Name: Example Work

Homework Week # 3

2D Vectors & Motion
Due Thurs 9/05/19

Reading

Tuesday: **C&J 3.3-3.5**

Thursday: **C&J 4.1-4.6**

It is required that students provide a sketch of the coordinate system and approximately scaled vector arrows for vector quantities. Don't forget to include such if you want full credit.

Focus on Concepts

Problem 1. 1.7.8

Problem 2. 1.7.12

Problem 3. 3.3.3

Problems

Problem 4. 1.6.33

Problem 5. 1.7.39

Problem 6. 1.8.46

Problem 7. 1.CCP.70

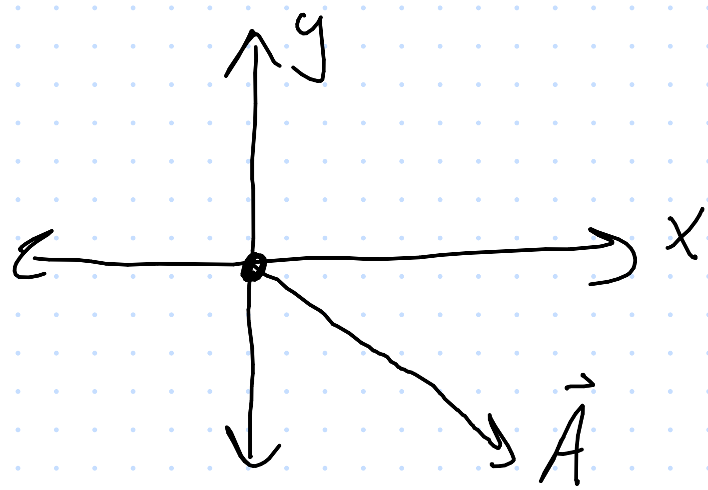
Problem 8. 3.1.3

Problem 9. 3.1.9

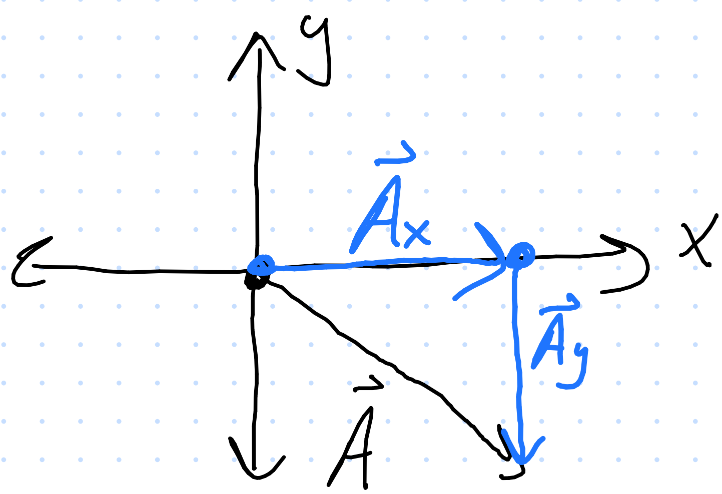
Problem 10. 3.3.12

1. FOC 1.7.8

If a displacement can be represented by



then it can be decomposed into x and y components

