

Lord, Help me be honest, calm and upright so that I write this exam with you by my side.

MID TERM EXAMINATION (2025-26)

CLASS XI

SUBJECT: PHYSICS

Time: 3 hrs

M.M.: 70

General Instructions:

- (i) This question paper has 33 questions and 8 printed pages in all. All the questions are compulsory.
- (ii) This Question Paper has five Sections: Section- A, Section -B, Section -C, Section- D and Section -E.
- (iii) Section -A contains sixteen questions, twelve MCQ and four Assertion - Reasoning based of one 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 questions of five marks each.
- (iv) 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 the three questions in Section- E. You have to attempt only one of the given choices in such questions.
- (v) Use of calculator is not permitted.

SECTION A

- 1 If velocity v , acceleration A and force F are chosen as fundamental quantities, then the dimensional formula of angular momentum in terms of v, A, F would be; 1
(a) $FA^{-1}v$ (c) Fv^2A^{-1}
(b) Fv^3A^{-2} (d) $F^2v^2A^{-1}$
- 2 The sum of 6.2g, 4.33g and 17.456g expressed in appropriate number of significant figures is ; 1
(a) 28.0g (c) 27.98g
(b) 27.9g (d) 27.986g
- 3 The displacement of a car is given as - 240 m, here negative sign indicates 1
(a) direction of displacement (c) position of car at that point
(b) negative path length (d) no significance of negative sign

4 A body moves in a straight line along Y-axis. Its distance y (in metre) from the origin is given by $y = 8t - 3t^2$. The average speed in the time interval from $t = 0$ second to $t = 1$ second is

- (a) -4 ms^{-1} (b) zero (c) 5 ms^{-1} (d) 6 ms^{-1}

5 If the displacement of an object is proportional to square of time, then the object is moving with

- (a) constant acceleration (c) constant velocity
(b) uniform motion (d) non uniform motion

6 A car covers first one third distance of its total journey with a speed of 36 km/h , second one third distance with speed of 54 km/h and the last one third distance with a speed of 72 km/h . The average speed of the car during the whole journey is ;

- (a) 45 km/h (c) 30 km/h
(b) 50 km/h (d) 60 km/h

7 If $|\vec{A}| = 2$, $|\vec{B}| = 4$, Then match the relations in column I with with angle θ between \vec{A} and \vec{B} , in column II

Column -I

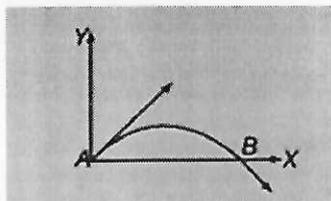
Column -II

- | | |
|---------------------------------|---------------------------------|
| 1) $\vec{A} \cdot \vec{B} = 0$ | (i) $\theta = 0^\circ$ |
| 2) $\vec{A} \cdot \vec{B} = +8$ | (ii) $\theta = 90^\circ$ |
| 3) $\vec{A} \cdot \vec{B} = 4$ | (iii) $\theta = 180^\circ$ |
| 4) $\vec{A} \cdot \vec{B} = -8$ | (iv) $\theta = 60^\circ$ |
| (a) 1 (i) 2 (ii) 3 (iii) 4 (iv) | (b) 1 (ii) 2 (i) 3 (iv) 4 (iii) |
| (c) 1 (iv) 2 (iii) 3 (ii) 4 (i) | (d) 1 (iv) 2 (i) 3 (ii) 4 (iii) |

8 The resultant of two vectors \vec{P} and \vec{Q} is perpendicular to \vec{P} and its magnitude is half that of \vec{Q} . The angle between \vec{P} and \vec{Q} is ;

- (a) 30° (c) 150°
(b) 60° (d) 120°

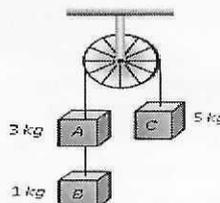
- 9 The velocity of a projectile at the initial point A is $2\hat{i} + 3\hat{j}$ m/s. Its velocity (in m/s) at point B is



- (a) $-2\hat{i} + 3\hat{j}$
 (b) $-2\hat{i} - 3\hat{j}$
 (c) $2\hat{i} - 3\hat{j}$
 (d) $2\hat{i} + 3\hat{j}$

- 10 Three weight A, B and C are connected by string as shown in the figure. The system moves over a frictionless pulley. The tension in the string connecting A and B is (where g is acceleration due to gravity).

