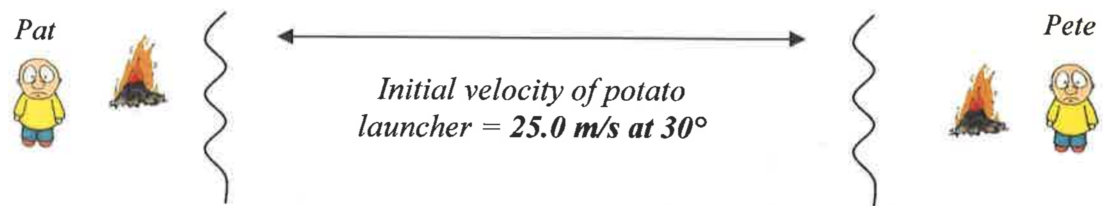
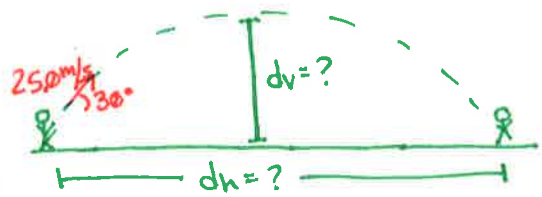
PAT PROJECTILE REVIEW (PPR)

1. **Pat's Potato**: Pat wants to shoot a potato he cooked in foil in his campfire to his brother, Pete, on the opposite riverbank.
   a. What is the total time in the air for the potato?
   b. What is its maximum height?
   c. If Pete is able to catch the potato, how far away from Pat is he?





$V_i = 25.0\ m/s\ @\ 30°$

$V_h = V_i \cos\theta$
$= (25.0\ m/s)\cos 30°$
$V_h = 21.7\ m/s$

$V_{v1} = V_i \sin\theta$
$= (25.0\ m/s)\sin 30°$
$V_{v1} = 12.5\ m/s$

a. $t_{total} = ? = t_{up} + t_{down}$

$\Delta V_v = V_{v2}^{\nearrow 0} - V_{v1} = g \cdot t_{up}$

$t_{up} = \frac{-V_{v1}}{g} = \frac{-12.5\ m/s}{-9.80\ m/s^2} = 1.28\ s$

$t_{total} = 1.28\ s + 1.28\ s$

$\boxed{t_{total} = 2.56\ s}$ ← 2 decimals
2.55 s if not rounding

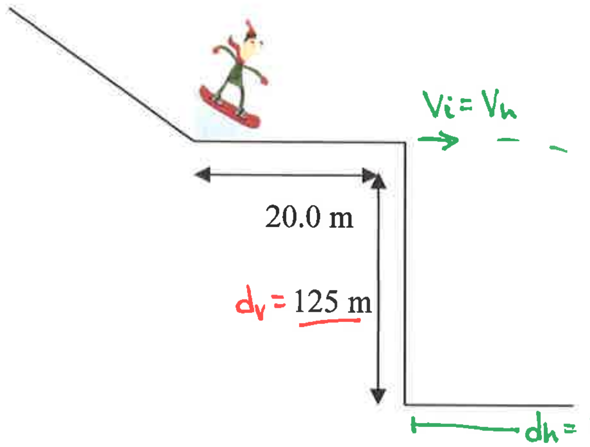
b. $d_v = ? = \frac{1}{2}gt^2$
$= \frac{1}{2}(9.80\ m/s^2)(1.28\ s)^2$

$\boxed{d_v = 8.03\ m}$ 3 sf
7.97 m if not rounding

c. $d_h = ? = V_h \cdot t_{total}$
$= (21.7\ m/s)(2.56\ s)$

$\boxed{d_h = 55.6\ m}$ 3 sf
55.2 m if not rounding

2. **Snowpack Pat**: It takes Pat 4.0 seconds to travel the last horizontal 20.0 m as shown below. Assume this constant velocity that is his launch speed:



a. How long is Pat in the air?
b. How far away does Pat land?
c. What are the magnitudes of the horizontal and vertical components of Pat just before landing?

