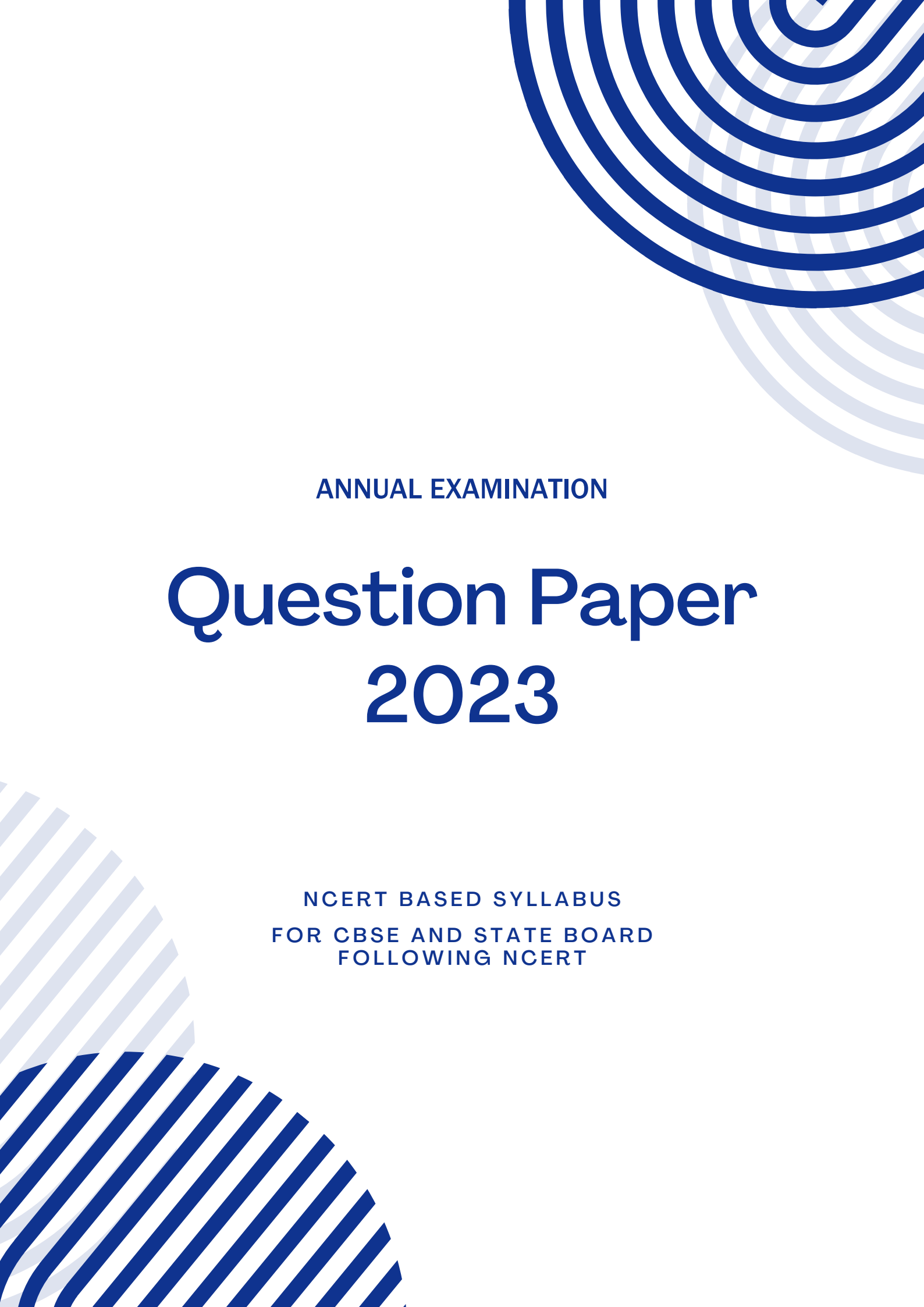




ANNUAL EXAMINATION

Question Paper 2023

NCERT BASED SYLLABUS
FOR CBSE AND STATE BOARD
FOLLOWING NCERT

Class - XI
Time - 3 Hours

Subject - Physics
Maximum Marks- 70

General Instructions:

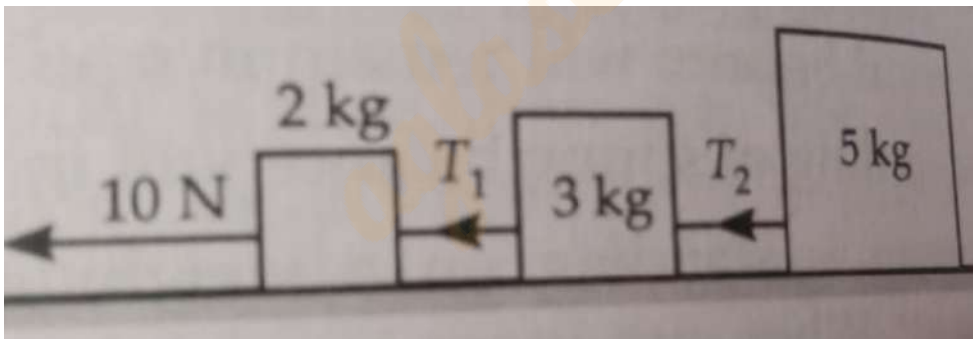
- (1) There are 35 questions in all. All questions are compulsory.
 - (2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
 - (3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three questions of five marks each and Section E contains two case study-based questions of 4 marks each.
 - (4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
 - (5) Use of calculators is not allowed.
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SECTION A

1. Which of the following pair does not have similar dimensions?
 - A. Stress and pressure
 - B. Angle and strain
 - C. Tension and Surface - tension
 - D. Planck's constant and angular momentum
2. A car travels from A to B at a speed of 20 km/hr and returns at a speed of 30 km/hr. The average speed of the car for the whole journey is
 - A. 5 km/hr
 - B. 24 km/hr
 - C. 25 km/hr
 - D. 50 km/hr
3. According to Hooke's law of elasticity, if stress is increased, the ratio of stress to strain
 - A. increases
 - B. decreases
 - C. becomes zero
 - D. remains constant
4. Radius of one arm of a hydraulic lift is four times of the radius of the other arm. What force should be applied on the narrow arm to lift 100 kg?
 - A. 26.5 N
 - B. 62.5 N
 - C. 6.25 N
 - D. 8.3 N

5. First law of thermodynamics corresponds to
 - A. conservation of energy
 - B. heat flow from hotter to colder body
 - C. law of conservation of angular momentum
 - D. Newton's law of cooling
6. Which one of the following is not a state function ?
 - A. temperature
 - B. volume
 - C. pressure
 - D. work
7. What is the maximum acceleration of the particle executing the SHM, $y = 2 \sin \left[\frac{\pi}{2} t + \theta \right]$, where y is in cm?
 - A. $\frac{\pi}{2} \text{ cm/s}^2$
 - B. $\frac{\pi^2}{2} \text{ cm/s}^2$
 - C. $\frac{\pi}{4} \text{ cm/s}^2$
 - D. $\frac{\pi^2}{4} \text{ cm/s}^2$
8. A wave is expressed by the equation $y = 0.5 \sin \pi (0.01 x - 3t)$ where x, y are in metre and t is in second. The speed of propagation will be:
 - A. 150 m/sec
 - B. 300 m/sec
 - C. 350 m/sec
 - D. 250 m/sec
9. Two bodies of masses 2kg and 4 kg are moving with velocities 2m/sec and 10m/sec towards each other due to mutual gravitational attraction. What is the velocity of their centre of mass?
 - A. 5m/sec
 - B. 6m/sec
 - C. 8m/sec
 - D. Zero
10. If a force acts on a body, whose line of action does not pass through its centre of gravity, then the body will experience
 - A. angular acceleration
 - B. linear acceleration
 - C. both (A) and (B)
 - D. none of these
11. Two racing cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same time t. The ratio of the angular speeds of the first to the second car will be
 - A. 1:1
 - B. $r_1 : r_2$
 - C. $m_1 : m_2$
 - D. $m_1 m_2 : r_1 r_2$

