BRAIN INTERNATIONAL SCHOOL

SUBJECT: PHYSICS **CLASS XI** **JULY, 2024**

CH: 3-MOTION IN A PLANE

1. The equation of projectile is $y = 16x - \frac{5x^2}{4}$. The horizontal range is-

   (a) 16 m (b) 8 m (c) 3.2 m (d) 12.8 m

2. A particle is projected with a velocity of 20 m/s at an angle of 30º to an inclined plane of inclination 30º to the horizontal. The particle hits the inclined plane at an angle 30º, during its journey. The time of flight is –

   (a) $\frac{4}{\sqrt{3}}$ (b) $\frac{2}{\sqrt{3}}$ (c) $\sqrt{3}$ (d) $\frac{\sqrt{3}}{2}$

3. An aeroplane is flying at a height of 1960 m in horizontal direction with a velocity of 360 km/hr. When it is vertically above the point. A on the ground, it drops a bomb. The bomb strikes a point B on the ground, then the time taken by the bomb to reach the ground is-

   (a) $20\sqrt{2}$ sec (b) 20 sec (c) $10\sqrt{2}$ sec (d) 10 sec

4.

5. A Vector$\vec{X}$, when added to the resultant of the vectors $\vec{A} = 3\hat{\imath} - 5\hat{\jmath} + 7\hat{k}$ and $\vec{B} = 2\hat{\imath} + 4\hat{\jmath} - 3\hat{k}$ gives a unit vector along Y-axis. Find the vector $\vec{X}$.

6. If $\vec{A} = 3\hat{\imath} + 2\hat{\jmath}$ and $\vec{B} = \hat{\imath} - 2\hat{\jmath} + 3\hat{k}$, find the magnitudes of $\vec{A} + \vec{B}$ and $\vec{A} - \vec{B}$.

7. Find the angle between the vectors

   $\vec{A} = \hat{\imath} + 2\hat{\jmath} - \hat{k}$ and $\vec{B} = -\hat{\imath} + \hat{\jmath} - 2\hat{k}$.

8. If vector $\vec{P}, \vec{Q}$ *and* $\vec{R}$ have magnitudes 5, 12 and 13 units and $\vec{P} + \vec{Q} = \vec{R}$, find the angle between $\vec{Q}$ *and* $\vec{R}$.

9. Find a vector whose length is 7 and which is perpendicular to each of the vectors:

   $\vec{A} = 2\hat{\imath} - 3\hat{\jmath} + 6\hat{k}$ And $\vec{B} = \hat{\imath} + \hat{\jmath} - \hat{k}$.

10. Rain is falling vertically with a speed of $30ms^{-1}$. A woman rides a bicycle with a speed of 10 ms^{-1} in the north to south direction. What is the relative velocity of rain with respect to the woman? What is the direction in which she should hold her umbrella to protect herself from the rain?

11. A man standing on a road has to hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and start running at 10 km/ h. He finds that raindrops are hitting his head vertically. Find the speed of raindrops with respect to (a) the road, (b) the moving man.

12. A man running on a horizontal road at 8 km/ h finds the rain falling vertically. He increases his speed to 12 km/ h and finds that the drops make angle 30 with the vertical. Find the speed and direction of the rain with respect to the road.

13. A ball rolls off the top of a stairway with a constant horizontal velocity u. If the steps are h meter high and w meter wide, show that the ball will just hit the edge of nth step if $n = \frac{2hu^2}{gw^2}$.

14. **Assertion:** If dot product and cross product of **A** and **B** are zero, it implies that one of the vectors **A** and **B** must be a null vector
Reason: Null vector is a vector with zero magnitude.

15. **Assertion:** The magnitude of velocity of two boats relative to river is same. Both boats start simultaneously from same point on one bank may reach opposite bank simultaneously moving along different paths.
Reason: For boats to cross the river in same time. The component of their velocity relative to river in direction normal to flow should be same.

16. **Assertion:** Two balls of different masses are thrown vertically upward with same speed. They will pass through their point of projection in the downward direction with the same speed.
Reason: The maximum height and downward velocity attained at the point of projection are independent of the mass of the ball.

17. **Assertion:** If there were no gravitational force, the path of the projected body always be a straight line.
Reason: Gravitational force makes the path of projected body always parabolic.

18. State triangle law of vector addition and derive a formula for magnitude of resultant of two vectors.

19. State parallelogram law of vector addition and derive a formula for magnitude of resultant of two vectors.

20. Derive various parameters in angular projectile motion

    (a) Equation of path (trajectory)

    (b) Time of flight

    (c) Maximum height attained

    (d) Horizontal range

    (e) Velocity at any instant

21. Derive various parameters in horizontal projectile motion

    (a) Equation of path (trajectory)

    (b) Time of flight

    (c) Horizontal range

    (d) Velocity at any instant

22. Show that there are two angles of projection for which the horizontal range is same for a projectile.

23. Find the angle of projection at which the horizontal range and maximum height of a projectile are equal.

24. Derive an expression for the centripetal acceleration of a body moving in a circular path of radius '*r*' with uniform speed '*v*'

25. **CASE STUDY**

    Projectile. A projectile is the name given to anybody which once thrown into space with some initial velocity, moves thereafter under the influence of gravity alone without being propelled by any engine or fuel. The path followed by a projectile is called its trajectory.

