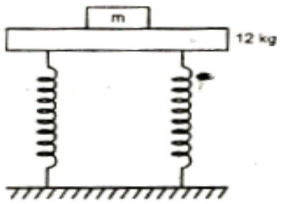
(iii) A stone is dropped into a well of depth 'h' and its splash is heard at the top of the well after an interval of 1.45 s. Calculate the depth of the well. Using the velocity of sound in air at room temperature equal to 332 ms^{-1}. **1+2+2**

OR

33. (i) The velocity (V) of a particle executing SHM varies with displacement (x) as given by the relation $4\ V^2 = 50 - x^2$

Find the value of displacement (x), when time period of oscillation is $\frac{x}{7}$ s (where x is in metre).

(ii)A tray of mass m =12 kg is supported by two identical springs of spring constant k as shown in the given figure. When the tray is pressed down slightly and released, it executes SHM with a time period of 1.5 s.



(a)Calculate the force constant of each spring.

(b) When another block of mass M (M > m) is placed on the tray, the period of SHM changes to 3 s. Find the mass M of the block. **2 + 3**