

## 24.3 Curvilinear Motion

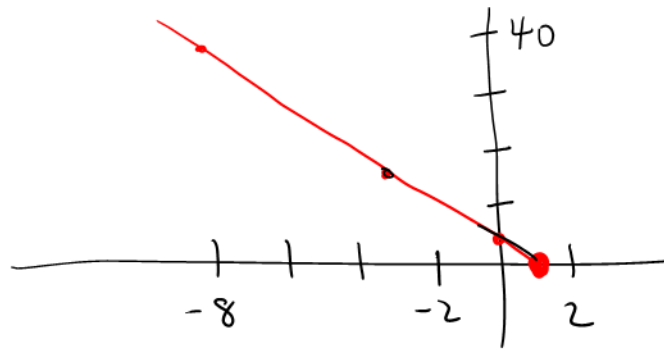
Ex:  $x = 1 - t^2$

$$y = 4t^2$$

position (in m)

$t$ : in s

$t$	$x$	$y$
0	1	0
1	0	4
2	-3	16
3	-8	36



### Notation

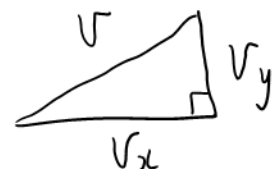
Velocity in x-direction :  $v_x$   
" y-direction :  $v_y$

### Calculation

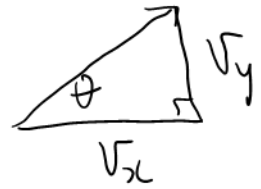
$$v_x = \frac{dx}{dt}$$

$$v_y = \frac{dy}{dt}$$

Speed  $v = \sqrt{v_x^2 + v_y^2}$



Direction  $\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right)$  (+180°?)



Draw the vector OR  
Add 180° when  $v_x < 0$

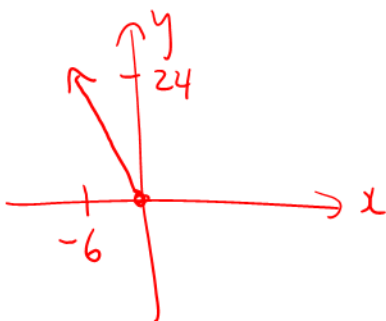
Ex:  $x = 1 - t^2$   $y = 4t^2$   
Find velocity at  $t = 3$  s.

$$v_x = -2t \quad v_y = 8t$$

$$\text{@ } t = 3: \quad v_x = -6 \quad v_y = 24$$

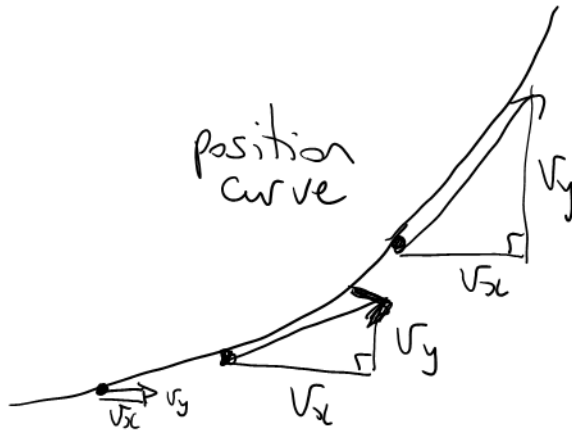
speed  $v = \sqrt{(-6)^2 + 24^2}$   
 $\approx 24.7$  m/s

direction  $\theta = \tan^{-1}\left(\frac{24}{-6}\right)$  (+180°?)



$v_x < 0$

$$= \tan^{-1}\left(\frac{24}{-6}\right) + 180^\circ$$
$$\approx 104^\circ$$



Velocity vector is tangent to the position curve.

length of velocity vector is the speed.