

1. A ball is dropped from rest at a height of 60 m above the ground. (a) What is its speed just before it hits the ground? (b) How long does it take to reach the ground?

Theory

(a) Given

$$v_0 = 0$$

$$y = -60 \text{ m}$$

$$v_y^2 = v_0^2 - 2gy$$

$$v_y^2 = -2gy$$

$$v_y = \sqrt{-2gy}$$

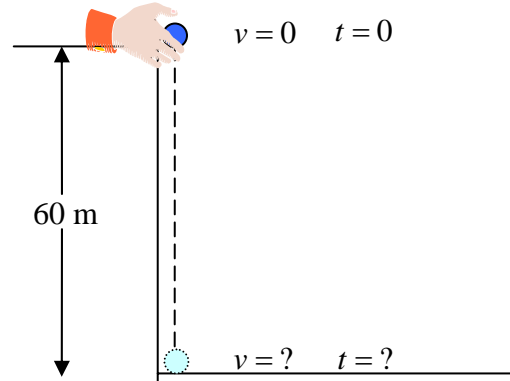
(b)

$$y = v_0t - \frac{1}{2}gt^2$$

$$y = -\frac{1}{2}gt^2$$

$$t = \sqrt{\frac{-2y}{g}}$$

Figure



Calculation

(a) $v_y = \sqrt{-2gy} = \sqrt{-2(9.81 \text{ m/s}^2)(-60 \text{ m})}$

$v_y = 34.3 \text{ m/s}$

(b) $t = \sqrt{\frac{-2y}{g}} = \sqrt{\frac{-2(-60 \text{ m})}{9.81 \text{ m/s}^2}}$

$t = 3.50 \text{ s}$

Answers (a) 34.3 m/s

(b) 3.50 s

2. A box slides down an incline with uniform acceleration. It starts from rest and attains a speed of 3 m/s in 5 s. Find (a) the acceleration and (b) the distance moved in first 8 s.

Theory

(a) Given

$$v_0 = 0$$

$$v = 3 \text{ m/s and } t = 5 \text{ s}$$

$$v = v_0 + at$$

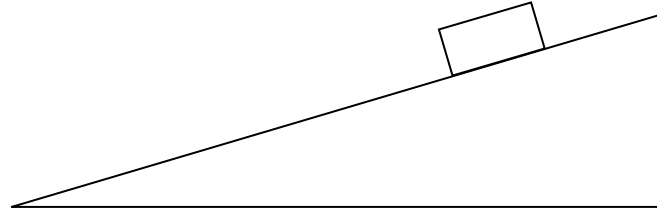
$$v = at$$

$$a = \frac{v}{t}$$

(b) $x = v_0 t + \frac{1}{2} at^2$

$$x = \frac{1}{2} at^2$$

Figure



Calculation

$$(a) \quad a = \frac{v}{t} = \frac{3 \text{ m/s}}{5 \text{ s}}$$

$$a = 0.600 \text{ m/s}^2$$

$$(b) \quad x = \frac{1}{2} at^2 = \frac{1}{2} (0.6 \text{ m/s}^2) (8 \text{ s})^2$$

$$x = 19.2 \text{ m}$$

Answers (a) 0.600 m/s²

(b) 7.5 m

3. A body projected upward from the level ground at an angle of 40° with the horizontal has an initial speed of 50 m/s. (a) How long will it take to hit the ground? (b) How far from the starting point will it strike?

Theory

(a) Given

$$\theta = 40^\circ$$

$$v_0 = 50 \text{ m/s}$$

$$v_{0y} = v_0 \sin \theta$$

$$v_{0x} = v_0 \cos \theta$$

$$y = v_{0y}t - \frac{1}{2}gt^2$$

$$y = (v_0 \sin \theta)t - \frac{1}{2}gt^2$$

$$0 = (v_0 \sin \theta)t - \frac{1}{2}gt^2$$

$$0 = t(v_0 \sin \theta - \frac{1}{2}gt)$$

$$t = 0 \text{ or}$$

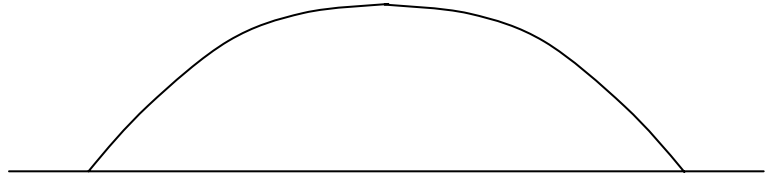
$$(v_0 \sin \theta - \frac{1}{2}gt) = 0$$

$$t = \frac{2v_0 \sin \theta}{g}$$

(b) $x = v_{0x}t$

$$x = (v_0 \cos \theta)t$$

Figure



Calculation

$$(a) \quad t = \frac{2v_0 \sin \theta}{g} = \frac{2(50 \text{ m/s})(\sin 40^\circ)}{9.81 \text{ m/s}^2}$$

$$t = 6.55 \text{ s}$$

$$(b) \quad x = (v_0 \cos \theta)t = (50 \text{ m/s})(\cos 40^\circ)(6.55 \text{ s})$$

$$x = 251 \text{ m}$$

Answer (a) 6.55 s

(b) 251 m