Delhi Public School, Howrah

PERIODIC TEST II (2025-2026)

Class-XI

Care must be taken not to write anything on the question paper. All the questions must be attempted in the correct sequence.

SUBJECT: PHYSICS (CODE- 042)

Time:-3 Hours **F.M.-70**

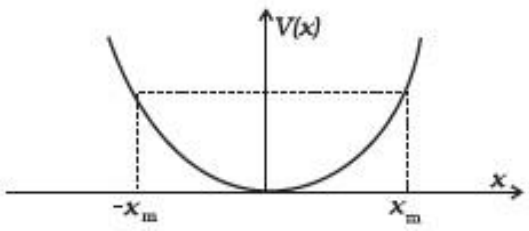
General Instructions:

(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.
(7) You may use the following values of physical constants where ever necessary
i. $c = 3 \times 10^8$ m/s
ii. $m_e = 9.1$ x10-31 kg
iii. $e = 1.6 \times 10^{-19}$ C
iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}
v. $h = 6.63 \times 10^{-34}$ Js
vi. $\varepsilon_0 = 8.854 \times 10^{-12}\ C^2N^{-1}m^{-2}$
vii. Avogadro's number = 6.023 X 10^{23} per gram mole

SECTION – A

16 × 1 = 16

1. The mean length of an object is 5 cm. Which of the following measurements is most accurate?
   (A) 4.9 cm (B) 4.805 cm (C) 5.25 cm (D) 5.4 cm
2. A mass of 5 kg is moving along a circular path of radius 1 m. If the mass moves with 300 revolutions per minute, its kinetic energy would be
   (A) 250 π^2 (B) 100 π^2 (C)5 π^2 (D) 0
3. The potential energy function for a particle executing linear SHM is given by V(x) = $\frac{1}{2}kx^2$. where k is the force constant of the oscillator. The graph of V(x) versus x is shown in the figure. If a particle of total energy E turns back when it reaches $x = \pm x_m$, then which of the following is correct?



(A) V = 0, K = E (B) V = E, K = 0 (C) V < E, K = 0 (D) V = 0, K < E

4. A car, moving with a speed of 50 km/hr, can be stopped by brakes after at least 6m. If the same car is moving at a speed of 100 km/hr, then the minimum stopping distance of the car will be
   (A) 12m (B) 18m (C) 24m (D) 6m
5. The angle between $\vec{A} = \hat{\imath} + \hat{\jmath}$ *and* $\vec{B} = \hat{\imath} - \hat{\jmath}$ is
   (A) 45^0 (B) 90^0 (C) -45^0 (D) 180^0
6. A particle of mass 0.3 kg subject to a force F = –kx with k = 15 N/m. What will be its initial acceleration if it is released from a point 20cm away from the origin?
   (A) 15 m/s^2 (B) 3 m/s^2 (C) 10 m/s^2 (D) 5 m/s^2
7. 25 N force is required to raise 75 kg mass from a pulley. If rope is pulled 12 m, then the load is lifted to 3m. Find the efficiency of pulley system.
   (A) 25% (B) 33.3% (C) 75% (D) 90%
8. A light string passing over a smooth light pulley connects two blocks of masses m, and m_2 (vertically). If the acceleration of the system is (g/8), then the ratio of masses is:
   (A) 8:1 (B) 9:7 (C) 4:3 (D) 5:3
9. For which of the following does the centre of mass lie outside the body?
   (A) A pen (B) A shotput (C) A dice (D) A bangle
10. A particle moving with a uniform acceleration travels 24 metre and 64 metre in first two consecutive intervals of 4 seconds each. Its initial velocity is
    (A) 1 m/s (B) 2 m/s (C) 5 m/s (D) 10 m/s
11. A mass m is moving with a constant velocity along a line parallel to the x-axis away from the origin. Its angular momentum w.r.t. the origin is:
    (A) zero (B) constant (C) goes on increasing (D) goes on decreasing
12. A dancer on ice spins faster when she folds her arms. This is due to:
    (A) Increase in energy and increase in angular momentum
    (B) Decrease in friction at the skates
    (C) Constant angular momentum and increase in kinetic energy
    (D) Increase in energy and decrease in angular momentum.

