



2023-24

HALF YEARLY EXAM

**NCERT BASED
SYLLABUS
DOWNLOAD PDF**

**FOR
CBSE BOARD
AND
STATE BOARDS**



Half Yearly Exam 2023-24

Question Paper

Class - XI
Time - 3 Hours

Subject - Physics
Maximum Marks - 70

General Instruction:

- (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. Which of the following represents the correct dimensions of the coefficient of viscosity?
(a) $[ML^{-1}T^{-2}]$ (b) $[ML^{-2}T^{-2}]$ (c) $[ML^{-1}T^{-1}]$ (d) $[MLT^{-2}]$
2. A person is sitting in a lift accelerating upwards. The measured weight of the person will be
(a) Less than actual weight (b) More than actual weight
(c) Equal to actual weight (d) zero
3. A particle is moving in a circle with uniform speed v . In moving from a point to its diametrically opposite point,
(a) The magnitude of change in momentum is mv
(b) The magnitude of change in momentum is $2mv$
(c) The change in kinetic energy is $(\frac{1}{2})mv^2$
(d) The change in kinetic energy is mv^2
4. A ball is released from the top of a tower of height h metre. It takes T second to reach the ground. What is the position of the ball in $T/3$ second?
(a) $h/9$ metre from the ground (b) $7h/9$ metre from the ground
(c) $8h/9$ metre from the ground (d) None of these
5. Identify the pair whose dimensions are equal.
(a) Torque and work (b) Stress and energy
(c) Force and stress (d) Force and work



6. The x and y co-ordinates of a particle at any time t are $x = 5t - 2t^2$ and $y = 10t$ respectively, where x and y are in metre and t in second. The acceleration of the particle at $t = 2s$ is
 (a) zero (b) 5 m/s^2 (c) -4 m/s^2 (d) -8 m/s^2
7. When two vectors $\vec{A}$ and $\vec{B}$ of magnitudes "a" and "b" are added ; the magnitude of the resultant vector is:
 (a) equal to (a+b) always (b) equal to (a-b) always
 (c) not more than $\sqrt{a^2 + b^2}$ (d) Not greater than (a+b)
8. An arrow is shot obliquely into air. Its range is **200 m** and its time of flight is **5 s**. If $g = 10 \text{ m/s}^2$, then the horizontal component of velocity of the arrow is
 (a) 12.5 ms^{-1} (b) 25 ms^{-1} (c) 31.25 ms^{-1} (d) 40 ms^{-1}
9. A force has magnitude **20N**. If one of its rectangular components is **12N**, the other rectangular component must be:
 (a) 8 N (b) 14 N (c) 16 N (d) 32 N
10. The number of particles crossing a unit area perpendicular to X-axis in unit time is given by

$$n = -D \frac{n_2 - n_1}{x_2 - x_1}$$
 where n_1 and n_2 are the number of particles per unit volume for the values of x meant to be x_1 and x_2 . Then the dimensions of the diffusion constant D will be
 (a) $[M^0 L^2 T^{-1}]$ (b) $[ML^2 T^{-1}]$ (c) $[MLT^{-1}]$ (d) None of these
11. A car moves from X to Y with a uniform speed v_1 and returns to X from Y with a uniform speed v_2 . The average speed for this round trip is
 (a) $\frac{2v_1 v_2}{v_1 + v_2}$ (b) $\sqrt{v_1 v_2}$ (c) $\frac{v_1 v_2}{v_1 + v_2}$ (d) $\frac{v_1 + v_2}{2}$
12. In case of projectile motion, the velocity
 (a) is perpendicular to the acceleration at one instant only.
 (b) is never perpendicular to acceleration.
 (c) is always perpendicular to acceleration.
 (d) is always at an angle less than 90° with the acceleration.

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 the 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 Assertion and Reason both are false.
13. **Assertion (A):** A body is momentarily at rest, at the instant, it reverses the direction of motion.
Reason (R): A body cannot have acceleration, if its velocity is zero at a given instant of time.
14. **Assertion (A):** When the time of flight of a projectile is halved, then the maximum height attained by the projectile becomes one fourth.
Reason (R): If H is the maximum height of a projectile and T is the time of flight, then $H \propto T^2$.
15. **Assertion (A):** The slope of momentum - time graph gives acceleration.
Reason (R): Acceleration is given by the rate of change of linear momentum.
16. **Assertion (A):** We cannot divide a vector quantity by another vector quantity.
Reason (R): We can divide a vector quantity by a scalar quantity.