12. At an instant t , the co-ordinates of a particle are $x = at^2$, $y = bt^2$ and $z = 0$. The magnitude of velocity of particle at an instant t is
- $t\sqrt{(a^2+b^2)}$
 - $\frac{v}{\sqrt{2}}$
 - $\frac{v}{\sqrt{3}}$
 - $2t\sqrt{a^2+b^2}$
13. Critical velocity of the liquid
- decreases when radius decreases
 - increases when radius increases
 - decreases when density increases
 - increases when density increases
14. An object is moving on a plane surface with uniform velocity 10m/sec in the presence of a force of 10 N . The frictional force between the object and the surface is
- 1 N
 - -10 N
 - 10 N
 - 100 N
15. Three blocks of masses 2kg , 3kg and 5kg are connected to each other with a light string and are then placed on a frictionless surface. The system is pulled by a force $F = 10\text{ N}$, then the tension T_1 is
- 1 N
 - 5 N
 - 8 N
 - 10 N



For Question No. 16 - 18

Two statements are given - one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

- Both A and R are true and R is the correct explanation of A
 - Both A and R are true but R is NOT the correct explanation of A
 - A is true but R is false
 - A is false and R is also false.
16. Assertion (A) :- Frictional forces are conservative forces.
Reason (R) :- Polishing surfaces always reduces friction.

17. Assertion (A) : - K.E is conserved at every instant of elastic collision.
Reason (R) :- No deformation of matter occurs in elastic collision.
18. Assertion (A) : - The size and shape of the rigid body remains unaffected under the effect of external forces.
Reason (R) :- The distance between two particles remains constant in a rigid body.

SECTION B

19. Draw the following graphs (expected nature only) representing motion of an object under free fall. Neglect air resistance.
- Variation of position with respect to time.
 - Variation of velocity with respect to time.
 - Variation of acceleration with respect to time.
 - How can the distance travelled be calculated from the velocity - time graph in a uniform one dimensional motion?
20. Determine a unit vector perpendicular to both $\vec{A} = 2\hat{i} + \hat{j} + \hat{k}$ and $\vec{B} = \hat{i} - \hat{j} + 2\hat{k}$

OR

Find the angle between the vectors $\vec{A} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{B} = -\hat{i} + \hat{j} - 2\hat{k}$

- State the advantages of SI over other system of units.
- Find the value of 60 J per min. on a system that has 100 g, 100 cm and 1 min as the base units.
- State and prove work – energy theorem.
- Show that the average K.E of a gas molecule is directly proportional to the absolute temperature of the gas.
- Derive the relationship of the (a) coefficient of superficial expansion (β) (b) coefficient of cubical expansion (γ) with the coefficient of linear expansion (α)

OR

Define the co-efficient of thermal conductivity and give its S.I. unit and dimensions.

SECTION C

26. Define Elastic collision and derive the expressions for the velocities of two bodies after collision in one dimension.

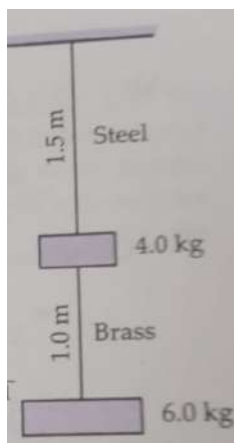
OR

A railway carriage of mass 9000 kg moving with a speed of 36 km/hr collides with a stationary carriage of the same mass. After the collision, the carriages get coupled and move together. What is their common speed after collision? What type of collision is this?

- A ball is released from the top of a tower of height h metres. It takes T second to reach the ground. What is the position of the ball in $\frac{T}{3}$ seconds?
- Derive an expression for the excess pressure inside a liquid drop.

OR

Two wires of diameters 0.25 cm, one made of steel and other made of brass are loaded as shown in figure. The unloaded length of steel wire is 1.5 m and that of brass wire is 1.0 m. Young's modulus of steel is 2.0×10^{11} Pa and that of brass is 0.91×10^{11} Pa. Compute the elongations of steel and brass wire.