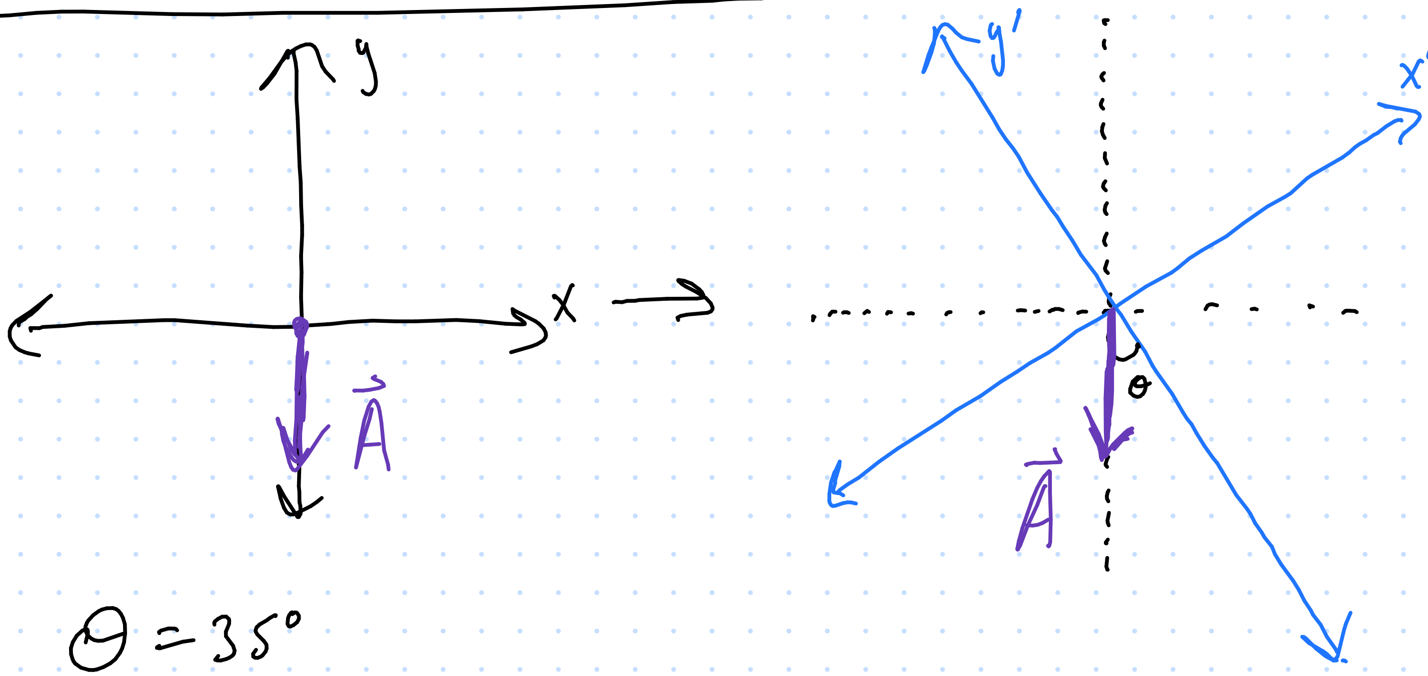


We write $\vec{A} = \vec{A}_x + \vec{A}_y$

$$\vec{A} = A_x \hat{\imath} + A_y \hat{\jmath}$$

2. <u>FOC 1.7.12</u> 1/2

Express a vector $\vec{A}$ in a different coordinate system that has the same origin as a standard x-y coordinate sys.



$\theta = 35°$

$\vec{A} = -450.0m\,\hat{j}$

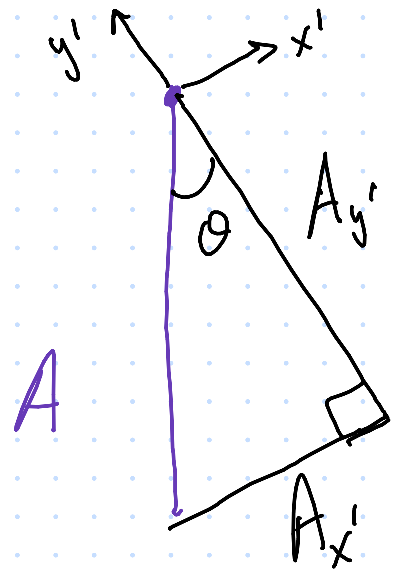
Find $A_{x'}, A_{y'}$ for $\vec{A} = A_{x'}\hat{x}' + A_{y'}\hat{y}'$

note: $\hat{j} \equiv$ (1 unit in y direction) so lets write $\hat{x}' \equiv \underline{1}$ unit in x' direction

$\hat{y}' \equiv \underline{1}$ unit in y' direction

2. FOC 1.7.12 2/2

I advise redrawing the right triangle we are using for the working coordinate system.