For question numbers 13 to 16, two statements are given- one labeled as Assertion (A) and the other labeled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

A. Both A and R are true and R is the correct explanation of A
B. Both A and R are true but R is NOT the correct explanation of A
C. A is true but R is false
Both A and R are false

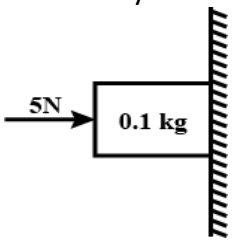
13. **Assertion (A)**: Linear momentum of an isolated system remains conserved in both elastic and inelastic collision.
    Reason (R): There is no loss of kinetic energy during collision between two bodies of an isolated system in any kind of collision.
14. **Assertion (A):** When projectiles have same velocity of projection, the maximum heights at angle θ and (90^0 - θ) are in the ratio $\tan^2\theta$: 1.
    Reason (R): The range is same for angles of projection θ and (90^0 - θ) for same velocity of projection.
15. **Assertion(A):** Work done in raising a box on to a platform depends on how fast it is raised.
    Reason(R): Work done against gravity depends on the nature of path taken.
16. **Assertion(A):** The centre of mass can be inside or outside the rigid body at which whole mass is assumed to be concentrated.
    Reason(R): Centre of mass of the body depends on the distribution of mass.

SECTION – B (5×2=10)

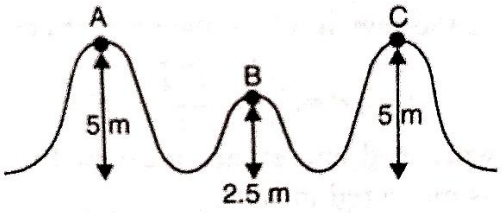
17. (i) The value of acceleration due to gravity is 980 cm/s^2. What will be its value if the unit of length is kilometre and that of time is minute?
    (ii) If 3.8 x 10^{-6} is added to 42 x 10^{-6}, then find the result of addition due regard to significant figures.
18. If $\vec{A}$ and $\vec{B}$ represent two adjacent sides of a parallelogram, then show that its area is $|\vec{A} \times \vec{B}|$.
19. Water drops fall freely from a tap at a height of 4.9 m. If time interval between successive drops is equal and the 4th drop is released when the first lands on the ground, find the separation between the second and third drops.
20. (A) A molecule in a gas container hits a horizontal wall with speed 200 m/s. During hitting it makes an angle 30° with the normal, and rebounds with the same speed.
    (i) Is momentum conserved in the collision? Give reason in support of your answer.
    (ii) Is the collision elastic or inelastic? Justify your answer with appropriate calculation (if necessary).

OR

20. (B) A body of mass 0.1 kg is pressed against a wall as shown in the figure below. Find the co-efficient of static friction for which the body is in equilibrium.



21. (A) A mass 5 kg starts sliding from A on a smooth surface as shown in the figure. Find the velocity of the mass at B and C?

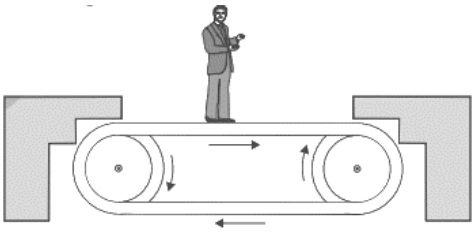


OR

21. (B)A pump on the ground floor of a building can pump up water to fill a tank of volume 30m³ in 15min. If tank is 40m above the ground, and the efficiency of the pump is 30%. How much electric power is consumed by the pump?

SECTION – C (7×3=21)

22. Figure shows a man standing stationary with respect to a horizontal conveyor belt that is accelerating with 1 m s $^{-2}$. 1+2



    i. What is the net force on the man?
    ii. If the coefficient of static friction between the man's shoes and the belt is 0.2, up to what acceleration of the belt can the man continue to be stationary relative to the belt? (Mass of the man = 65 kg.)

