

Panel 1

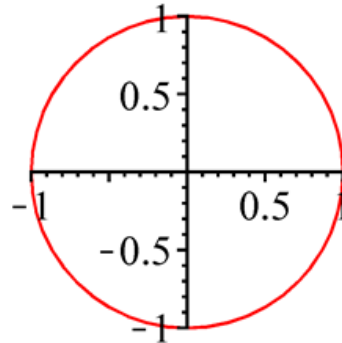
## Parametric Plane Curves, Position Vectors, Vector Functions

$$f := t \rightarrow \cos(t) : g := t \rightarrow \sin(t) :$$

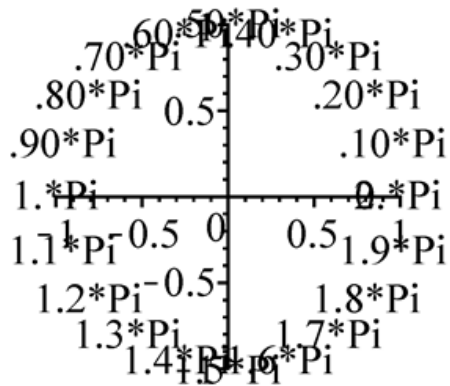
$$f(t) = \cos(t)$$

$$g(t) = \sin(t)$$

$[f(t), g(t)] \rightarrow$



(Plotted from 0 to  $2\pi$ .)



What is the starting point? Ending point?



Orientation of motion?

1

2

Panel 2

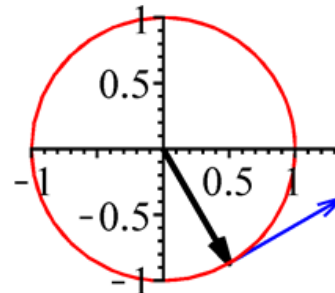
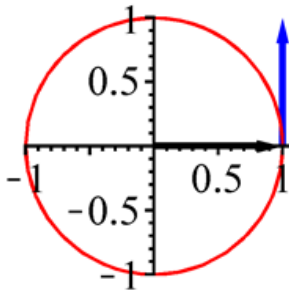
**Velocity Vector**

$$\mathbf{v}(t) = \mathbf{r}'(t)$$

**Example**

$$\mathbf{r} := t \rightarrow \langle \cos(t), \sin(t) \rangle : \mathbf{r}(t) = \begin{bmatrix} \cos(t) \\ \sin(t) \end{bmatrix} \quad \mathbf{r}'(t) = \begin{bmatrix} -\sin(t) \\ \cos(t) \end{bmatrix}$$

$$\mathbf{r}'(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad \mathbf{r}'\left(\frac{11 \cdot \pi}{3}\right) = \begin{bmatrix} \frac{1}{2} \sqrt{3} \\ \frac{1}{2} \end{bmatrix}$$



What do you notice about the derivative/velocity vector and the curve?



Panel 3

$$\mathbf{r}(t_0) = \begin{bmatrix} \frac{1}{2} \\ -\frac{1}{2} \sqrt{3} \end{bmatrix} \xrightarrow{\text{at 10 digits}} \begin{bmatrix} 0.5000000000 \\ -0.8660254040 \end{bmatrix}$$

$$\mathbf{r}(t_0 + \Delta t) = \begin{bmatrix} \sin\left(\frac{1}{6} \pi + 0.2\right) \\ -\sin\left(\frac{1}{3} \pi - 0.2\right) \end{bmatrix} \xrightarrow{\text{at 10 digits}} \begin{bmatrix} 0.6620859765 \\ -0.7494278883 \end{bmatrix}$$

$$\frac{\mathbf{r}(t_0 + \Delta t) - \mathbf{r}(t_0)}{\Delta t} = \begin{bmatrix} 5.000000000 \sin\left(\frac{1}{6} \pi + 0.2\right) - 2.500000000 \\ -5.000000000 \sin\left(\frac{1}{3} \pi - 0.2\right) + 2.500000000 \sqrt{3} \end{bmatrix}$$

$$\xrightarrow{\text{at 10 digits}} \begin{bmatrix} 0.810429882 \\ 0.582987578 \end{bmatrix}$$

Panel 4

## Space Curves

### *Example*

$$f := t \rightarrow 5 \cdot \cos(t) :$$

$$g := t \rightarrow 5 \cdot \sin(t) :$$

$$h := t \rightarrow t :$$

$$f(t) = 5 \cos(t)$$

$$g(t) = 5 \sin(t)$$

$$h(t) = t$$

$$r := t \rightarrow \langle f(t), g(t), h(t) \rangle :$$

$$r(t) = \begin{bmatrix} 5 \cos(t) \\ 5 \sin(t) \\ t \end{bmatrix}$$



<http://stevie.dhcp.rose-h>

Panel 5

## Space Curves

### Example

$$f := t \rightarrow 5 \cdot \cos(t) :$$

$$g := t \rightarrow 5 \cdot \sin(t) :$$

$$h := t \rightarrow t :$$

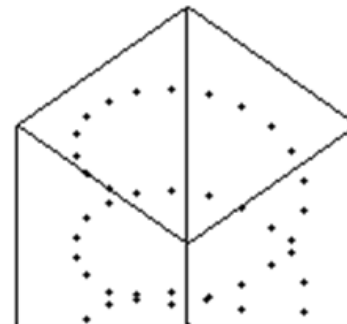
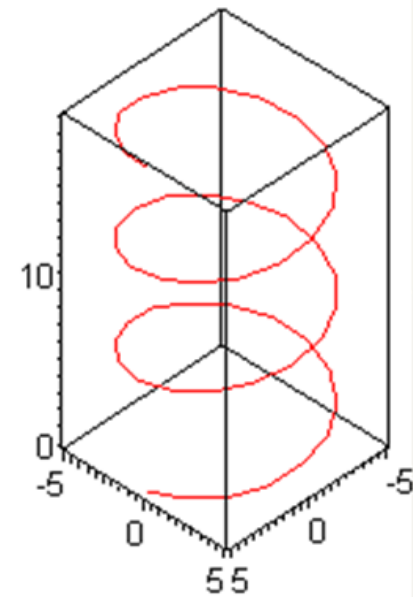
$$f(t) = 5 \cos(t)$$

$$g(t) = 5 \sin(t)$$

$$h(t) = t$$

$$r := t \rightarrow \langle f(t), g(t), h(t) \rangle :$$

$$r(t) = \begin{bmatrix} 5 \cos(t) \\ 5 \sin(t) \\ t \end{bmatrix}$$

 $[f(t), g(t), h(t)] \rightarrow$ 


Panel 6

## Space Curves

### Example

$$f := t \rightarrow 5 \cdot \cos(t) :$$

$$g := t \rightarrow 5 \cdot \sin(t) :$$

$$h := t \rightarrow t :$$

$$f(t) = 5 \cos(t)$$

$$g(t) = 5 \sin(t)$$

$$h(t) = t$$

$$\mathbf{r} := t \rightarrow \langle f(t), g(t), h(t) \rangle :$$

$$\mathbf{r}(t) = \begin{bmatrix} 5 \cos(t) \\ 5 \sin(t) \\ t \end{bmatrix}$$