$A = 450.0$

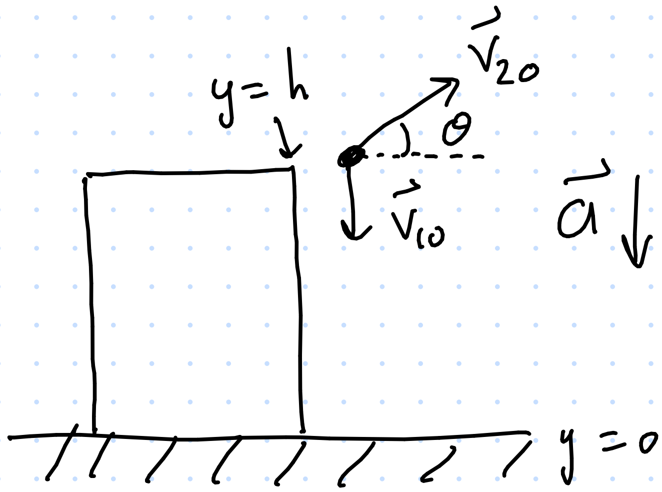
$\theta = 35^\circ$

$$A_{x'} = -A \sin\theta \qquad A_{y'} = -A\cos\theta$$

$$\boxed{\begin{aligned} A_{x'} &= -258\,m \\ A_{y'} &= -369\,m \end{aligned}}$$

3. FOC 3.3.3

Consider 2 cases when $|\vec{a}| = g$



Using 

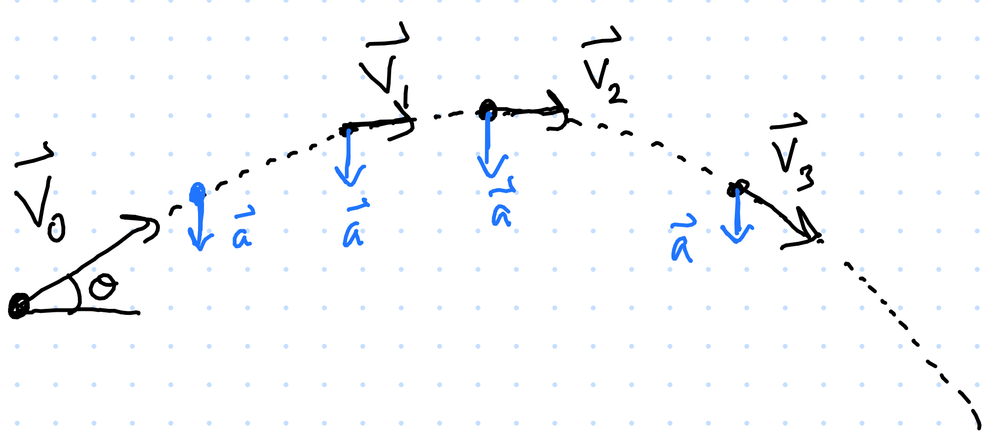
$$\vec{a} = -g\hat{j}$$

$$\vec{v}_{10} = -v_0\hat{j}$$

$$\vec{v}_{20} = v_0(\cos\theta\hat{i} + \sin\theta\hat{j})$$

Remember $\vec{v} \neq \vec{a}$! For such a projectile the acceleration due to gravity (from the earth) is g downwards.

(c) Same $\vec{a}$ at all times



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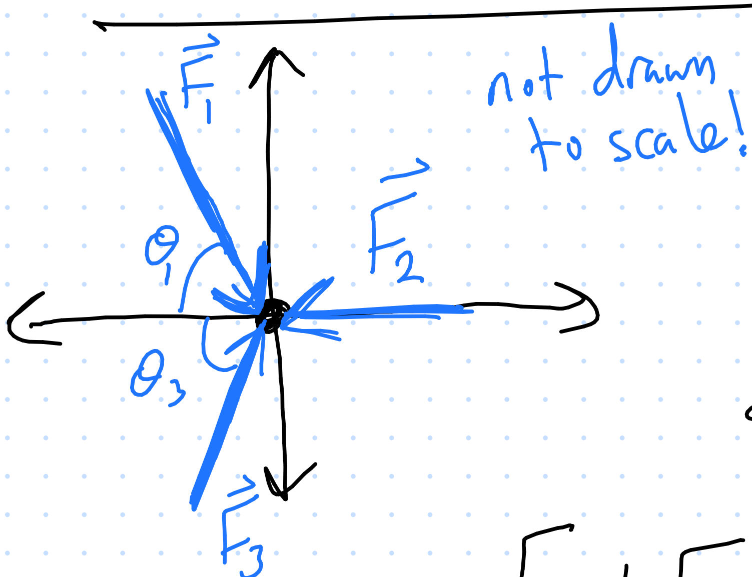
4. 1.6.33

1/2

Find $\vec{F}_3$ s.t. $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 0$

if $\vec{F}_1 = F_1 \left(+\cos\theta_1 \hat{\imath} - \sin\theta_1 \hat{\jmath} \right)$, $F_1 = 50.0\,N$, $\theta_1 = 60.0°$

and $\vec{F}_2 = -F_2 \hat{\imath}$, $F_2 = 90.0\,N$.



