

$$\text{Slope} = m = \frac{dy}{dx}$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$y = mx + c$$

$$m = \tan \theta$$

Find slope to curve  $y = x^2 + 3x$   
when  $x = 1$ .

$$y = x^2 + 3x$$

$$\frac{dy}{dx} = 2x + 3$$

$$m = 2(1) + 3 = 5$$

Find slope to  $y = x^2 - 9x + 1$   
when  $x = -2$ .

$$\frac{dy}{dx} = 2x - 9$$

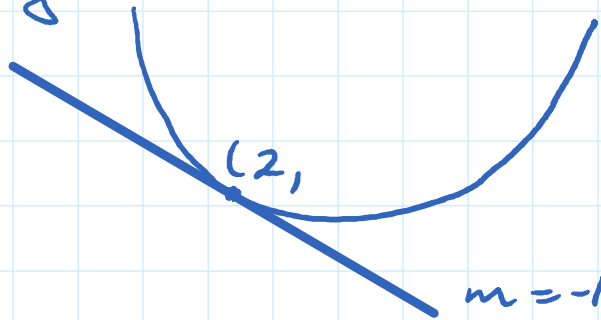
$$m = 2(-2) - 9 = -13$$

Find tangent to  $y = x^2 - 5x + 1$   
when  $x = 2$ .

$$\frac{dy}{dx} = 2x - 5$$

$$x = 2 \quad m = 2(2) - 5 = -1$$

Tangent = Line



$$y - y_1 = m(x - x_1)$$

$$x = 2$$

$$y = x^2 - 5x + 1$$

$$y = 4 - 10 + 1$$

$$= -5$$

$$(2, -5) \quad m = -1$$

$$y + 5 = -1(x - 2)$$

$$y + 5 = -x + 2$$

$$x + y = -3.$$

Find tangent to  $y = x^2 - 7x - 3$   
when  $x = -1$ .

$$\frac{dy}{dx} = 2x - 7$$

$$x = -1 \quad m = 2(-1) - 7 = -9$$

$$x = -1 \quad y = x^2 - 7x - 3$$

$$y = (-1)^2 - 7(-1) - 3 = 5$$

$$y - 5 = -9(x + 1)$$

Find point on  $y = x^2 - 7x + 3$   
where tangent has a slope  
of 5.

$$\frac{dy}{dx} = 2x - 7$$

$$2x - 7 = 5$$

$$x = 6$$

$$y = 6^2 - 7(6) + 3 = -3$$

$$(6, -3)$$

Find point on  $y = x^2 - 3x + 5$   
where tangent is parallel  
to  $7x + y = 8$ .

$$y = x^2 - 3x + 5$$

$$\frac{dy}{dx} = 2x - 3$$

Parallel  
Same slope

$$7x + y = 8$$

0

$$y = -7x + 8$$

$$m = -7$$

$$\frac{dy}{dx} = -7$$

$$2x - 3 = -7$$

$$2x = -4$$

$$x = -2$$

$$y = (-2)^2 - 3(-2) + 5$$

$$= 15 \quad (-2, 15)$$

Find point on  $y = x^2 - 7x - 3$   
 where tangent  $\perp$  perpendicular  
 to  $x - 5y = 8$

$$y = x^2 - 7x - 3$$

$$m = \frac{dy}{dx} = 2x - 7$$

$$x - 5y = 8$$

$$-5y = -x + 8$$

$$5y = x - 8$$

$$y = \frac{1}{5}x - \frac{8}{5}$$

$$m = \frac{1}{5}$$

$$2x - 7 = -5$$

$$x = 1$$

$$y = 1 - 7 - 3 = -9 \quad (1, -9)$$

Find point on  $y = x^2 - 3x - 5$  where tangent turned into  $x$ -axis at  $45^\circ$ .

$$\frac{dy}{dx} = 2x - 3$$

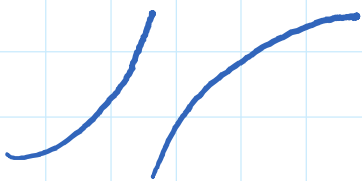
$$m = \tan 45 = 1$$

$$2x - 3 = 1$$

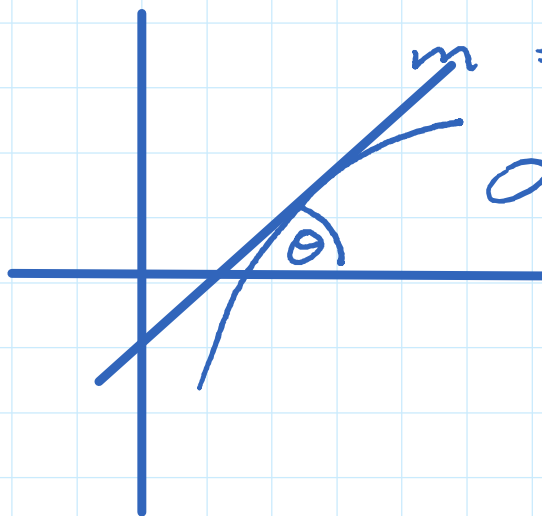
$$x = 2$$

$$y = -7 \quad (2, -7)$$

Increasing / Decreasing.



