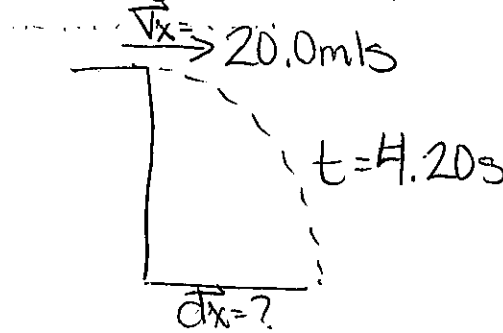Name: **Key**

1. A ball is kicked off the top of a building at a horizontal velocity of 20.0 m/s. It lands on the ground 4.20 s later; how far from the base of the building does the ball land? [84.0 m]
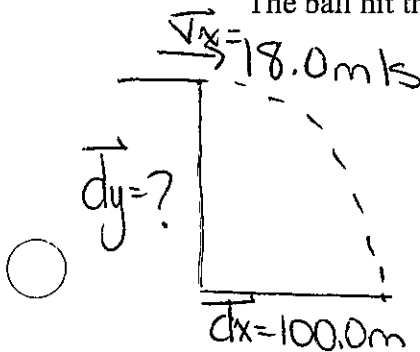
$\vec{V_x} \Rightarrow 20.0 \text{m/s}$

$t = 4.20 s$

$\vec{d_x} = ?$

$\vec{d_x} = \vec{V_x} t$

$\vec{d_x} = (20.0 \text{m/s})(4.20 s)$

$\boxed{\vec{d_x} = 84.0 \text{m}}$

2. Terry kicked a soccer ball horizontally with a velocity of 18.0 m/s from the top of a cliff. The ball hit the ground 100.0 m from the base of the cliff. How high is the cliff? [151 m]
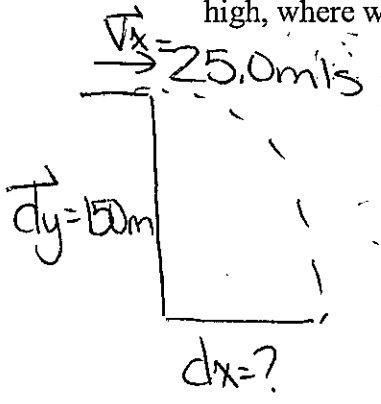
$\vec{V_x} = 18.0 \text{m/s}$

$\vec{d_y} = ?$

$\vec{d_x} = 100.0 \text{m}$

$t = \dfrac{\vec{d_x}}{\vec{V_x}}$

$t = \dfrac{100.0 \text{m}}{18.0 \text{m/s}} = 5.56... s$

$\Delta \vec{d_y} = \cancel{\vec{V_{iy}} t}^{0} + \frac{1}{2} \vec{a_y} t^2$

$= (\frac{1}{2})(-9.81 \text{m/s}^2)(5.56... s)^2$
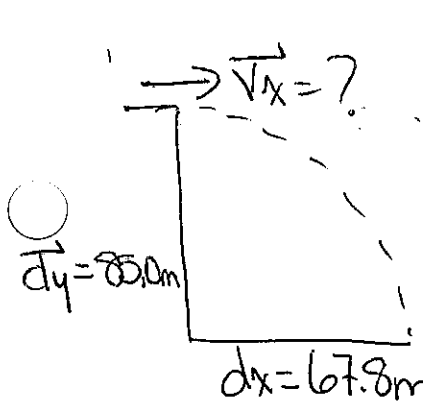
$\boxed{\vec{d_y} = -151 \text{m}}$

3. A canon ball is shot horizontally off a fort with a velocity of 25.0 m/s. The fort is 150 m high, where will the canon ball hit the ground? [138 m]

$\vec{V_x} = 25.0 \text{m/s}$

$\vec{d_y} = 150 \text{m}$

$\vec{d_x} = ?$

$\Delta \vec{d_y} = \cancel{\vec{V_{iy}} t}^{0} + \frac{1}{2} \vec{a_y} t^2$

$t = \sqrt{\dfrac{2\vec{d_y}}{\vec{a_y}}}$

$t = \sqrt{\dfrac{2(-150 \text{m})}{-9.81 \text{m/s}^2}} = 5.53... s$

$\vec{d_x} = \vec{V_x} t$

$= (25.0 \text{m/s})(5.53... s)$

$\boxed{\vec{d_x} = 138 \text{m}}$

4. An object is thrown horizontally off an 85.0 m building. If the object hits 67.8 m from the base of the building, what was the horizontal velocity of the object? [16.3 m/s]

