

Example 1

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Example 1



1) It normal takes you 10 min to travel 5.0 mi to school along a straight road. You leave home 15 minutes before class begins. Delays caused by a broken traffic light slow down traffic to 20 mi/hr for the first 2.0 mi of the trip. Will you be late for class?

$$\Delta t_{total} = \Delta t_1 + \Delta t_2$$

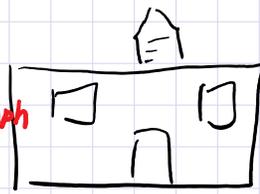
$$\Delta t_{total} = 12 \text{ min}$$

$$\Delta x = 5 \text{ mi} \quad \Delta t = 10 \text{ min} \left(\frac{1 \text{ hr}}{60 \text{ min}} \right) = .1667 \text{ hr}$$



$$v = \frac{\Delta x}{\Delta t}$$

$$v = \frac{5 \text{ mi}}{.1667 \text{ hr}} = 29.99 \text{ mph}$$



$$v_1 = 20 \text{ mph}$$

$$\Delta x_1 = 2 \text{ mi}$$

$$\Delta t_1 = ?$$

$$v_1 = \frac{\Delta x_1}{\Delta t_1}$$

$$\Delta t_1 = \frac{\Delta x_1}{v_1}$$

$$\Delta t_1 = \frac{2 \text{ mi}}{20 \frac{\text{mi}}{\text{hr}}}$$

$$\Delta t_1 = .1 \text{ hr}$$

$$\Delta t_1 = .1 \text{ hr} \left(\frac{60 \text{ min}}{1 \text{ hr}} \right) = 6 \text{ min}$$

$$\Delta x_2 = 3 \text{ mi}$$

$$\Delta t_2 = ?$$

$$\Delta t_2 = \frac{\Delta x_2}{v}$$

$$\Delta t_2 = \frac{3 \text{ mi}}{29.99 \text{ mi/hr}}$$

$$\Delta t_2 = .1 \text{ hr}$$

$$\Delta t_2 = 6 \text{ min}$$

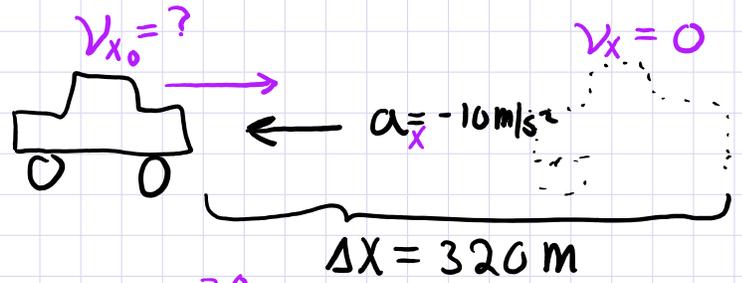
Example 2

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Example 2



2) In coming to a stop, a car leaves skid marks on the highway 320 m long. Assuming a deceleration of 10 m/s^2 (roughly the maximum for rubber tires on dry pavement), estimate the speed of the car just before braking?



$$v_x^2 = 0 = v_{x_0}^2 + 2a_x \Delta x$$

$$v_{x_0} = \sqrt{-2a_x \Delta x}$$

$$v_{x_0} = \sqrt{+2(-10\text{ m/s}^2)(320\text{ m})}$$

$$v_{x_0} = 80\text{ m/s}$$

Example 3

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3) On a highway at night you see a stalled car and brake to a stop. As you brake, the velocity of your car decreases at a rate of 5.0 m/s^2 .

a) If your initial velocity is 15 m/s what is your stopping distance?

b) How much time does it take you to stop?

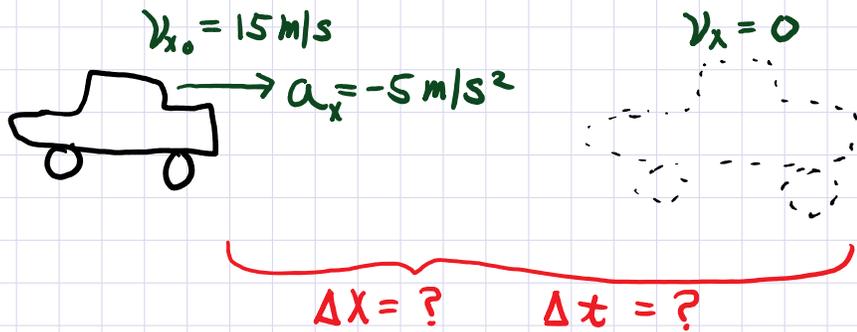
b) $t = ?$

$$v_x = v_{x_0} + a_x t$$

$$t = \frac{-v_{x_0}}{a_x}$$

$$t = \frac{-15 \text{ m/s}}{-5 \text{ m/s}^2}$$

$$t = 3 \text{ s}$$



a) $\Delta x = ?$

$$\Delta x = v_{x_0} t + \frac{1}{2} a_x t^2$$

$$\Delta x = (15 \text{ m/s})(3 \text{ s}) + \frac{1}{2} (-5 \text{ m/s}^2)(3 \text{ s})^2$$