SECTION-B

17. Check the dimensional correctness of the following equation:

$$T = K \sqrt{\frac{\rho \cdot r^3}{S}}$$

where ρ is the density, r is the radius and S is the surface tension and K is a dimensionless constant and T is the time period of oscillation.

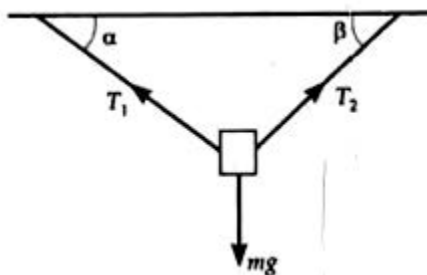
18. Find the angle of projection for which the horizontal range and the maximum height attained by a projectile are equal.
19. Two vectors $\vec{A} = 5\hat{i} + 7\hat{j} - 3\hat{k}$ and $\vec{B} = 2\hat{i} + 2\hat{j} - \alpha\hat{k}$ are mutually perpendicular to each other. What is the value of α ?
20. (a) What is meant by significant figures in a measured quantity?
(b) State the number of significant figures in the following: (i) 0.050 m (ii) 2.000 m
21. If velocity (v), acceleration (a) and force (F) are assumed as fundamental quantities in place of mass (M), length (L) and time (T) respectively, obtain the dimensional formula of Young's modulus in terms of v , a and F .

OR

A stone is thrown vertically upwards from the top of a building, with a speed of 14.7 m/s. If it returns to the earth in 8 s, calculate the height of the building.

SECTION-C

22. A body of mass $m = 5$ kg is suspended by two strings making angles $\alpha = 30^\circ$ and $\beta = 45^\circ$ with the horizontal as shown in figure. Find the tensions T_1 and T_2 in the strings.



(Given $g = 10 \text{ m/sec}^2$)

23. Find the dimensions of $a \times b$ in the given equation:

$$P = \frac{a}{bx} - \frac{t^2}{b}$$

where P is the power, x is the distance and t is the time.

24. Police in a jeep is chasing a pickpocket. The police jeep is moving with uniform velocity $\mathbf{v}$. A pickpocket starts a motorcycle when the police jeep is at a distance $\mathbf{d}$ from him. The motorcycle starts moving with uniform acceleration $\mathbf{a}$. Prove that the pickpocket will be caught only if $\mathbf{v} \geq \sqrt{2\mathbf{a}\mathbf{d}}$.
25. A motor car, starting from rest, moves with uniform acceleration and attains a velocity of 8 ms^{-1} in 8 s. It then moves with uniform velocity and is finally brought to rest in 32 m under uniform retardation. The total distance covered by the car is 464 m. Find
(i) the acceleration (ii) the retardation and (iii) the total time taken.
26. The value of universal gravitational constant is $6.6 \times 10^{-11} \text{ Nm}^2 \text{ kg}^{-2}$ in SI units. Find its value in CGS system.

27. State Parallelogram law of vector addition and with the help of relevant diagram, derive expression for the (i) magnitude and (ii) direction of the resultant of two vectors using this law.
28. Derive an expression for the magnitude and direction of centripetal acceleration for a particle moving in a circular path with constant speed.

OR

Determine the area of a parallelogram whose diagonals are given by vectors $3\hat{i} + 2\hat{j} - 7\hat{k}$ and $5\hat{i} + 6\hat{j} - 3\hat{k}$.

SECTION-D

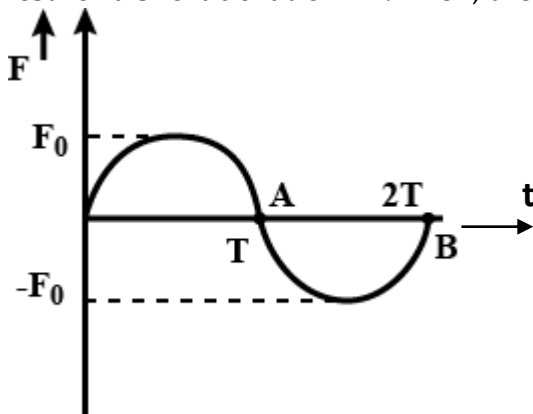
29. Read the following paragraph and answer the questions that follow.