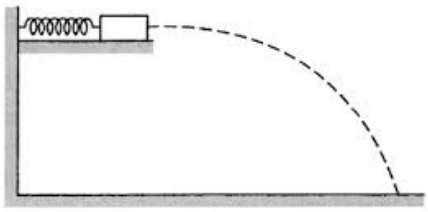
23. i. Derive the kinematic equation: $s = ut + \frac{1}{2}at^2$. (Derive graphically), where, 't' is the time taken to move, 'u' is the initial velocity, 'a' is the acceleration, 's' is the displacement covered by the body. Assume that object is moving under uniform acceleration. 2+1

i. A body has zero velocity but still has non-zero acceleration. Explain it with proper example.

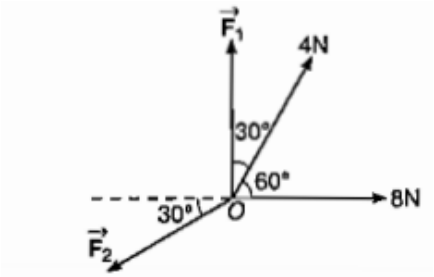
24. The frequency of vibration (f) of a string depends on the length (L) between the nodes, the tension (F) in the string and its mass per unit length (m). Show dimensionally that its frequency can be written as $f \propto \frac{1}{L}\sqrt{\frac{T}{m}}$. 3

25. i. Find the value of coefficient of restitution for a collision when it is elastic in nature. Give proper reason of it. 1.5+1.5

ii. A small block of mass is pressed against a horizontal spring fixed at one end to compress the spring through 5.0 cm. When released the block moves horizontally till it leaves the spring. Where will it hit the ground at a distance 2m below the slab? [k= 100 N/m, m = 100 g]



26. i. An object is in equilibrium under four concurrent forces in the directions shown in figure. Find the magnitude of F_1 and F_2. 2+1



ii. Can three non-coplanar vectors give zero resultant? Justify.

27. A body is projected with a speed of 30 ms^{-1} at an angle of 30^0 with the vertical. Find the 1+1+1

i. maximum height,
ii. time of flight,
iii. the horizontal range of the motion. [Take g = 10 m/s^2]

28. i. Show that the rate of change of angular momentum of a particle is equal to the torque acting on it. 2+1

ii. State the law of conservation of angular momentum. Write its mathematical expression.

SECTION – D

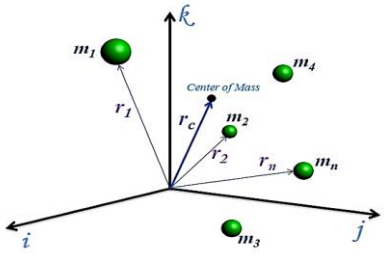
29. **Read the following passage and answer the questions based on that.** **(4 ×1=4)**

The centre of mass of a body is a point at which the entire mass of the body is supposed to be concentrated. The Position vector $\vec{r}$ of COM of the system of two particles of masses m_1 and m_2 with position vector $\overrightarrow{r_1}$ and $\overrightarrow{r_2}$ is given by

$$\vec{r} = \frac{m_1\overrightarrow{r_1} + m_2\overrightarrow{r_2}}{m_1 + m_2}$$

for an isolated system, where no external force is acting $\overrightarrow{V_{CM}}$ = constant.

Under no circumstance, the velocity of centre of mass of an isolated system can undergo a change.



Center of Mass of A System of Particles

I. An electron and a proton move towards each other with velocities v_1 and v_2 respectively, then the velocity of their centre of mass is 1

(A) $2v_1$ (B) 0 (C) v_2 (D) $v_1 + v_2$

II. Two bodies of masses 1 kg and 2 kg are located at (1, 2) and (-1, 3) respectively. The co-ordinate of the centre of mass is 1

(A) (1/3, 8/3) (B) (- 1/3, 8/3) (C) (1/3, - 8/3) (D) (- 1/3, - 8/3)

III. Two blocks of masses 5 kg and 2 kg are placed on a frictionless surface and connected by a spring. An external kick glues 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 is 1

(A) 10 m/s (B) 70 m/s (C) 28 m/s (D) 20 m/s

IV. "The centre of mass of a body can lie where there is absolutely no mass". The given statement is 1

(A) Valid for some cases (B) Invalid for all the cases

(C) Valid for all the cases (D) None of the above

30. **Read the following passage and answer the questions based on that.**

Three blocks of masses $M_1 = 3m$, $M_2 = 2m$ and $M_3 = m$ connected by two strings are placed on a horizontal frictionless surface as shown. A horizontal force F is applied to mass M_3 to move the whole system.

