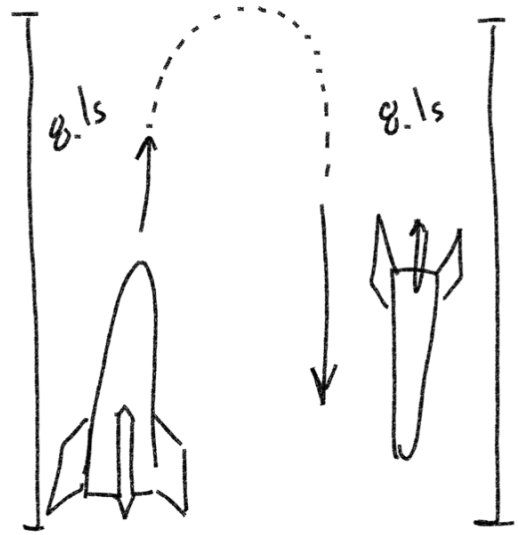
M-GP General Physics Week 19 2/12



16.2 seconds to go and return to the earth.

Takes 8.1s to exhaust all of the initial velocity.

Gravity $\rightarrow -9.8\,m/s^2 \approx -10\,m/s^2$

Every 1 second, velocity decreases by $10\,m/s$

$$\cancel{v_f}^{\,0} = v_0 + at$$
$$-at \qquad -at$$

$$-at = v_0$$
$$-(-10\,m/s^2)(8.1s) = \boxed{81\,m/s}$$

$81\,m/s \longrightarrow 181\,mi/hr$

How low do planes fly? $1100\,ft \rightarrow \boxed{335\,m}$

Time to max height $\rightarrow 8.1s$ $\quad v_0 = 81\,m/s$

How would we find max height?

$$y = \cancel{y_0}^{\,0} + v_0 t + \tfrac{1}{2}at^2$$
$$(81\,m/s)(8.1s) - 4.9(8.1s)^2 = \boxed{335\,m}$$

Supersonic speed: $\underline{\underline{343\ m/s}}$

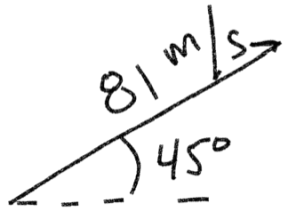
Max height

$$y = \cancel{y_0}^{\,0} + v_0 t - 4.9t^2$$

$$\downarrow$$

$$343t - 4.9t^2$$

Maximize distance



① Time of flight/ time to impact

② Horizontal Distance

③ Max height

④ Velocity upon impact

① Time of flight

$$y = \cancel{y_0}^{\,0} + V_{0y} t - 4.9t^2$$

2 answers

$$0 = (81 \sin 45)t - 4.9t^2$$

$+4.9t^2$ $\qquad$ $+4.9t^2$

$$\frac{4.9t^{\cancel{2}}}{4.9\cancel{t}} = \frac{(81 \sin 45)\cancel{t}}{4.9\cancel{t}}$$