Conservation of Linear Momentum

In an isolated system (i.e., a system having no external force), mutual forces (called internal forces) between pairs of particles in the system cause a change in momentum of the individual particles.

Let a bomb be at rest, then its momentum will be zero. If the bomb explodes into two equal parts, then the parts fly off in exactly opposite directions with the same speed, so that the total momentum is still zero. Here, no external force is applied on the system of particles (bomb).

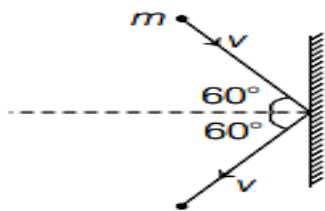
- i) A shell of mass 10 kg is moving with a velocity of 10 ms^{-1} when it blasts and forms two parts of mass 9 kg and 1 kg respectively. If the first mass is stationary, the velocity of the second is
 (a) 1 m/s (b) 10 m/s (c) 100 m/s (d) 1000 m/s
- ii) A bullet of mass 10 g is fired from a gun of mass 1 kg with the recoil velocity of the gun as 5 m/s. The muzzle velocity of bullet will be
 (a) 30 km/min (b) 60 km/min (c) 30 m/s (d) 500 m/s
- iii) Conservation of momentum in a collision between particles can be understood from
 (a) Conservation of energy. (b) Newton's first law only.
 (c) Newton's second law only. (d) Both Newton's second and third law.
- iv) A unidirectional force F varying with time t as shown in the figure acts on a body initially at rest for a short duration $2T$. Then, the velocity acquired by the body is



- (a) $\pi F_0 T / 4m$ (b) $\pi F_0 T / 2m$ (c) $F_0 T / 4m$ (d) zero

OR

A rigid ball of mass m strikes a rigid wall at 60° and gets reflected without loss of speed as shown in the figure. The magnitude of the impulse imparted by the wall on the ball will be



(a) mv

(b) $2mv$

(c) $mv/2$

(d) $mv/3$

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

Uniform circular motion:

Circular motion is an example of motion in two dimensions. To create circular motion in a body it must be given some initial velocity and a force must then act on the body which is always directed at right angles to the instantaneous velocity. Since this force is always at right angles to the displacement therefore no work is done by the force on the particle. Hence, its kinetic energy and thus speed is unaffected. But due to simultaneous action of the force and the velocity the particle follows resultant path, which in this case is a circle.

- i) In uniform circular motion of a particle,
 - (a) velocity is constant but acceleration is variable
 - (b) velocity is variable but acceleration is constant
 - (c) Both speed and acceleration are constants
 - (d) speed is constant but acceleration is variable
- ii) A stone is tied to one end of rope and rotated in a circular motion. If the string suddenly breaks at a point, then the stone travels
 - (a) in perpendicular direction to the radial line at that point
 - (b) in the direction of the centrifugal force
 - (c) towards the centripetal force
 - (d) in tangential direction to the radial line at that point
- iii) Two particles A and B are moving in uniform circular motion in concentric circles of radii r_A and r_B with speed v_A and v_B respectively. Their time period of rotation is the same. The ratio of the angular speed of A to that of B will be
 - (a) $v_A : v_B$
 - (b) $r_A : r_B$
 - (c) $1 : 1$
 - (d) $r_B : r_A$
- iv) If the length of the second's hand of a clock is 10 cm, the speed of its tip (in cms^{-1}) is nearly
 - (a) 2
 - (b) 0.5
 - (c) 1.05
 - (d) 3

OR

A particle is moving uniformly in a circular path of radius r . When it moves through an angular displacement θ , then the magnitude of the corresponding linear displacement will be

- (a) $2r\cos(\theta/2)$
- (b) $2r\cot(\theta/2)$
- (c) $2r\tan(\theta/2)$
- (d) $2r\sin(\theta/2)$

SECTION-E

31. Derive the equation of trajectory, time of flight, maximum height and horizontal range of a projectile when projected at an angle θ with the horizontal from the ground.

