CLASS XI - PHYSICS

✣ General instructions:

1. The Question Paper contains five sections.
2. Section A has 10 questions carry 1 mark each.
3. Section B has 4 questions carry 2 marks each.
4. Section C has 4 questions carry 3 marks each.
5. Section D has 1 question of 5 marks.
6. Section E has 1 question of 5 marks

✣ SECTION A

1. A person is standing in an elevator. In which situation he finds his weight less?
   (a) When the elevator moves upward with constant acceleration
   (b) When the elevator moves downward with constant acceleration
   (c) When the elevator moves upward with uniform velocity
   (d) When the elevator moves downward with uniform velocity

2. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?
   (a) $\sqrt{(gR)}$ (b) $\sqrt{(2gR)}$ (c) $\sqrt{(3gR)}$ (d) $\sqrt{(5gR)}$

3. The force on a particle as the function of displacement x (in x-direction) is given by $F=10+0.5\,x$. The work done corresponding to displacement of particle from $x=0$ to $x=2$ unit is:
   (a) 25 J (b) 29 J (c) 21 J (d) 18 J

4. If the kinetic energy of a body becomes four times of its initial value, then New momentum will:
   (a) become twice its initial value
   (b) become thrice its initial value
   (c) become four times its initial value
   (d) remain constant

5. The angular momentum of a moving body remains constant, if:
   (a) net external force is applied
   (b) net pressure is applied

(c) net external torque is applied
(d) net external torque is not applied

6. Two particles which are initially at rest move towards each other under the action of their internal attraction. If their speeds are V and 2V at any instant, then the speed of center of mass of the system will be
(a) 2V (b) zero (c) 1.5V (d) V

7. A satellite of the earth is revolving in a circular orbit with a uniform speed V. If the gravitational force suddenly disappears, the satellite will:
(a) continue to move with velocity V along the original orbit
(b) move with a velocity V tangentially to the original orbit
(c) fall down with increasing velocity
(d) ultimately come to rest, somewhere on the original orbit

8. Two satellites of masses m_1 and m_2 ($m_1 > m_2$) are going around the earth in orbits of radii r_1 and r_2 ($r_1 > r_2$). Which statement about their velocities is correct?
(a) $v_1 = v_2$ (b) $v_1 < v_2$
(c) $v_1 > v_2$ (d) $v_1 \propto v_2$

ASSERTIONS AND REASONS

Directions. In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as
(a) If both assertion and reason are true and reason is the correct explanation of the assertion,
(b) If both assertion and reason are true but reason is not correct explanation of the assertion,
(c) If assertion is true, but reason is false.
(d) If both assertion and reason are false.

9. Assertion. It is difficult to move a cycle along the road with its brakes on.
Reason. Sliding friction is greater than rolling friction.

10. Assertion. When a body moves along a circular path, no work is done by the centripetal force.

Reason. The centripetal force is used in moving the body along the circular path and hence no work is done.

✣ SECTION-B

11. Obtain an expression for the maximum speed 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.

12. Two springs have force constants k_1 & k_2 ($k_1 > k_2$). On which spring is more work done, if
    (i) they are stretched by the same force and
    (ii) they are stretched by the same amount?

13. From a uniform circular disc of radius R, a circular hole of radius R/2 is cut out. The centre of the hole is at R/2 from the centre of original disc. Locate the centre of gravity of the resulting body.

    OR

    The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds.
    (i) What is its angular acceleration, assuming the acceleration to be uniform?
    (ii) How many revolutions does the wheel make during this time?

14. Define acceleration due to gravity. Derive expression for the variation of 'g' with height from the surface of the earth.

✣ SECTION-C

15. Prove that the angular momentum of a particle is equal to twice the product of its mass and areal velocity. How does it lead to Kepler's second law of planetary motion?

16. (i) What will be the duration of the day, if earth suddenly shrinks to 1/64 of its original volume, mass remaining the same?
    (ii) Why are the doors provided with handles near the outer edges far away from the hinges?

    OR

(i) Energy of 484 J is spent in increasing the speed of a flywheel from 60 rpm to 360 rpm. Find the moment of inertia of the wheel.
(ii) Does the moment of inertia of a rigid body change with the speed of rotation?

17. Derive an expression for the escape velocity of a satellite projected from the surface of the earth.

18. Find the potential energy of a system of four particles, each of mass m, placed at the vertices of a square of side L. Also obtain the potential at the centre of the square.

✣ SECTION-D

19. (i) Define elastic collision. Two bodies of masses m_1 and m2 moving with velocities u_1 and u2 undergo one dimensional elastic collision. Determine their velocities after the collision.
(ii) What percentage of kinetic energy of a moving particle is transferred to a stationary particle, when moving particle strikes with a stationary particle of mass 9 times in mass?

OR

(i) Derive an expression for the potential energy of an elastic stretched spring. Also plot graph between energy and displacement to show conservation of energy in elastic spring.
(ii) A ball at rest is dropped from a height of 12 m. It loses 25% of its kinetic energy in striking the ground, find the height to which it bounces. How do you account for the loss in kinetic energy?

✣ SECTION-E

20. Conservation of Linear Momentum

Consider an isolated system of n interacting particles. The mutual forces between pairs of particles in the system cause changes in momenta of the individual particles. By third lose, the mutual forces between any pair of particles are equal and opposite. By second b/w, the changes in momenta for any pair of particles are Fit and -FAt. Thus the momentum

changes cancel in pairs and total momentum of the system remains constant. That leads to a fundamental principle of physics called the law of conservation of linear momentum. This law states that the total linear momentum of an isolated system of interacting particles is conserved. The recoil of a gun on firing, explosion of a bomb into different fragments due to internal forces, the working of rockets and jet planes, etc; can the explained on basis of momentum conservation

QUESTIONS (Answer the following questions)

(i) A gun fires a bullet of mass 50 g with a velocity of 30 m/s. Because of this, the gun is pushed back with a velocity of 1 m/s. The mass of the gun is:
(a) 5.5 kg (b) 3.5 kg (c) 1.5 kg (d) 0.5 kg

(ii) A body of mass M moving with velocity V explodes into two equal parts. If one comes to rest and the other part moves with velocity v, what would be the value of v?
(a) V (b) V/2 (c) 4V (d) 2 V

(iii) Draw a graph between momentum and mass for constant speed.

OR

Why a cricket player lowers his hands while catching a ball?

(iv) A rubber ball of mass 50g falls from a height of 1m and rebounds to a height of 0.5m. Find the impulse and the average force between the ball and ground if the time for which they are in contact was 0.1s.

* * * * * * * * * * * * * * * *