- (a) g
 (b) $\frac{g}{9}$
 (c) $\frac{8g}{9}$
 (d) $\frac{10g}{9}$



- 11 A particle of mass 10 kg is moving in straight line, if its displacement x with time t is given by $x=(t^3-2t-10)$ m, then the force acting on it at the end of 4 sec is;

- (a) 300N
 (b) 1200 N
 (c) 24 N
 (d) 240 N

- 12 A car moves at a speed of 20 m/s on a banked road and describes an arc of a circle of radius $40\sqrt{3}$ m. The angle of banking in degrees is ($g = 10$ m/s²)

- (a) ~~250~~ 25°
 (b) ~~600~~ 60°
 (c) ~~300~~ 30°
 (d) ~~450~~ 45°

Questions 13 to 16 consist of two statements each printed as Assertion (A) and Reason (R). While answering these questions you are required to choose any one of the following four responses.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A)

- (b) Both (A) and (R) are true and (R) is not the correct explanation of (A)
- (c) (A) is true but (R) is false
- (d) (A) is false but (R) is true

- 13 Assertion: The number of significant figures in 80200 is 3 1
Reason: All the zeros are not significant.
- 14 Assertion: When range of a projectile is maximum, its angle of projection may be 45° or 135° . 1
Reason: Whether θ is 45° or 135° value of range remains the same, only the sign changes.
- 15 Assertion: If dot product and cross product of \vec{P} and \vec{Q} are zero, it implies that one of the vectors \vec{P} and \vec{Q} must be a null vector. 1
Reason: Null vector is a vector with zero magnitude.
- 16 Assertion: A body may be accelerated even when it is moving uniformly. 1
Reason: When direction of motion of the body is changing, the body must have acceleration.

SECTION -B

- 17 Find the value of 60 J /min on a system that has 100 g , 100 cm and 1 min as the base units . 2
- 18 If $A^{\rightarrow} = 3\hat{i} + 4\hat{j}$ and $B^{\rightarrow} = 7\hat{i} + 24\hat{j}$, find a vector having the same magnitude as B^{\rightarrow} and parallel to A^{\rightarrow} . 2

OR

A unit vector is represented by $a\hat{i} + b\hat{j} + c\hat{k}$. If the values of 'a' and 'b' are 0.6 and 0.8 respectively, find the value of c.

- 19 A balloon is ascending at the rate of 9.8 m/s at a height of 39.2m above the ground when a food packet is dropped from the balloon. After how much time does it reach the ground? Take $g = 9.8 \text{ m/s}^2$. 2
- 20 Show that when the horizontal range is maximum, height attained by the body is one fourth the maximum range in the projectile motion. 2

OR

What is the angle of projection for which the horizontal range is maximum? Prove it

- 21 Define angle of friction and angle of repose. Establish relation between angle of friction and angle of repose. 2

SECTION -C

- 22 The frequency 'f' of vibration of a stretched string depends upon: 3

Its length 'l'

The mass per unit length 'm'

The tension 'T' in the string. *na*

Obtain dimensionally an expression for frequency 'f'.

- 23 Find the equation for the velocity of a particle, if the acceleration of the particle is given by $a(t) = 16t^3 + 48$ and the velocity of the particle at $t=0$ is 30 m/s. Where t is in sec. 3

- 24 A river 400 m wide is flowing at a rate of 2.0 m/s. A boat is sailing at a velocity of 10.0 m/s with respect to the water, in a direction perpendicular to the river. (a) Find the time taken by the boat to reach the opposite bank. (b) How far from the point directly opposite to the starting point does the boat reach the opposite bank? 3

- 25 (a) Find the dimensions of the quantity q from the expression $T = 2\pi \frac{\sqrt{ml^3}}{\sqrt{3Yq}}$ where T is the time period of the bar of length l, mass m and Young's modulus Y. *c.T* 3

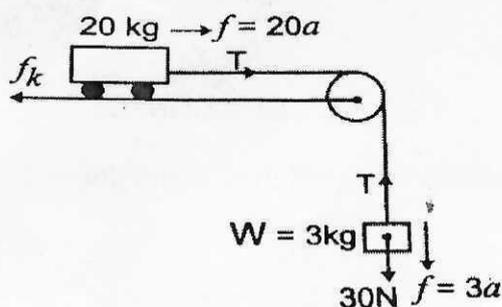
(b) The dimensions $M L^{-1} T^{-1}$ is related to which physical quantity? *co ✓*

- 26 A fighter plane is flying horizontally at an altitude of 1.5 km with a speed of 720 km/h, passes directly overhead an anti-aircraft gun. At what angle from the vertical should the gun be fired for the shell muzzle speed 600 m/s to hit the plane? (At what maximum altitude should the pilot fly the plane to avoid being hit?) Take $g = 10 \text{ m/s}^2$. 3

OR

The sum of the magnitudes of two forces acting at a point is 18N and the magnitude of their resultant is 12 N. If the resultant makes an angle of 90° with the force of smaller magnitude, what are the magnitudes of the two forces?

