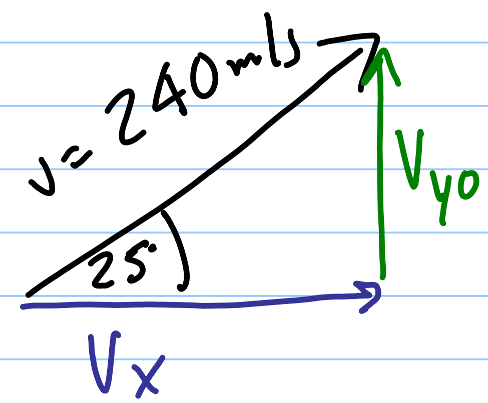
Note Title 27/09/2009

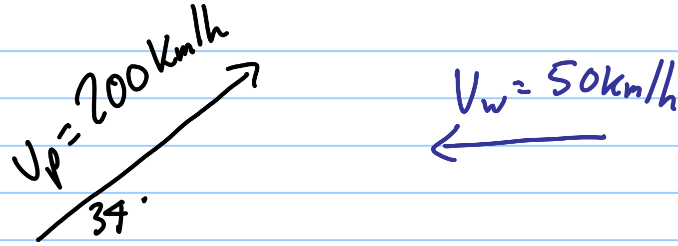
1)



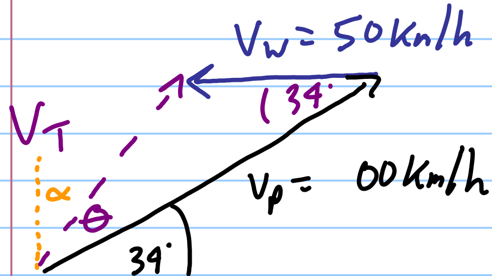
$V_x = 240 \cos 25$
$= 218$ m/s

$V_{y0} = 240 \sin 25$
$= 101$ m/s

2)



Trig Method



$$V_T^2 = V_p^2 + V_w^2 - 2V_pV_w\cos 34°$$

$$V_T = \boxed{161 \text{ km/h}}$$

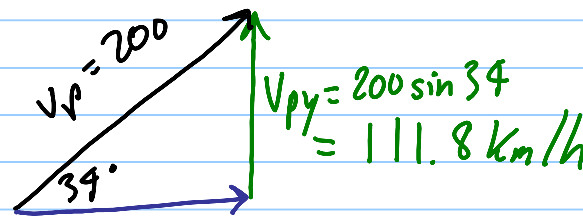
$$\frac{\sin\theta}{50} = \frac{\sin 34}{160.99}$$

