$\boxed{\text{Lesson 3}}$

Prove that if $f(x) = x^{-2}$ then $f'(x) = \frac{-2}{x^3}$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \to 0} \frac{(x+h)^{-2} - x^{-2}}{h}$$

$$= \lim_{h \to 0} \frac{\frac{1}{(x+h)^2} - \frac{1}{x^2}}{h}$$

$$= \lim_{h \to 0} \frac{\frac{x^2 - (x+h)^2}{x^2(x+h)^2}}{h}$$

$$= \lim_{h \to 0} \frac{x^2 - (x+h)^2}{h x^2 (x+h)^2}$$

$$= \lim_{h \to 0} \frac{x^2 - x^2 - 2xh - h^2}{h x^2 (x+h)^2}$$

$$= \lim_{h \to 0} \frac{-2xh - h^2}{h x^2 (x+h)^2}$$

$$= \lim_{h \to 0} \frac{-2x - h}{x^2 (x+h)^2}$$

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

$$= \frac{-2}{x^3}$$

$\square$.

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6. $y = x^2$

$\frac{dy}{dx} = 2x.$

at $x=2$

$\frac{dy}{dx} = 4$

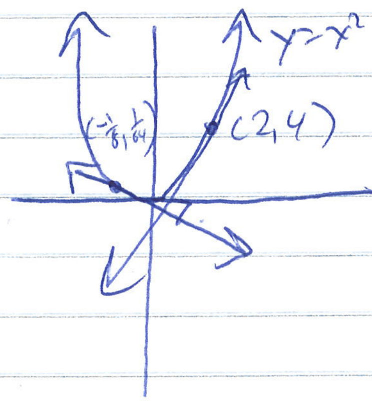
at $x = -\frac{1}{8}$

$\frac{dy}{dx} = 2\left(-\frac{1}{8}\right)$

$= -\frac{1}{4}$

$\therefore$ lines have $\perp$ slopes.

Sketch



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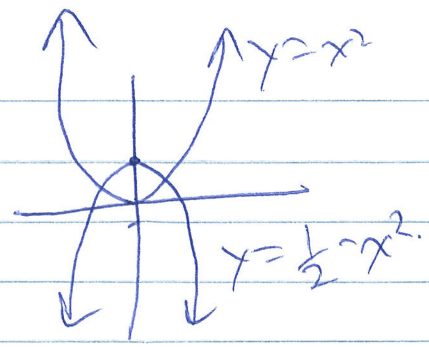
Problem 2



① $y = x^2$ $\quad \frac{dy}{dx} = 2x$

② $y = \frac{1}{2} - x^2$ $\quad \frac{dy}{dx} = -2x$

Find POI $\quad x^2 = \frac{1}{2} - x^2$

$2x^2 = \frac{1}{2}$

$x^2 = \frac{1}{4}$

$x = \pm \frac{1}{2}$

at $x = \frac{1}{2}$

① $\frac{dy}{dx} = 2\left(\frac{1}{2}\right) = 1$ $\qquad$ ∴ slopes of tangent are $\perp$

② $\frac{dy}{dx} = -2\left(\frac{1}{2}\right) = -1$

at $x = -\frac{1}{2}$

① $\frac{dy}{dx} = 2\left(-\frac{1}{2}\right) = -1$ $\qquad$ ∴ slopes of tangents are $\perp$

② $\frac{dy}{dx} = -2\left(-\frac{1}{2}\right) = 1$

$\square$.