$$t = \frac{81 \sin 45}{4.9} = \boxed{11.7\,s}$$

Time to impact: 11.7s

$81 \sin 45 = 57.3 \, m/s$

② Horizontal Distance traveled $81 \cos 45 = 57.3 \, m/s$

$$x_f = \cancel{x_0}^{\,0} + V_{0x} t$$

$$(81 \cos 45)(11.7) = \boxed{670 m}$$

③ Max Height time → Max height

Velocity @ Max Height = 0 m/s

$$\frac{11.7}{2} = 5.85 s$$

$$V_f = V_i + at$$

$$0 = (81 \sin 45) + (-9.8)t$$

$$+9.8t \qquad\qquad +9.8t$$

$$\frac{9.8t}{9.8} = \frac{81 \sin 45}{9.8} = \boxed{5.84 s}$$

$$y = \cancel{y_0}^{\,0} + V_{0y} t - 4.9t^2$$

$$(81 \sin 45)(5.84) - 4.9(5.84)^2$$

$$= \boxed{167.4 m}$$

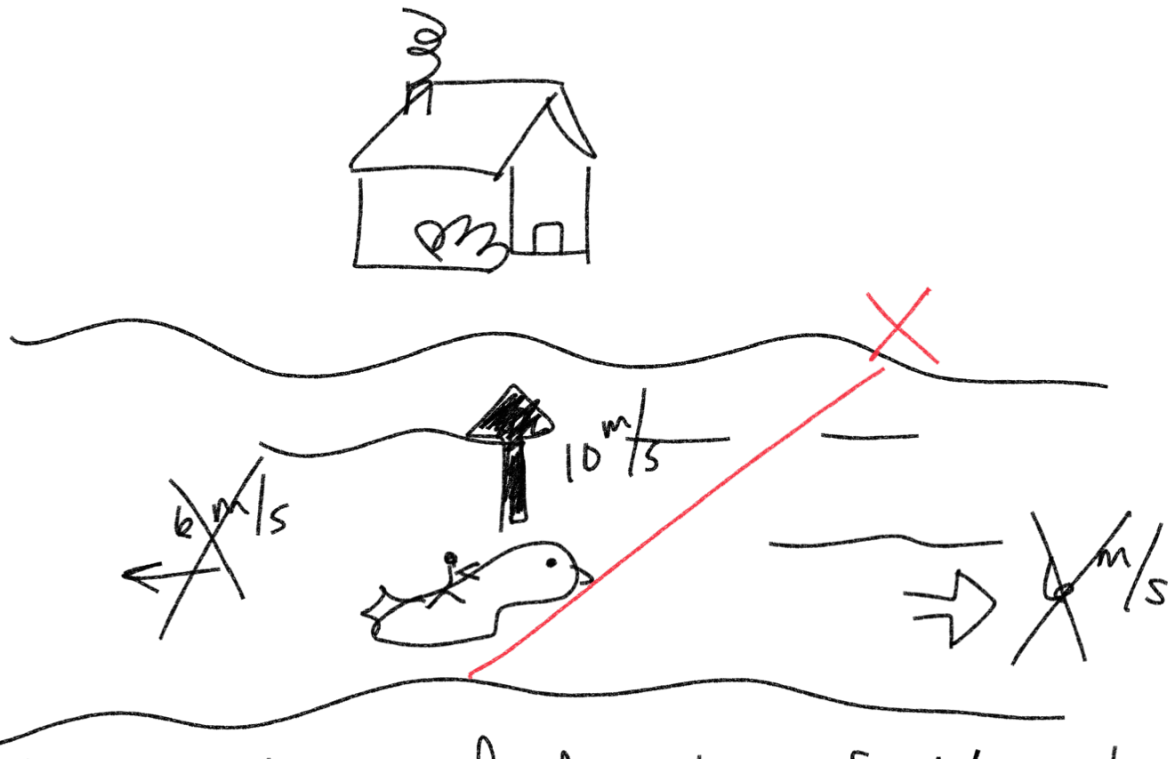
without angle, max height was $\frac{335 m}{2}$

④ Velocity upon impact

$$V_f = V_{oy} + at \qquad -V_{oy}$$

$$81 \sin 45 - 9.8(11.7) = \boxed{-57.4 \text{ m/s}}$$

$$V_{oy} \rightarrow 81 \sin 45 = 57.4$$



Find magnitude and direction of the velocity necessary.

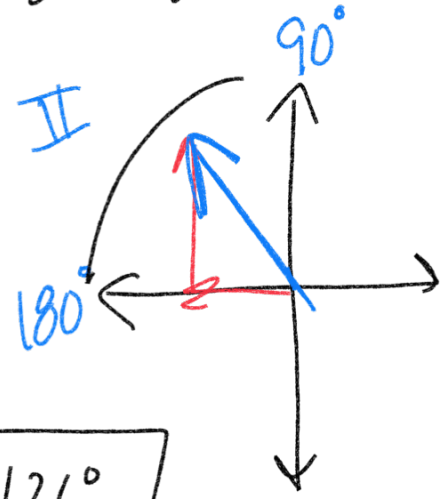
$$r = \sqrt{x^2 + y^2}$$

$$\sqrt{(-6)^2 + (10)^2}$$

$$\sqrt{36 + 100} = \sqrt{136} = \boxed{11.66\ m/s}$$

$$\theta = \tan^{-1}\left(\frac{y}{x}\right)$$

$$\tan^{-1}\left(\frac{10}{-6}\right) = -59^\circ$$



$$180^\circ + (-59^\circ) = 121^\circ$$

$$\boxed{11.66\ m/s,\ 121^\circ}$$