$$\theta = 10°$$

$$\alpha = 90 - 34 - 10°$$

$$= \boxed{46° \text{ E of N}}$$

Component Method



$V_{px} = 200\cos 34$

$= 165.8$ km/h

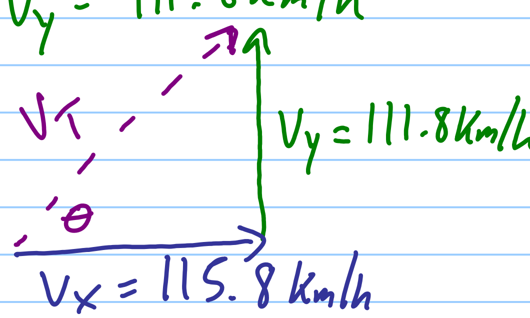
$V_{wx} = -50$ km/h

$$\sum V_x = V_{px} + V_{wx}$$

$$= 165.8 - 50$$

$$= 115.8 \text{ km/h}$$

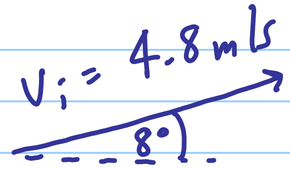
$$\sum V_y = 111.8 \text{ km/h}$$

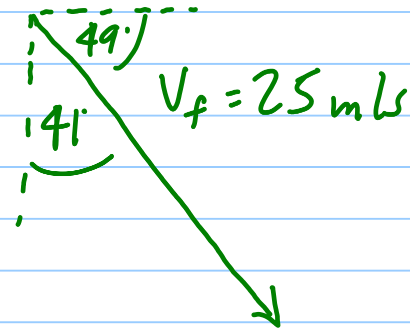


$$V_T = \sqrt{V_x^2 + V_y^2} = \boxed{161 \text{ km/h}}$$

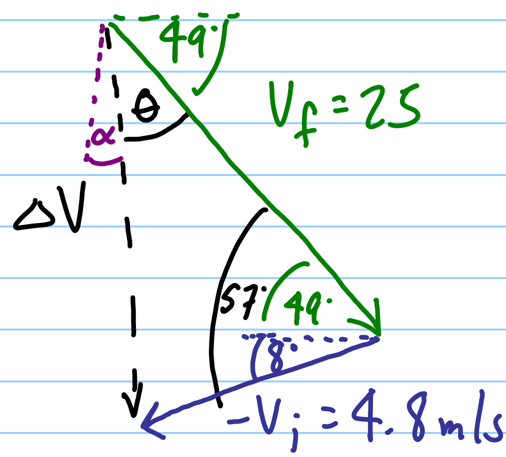
$$\theta = \tan^{-1}\left(\frac{111.8}{115.8}\right) = \boxed{44° \text{ N of E}}$$

3)





$$\Delta V = V_f - V_i$$



$$\Delta V^2 = V_f^2 + V_i^2 - 2V_fV_i\cos 57$$

$$\Delta V = \boxed{22.7\ m/s}$$

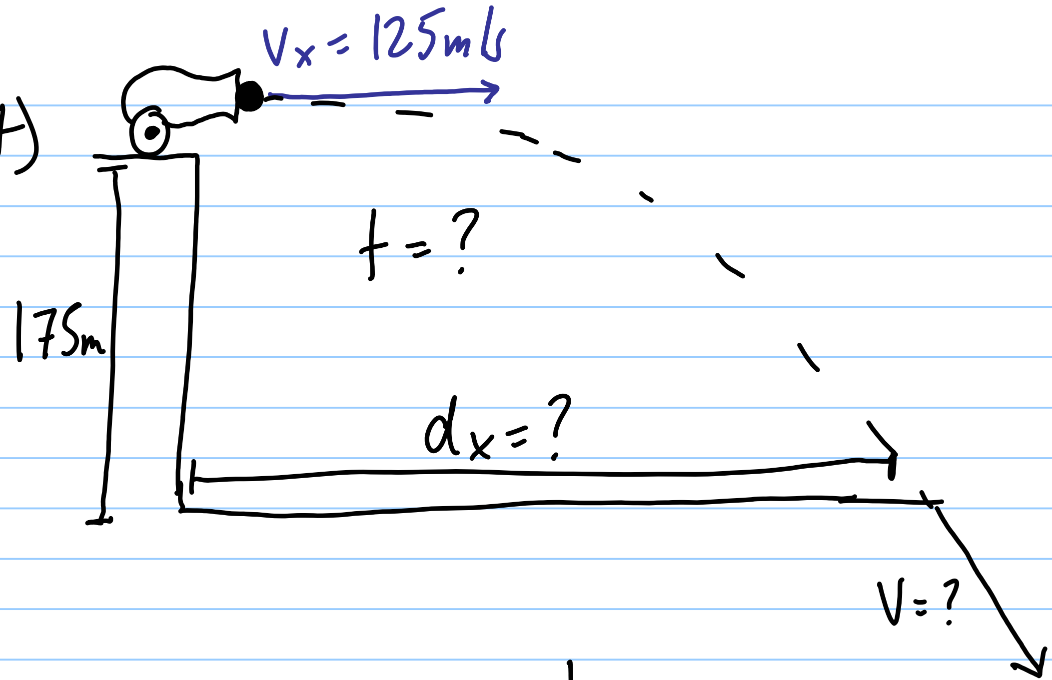
$$\frac{\sin\theta}{4.8} = \frac{\sin 57}{22.7}$$

$$\theta = 10.2^\circ$$

$$\alpha = 90 - 49 - 10.2$$

$$= \boxed{30.8^\circ \text{ E of S}}$$

4)



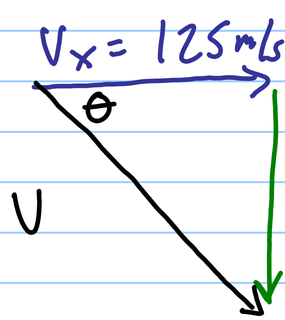
X	Y
$v_x = 125\text{ m/s}$	V_y
d_x	$V_{y0} = 0$
$t = 5.976\text{ s}$	$a_y = -9.80\text{ m/s}^2$
$d_x = v_x t$	$d_y = -175\text{ m}$
$= \boxed{747\text{ m}}$	t

