

Example 2

Wednesday, September 9, 2015 7:08 AM

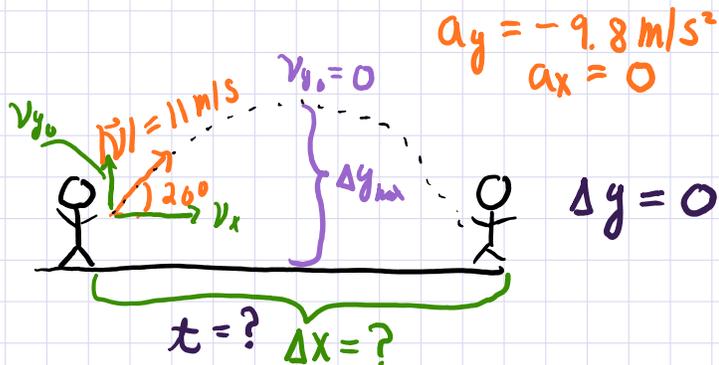
Example 2



2) A long jumper leaves the ground at an angle of 20.0° above the horizontal and at a speed of 11.0 m/s .

a) How far does he jump in the horizontal direction?

b) What is the maximum height reached?



$$v_x = |v| \cos(20^\circ)$$

$$v_x = (11 \text{ m/s}) \cos(20^\circ)$$

$$v_x = 10.3 \text{ m/s}$$

$$v_{y0} = |v| \sin(20^\circ)$$

$$v_{y0} = (11 \text{ m/s}) \sin(20^\circ)$$

$$v_{y0} = 3.76 \text{ m/s}$$

a) $\Delta x = v_x t$ \rightarrow $\Delta x = (10.3 \text{ m/s})(.767 \text{ s})$

$\Delta x = 7.9 \text{ m}$

$$\Delta y = v_{y0} t + \frac{1}{2} a_y t^2$$

$$0 = v_{y0} t + \frac{1}{2} a_y t^2$$

$$0 = (v_{y0} + \frac{1}{2} a_y t) t$$

$$t = 0$$

$$v_{y0} + \frac{1}{2} a_y t = 0$$

$$\frac{1}{2} a_y t = -v_{y0}$$

$$t = \frac{-2 v_{y0}}{a_y}$$

$$t = \frac{+2(3.76 \text{ m/s})}{+9.8 \text{ m/s}^2}$$

$$t = .767 \text{ s}$$

b) $v_y = v_{y0}^2 + 2 a_y \Delta y_{\text{max}}$

$$\Delta y_{\text{max}} = \frac{-v_{y0}^2}{2 a_y}$$

$$\Delta y_{\text{max}} = \frac{-(3.76 \text{ m/s})^2}{2(-9.8 \text{ m/s}^2)}$$

$$\Delta y_{\text{max}} = .72 \text{ m}$$

extra: when landing

$$v_y = v_{y0} + a_y t$$

$$v_y = 3.76 \text{ m/s} + (-9.8 \text{ m/s}^2)(.767 \text{ s})$$

$$v_y = -3.76 \text{ m/s}$$

$$v_x = 10.3 \text{ m/s}$$

$$R = \frac{v_0^2 \sin(2\theta)}{g}$$

11

g

Example 3

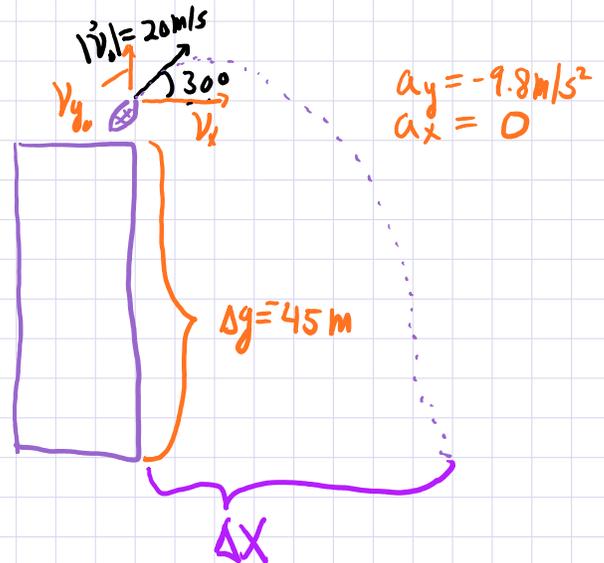
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Example 3

3) A football is thrown from the top of a building upward at an angle of 30.0° to the horizontal and with an initial speed of 20.0 m/s . If the height of the building is 45.0 m

- How long is it before the stone hits the ground?
- What is the velocity of the football just before it hits the ground?
- How far from the building does it hit the ground?



$$v_x = |v_0| \cos(30^\circ) \quad v_y = |v_0| \sin(30^\circ)$$

$$v_x = (20 \text{ m/s}) \cos(30^\circ) \quad v_y = (20 \text{ m/s}) \sin(30^\circ)$$

$$v_x = 17.3 \text{ m/s} \quad v_y = 10 \text{ m/s}$$

a) $t = ?$

$$\Delta y = v_{y0} t + \frac{1}{2} a_y t^2$$

$$\frac{1}{2} a_y t^2 + v_{y0} t - \Delta y = 0$$

$$t^2 + \frac{2v_{y0}}{a_y} t - \frac{2\Delta y}{a_y} = 0$$

$$t^2 + \frac{2(10 \text{ m/s})}{-9.8 \text{ m/s}^2} t - \frac{2(-45 \text{ m})}{-9.8 \text{ m/s}^2} = 0$$

$$t^2 - 2.045 t - 9.185^2 = 0$$

$$ax^2 + bx + c = 0$$

$$1 \quad -2.045 \quad -9.185^2$$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$t = \frac{2.045 \pm \sqrt{(-2.045)^2 - 4(1)(-9.185^2)}}{2}$$

$$t = \frac{2.045 \pm 6.585}{2}$$

$$t = \frac{2.045 + 6.585}{2} \quad \text{or} \quad \frac{2.045 - 6.585}{2}$$

b) $v_x = 17.3 \text{ m/s}$

$$v_y = v_{y0} + a_y t$$

$$v_y = 10 \text{ m/s} + (-9.8 \text{ m/s}^2)(4.31 \text{ s})$$

$$v_y = -32.24 \text{ m/s}$$

$$|v| = \sqrt{v_x^2 + v_y^2}$$

$$|v| = \sqrt{(17.3 \text{ m/s})^2 + (-32.24 \text{ m/s})^2}$$

$$|v| = 36.59 \text{ m/s}$$

$$\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right)$$

$$\theta = \tan^{-1}\left(\frac{-32.24 \text{ m/s}}{17.3 \text{ m/s}}\right)$$

$$\theta = -61.78^\circ \approx -62^\circ \text{ below } (+) \text{ x axis}$$



$$t = \frac{2.045 + 6.585}{2}$$

$$t = 4.315$$

$$\text{or } \frac{2.045 - 6.585}{2}$$

$$\text{or } -2.275$$

$$c) \Delta X = v_x t$$

$$\Delta X = (17.3 \text{ m/s})(4.315)$$

$$\Delta X = 74.6 \text{ m}$$

equations

Monday, September 14, 2015 7:55 AM

$$v_{y_0} \quad a_y$$

$$v_y = v_{y_0} + a_y t$$

$$\Delta y = \left(\frac{v_{y_0} + v_y}{2} \right) t$$

$$\Delta y = v_{y_0} t + \frac{1}{2} a_y t^2$$

$$v_y^2 = v_{y_0}^2 + 2 a_y \Delta y$$

$$\Delta x = v_x t$$