

Answers

Projectile Motion Practice

1. An object spent 8.45 seconds in the air. It was launched at 35° above horizontal.
- Find the initial velocity of the object if it landed at the same level it was launched from.
 - Find the initial velocity of the object if it landed 5.4 meters above its launching point.

$$G: t_{air} = 8.45 \text{ s}$$

a) $\theta = 35^\circ$ above
 $a_y = -9.8 \text{ m/s}^2$

$$R: \vec{v}_i = ? \text{ [m/s]}$$

$\therefore S$: The initial velocity was 72 m/s [35° above horizontal].

$$A: t_{air} = 2t_{h_{max}}$$

$$t_{h_{max}} = \frac{t_{air}}{2}$$

$$v_i = \frac{v_{iy}}{\sin \theta}$$

$$v_{iy} = v_{fy} - a_y \Delta t_{h_{max}}$$

$$S: \quad = 0 - (-9.8) \left(\frac{8.45}{2} \right)$$

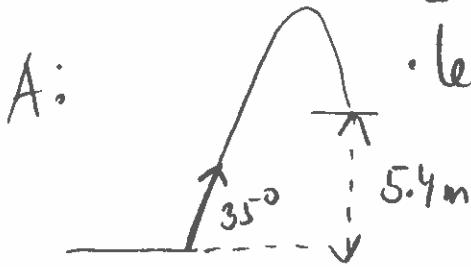
$$= 41.405 \text{ m/s}$$

$$v_i = \frac{41.405}{\sin 35^\circ}$$

$$v_i = 72 \text{ m/s}$$

#1 b)

- let $v_{iy} = y$
- let $t_{air} = t$
- let $a_y = -a$



$$t_{air} = t_{h_{max}} + t_{ff}$$

$$= \frac{0 - v_{iy}}{a_y} + \sqrt{\frac{2 \Delta y}{a_y}}$$

$$0 - \Delta y = - (h_{max} - 5.4)$$

$$= - \left(\frac{0^2 - v_{iy}^2}{2a_y} - 5.4 \right)$$

$$= - \left(\frac{-v_{iy}^2 - 10.8 a_y}{2a_y} \right)$$

$$= \frac{v_{iy}^2 + 10.8 a_y}{2a_y}$$

$$t = \frac{-y}{a} + \sqrt{\frac{2(y^2 + 10.8a)}{2a}}$$

$$t = \frac{-y}{a} + \sqrt{\frac{y^2 + 10.8a}{a}}$$

$$t + \frac{y}{a} = \frac{1}{\sqrt{a}} \cdot \sqrt{y^2 + 10.8a}$$

$$t a + y = \sqrt{y^2 + 10.8a}$$

$$(ta)^2 + 2tay + y^2 = y^2 + 10.8a$$

$$y = \frac{10.8a - ta^2}{2ta}$$

$$y = \frac{10.8 - t^2 a}{2t}$$

$$y = \frac{10.8 - (8.45)^2 (-9.8)}{2(8.45)}$$

$$y = 42 \text{ m/s}$$

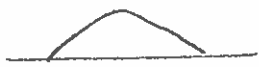
$$v_i = \frac{y}{\sin 35^\circ} = \underline{\underline{73 \text{ m/s}}}$$

2. Find the initial velocity of an object that was launched at 60° above the horizontal, given that its horizontal displacement was 78 m to the left of the launching point. Assume the same launching and landing level.

G: $\theta = 60^\circ$ above h.
 $d_x = 78 \text{ m [L]}$

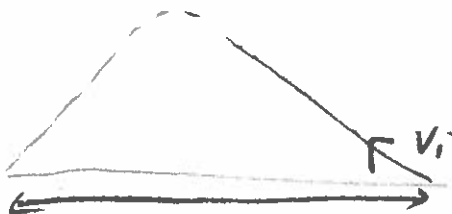
A: $t_{\text{air}} = 2 \cdot t_{\text{max}}$
 $= 2 \left(\frac{0 - v_{iy}}{a_y} \right)$
 $= 2 \left(\frac{0 - v_i \sin 60^\circ}{a_y} \right)$

S: $\vec{v}_i = 3.0 \times 10^1 \text{ m/s}$
 $[60^\circ \text{ above horizontal}]$



R: $\vec{v}_i = ? \text{ [m/s]}$

A:



$d_x = 78 \text{ m}$

Extra:

S: $d_x = v_{ix} \cdot t_{\text{air}}$
 $78 = (v_i \cos 60^\circ) 2 \left(\frac{-v_i \sin 60^\circ}{a_y} \right)$
 $78 = +v_i^2 \cdot \cos 60^\circ \cdot \sin 60^\circ \cdot 2$

$\frac{764.4}{0.866} = v_i^2 \cdot \frac{0.866}{0.866}$ $\rightarrow v_i = \sqrt{882.6789} \dots$
 $v_i = 3.0 \times 10^1 \text{ m/s}$

3. Find the initial velocity of an object that covered 9.23 m of horizontal distance after it was thrown with speed of 15 m/s. It landed at the same level it was launched from.

This Can be solve by graphing.

G: $d_x = 9.23 \text{ m}$
 $v_i = 15 \text{ m/s}$



R: $\theta = ? [^\circ]$

$d_x = 2 \left(\frac{0 - v_i \sin \theta}{a_y} \right) \cdot v_i \cos \theta$

$d_x \cdot a_y = -2 (v_i \sin \theta \cdot v_i \cos \theta)$

$\frac{(9.23)(-9.8)}{(-2)(15)(15)} = \sin \theta \cdot \cos \theta$

A: $t_{\text{air}} = 2 t_{\text{max}}$
 $d_x = t_{\text{air}} \cdot v_i \cos \theta$ $\left. \begin{array}{l} 0.2010 = \sin \theta \cdot \cos \theta \\ \therefore \theta = 12^\circ \text{ also } 78^\circ \end{array} \right\} \text{Desmos}$