$$d = v_0 t + \tfrac{1}{2} a t^2$$

$$t = \sqrt{\frac{2d}{a}}$$

$$= \sqrt{\frac{2(-175)}{-9.80}}$$

$$\boxed{= 5.98\text{ s}}$$



$$V_y = V_{y0} + at$$

$$= -58.6\text{ m/s}$$

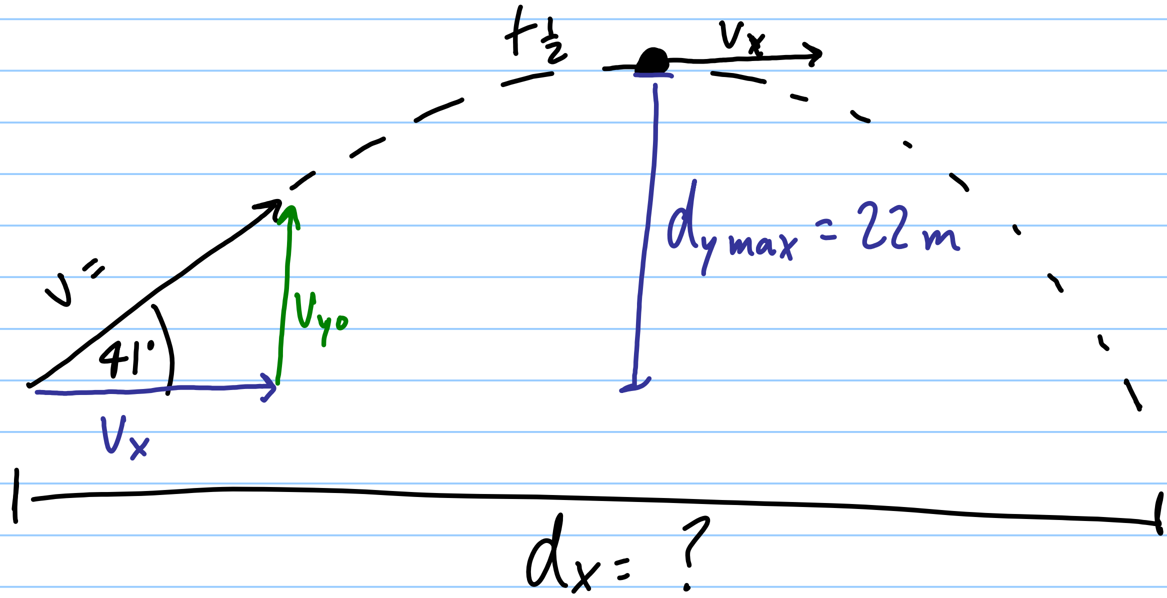
$$v = \sqrt{V_x^2 + V_y^2}$$

$$= \boxed{138\text{ m/s}}$$

$$\theta = \tan^{-1}\left(\frac{58.6}{125}\right)$$

$$= \boxed{25^\circ \text{ below horiz}}$$

5)



x	y @ $t_{\frac{1}{2}}$
$V_x = 23.9\,m/s$	$V_y = 0$
$d_x =$	$V_{yo} =$
$t = 2 \times t_{\frac{1}{2}} = 4.24\,s$	$a_y = -9.80\,m/s^2$
$d_x = V_x t$	$d_y = 22\,m$
$= \boxed{101\,m}$	$t_{\frac{1}{2}} =$

