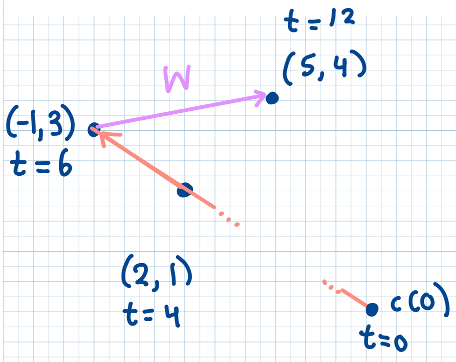
1. A particle travels at constant velocity on the time intervals $[0,6]$ and $(6,12]$. It is at $(2,1)$ at time 4, at $(-1,3)$ at 6, and $(5,4)$ at time 12. Write an equation that describes the position of the particle at time t and determine the position of the particle at time 0.



$$V = (-1,3) - (2,1) = \langle -3, 2 \rangle$$

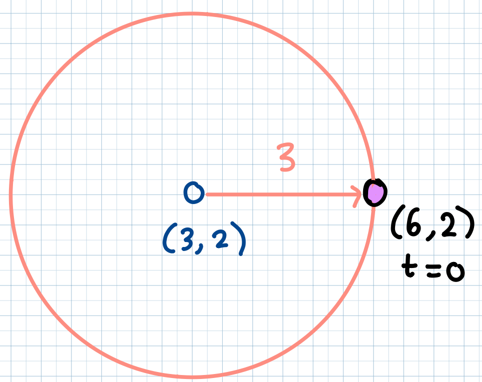
$$W = (5,4) - (-1,3) = \langle 6, 1 \rangle$$

$$c(t) = \begin{cases} \frac{t-4}{2} V + (2,1) & \text{if } 0 \le t \le 6 \\ \frac{t-6}{6} W + (-1,3) & \text{if } 6 < t \le 12 \end{cases}$$

$$= \begin{cases} \frac{t-4}{2} \langle -3, 2 \rangle + (2,1) & \text{if } 0 \le t \le 6 \\ \frac{t-6}{6} \langle 6, 1 \rangle + (-1,3) & \text{if } 6 < t \le 12. \end{cases}$$

$$c(0) = \frac{0-4}{2} \langle -3, 2 \rangle + (2,1) = -2 \langle -3, 2 \rangle + (2,1) = (8, -3)$$

2. A particle rotates counterclockwise around the point $(3,2)$ at constant speed of 4. It is at the point $(6,2)$ at time 0. Write an equation that models the position of the particle at time t.



$$c(t) = \langle 3\cos(d(t)), 3\sin(d(t)) \rangle + (3, 2)$$

where

$$d(0) = 0 \quad \text{and} \quad 3d(t) = 4t.$$

Take $d(t) = \frac{4}{3} t$ so

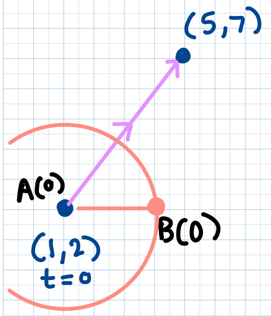
$$c(t) = \left(3\cos\left(\tfrac{4}{3} t\right) + 3, 3\sin\left(\tfrac{4}{3} t\right) + 2 \right).$$

3. Take A to be a particle that moves on the line segment with endpoints $(1,2)$ and $(5,7)$. It is at $(1,2)$ at time 0 and it moves along the line segment at a speed of 2. Take B to be a particle that rotates around A in a counter clockwise direction as A travels. It is a distance of 3 to the right of A at time 0 and has a speed of 14.

a Write down equations that model the motion for A and B.

b Determine how long it takes for A to reach $(5,7)$.

c Determine how many full orbits B has made by the time A reaches $(5,7)$.