Examples of projectile motion: (i) A javelin thrown by an athlete. (ii) An object dropped from an aeroplane. (iii) A bullet fired from a rifle. (iv) A jet of water coming out from the side hole of a vessel. (v) A stone thrown horizontally from the top of a building

Principle of physical independence of motions.

In the absence of air resistance, the motion of a projectile is considered as the combination of the following two independent motions:

(a) Motion along horizontal direction with uniform velocity.

(b) Motion along vertical direction under gravity i.e., with uniform acceleration equal to g.

(i) For a projectile, (range) ^2 is 48 times of (maximum height) ^2 obtained. The angle of projection is

(a) 60^0 (b) 30^0 (c) 45^0 (d) 75^0

(ii) A particle is projected at an angle 45°. The relation between range and maximum height attained by the particle is

(a) R=4H (b) 4R=H (c) 2H=R (d) none of these.

(iii) At the uppermost point of a projectile, its velocity and acceleration are at an angle of

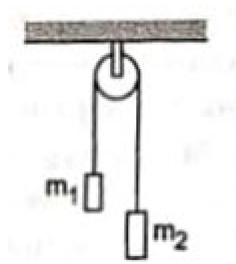
(a) 0^0 (b) 45^0 (c) 90^0 (d) 180^0

(iv) A cricket ball is hit at 45^0 to the horizontal with a kinetic energy E. The kinetic energy at the highest point is

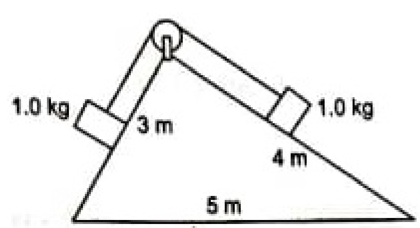
(a) 0 (b) E/2 (c) E/$\sqrt{2}$ (d) E

CHAPTER 5: LAWS OF MOTION

26. In a simple Atwood machine, two unequal masses m_1 *and* m_2 are connected by a string going over a clamped light smooth pulley. În a typical arrangement (figure) m_1 = 300 g and m_2 = 600 g. The system is be released from rest. (a) Find the distance travelled by the first block in the first two seconds. (b) Find the tension in the string. (c) Find the force exerted by the clamp on the pulley.



27. Consider the situation shown in figure. All the surfaces are frictionless and the string and the pulley are light. Find the magnitude of the acceleration of the two blocks.



28. Two masses 8 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses, and the tension in the string when the masses are released.
29. Two billiard balls each of mass 0.05 kg moving in opposite directions with speed 6 m s-1 collide and rebound with the same speed. What is the impulse imparted to each ball due to the other?
30. **Assertion:** On a rainy day, it is difficult to drive a car or bus at high speed.
Reason: The value of coefficient of friction is lowered due to wetting of the surface.
31. **Assertion:** A rocket works on the principle of conservation of linear momentum.
Reason: Whenever there is change in momentum of one body, the same change occurs in the momentum of the second body of the same system but in the opposite direction.
32. **Assertion:** An object can move with constant velocity if no net force acts on it.
Reason: No net force is needed to move an object with constant velocity.
33. **Assertion:** For the motion of electron around nucleus, Newton's second law is used.
Reason: Newton's second law can be used for motion of any object.
34. **Assertion:** Same force applied for the same time causes the same change in momentum for different bodies
Reason: The total momentum of an isolated system of interacting bodies remains conserved.
35. **Assertion:** A cricketer moves his hands forward to catch a ball so as to catch it easily without hurting.
Reason: He tries to decrease the distance travelled by the ball so that it hurts less.
36. **Assertion:** The two bodies of masses M and m ($M > m$) are allowed to fall from the same height if the air resistance for each be the same then both the bodies will reach the earth simultaneously.
Reason: For same air resistance, acceleration of both the bodies will be same.
37. **Assertion:** A block placed on a table is at rest, because action force cancels the reaction force on the block.
Assertion: The net force on the block is zero.
38. **Assertion:** There is a stage when frictional force is not needed at all to provide the necessary centripetal force on a banked road.
Reason: On a banked road, due to its inclination the vehicle tends to remain inwards without any chances of skidding.
39. **Assertion:** Force is required to move a body uniformly along a circle.
Reason: When the motion is uniform, acceleration is zero.
40. **Assertion:** Linear momentum of a body changes even when it is moving uniformly in a circle.
Reason: In uniform circular motion, velocity remains constant.
41. **Assertion:** Frictional forces are conservating forces.
Reason: Potential energy can be associated with frictional forces.
42. Show that newton's second law of motion is the real law of motion.
43. Define angle of repose and angle of friction. Establish a relation between them.
44. Derive an expression for acceleration of a body down a rough inclined plane? (Sliding only)
45. Explain why it is easier to pull a lawn roller than to push it.
46. Discuss the concept of apparent weight of a man in an elevator.
47. Discuss the banking of roads and railway tracks and derive a formula for safe turning on a rough banked road.
48. Why does a cyclist bend while taking a circular turn? Explain with the help of necessary calculations.