Increasing



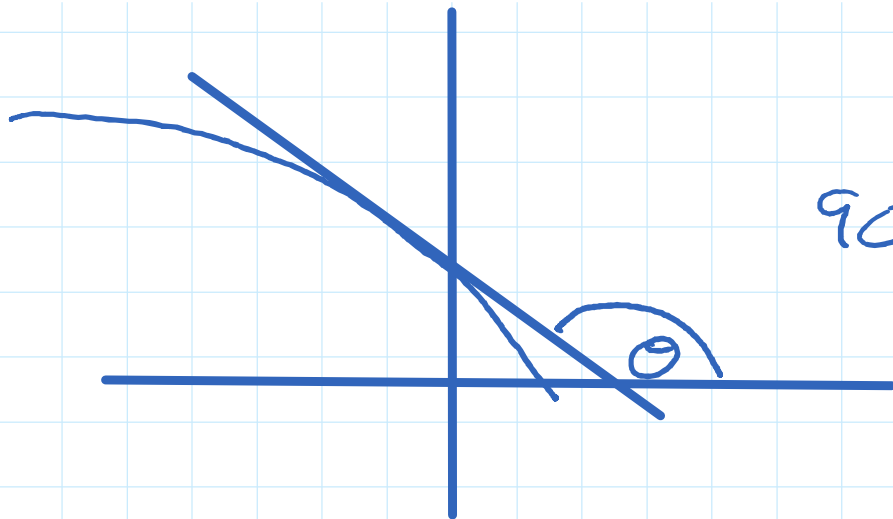
$$m = \frac{dy}{dx} > 0$$

$$0 < \theta < 90$$

$$\tan \theta > 0$$

$$m > 0$$

$$\frac{dy}{dx} > 0$$



$$90 < \theta < 180$$

$$\tan \theta < 0$$

$$m < 0$$

$$\frac{dy}{dx} < 0$$

Learn

Increasing curve	$\frac{dy}{dx} > 0$
Decreasing curve	$\frac{dy}{dx} < 0$

For what  $x$  is  $f(x) = x^2 - 12x + 5$  increasing.

$$f(x) = x^2 - 12x + 5$$

$$f'(x) = 2x - 12 > 0$$

$$2x > 12$$

$$x > 6$$

For what  $x$  is  $y = x^3 - 6x^2 + 5$  decreasing?

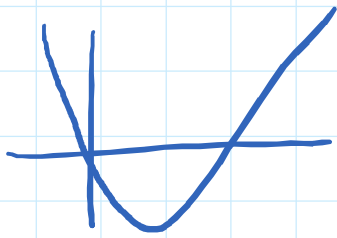
$$y = x^3 - 6x^2 + 5$$

$$\frac{dy}{dx} = 3x^2 - 12x < 0$$

$$x^2 - 4x < 0$$

$$x^2 - 4x = 0$$

$$x(x-4) = 0$$



$$x = 0 \quad x = 4$$

$$0 < x < 4$$



$y = \frac{2x}{x-3}$ . Is the curve  
increasing where  $x \in \mathbb{R}$  and  
 $x = 3$ .

$$u = 2x$$

$$v = x - 3$$

$$\frac{du}{dx} = 2$$

$$\frac{dv}{dx} = 1$$

$$\frac{dy}{dx} = \frac{2(x-3) - 2x}{(x-3)^2}$$

$$\frac{-6}{(x-3)^2} < 0 \Rightarrow$$

decreasing  $\rightarrow$

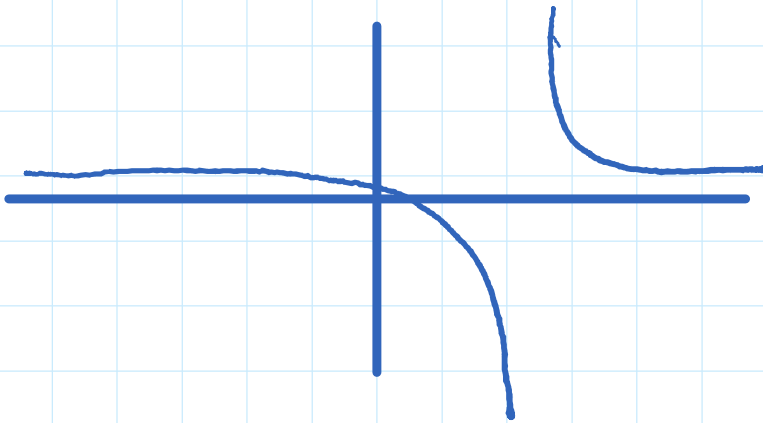
$-6 < 0$   
 $(x-3)^2 > 0$  any number squared is positive.

$$x \neq 3$$

$$y = 2$$

$$\frac{2x}{x-2} = 2$$

$$2x = 2(x-2)$$



Non  
centered  
graph.