$\vec{V_x} = ?$

$\vec{d_y} = 85.0 \text{m}$

$\vec{d_x} = 67.8 \text{m}$ $t = 4.16... s$

$t = \sqrt{\dfrac{2\vec{d_y}}{\vec{a_y}}}$

$t = \sqrt{\dfrac{2(-85.0 \text{m})}{-9.81 \text{m/s}^2}}$

$\vec{V_x} = \dfrac{\vec{d_x}}{t}$

$= \dfrac{67.8 \text{m}}{4.16 s}$

$\boxed{\vec{V_x} = 16.3 \text{m/s}}$

5. Graeme kicks a football into the air from the ground at an angle of 40° from the horizontal at a velocity of 18.0 m/s. How far will the football travel horizontally? [32.5 m]
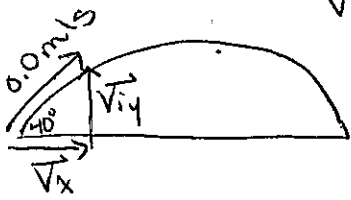
$\vec{V_{iy}} = 18.0\sin 40°$
$= 11.6\,m/s$
$\vec{V_x} = 18.0\cos 40°$
$= 13.8\,m/s$

$a = \dfrac{-2\vec{V_{iy}}}{t}$

$t = \dfrac{-2(11.6\,m/s)}{-9.81\,m/s^2}$

$t = 2.36\,s$

$\vec{d_x} = \vec{V_x}t$
$= (13.8\,m/s)(2.36s)$
$= (18.0\cos 40°)(2.36s)$
$\boxed{\vec{d_x} = 32.5\,m}$

6. A canon ball was shot out of a canon at Travis. The canon was angled at 35° to the horizontal. The canon ball was in the air for 9.26 s. At what initial velocity was the cannonball shot? [79.2 m/s]

$t = 9.26s$
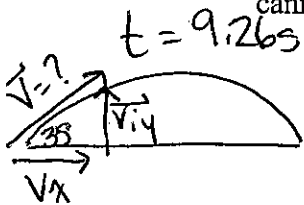
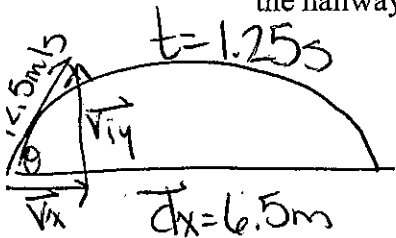$\vec{a} = \dfrac{-2\vec{V_{iy}}}{t}$

$\vec{V_{iy}} = \dfrac{\vec{a}t}{-2} = \dfrac{(-9.81\,m/s^2)(9.26s)}{-2} = 45.4\,m/s$

$\sin 35° = \dfrac{45.4\,m/s}{\vec{V}}$

$\boxed{\vec{V} = 79.2\,m/s}$

7. Brandon kicks his physics book in the air at a velocity of 12.5 m/s. It lands 6.5 m down the hallway 1.25 s later. What angle did he kick the ball at? [65°]

$t = 1.25s$
$\vec{d_x} = 6.5\,m$

$\vec{V_x} = \dfrac{\vec{d_x}}{t}$
$= \dfrac{6.5\,m}{1.25s}$
$\vec{V_x} = 5.2\,m/s$

$\cos\theta = \dfrac{5.2\,m/s}{12.5\,m/s}$

$\boxed{\theta = 65°}$

8. An arrow is shot 25.6 m/s from the top of a 123 m high cliff at an angle of 38°. How far will the arrow land from the base of the cliff? [~~m]

t_1
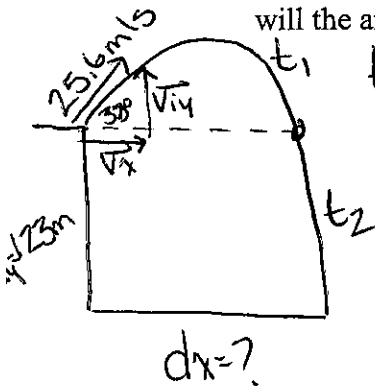
$t_1 = \dfrac{-2\vec{V_{iy}}}{\vec{a_y}}$
$= \dfrac{-2(25.6\sin 38°)}{-9.81}$
$t_1 = 3.21s$

t_2

$d_x = ?$

$t_{total} =$ ~~~~ 10.07s

$\Delta\vec{d_y} = \vec{V_{iy}}t + \tfrac{1}{2}\vec{a}t^2$
$-123 = (25.6\sin 38°)(t_2) + (\tfrac{1}{2})(-9.81)t_2^2$

Graphing Calc. → Intersection

$t_2 =$ ~~~~ 6.87s

$\vec{d_x} = \vec{V_x}t$
$= (25.6\cos 38°)(\overset{10.07}{\text{~~~~~}})$
$\boxed{\vec{d_x} = \text{~~~~~} 203\,m}$