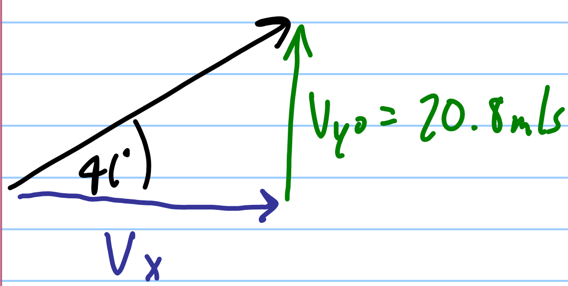
$\cancel{V}^{2\,0} = V_o^2 + 2ad$

$V_o = \sqrt{-2ad}$

$= \underline{\underline{20.8\ m/s}}$

$\cancel{V}^{0} = V_o + a t_{\frac{1}{2}}$

$t_{\frac{1}{2}} = \frac{-V_o}{a} = \underline{\underline{2.12\ s}}$



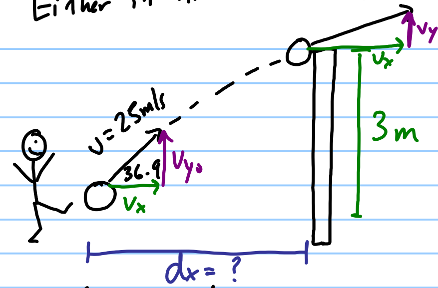
$\tan 41 = \frac{V_{yo}}{V_x}$

$V_x = \frac{V_{yo}}{\tan 41}$

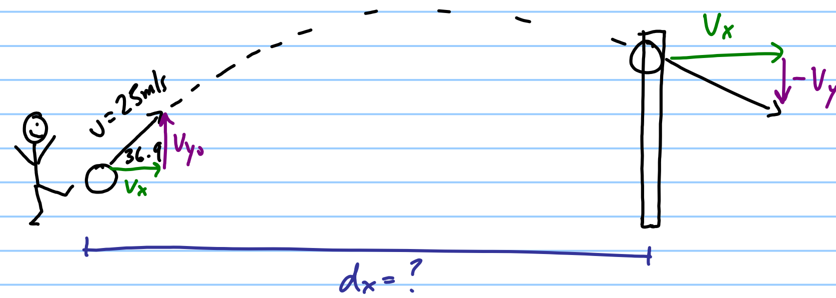
$= \underline{\underline{23.9\,m/s}}$

Either it hit on the way up...

6.)

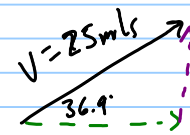


or the way down...



The good news is the final v_y will be the same speed but + on the way up and − on the way down.

So let's find that first.



$v_{y_0} = 25 \sin 36.9 = 15.01\,m/s$

$v_x = 25 \cos 36.9 = 19.99\,m/s$

x	y
$v_x = 19.99\,m/s$	$v_y = ?$
$d_x =$	$v_{y_0} = 15.01\,m/s$
$t =$	$a_y = -9.80\,m/s^2$
	$d_y = 3.0\,m$
	$t =$

$$v^2 = v_0^2 + 2ad$$

$$v = \pm\sqrt{v_0^2 + 2ad}$$

$$= \pm\sqrt{(15.01)^2 + 2(-9.80)(3.0)}$$

$$= +12.90\,m/s \text{ and } -12.09\,m/s$$

on the way up　　on the way down

On the way up:

$v = v_0 + at$　　$t = \dfrac{v - v_0}{a} = \dfrac{12.90 - 15.01}{-9.80}$

$= 0.2153\,s$

$d_x = v_x t$

$= (19.99)(0.2153)$

$= \boxed{4.3\,m}$

On the way down:

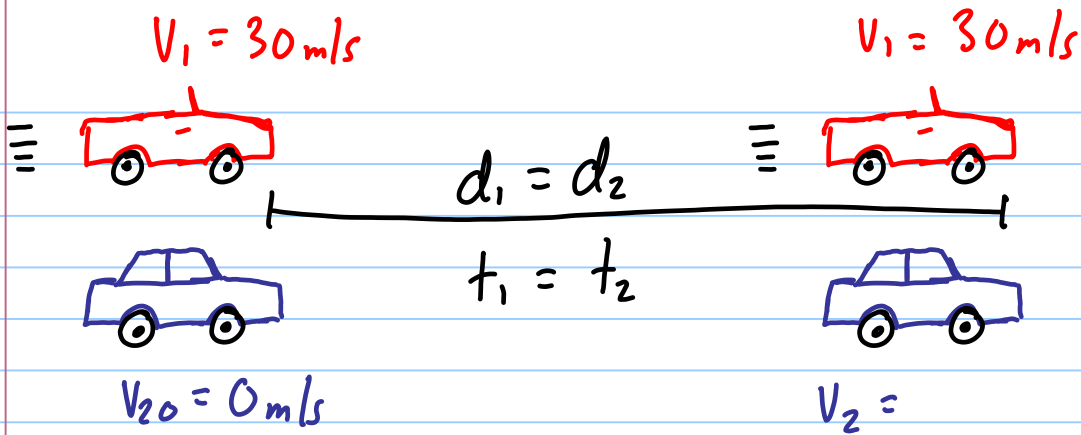
$t = \dfrac{v - v_0}{a} = \dfrac{-12.90 - 15.01}{-9.80}$

$= 2.848\,s$

$d_x = v_x t$

$= (19.99)(2.848)$

$= \boxed{56.9\,m}$



Speeding Car (const v)

$V_1 = 30\,m/s$

$d_1 =$

$t_1 =$

$$V_1 = \frac{d_1}{t_1}$$

$$d_1 = v_1 t_1 = 30 t_1$$
$$= 30 t_2$$

Police Car (const. a)