a. $t_{total} = ? = t_{down}$

$\hookrightarrow d_v = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2d_v}{g}} = \sqrt{\frac{2(-125m)}{(-9.80 m/s^2)}}$

$\boxed{t_{down} = 5.05s}$ 3 sf

b. $d_h = ? = V_h \cdot t_{total}$

$\downarrow$ $\hookrightarrow t_{fall} = t_{total}$

$V_h = \frac{d}{t} = \frac{20.0 m}{4.0 s} = 5.0 m/s$

$d_h = (5.0 m/s)(5.05 s)$

$\boxed{d_h = 25 m}$ 2 sf

c. V_h & V_{v2} at bottom = ?

V_h = constant

$\Delta V_v = V_{v2} - V_{v1} = g \cdot t_{fall}$ ($V_{v1} = 0$)

$V_{v2} = (9.80 m/s^2)(5.05 s)$

$\boxed{V_h = 5.0 m/s \qquad V_{v2} = -49.5 m/s}$

3. **Pat Plays Tennis**: At the ball's maximum height…
   a. What is the ball's velocity?
   b. In what direction is the ball accelerating?
   c. What is the magnitude of its horizontal acceleration? Vertical?
   d. How does its time up to max height compare with its time down?

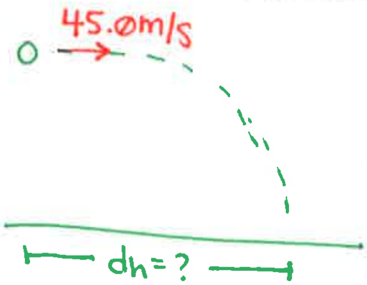
a. V_v at max. height is Ø m/s

b. at max. height, the ball is accelerating downwards

c. $a_h = Ø\ m/s^2$; $a_v = g = 9.8Ø\ m/s^2$ (downward)

d. $t_{up} = t_{down}$ for type II projectiles

4. **Paintball Pat**: Pat launches a paintball horizontally with an initial velocity of 45.0 $^m/_s$. The object strikes the ground 4.2 seconds later. How far from the muzzle does the ball land?



$V_h = 45.0\ m/s$

$t_{fall} = t_{total} = 4.2s$

$d_h = ?$

$d_h = V_h \cdot t_{total}$

$= (45.0 m/s)(4.2s)$

$\boxed{d_h = 190m}$ 2 sf

5. **Pat's Pole Vault**: Pat launches himself at 17 m/s at an angle of 40°.
   a. What is the x-component of Pat's launch speed?
   b. If Pat wants to land 35 meters away, what is the minimum speed he needs to launch at?

$V_i = 17\ m/s\ @\ 40°$

$V_h = V_i \cos\theta$

$= (17\ m/s) \cos 40°$

$V_h = 170\ m/s$

$V_v = V_i \sin\theta$

$= (17\ m/s) \sin 40°$

$V_v = 11\ m/s$

a. $V_h = 170\ m/s$

b. $V_i = ?$ $d_h = \frac{V_i^2 \sin(2\cdot\theta)}{g} \Rightarrow V_i = \sqrt{\frac{d_h \cdot g}{\sin(2\theta)}}$

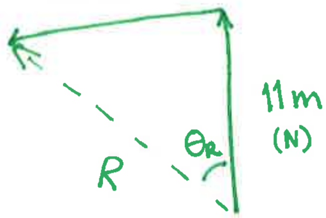
$V_i = \sqrt{\frac{(35\ m)(9.80\ m/s^2)}{\sin(2\cdot 40°)}}$

$V_i = 19\ m/s$ 2 sf

6. **Pat & His Parakeet**: Pat's parakeet, Polly, flies 11 meters North and 16 meters West to get to Pat's House.

a. What direction would the resultant displacement be in?

