

Physics

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(Chapter 4) (Laws of Motion) (Exercises)

(Class 11)

Where, $\delta t = 11 - 10 = 1 \text{ s}$ and $a_y = g = 10 \text{ m/s}^2$

$$\therefore v_y = 0 + 10 \times 1 = 10 \text{ m/s}$$

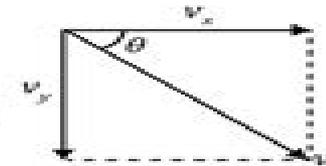
The resultant velocity (V) of the stone is given as:

$$V = \sqrt{v_x^2 + v_y^2} = \sqrt{20^2 + 10^2} = \sqrt{4000 + 100}$$
$$\sqrt{500} = 22.36 \text{ m/s}$$

Let θ be the angle made by the resultant velocity with the horizontal component of velocity, v_x .

$$\therefore \tan \theta = \left(\frac{v_y}{v_x}\right) \Rightarrow \theta = \tan^{-1}\left(\frac{10}{20}\right) = \tan^{-1}(0.5)$$
$$= 26.57^\circ$$

When the stone is dropped from the truck, the horizontal force acting on it becomes zero. However, the stone continues to move under the influence of gravity. Hence, the acceleration of the stone is 10 m/s^2 and it acts vertically downward.



Question 4.12:

A bob of mass 0.1 kg hung from the ceiling of a room by a string 2 m long is set into oscillation. The speed of the bob at its mean position is 1 m s^{-1} . What is the trajectory of the bob if the string is cut when the bob is (a) at one of its extreme positions, (b) at its mean position?

Answer 4.12:

(a) Vertically downward and parabolic path.

At the extreme position, the velocity of the bob becomes zero. If the string is cut at this moment, then the bob will fall vertically on the ground.

(b) At the mean position, the velocity of the bob is 1 m/s . The direction of this velocity is tangential to the arc formed by the oscillating bob. If the bob is cut at the mean position, then it will trace a projectile path having the horizontal component of velocity only. Hence, it will follow a parabolic path.

Question 4.13:

A man of mass 70 kg stands on a weighing scale in a lift which is moving

(a) upwards with a uniform speed of 10 m s^{-1} ,

(b) downwards with a uniform acceleration of 5 m s^{-2} ,

(c) upwards with a uniform acceleration of 5 m s^{-2} . What would be the readings on the scale in each case?

(d) What would be the reading if the lift mechanism failed and it hurtled down freely under gravity?

Answer 4.13:

Mass of the man, $m = 70 \text{ kg}$ and acceleration, $a = 0$

Using Newton's second law of motion, we can write the equation of motion as: $R - mg = ma$

Where, ma is the net force acting on the man.

(a) As the lift is moving at a uniform speed, acceleration, $a = 0$

$$R = mg = 70 \times 10 = 700 \text{ N}$$

$$\therefore \text{Reading on the weighing scale} = \frac{700}{g} = \frac{700}{10} = 70 \text{ kg}$$

(b) Mass of the man, $m = 70 \text{ kg}$

Acceleration, $a = 5 \text{ m/s}^2$ downward

Using Newton's second law of motion, we can write the equation of motion as: $R + mg = ma$

$$R = m(g - a) = 70 (10 - 5) = 70 \times 5 = 350 \text{ N}$$

$$\therefore \text{Reading on the weighing scale} = \frac{350}{g} = \frac{350}{10} = 35 \text{ kg}$$

(c) Mass of the man, $m = 70 \text{ kg}$

Acceleration, $a = 5 \text{ m/s}^2$ upward

Mastering Physics Solutions Chapter 4

Yijin Wang

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