OR

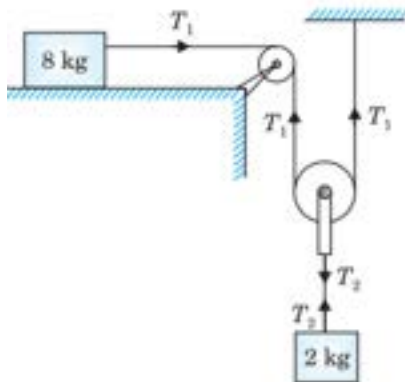
- a) What is a projectile?
- b) The maximum range of a projectile is $2/\sqrt{3}$ times its actual range. What is the angle of projection for the actual range?
- c) Two balls are thrown with the same initial velocity at angles θ and $(90-\theta)$ with the horizontal. Calculate the ratio of the maximum heights attained by them?



32. (a) An object moving with initial velocity ' u ' is accelerated uniformly by an acceleration ' a '. Then derive the expression for its final velocity ' v ' after travelling distance ' s ' in a straight line in terms of u , a and s .
- (b) In a car race, car A takes time ' t ' less than car B and passes the finishing point with a velocity ' v ' more than the velocity with which car B passes the point. Assuming that the cars start from rest and travel with constant accelerations a_1 and a_2 respectively, show that
- $$v = t\sqrt{a_1 a_2}$$

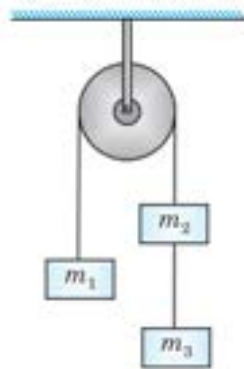
OR

- a) Derive an equation for the distance covered by a uniformly accelerated body in the n^{th} second of its motion.
- b) A body travels half of its total path in the last second of its fall from rest. Calculate the time of its fall.
- c) From the top of a tower, one ball is thrown vertically upwards and another ball vertically downwards with the same speed. Which of the balls will touch the ground with higher velocity and why?
33. (a) Derive an expression for the work done against friction when a body is made to slide up a rough inclined plane.
- (b) In the figure shown below, calculate the acceleration of 8 kg block and 2 kg block.



OR

- (a) State the laws of limiting friction.
- (b) Derive the relation between angle of friction and angle of repose with the help of appropriate diagrams.
- (c) Three bodies m_1 , m_2 and m_3 are hanging on a string over a fixed pulley as shown in figure. If $m_1 : m_2 : m_3 = 1 : 2 : 3$, find the ratio of the tensions in the strings connecting bodies m_1 to m_2 and m_2 to m_3 .



QUESTION PAPERS

GET PREVIOUS YEAR QUESTION PAPERS FOR ALL CLASSES FOR CBSE, ISCSE, ISC AND ALL ALL STATE BOARDS HERE AT [AGLASEM.COM](https://www.aglasem.com)

BOARD WISE

- **Andhra Pradesh Board Question Papers**
- **Assam Board Question Papers**
- **Bihar Board Question Papers**
- **Chhattisgarh Board Question Papers**
- **Goa Board Question Papers**
- **Gujarat Board Question Papers**
- **Haryana Board Question Papers**
- **Himachal Pradesh Board Question Papers**
- **J&K State Board Question Papers**
- **Jharkhand Board Question Papers**
- **Karnataka Board Question Papers**
- **Kerala Board Question Papers**
- **Madhya Pradesh Board Question Papers**
- **Maharashtra State Board Question Papers**
- **Manipur Board Question Papers**
- **Meghalaya Board Question Papers**
- **Mizoram Board Question Papers**
- **Nagaland Board Question Papers**
- **Orissa Board Question Papers**
- **Punjab Board Question Papers**
- **Rajasthan Board Question Papers**
- **Tamil Nadu Board Question Papers**
- **Telangana State Board Question Papers**
- **Tripura Board Question Papers**
- **Uttarakhand Board Question Papers**
- **Uttar Pradesh (UP) Board Question Papers**
- **West Bengal (WB) Board Question Papers**