$\Sigma \vec{F} = 0$

$\Sigma F_x = 0$ $\qquad$ $\Sigma F_y = 0$

$F_{1x} + F_{2x} + F_{3x} = 0$ $\qquad$ " $\quad$ "

so

$$F_{3x} = -\left(F_{1x} + F_{2x} \right) = -\left(+F_1 \cos\theta_1 - F_2 \right)$$

$$F_{3y} = -\left(F_{1y} + F_{2y} \right) = -\left(-F_1 \sin\theta_1 \right)$$

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4. 1.6.33 2/2

$F_{3x} = F_2 - F_1 \cos\theta_1$ $F_{3y} = +F_1 \sin\theta_1$

$F_{3x} = 65.0N$ $F_{3y} = 43.3N$

We're not finished!

$F_3 = \sqrt{F_{3x}^2 + F_{3y}^2}$ $\tan\theta_3 = \frac{F_{3y}}{F_{3x}}$

$$\boxed{\begin{aligned} F_3 &= 78.1N \\ \theta_3 &= 33.7^\circ \end{aligned}}$$

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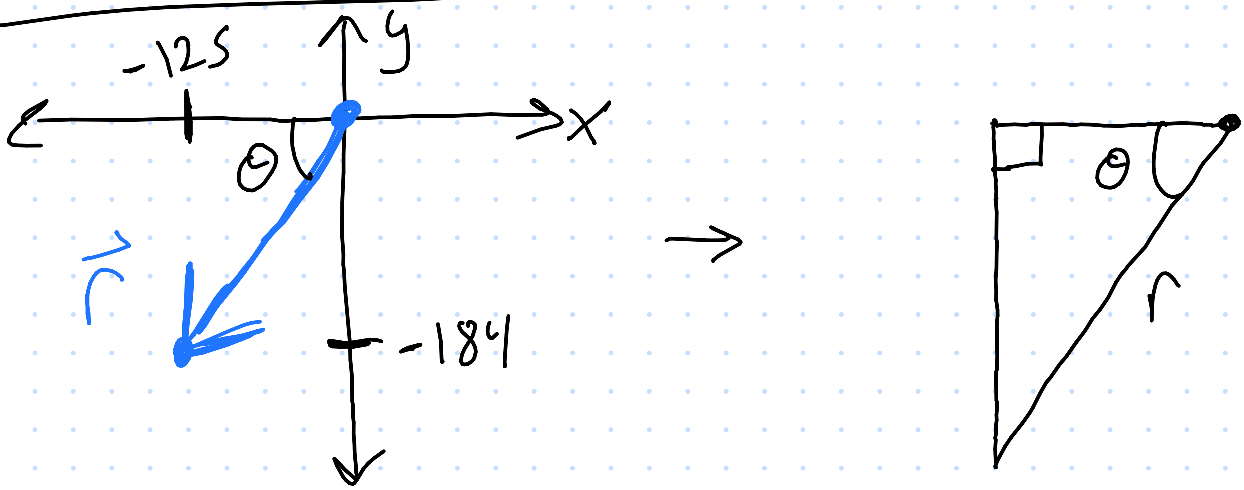
S. 1.7.39

$\vec{r} = (-125\hat{i} - 184\hat{j})\,m$ for 

Find r, θ



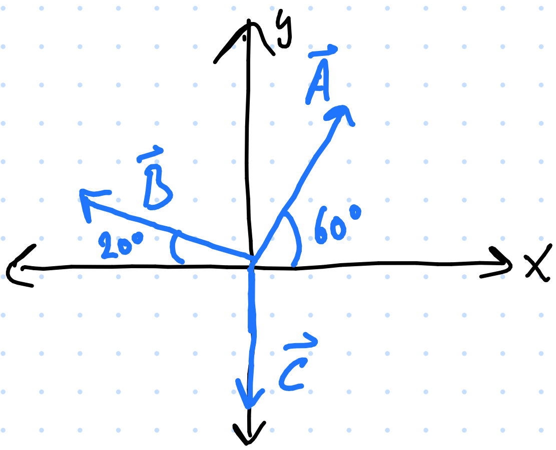
$$r = \sqrt{x^2 + y^2}$$

$$\tan\theta = \frac{y}{x}$$

$$\boxed{\begin{array}{c} r = 222\,m \\ \theta = 55.8^\circ \end{array}}$$

G. 1.8.46

Find $\vec{R}$ if $A = 5.00m$, $B = 5.00m$, $C = 4.00m$.