$$\Delta x = 45 \text{ m} - 22.5 \text{ m}$$

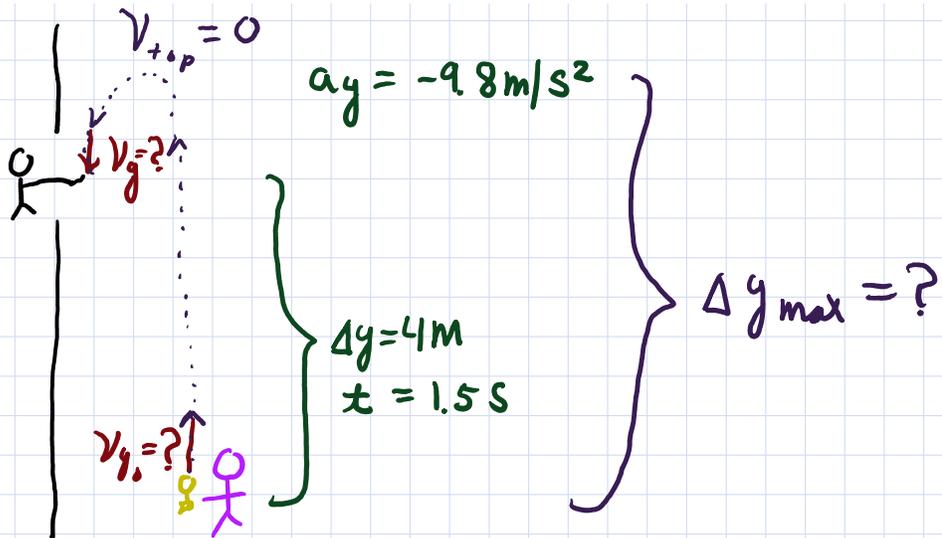
$$\Delta x = 22.5 \text{ m}$$

Example 4

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Example 4
 4) A student throws a set of keys vertically upward to her sorority sister, who is in a window 4.00 m above. The keys are caught 1.50 s later by the sister's outstretched hand.
 a) With what initial velocity were the keys thrown?
 b) What was the velocity of the keys just before they were caught?



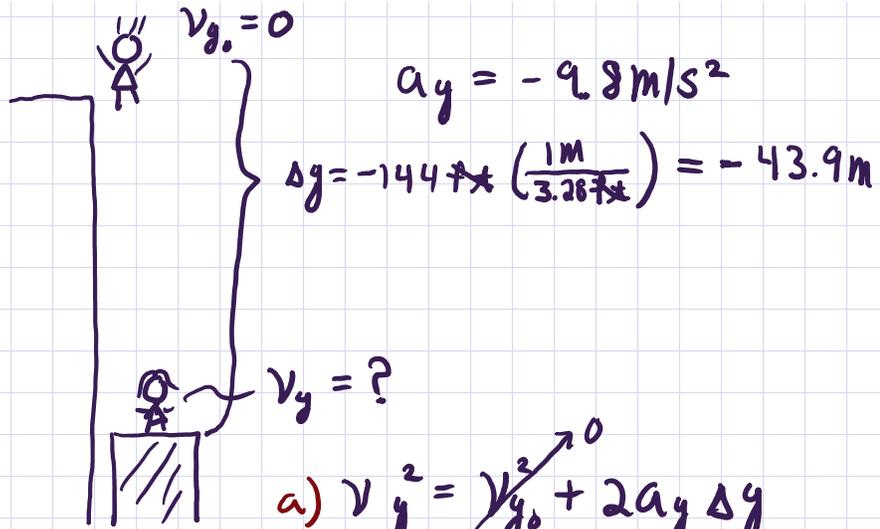
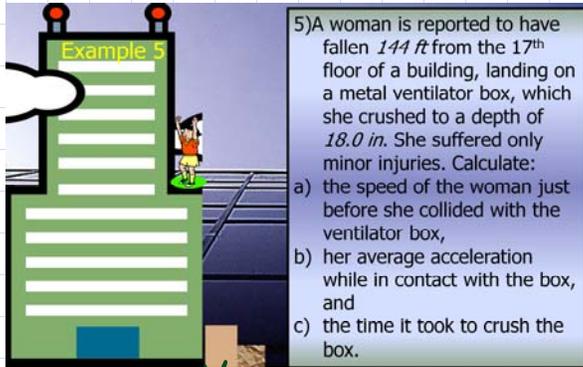
a) $\Delta y = v_{y0} t + \frac{1}{2} a_y t^2$
 $v_{y0} t = \Delta y - \frac{1}{2} a_y t^2$
 $v_{y0} = \frac{\Delta y}{t} - \frac{1}{2} a_y t$
 $v_{y0} = \frac{4\text{m}}{1.5\text{s}} + \frac{1}{2} (+9.8\text{m/s}^2)(1.5\text{s})$
 $v_{y0} = 10.0167\text{m/s} \approx 10.02\text{m/s}$

b) $v_y = ?$
 $v_y = v_{y0} + a_y t$
 $v_y = (10.0167\text{m/s}) + (-9.8\text{m/s}^2)(1.5\text{s})$
 $v_y = -4.68\text{m/s}$

c) $\Delta y_{\text{max}} = ?$
 $v_y^2 = v_{y0}^2 + 2 a_y \Delta y_{\text{max}}$
 $2 a_y \Delta y_{\text{max}} = -v_{y0}^2$
 $\Delta y_{\text{max}} = \frac{-v_{y0}^2}{2 a_y} = \frac{+(10.0167\text{m/s})^2}{2 (+9.8\text{m/s}^2)}$
 $\Delta y_{\text{max}} = 5.12\text{m}$

