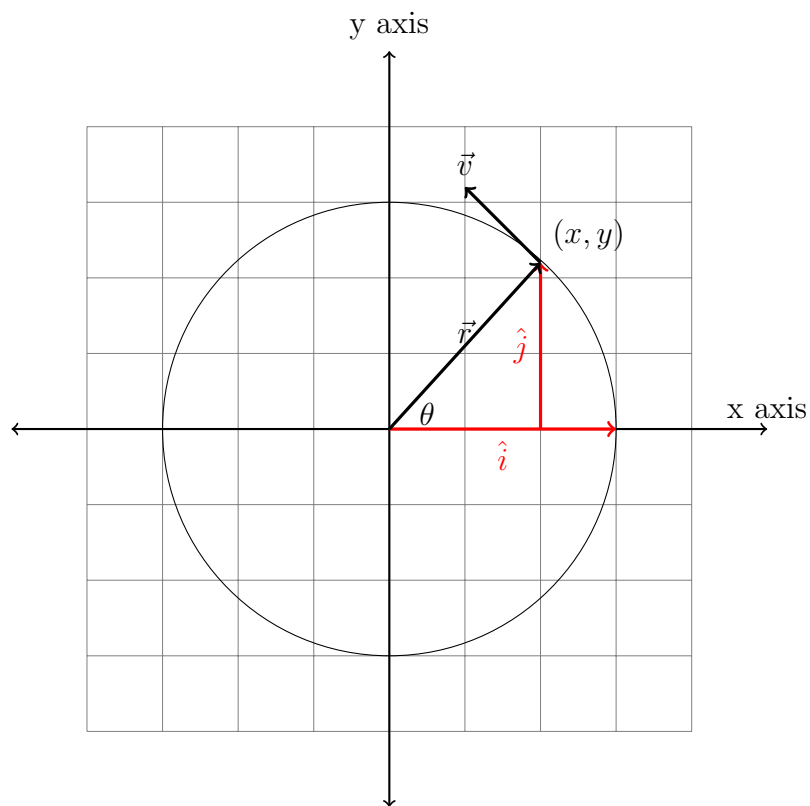


# University Physics 1A

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## Circular Motion



The position of an object in circular motion:

$$\vec{r} = x\hat{i} + y\hat{j}$$

## Constant Speed

$$\begin{aligned}\text{speed } v &= \frac{\text{distance traveled}}{\text{time}} \\ &= \frac{\text{arc length}}{\text{time}} \\ &= \frac{r\theta}{t}\end{aligned}$$

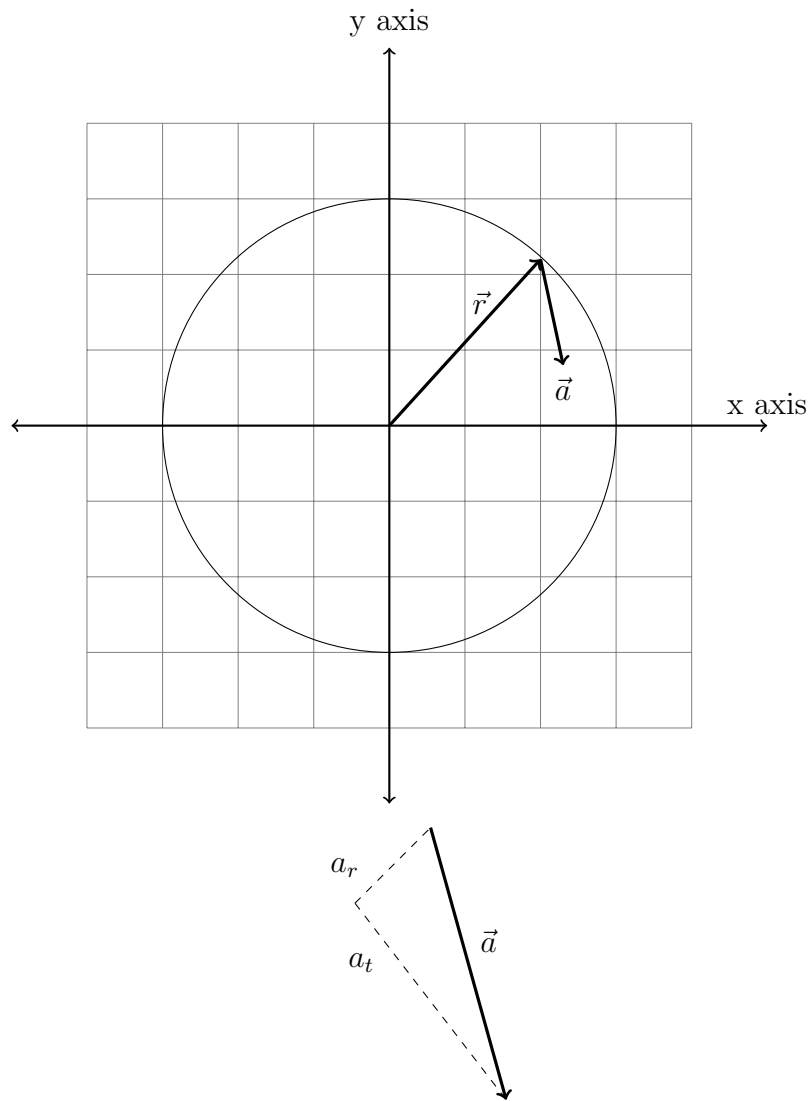
where  $t$  is the time it takes to travel  $\theta$ .

$$\begin{aligned}\theta &= \frac{vt}{r} \\ \vec{r} &= x\hat{i} + y\hat{j} \\ &= r \cos \theta \hat{i} + r \sin \theta \hat{j} \\ \vec{r} &= r \cos\left(\frac{vt}{r}\right)\hat{i} + r \sin\left(\frac{vt}{r}\right)\hat{j} \\ \vec{v} &= \frac{d\vec{r}}{dt} \\ &= -r \frac{v}{r} \sin\left(\frac{vt}{r}\right) + r \frac{v}{r} \cos\left(\frac{vt}{r}\right)\hat{j} \\ &= -v \sin\left(\frac{vt}{r}\right)\hat{i} + v \cos\left(\frac{vt}{r}\right)\hat{j} \\ \vec{a} &= \frac{d\vec{v}}{dt} \\ &= -v \frac{v}{r} \cos\left(\frac{vt}{r}\right)\hat{i} - v \frac{v}{r} \sin\left(\frac{vt}{r}\right)\hat{j} \\ &= -\frac{v^2}{r} (\cos\left(\frac{vt}{r}\right)\hat{i} + \sin\left(\frac{vt}{r}\right)\hat{j}) \\ \|\vec{a}\| &= \frac{v^2}{r}\end{aligned}$$

Note that the direction of  $\vec{a}$  is the opposite of  $\vec{r}$  and points towards the center of the circle.

## Changing Speed

If  $v$  is not constant:



$$a_r = \frac{v^2}{r}$$

$$a_t = \frac{dv}{dt} = \text{rate of change of speed}$$

## Reminders and Homework

Complete the homework on TheExpertTA and WebAssign.  
**Remember to bring the Activities Manual**

You can find all my notes at <http://omgimanagerd.tech/notes>. If you have any questions, comments, or concerns, please contact me at [alvin@omgimanagerd.tech](mailto:alvin@omgimanagerd.tech)