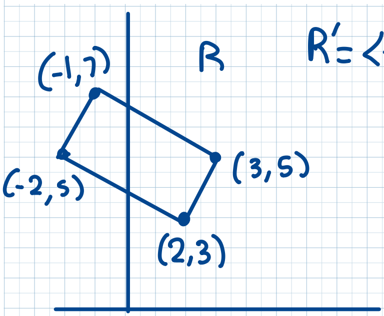
a. $A(t) = 2t\left\langle \frac{4}{\sqrt{41}}, \frac{5}{\sqrt{41}} \right\rangle + (1,2)$

$B(t) = \left\langle 3\cos\left(\frac{14}{3}t\right), 3\sin\left(\frac{14}{3}t\right) \right\rangle + A(t)$

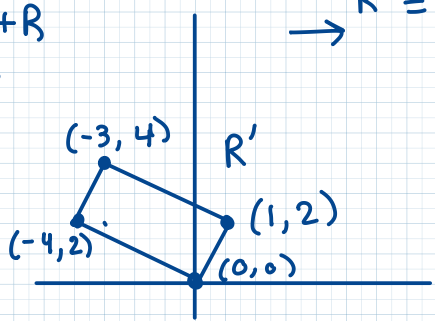
b. It takes $\frac{\sqrt{41}}{2} \approx 3.20$ time

c. $\dfrac{\left(\frac{\sqrt{41}}{2}\right)}{\left(\frac{3\pi}{7}\right)} \approx 2.38$ so 2 full orbits.

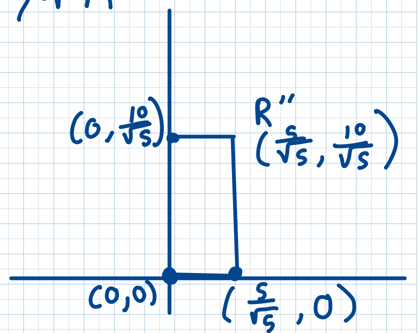
4. A rectangle R has vertices at $(2,3)$, $(3,5)$, $(-1,7)$, and $(-2,5)$. Determine a rigid transformation so that the vertex of R at $(2,3)$ is at $(0,0)$ and the edge $\overline{(2,3)(3,5)}$ is on the x-axis. Then determine the positions of vertices after applying this transformation.



$R' = \langle -2,-3 \rangle + R \longrightarrow$



$\longrightarrow R'' = \left\langle \frac{1}{\sqrt{5}}, -\frac{2}{\sqrt{5}} \right\rangle * R'$



$(2,3)$	$\langle -2,-3\rangle + (2,3) = (0,0)$	$\left\langle \frac{1}{\sqrt{5}}, -\frac{2}{\sqrt{5}} \right\rangle * (0,0) = (0,0)$
$(3,5)$	$\langle -2,-3\rangle + (3,5) = (1,2)$	$\left\langle \frac{1}{\sqrt{5}}, -\frac{2}{\sqrt{5}} \right\rangle * (1,2) = \left(\frac{5}{\sqrt{5}}, 0\right)$
$(-1,7)$	$\langle -2,-3\rangle + (-1,7) = (-3,4)$	$\left\langle \frac{1}{\sqrt{5}}, -\frac{2}{\sqrt{5}} \right\rangle * (-3,4) = \left(\frac{5}{\sqrt{5}}, \frac{10}{\sqrt{5}}\right)$
$(-2,5)$	$\langle -2,-3\rangle + (-2,5) = (-4,2)$	$\left\langle \frac{1}{\sqrt{5}}, -\frac{2}{\sqrt{5}} \right\rangle * (-4,2) = \left(0, \frac{10}{\sqrt{5}}\right)$

Transformation is $T(\square) = \left\langle \frac{1}{\sqrt{5}}, -\frac{2}{\sqrt{5}} \right\rangle * \left(\langle -2,-3\rangle + \square\right)$

New Vertices are $(0,0)$, $\left(\frac{5}{\sqrt{5}}, 0\right)$, $\left(\frac{5}{\sqrt{5}}, \frac{10}{\sqrt{5}}\right)$, $\left(0, \frac{10}{\sqrt{5}}\right)$.