PAT PROJECTILE PRACTICE PROBLEMS (PPPP)

1. Pat aims his potato gun horizontally at a target 90.0 meters away. He lines the bull's eye up in the sights. The potato leaves the gun with a horizontal velocity of 200. $^{m}/_{s}$.
   a. How much time does it take the potato to reach the target?
   b. Does Pat hit the bull's eye (assuming the left-right aim is good)? If not, by how much does he miss?

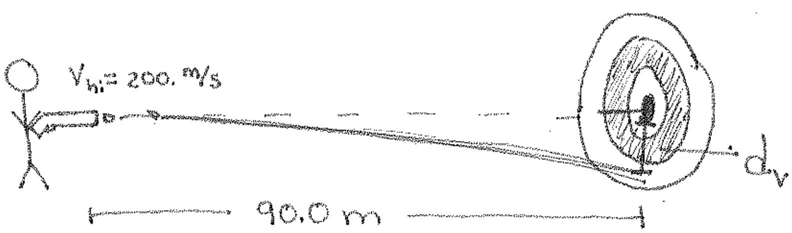
$d_h = 90.0 m$
$V_h = 200. m/s$
$a_h = 0 m/s^2$
$a_v = g = 9.80 m/s^2$
$V_v = 0 m/s$

a) $d_h = V_h \cdot t \Rightarrow t = \frac{d_h}{V_h}$

$t = \frac{90.0 m}{200. m/s}$

$t = 0.450 s$

b.



$d_v = \frac{1}{2} g t^2$

$= \frac{1}{2} (9.80 m/s^2)(0.450 s)^2$

$d_v = 0.992 m$ No! He'll miss the bull's eye by 0.992 m!

2. Pat is out in an open flat grassy field. He holds the potato gun 1.25 meters off of the ground and fires it horizontally. The potato leaves the gun with a velocity of 300. $^{m}/_{s}$.
   a. How far will the bullet travel horizontally before hitting the ground?
   b. After 0.25 seconds of falling, what are the horizontal and vertical components of its velocity?

a. $d_v = 1.25m$ $\quad V_h = 300.\ m/s$

$V_v = 0\ m/s$ $\quad a_h = 0\ m/s^2$

$a_v = 9.80\ m/s^2$ $\quad d_h = ?$

$$d_v = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{\frac{2 d_v}{g}}$$

$$t = \sqrt{\frac{2(1.25\ m)}{9.80\ m/s^2}}$$

$$t = 0.505s$$

$$d_h = V_h \cdot t$$

$$= (300.\ m/s)(0.505s)$$

$$\boxed{d_h = 152\ m}$$

b. V_h = constant !

$$V_v = g \cdot t$$

$$= (9.80\ m/s^2)(0.25s)$$

$V_h = 300.\ m/s$ $\quad V_v = 2.5\ m/s$ downward

3. Pat is sitting on the flat ground with his potato gun. He aims it at 30° from the horizontal and fires the potato with a velocity of 300. $^{m}/_{s}$.
   a. What are the horizontal and vertical components just as it is fired?
   b. What are the horizontal and vertical components at the top of its path?
   c. How much time does it take to reach the top of its path?
   d. How much time does it stay in the air?
   e. How far away from Pat does the potato hit the ground?

a. $V_i = 300. \text{ m/s} @ 30°$

$V_h = V_i \cos\theta$ $= (300. \text{ m/s}) \cos 30°$

$V_v = V_i \cdot \sin\theta$ $= (300. \text{ m/s}) \cos 30°$

$V_h = 26\bar{0} \text{ m/s}$ $V_v = 15\bar{0} \text{ m/s}$

b. $V_h = 26\bar{0} \text{ m/s}$ $V_v = 0 \text{ m/s}$

c. $\Delta V_v = g \cdot t \Rightarrow t_{up} = \frac{\Delta V}{g}$

$= \frac{15\bar{0} \text{ m/s}}{9.80 \text{ m/s}^2}$

$t_{up} = 15.3 \text{ s}$

d. $t_{up} = t_{down} = 15.3 \text{s}$

$t_{total} = t_{up} + t_{down}$

$= 15.3 \text{s} + 15.3 \text{s}$

$t_{total} = 30.6 \text{ s}$

e. $d_h = V_h \cdot t_{total}$

$= (26\bar{0} \text{ m/s}) \cdot (30.6 \text{s})$

$= 7959.2 \text{ m}$

$d_h = 7960 \text{ m}$ 3 s.f.

4. Pat is sitting on top of a 200. meter high cliff with his potato gun. He fires it at 40° from the horizontal with a velocity of 300. m/s.
   a. What are the horizontal and vertical components of its velocity when it is fired?
   b. How much time does it take to reach its peak height?
   c. How much time does it take to reach the ground?
   d. What is its vertical component just before it hits the ground?
   e. How far (horizontally) away from the cliff does the potato hit the ground?

a. $V_h = V_i \cos\theta$ $\quad\quad$ $V_v = V_i \cdot \sin\theta$

$= (300.\ m/s) \cos 40°$ $\quad\quad$ $= (300.\ m/s) \cdot \sin 40°$

$V_h = 23\bar{0}\ m/s$ $\quad\quad$ $V_{v_i} = 193\ m/s$

b. $\Delta V_v = g \cdot t \Rightarrow t = \frac{\Delta V}{g}$

$= \frac{193\ m/s}{9.80\ m/s^2}$

$t_{up} = 19.7\ s$

c. $d_v = \frac{1}{2} g t^2$

$= \frac{1}{2}(9.80\ m/s^2)(19.7\ s)^2$

$d_v = 1897\ m$

↑ max height above cliff

Total $d_v = 1897\ m + 200\ m = 2097\ m$

$d_v = \frac{1}{2} g t^2 \Rightarrow t = \sqrt{\frac{2 d_v}{g}}$

$t_{down} = \sqrt{\frac{2(2097\ m)}{9.80\ m/s^2}}$

$t_{down} = 20.7\ s$

$t_{total} = t_{up} + t_{down} = 19.7\ s + 20.7\ s$

$t_{total} = 40.4\ s$

d. $V_v = g t \Rightarrow V_v = 0$ @ top, so use t_{down}!

$= (9.80\ m/s^2)(20.7\ s)$

$V_v = 203\ m/s$

e. $d_h = V_h \cdot t_{total}$

$= (230\ m/s)(40.4\ s) = 9276.5$

$d_h = 9280\ m$ / 3 s.f.