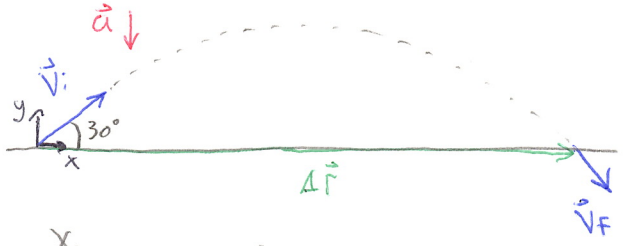
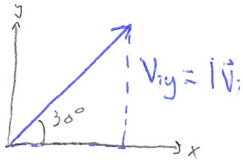
KINEMATICS: PROJECTICE MOTION – FUNDAMENTAL EXAMPLES SOLUTIONS

(1)





$V_{iy} = |\vec{V}_i| \sin(30) = 21 \text{ m/s}$

$V_{ix} = |\vec{V}_i| \cos(30^\circ) \approx 36.37 \text{ m/s}$

$x_i = 0 \text{ m}$ $\quad y_i = 0 \text{ m}$

$x_f = ?$ $\quad y_f = 0 \text{ m}$

$V_{ix} = 36.37 \text{ m/s}$ $\quad V_{iy} = 21 \text{ m/s}$

$V_{fx} = 36.37 \text{ m/s}$ $\quad V_{fy} = ?$

$a_x = 0 \text{ m/s}^2$ $\quad a_y = -9.8 \text{ m/s}^2$

$\Delta t = ?$

$$y_f = y_i + V_{iy}\Delta t + \tfrac{1}{2} a_y \Delta t^2$$

$$0 = 0 + (21)\Delta t + \tfrac{1}{2}(-9.8)\Delta t^2$$

$$0 = 21\Delta t - 4.9\Delta t^2$$

$$0 = 21 - 4.9\Delta t$$

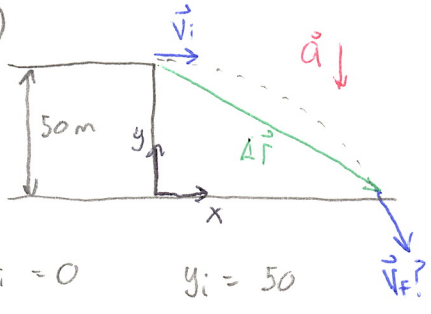
$$\Delta t = \frac{21}{4.9} \approx 4.29 \text{ SECONDS}$$ b)

$$x_f = x_i + V_{ix}\Delta t + \tfrac{1}{2} a_x \Delta t^2$$

$$x_f = 0 + (36.37)(4.29) + \tfrac{1}{2}(0)\Delta t^2$$

a) $x_f \approx 156 \text{ m}$

(2)



$x_i = 0$ $\quad y_i = 50$

$x_f = ?$ $\quad y_f = 0$

$V_{ix} = 30 \text{ m/s}$ $\quad V_{iy} = 0$

$V_{fx} = 30 \text{ m/s}$ $\quad V_{fy} = ?$

$a_x = 0$ $\quad a_y = -9.8 \text{ m/s}^2$

$\Delta t = ?$

$$y_f = y_i + V_{iy}\Delta t + \tfrac{1}{2} a_y \Delta t^2$$

$$0 = 50 + 0\Delta t + \tfrac{1}{2}(-9.8)\Delta t^2$$

$$0 = 50 - 4.9\Delta t^2$$

$$\Delta t^2 = \frac{50}{4.9}$$

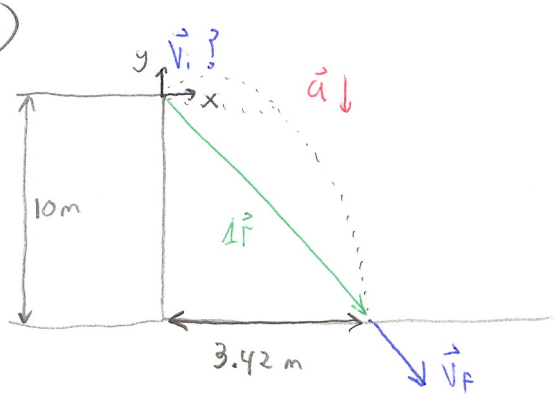
$$\Delta t = \sqrt{\frac{50}{4.9}} \approx 3.19 \text{ SECONDS}$$ b)

$$x_f = x_i + V_{ix}\Delta t + \tfrac{1}{2} a_x \Delta t^2$$

$$x_f = 0 + (30)(3.19) + \tfrac{1}{2}(0)\Delta t^2$$

a) $x_f \approx 96 \text{ m}$

(3)



$x_i = 0\,m$ $\quad y_i = 0\,m$

$x_f = 3.42\,m$ $\quad y_f = -10\,m$

$V_{ix} = ?$ $\quad V_{iy} = ?$

$V_{fx} = 1.71\,m/s$ $\quad V_{fy} = -14.8\,m/s$

$a_x = 0\,m/s^2$ $\quad a_y = -9.8\,m/s^2$

$\Delta t = ?$

PROJECTILE MOTION ... $a_x = 0$ SO ... $V_{ix} = V_{fx}$

$$x_f = x_i + V_{ix}\Delta t + \tfrac{1}{2}a_x\Delta t^2$$

$$3.42 = 0 + 1.71\Delta t + \tfrac{1}{2}(0)\Delta t^2$$

$$3.42 = 1.71\Delta t$$

$$\Delta t = 2 \text{ SECONDS}$$

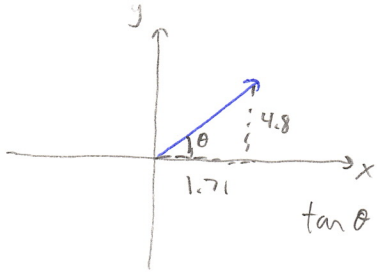
$$y_f = y_i + V_{iy}\Delta t + \tfrac{1}{2}a_y\Delta t^2$$

$$-10 = 0 + V_{iy}(2) + \tfrac{1}{2}(-9.8)(2)^2$$

$$-10 = 2V_{iy} - 19.6$$

$$9.6 = 2V_{iy}$$

$$V_{iy} = 4.8\,m/s$$



$$\tan\theta = \frac{4.8}{1.71}$$

$$\theta \approx 70^\circ$$

$$\vec{V} = \langle 1.71, 4.8 \rangle\,m/s$$

$$|\vec{V}| = \sqrt{1.71^2 + 4.8^2}$$

$|\vec{V}| \approx 5.1\,m/s$ @ 70° FROM +X TO +y AXIS