$V_2 =$

$V_{20} = 0$

$a_2 = 3\,m/s^2$

$d_2 = d_1 = 30 t_2$

$t_2 =$

$$d_2 = \cancel{V_{20}}^{\,0}\,t_2 + \frac{1}{2} a_2 t_2^2$$

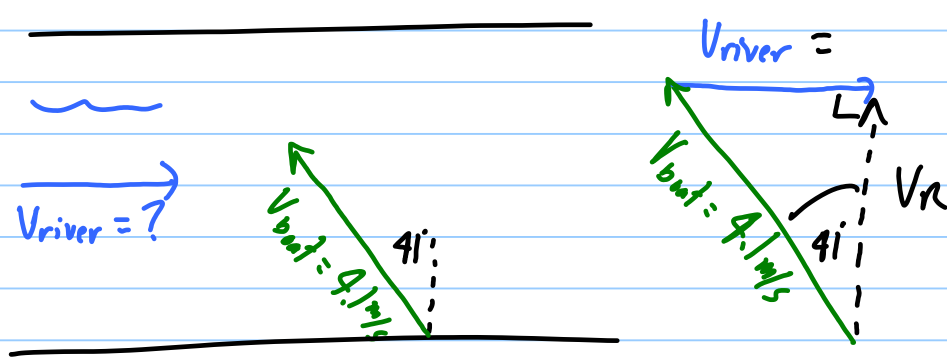
$$30 t_2 = \frac{1}{2} a_2 t_2^2$$

$$30 \cancel{t_2} = \frac{1}{2}(3) t_2^{\cancel{2}}$$

$$\boxed{t_2 = 20\,s}$$

$$d_1 = v_1 t_1$$
$$= (30)(20) = \boxed{600m}$$

8.)



$$\sin 41° = \frac{V_{river}}{V_{boat}}$$

$$V_{river} = (4.1)\sin 41 = \boxed{2.7\ m/s}$$

$$\cos 41 = \frac{V_R}{V_{boat}}$$

$$V_R = (4.1)\sin 41° = \boxed{3.1\ m/s}$$

9.)

Vx

- There is no net force in the x-direction
- Therefore the x-velocity is constant.
- And so it will be the same when it strikes the ground

Vy

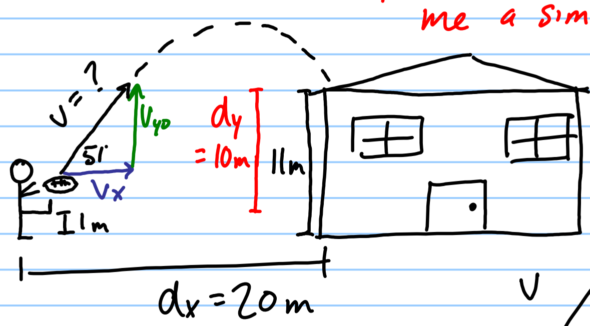
- There is a constant acceleration in the y-direction due to gravity.
-Therefore the intitial speed upwards will be the same as the final speed downwards if it returns to the same height.

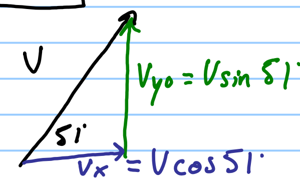
Vtotal

If the x and y-components of the initial and final speeds are equal then they will form congruent triangles, where the hypotenuses are equal.

Ok, so this one gets ugly... too ugly for a test question. But I'll give you ₱ 1 000 000 (Physics dollars) if you can show me a simpler solution.

Bonus:





x	y
$V_x = V\cos 51°$	V_y
$d_x = 20m$	$V_{yo} = V\sin 51°$
t	$a_y = -9.80 m/s$
$t = \frac{d_x}{V_x} = \frac{d_x}{V\cos 51°}$	$d_y = 10m$ $d_y = V_o t + \frac{1}{2}a_y t^2$
	t $d_y = (V\sin 51°)t + \frac{1}{2}at^2$

$$d_y = (\cancel{v}\sin 51°)\left(\frac{d_x}{\cancel{V}\cos 51}\right) + \frac{1}{2}a\left(\frac{d_x}{V\cos 51°}\right)^2$$

$$\boxed{\frac{\sin\theta}{\cos\theta} = \tan\theta}$$

$$d_y = d_x\frac{\sin 51°}{\cos 51°} + \frac{1}{2}a\frac{d_x^2}{v^2\cos^2 51°}$$

$$d_y - d_x\tan 51° = \frac{1}{2}a\frac{d_x^2}{V^2\cos^2 51°}$$

$$V^2 = \frac{\frac{1}{2}a\,d_x^2}{(d_y - d_x\tan 51°)\cos^2 51}$$

$$V = \sqrt{\frac{\frac{1}{2}a\,d_x^2}{(d_y - d_x\tan 51°)\cos^2 51}}$$

$$V = \sqrt{\frac{\frac{1}{2}(-9.8)(20)^2}{(10 - 20\tan 51°)\cos^2 51}} = \boxed{18.3\ m/s}$$