b. What is the resultant displacement?



a. Northwest

$$\theta_R = \tan^{-1}\left(\frac{16m}{11m}\right)$$

$$\boxed{\theta_R = 55° \text{ W of N}}$$

OR 35° N of W

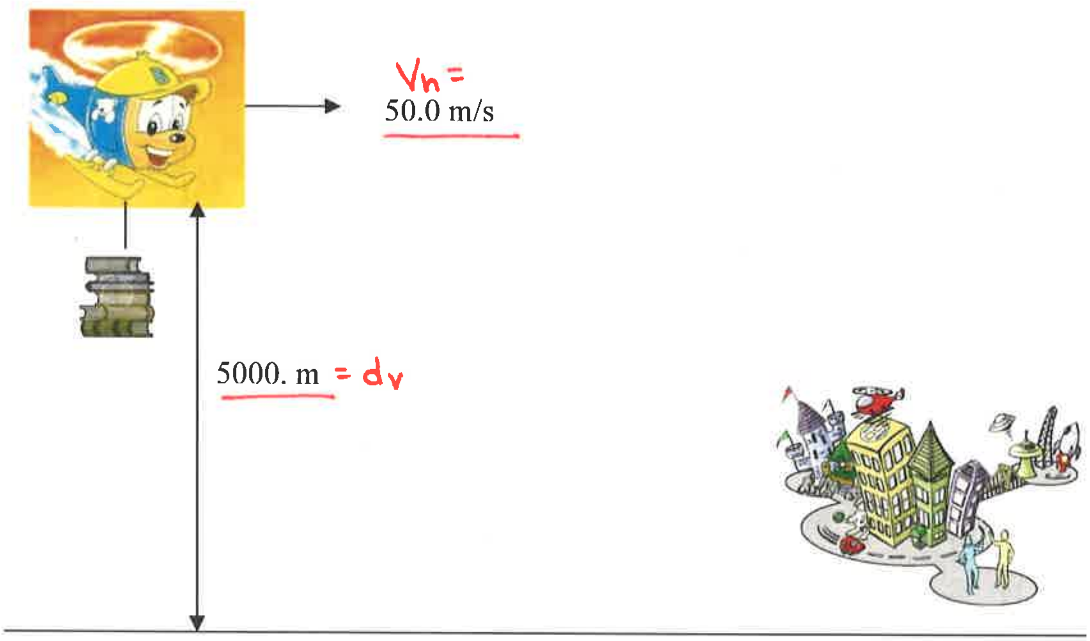
b. $R = ?$

$$R = \sqrt{R_x^2 + R_y^2}$$

$$= \sqrt{(16m)^2 + (11m)^2}$$

$$\boxed{R = 19\text{ m}}$$

7. **Pilot Pat**: Pat's helicopter flies at a constant 50.0 m/s. Calculate how far away (the horizontal range) Pat should release the supplies so they land at the village.
   a. How will the horizontal location of the package compare with the helicopter's horizontal location?
   b. What are the horizontal and vertical components of the helicopter's speed?
   c. What is the package's horizontal speed after 2 seconds?



$d_h = ?$ $\quad d_h = V_h \cdot t_{total}$ $\quad (t_{total} = t_{down})$

$\hookrightarrow d_v = \frac{1}{2}gt^2 \Rightarrow t_{down} = \sqrt{\frac{2d_v}{g}}$

$d_h = (50.0\,m/s)(31.94\,s)$

$= \sqrt{\frac{2(-5000.\,m)}{(-9.80\,m/s^2)}}$

$t_{down} = 31.94\,s$

$\boxed{d_h = 16\bar{0}0\,m}$ 3sf

or $1.60 \times 10^3\,m$

a. They both have constant hor. velocity, so their horizontal positions are the same.

b. $V_h = 50.0\,m/s$ $\qquad V_{v1} = 0\,m/s$

c. $V_h = \text{constant} = 50.0\,m/s$