$$\vec{R} = \vec{A} + \vec{B} + \vec{C}$$

$$R_x = A_x + B_x + C_x$$

$$R_y = A_y + B_y + C_y$$

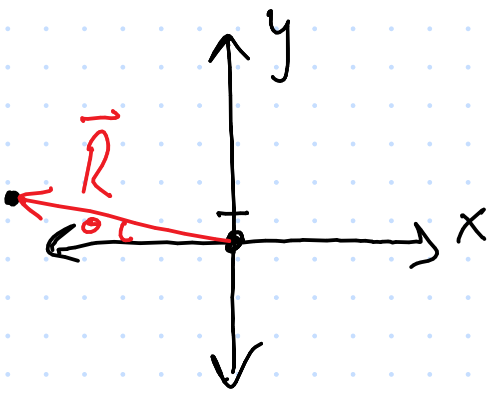
$A_x = +A\cos 60°$ $\quad B_x = -B\cos 20°$ $\quad C_x = 0$

$A_y = +A\sin 60°$ $\quad B_y = +B\sin 20°$ $\quad C_y = -C$

$$R_x = (5.00m)(\cos 60° - \cos 20°)$$

$$R_y = (5.00\sin 60° - 4.00)m$$

$$\vec{R} = (-2.20\,\hat{i} + 0.33\,\hat{j})m$$



$\boxed{\vec{R} = 2.22m,\ 8.54° \text{ from } -x\text{-axis}}$

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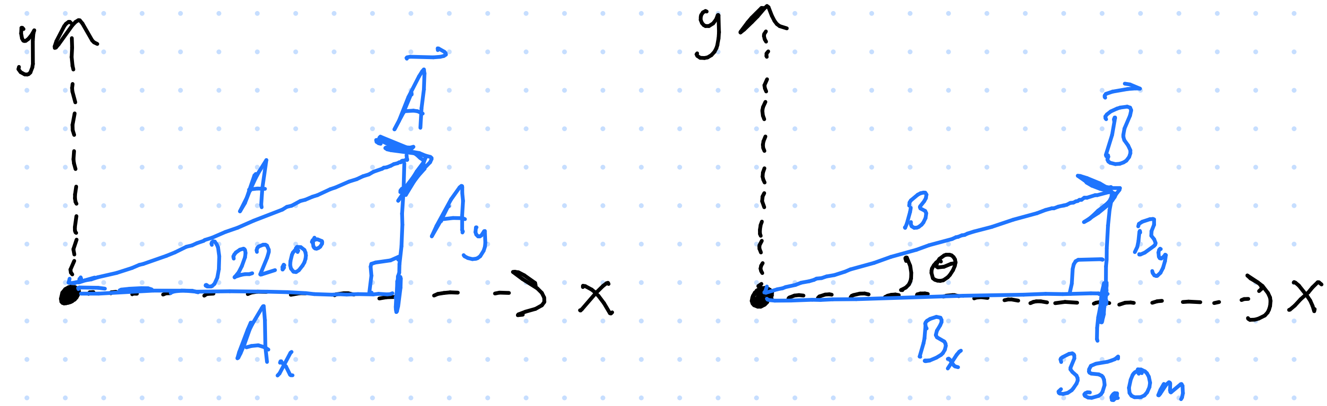
7. 1.CCP.70

Find A and B_y if $\vec{A} = \vec{B}$.