29. Show that, for small oscillations, the motion of a simple pendulum is simple harmonic. Derive an expression for its time period. Does it depend on the mass of the bob?
30. The distances of two planets from the sun is 10^{13} m and 10^{12} m respectively. Find the ratio of time periods and speeds of the two planets.

OR

The escape velocity on the earth is 11.2 km/s. What is its value for a planet having double the radius and eight times the mass of the earth?

SECTION D

31. (A) Discuss analytically the formation of a stationary wave in a string, clamped at its ends. Obtain the expression of the fundamental frequency. Show that in case of a string, the frequencies of the first four harmonic are in the ratio 1:2:3:4.
(B) The length of a string tied to two rigid supports is 40 cm. What is the wave length (in cm) of the stationary wave produced on it if the string is plucked at its centre?

OR

- (A) What are beats? Explain the formation of beats analytically. Prove that the beat frequency is equal to the difference in frequencies of the two superposing waves.
- (B) A tuning fork arrangement (pair) produces 4 beats s^{-1} with one fork of frequency 288 Hz. A little wax is placed on the unknown fork and it then produces 2 beats s^{-1} . What is the frequency of the unknown fork?
32. State Bernoulli's theorem. With the help of a suitable diagram, establish Bernoulli's equation for liquid flow. Write the formula and SI unit of velocity head.

OR

- (A) What is capillarity? Derive an expression for the height to which the liquid having an angle of contact θ rises in a capillary tube of radius r .
- (B) What happens when a capillary tube of insufficient length is dipped in a liquid?

33. (A) Derive the expression for the acceleration due to gravity at a depth d from the centre of the earth. What happens to “ g ” at the centre of the earth?
 (B) What is the relation between height h and depth d at which the value of g is the same?

OR

- (A) Define Escape velocity. Obtain an expression for the escape velocity of a body from the surface of the earth.
 (B) Calculate the value of orbital velocity for an artificial satellite of the Earth orbiting at a height equal to the radius of the earth. ($R=6400$ km)

SECTION E

34. Case Study-

Read the following paragraph and answer the questions.

The law of Conservation of linear momentum states that the total linear momentum of an isolated system of interacting particles is conserved. The recoil of a gun on firing, the explosion of a bomb into different fragments due to internal forces the working of rockets and jet planes etc.; can be explained on the basis of momentum conservation.

- A gun fires a bullet of mass 50 g with a velocity of 30m/sec. Because of this, the gun is pushed back with a velocity of 1m/sec. Find the mass of the gun.
- A body of mass M moving with velocity V explodes into two equal parts. If one comes to rest and the other parts moves with a velocity v , what would be the value of v ?
- A body of mass 0.25 kg is projected with a muzzle velocity of 100 m/sec from a tank of mass 100 kg. What is the recoil velocity of the tank?

OR

A bomb of mass 9 kg explodes into 2 pieces of masses 3 kg and 6 kg. The velocity of the mass of 3 kg is 1.6m/sec. Find the K.E of the mass of 6 kg.

35. A body is said to be a projectile if it is projected into space with some initial velocity and then it continues to move in a vertical plane such that its horizontal acceleration is zero and vertical downward acceleration is equal to g . If an object is projected from the origin with initial velocity u making an angle θ with the X – axis then at any instant t , the path of the projectile is parabolic, maximum height attained by the projectile is $H = \frac{u^2 \sin^2 \theta}{2g}$, the time of flight $T = \frac{2u \sin \theta}{g}$ and the horizontal distance travelled by the projectile during its time of flight is called its range $R = \frac{u^2 \sin 2\theta}{g}$

- The velocity of a projectile is 10m/sec. At what angle to the horizontal should it be projected so that it covers maximum horizontal distance?
- Why does the direction of motion of a projectile become horizontal at the highest point of its trajectory?
- A particle is projected with a certain velocity at two different angles of projections with respect to horizontal plane so as to have the same range R on a horizontal plane. If “ t_1 ” and “ t_2 ” are the time taken for the two paths, then find the value of $t_1 t_2$ (product of t_1 and t_2)

OR

A particle is projected at an angle of 45° . Find the relation between the range and the maximum height attained by the particle.