- 27 What is the acceleration of the block and trolley system if the coefficient of friction between the trolley and the surface is 0.04? What is the tension in the string
(Take $g=10 \text{ m/s}^2$). Neglect the mass of the string.



- 28 Define centripetal acceleration. Derive an expression for the centripetal acceleration of a particle moving with uniform speed 'v' along a circular path of radius 'r'. Give the direction of this acceleration

SECTION - D

- 29 According to Newton's second law of motion, $F = ma$, where F is force required to produce an acceleration a in a body of mass m. if $a = 0$, then $F = 0$ i. e. no external force is required to move a body uniformly along a straight line. If a force act on a body for t seconds, the effect of force is given by impulse = $F \times t =$ change in linear momentum of body.

With the help of passage given above, answer the following questions

(i) A cricket ball of mass 150 g is moving with a velocity of 12 m/s and is hit by a bat so that the ball is turned back with a velocity of 20 m/s. if duration on contact between the ball and bat is 0.01 s the impulse of force is

- (a) 7.4 Ns (c) 1.2 Ns
(b) 4.8 Ns (d) 4.7 Ns

(ii) The force acting on the object whose linear momentum changes by 20 kg m/s in 10 s is

- (a) 2 N (c) 200 N
(b) 20 (d) 0.2 N

(iii) A bus moving with a velocity of 36 km/h has a weight of $50 \times 10^3 \text{ Kg}$. The force required to stop it in 10s is

- (a) 50N (c) 50×10^3 N
 (b) 100N (d) 50×10^2 N

(iv) An impulsive force of 100 N acts on an object for 1 s. The change in its linear momentum is

- (a) 10 Ns (c) 1000 Ns
 (b) 100 Ns (d) 1 Ns

30 The method of dimensions is used to check the correctness of physical equations, convert units, and establish relationships between physical quantities. Every physical quantity can be expressed in terms of fundamental quantities (Mass [M], Length [L], Time [T]). The dimensional formula shows how a physical quantity depends on these fundamental quantities. By comparing the dimensions on both sides of an equation, we can verify its correctness without performing actual experiments

- (i) The period of a simple pendulum is given by $T = 2\pi\sqrt{l/g}$ where l is length of the pendulum and g is acceleration due to gravity. Show that this equation is dimensionally correct. 2
 (ii) The dimensional formula of pressure and energy. 1
 (iii) Write the dimensions of a and b in the formula $v = a + bt$ where v is the velocity and t is the time. 1

SECTION -E

31. (a) State Parallelogram law of vector addition. Prove that resultant of two vectors A and B is given by $=\sqrt{A^2 + 2AB\cos\theta + B^2}$ where θ is the angle between the two vectors. 5
 (b) If $\vec{a} = 5\hat{i} - \hat{j} - 3\hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} - 5\hat{k}$, then show that the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are perpendicular.

OR

- (a) Show that path followed by a projectile is parabolic for a projectile fired at an angle θ with the horizontal. Calculate its time of flight
 (b) A projectile can have same range R for two angles of projections. If t_1 and t_2 be the time of flights in the two cases, prove that, $t_1 t_2 = 2R/g$ where g is acceleration due to gravity

32. (a) Prove that the distance travelled by an object in n th second is given by 5
 $S_{nth} = u + (a/2)(2n - 1)$

(b) A body describes 10m in the third second and 12m in the fifth second with uniform acceleration. Find the distance covered by it in the next 3 seconds

OR

(a) Derive the second equation of motion $S = ut + (1/2)at^2$ where symbols have the usual meaning.

(b) A body starting from rest accelerates uniformly along a straight line at the rate of 10 m/s^2 for 5 sec. It moves for 2 s with uniform velocity of 5 m/s . Then it retards uniformly and comes to rest in 3 sec.

(i) Draw velocity -Time graph of the body

(ii) Calculate total distance travelled by the body.

33. (a) What is meant by banking of roads? Obtain an expression for the maximum speed 5 with which a vehicle can safely negotiate a curved road banked at an angle θ . The coefficient of friction between the wheels and the road is μ .

(b) A motorcyclist at a speed of 5 m/s is describing a circle of radius 25 m . Find his inclination with the vertical. What is the value of the coefficient of friction between the road and the tyres? Take $g = 10 \text{ m/s}^2$.

OR

(a) State and prove the law of conservation of momentum.

(b) An explosion blows a rock into three pieces. Two pieces whose masses are 200 kg and 100 kg go off at right angle to each other with velocity of 8 m/s and 12 m/s respectively. If third piece flies off with a velocity of 25 m/s , calculate the mass of this third piece.

$v^2 - u^2 = 2as$
 $S = ut + \frac{1}{2}at^2$

$S = \frac{D}{K}$

$ML^{-1}T^{-2}$

S =