If $\vec{A} = \vec{B}$ then

(i) $A = B$, $\theta_A = \theta_B$

(ii) $A_x = B_x$, $A_y = B_y$

$\therefore$ $\tan\theta = \dfrac{B_y}{B_x} \rightarrow B_y = (35.0\,m)\tan 22.0°$

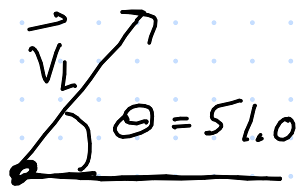
$\cos\theta = \dfrac{A_x}{A} \rightarrow A = \dfrac{(35.0\,m)}{\cos 22.0°}$

$$\boxed{B_y = 14.1\,m,\ A = 37.7\,m}$$

8. 3.1.3

$\vec{a} = 340 \frac{m}{s^2}$, 51° for $t = 0.050\,s$

calculate $\vec{V}_L = V_{Lx}\hat{i} + V_{Ly}\hat{j}$



$$\vec{V}_L = \vec{a}\,t \begin{cases} V_{Lx} = a_x t \\ V_{Ly} = a_y t \end{cases}$$

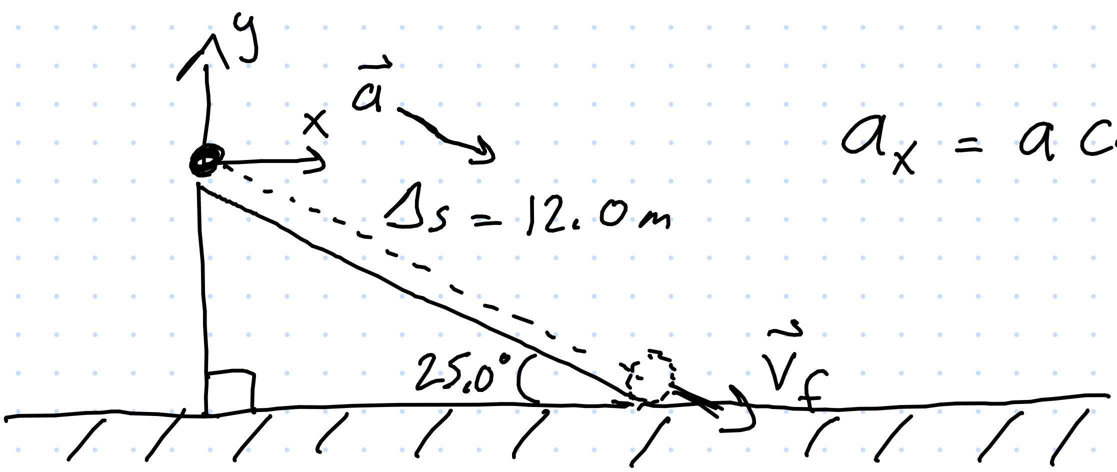
$a_x = a\cos\theta = 214\ m/s^2$

$a_y = a\sin\theta = 264\ m/s^2$

$\downarrow$

$$\boxed{\begin{aligned} V_{Lx} &= 10.7\ m/s^2 \\ V_{Ly} &= 13.2\ m/s^2 \end{aligned}}$$

9. 3.1.9 If $\vec{v}_0 = 0$, $\Delta s = 12.0\,m$ and $|\vec{v}_f| = v_f = 7.70\,\frac{m}{s}$ (a) find a and (b) a_x if $\theta = 25.0°$



$a_x = a \cos 25.0°$

For s-direction: $v^2 = v_0^2 + 2a\Delta s$

$v_0 = 0 \longrightarrow a = \dfrac{v^2}{2\Delta s} = \dfrac{(7.70)^2}{2(12.0)} \dfrac{m^2/s^2}{m}$

$$\boxed{\begin{aligned} a &= 2.47\,\frac{m}{s^2} \\ a_x &= 2.24\,\frac{m}{s^2} \end{aligned}}$$

10. 3.3.12

If $\vec{V}_o = 5480 \frac{m}{s} \hat{i}$ and for 842 s an acceleration $\vec{a} = (1.20\hat{i} + 8.40\hat{j}) \frac{m}{s^2}$ is applied then what is V_x and V_y?

$$\vec{V} = \vec{V}_o + \vec{a}\,t = \begin{cases} V_x = V_{ox} + a_x t \\ V_y = V_{oy} + a_y t \end{cases}$$

$V_{ox} = 5480 \frac{m}{s}$

$V_{oy} = 0$

$$\boxed{\begin{aligned} V_x &= 6490 \frac{m}{s} \\ V_y &= 7073 \frac{m}{s} \end{aligned}}$$