I. Calculate the tensions in the strings connected between M_2 and M_3. Show necessary calculations. 2

II. Find acceleration of the whole system on the frictionless surface due to the force applied on mass M_3. 1

III. Do action and reaction forces balance each other in this case? Justify it. 1

SECTION - E

31. (A) i. Show that the only acceleration acting on a body executing uniform circular motion is towards its center along the radius. Hence find its expression. 3+2

ii. A body of mass 1kg initially at rest explodes and breaks into three fragments of masses in the ratio 1:1:3. The two pieces of equal mass fly off perpendicular to each other with a speed of 30 m/s each. What is the velocity of the heavier fragment?

31. (B) **OR** 2+3

i. Find the expression of magnitude of the resultant of two vectors $\vec{A}$ and $\vec{B}$ with the help of parallelogram law. Given the angle between two vectors is θ.

ii. A man can swim with a speed of 4 km/hr in still water. How long does he take to cross a river 1km wide if the river flow steadily at 3 km/hr and he makes his strokes normal to the river current? How far down the river does he go when he reaches the other bank?

32. (A) A man of mass 70 kg stands on a weighing scale in a lift which is moving (i) upwards with a uniform speed of 10 m/s. (ii) downwards with a uniform acceleration of 5 m/s^2. (iii) Upwards with a uniform acceleration of 5 m/s^2. 1+3+1

i. In which case the man would feel his weight more and why?

ii. Find the readings on the scale in each case?

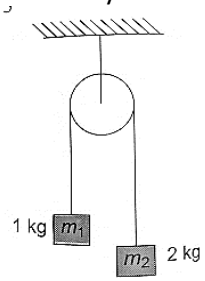
iii. What would be the reading if the lift mechanism failed and it starts falling freely under gravity?

32. **OR** 2+1+2

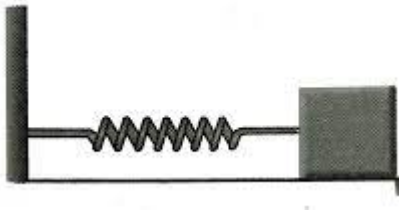
(B) i. Find the maximum speed 'v' with which a car can turn safely on a horizontal circular road of radius '**R**'. [Take the coefficient of static friction between tyres of car and road as μ]

ii. Why banking is made on a level circular road?

iii. Find acceleration of the system shown in the figure given below.



33. (A) i. Derive the expression of potential energy of a spring of constant **K** when stretched to a distance of '**X**' from its mean position. 2+2+1



i.

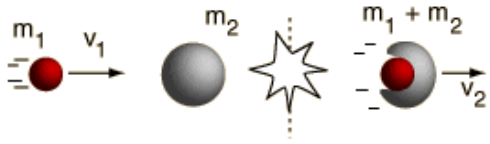
ii. When a spring is stretched by 2 cm, energy stored in it is 100 erg. When the same spring is stretched by 10 cm, then find the energy stored in it. Calculate the spring constant of the spring.

iii. When a block is attached to the end of such spring and allowed to oscillate, show graphically its total mechanical energy remains conserved during oscillation.

33. **OR** 2+2+1

(B) i. What do you mean by conservative force? Give proper example of it.

ii. An object of mass m_1 initially moving with speed v_1 collides with another stationary object of mass m_2 and after collision they move together with a common speed v_2 as shown in figure below. Show that kinetic energy of this system is lost in this collision.



a.

iii. iii. Is the principle of conservation of energy violated in case of an inelastic collision? Justify it.