Example 5

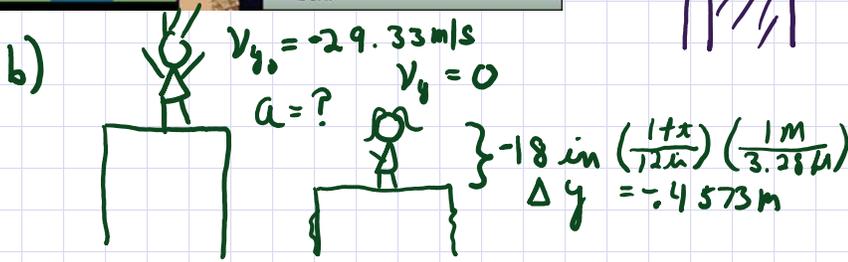
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$$a) v_y^2 = v_{y0}^2 + 2a_y \Delta y$$

$$v_y = \sqrt{2(+9.8 \text{ m/s}^2)(+43.9 \text{ m})}$$

$$v_y = -29.33 \text{ m/s}$$



$$v_y^2 = v_{y0}^2 + 2a_y \Delta y$$

$$a_y = \frac{-v_y^2}{2\Delta y}$$

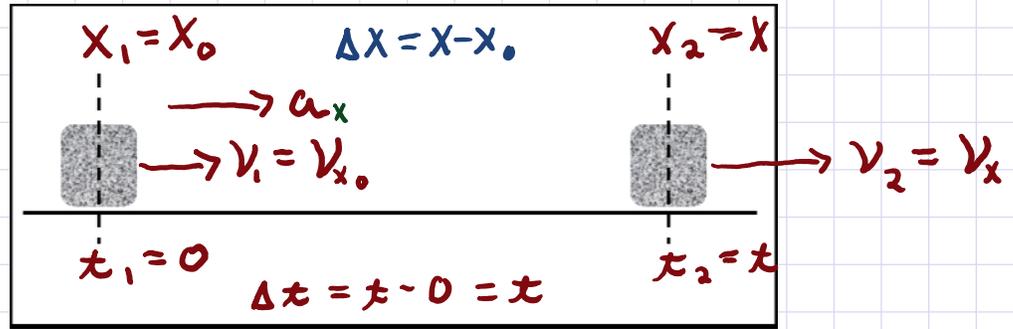
$$a_y = \frac{-(-29.33 \text{ m/s})^2}{2(-0.4573 \text{ m})}$$

$$a_y = 940.57 \text{ m/s}^2$$

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

$$t = \frac{-v_{y0}}{a_y} = \frac{-(-29.33 \text{ m/s})}{940.57 \text{ m/s}^2}$$

$$t = .0312 \text{ s}$$



$$\bar{v} = \frac{\Delta x}{\Delta t}$$

$$\frac{v_x + v_{x_0}}{2} = \frac{\Delta x}{t}$$

$$\textcircled{1} \quad \Delta x = \left[\frac{v_x + v_{x_0}}{2} \right] t$$

No a !

$$\Delta x = \frac{(v_{x_0} + a_x t + v_{x_0})}{2} t$$

$$\Delta x = \frac{(2v_{x_0} + a_x t)}{2} t$$

$$\textcircled{3} \quad \Delta x = v_{x_0} t + \frac{1}{2} a_x t^2$$

No v_x

$$a_x = \frac{\Delta v_x}{t}$$

$$a_x = \frac{v_x - v_{x_0}}{t}$$

$$\textcircled{2} \quad v_x = v_{x_0} + a_x t$$

No Δx

$$\Delta x = \left(\frac{v_x + v_{x_0}}{2} \right) t$$

$$t = \Delta x \left(\frac{2}{v_x + v_{x_0}} \right)$$

$$v_x = v_{x_0} + a_x \left[\Delta x \left(\frac{2}{v_x + v_{x_0}} \right) \right]$$

$$v_x = v_{x_0} + 2 a_x \Delta x \left(\frac{1}{v_x + v_{x_0}} \right)$$

$$v_x - v_{x_0} = 2 a_x \Delta x \left(\frac{1}{v_x + v_{x_0}} \right)$$

$$(v_x + v_{x_0})(v_x - v_{x_0}) = 2 a_x \Delta x$$

$$v_x^2 - v_{x_0}^2 = 2 a_x \Delta x$$

$$\textcircled{4} \quad v_x^2 = v_{x_0}^2 + 2 a_x \Delta x$$

No t