

Example 7

Concavity Test

① Get $f'(x)$

$$f'(x) = \frac{d}{dx} [x^2]$$

"

$$2x^{2-1}$$

"

$$2x^1$$

"

$$\boxed{f'(x) = 2x}$$

② Get $f''(x)$

$$f''(x) = \frac{d}{dx} [2x]$$

"

$$2 \cdot \frac{d}{dx} [x]$$

"

$$2 \cdot 1x^{1-1}$$

"

$$2 \cdot 1x^0$$

"

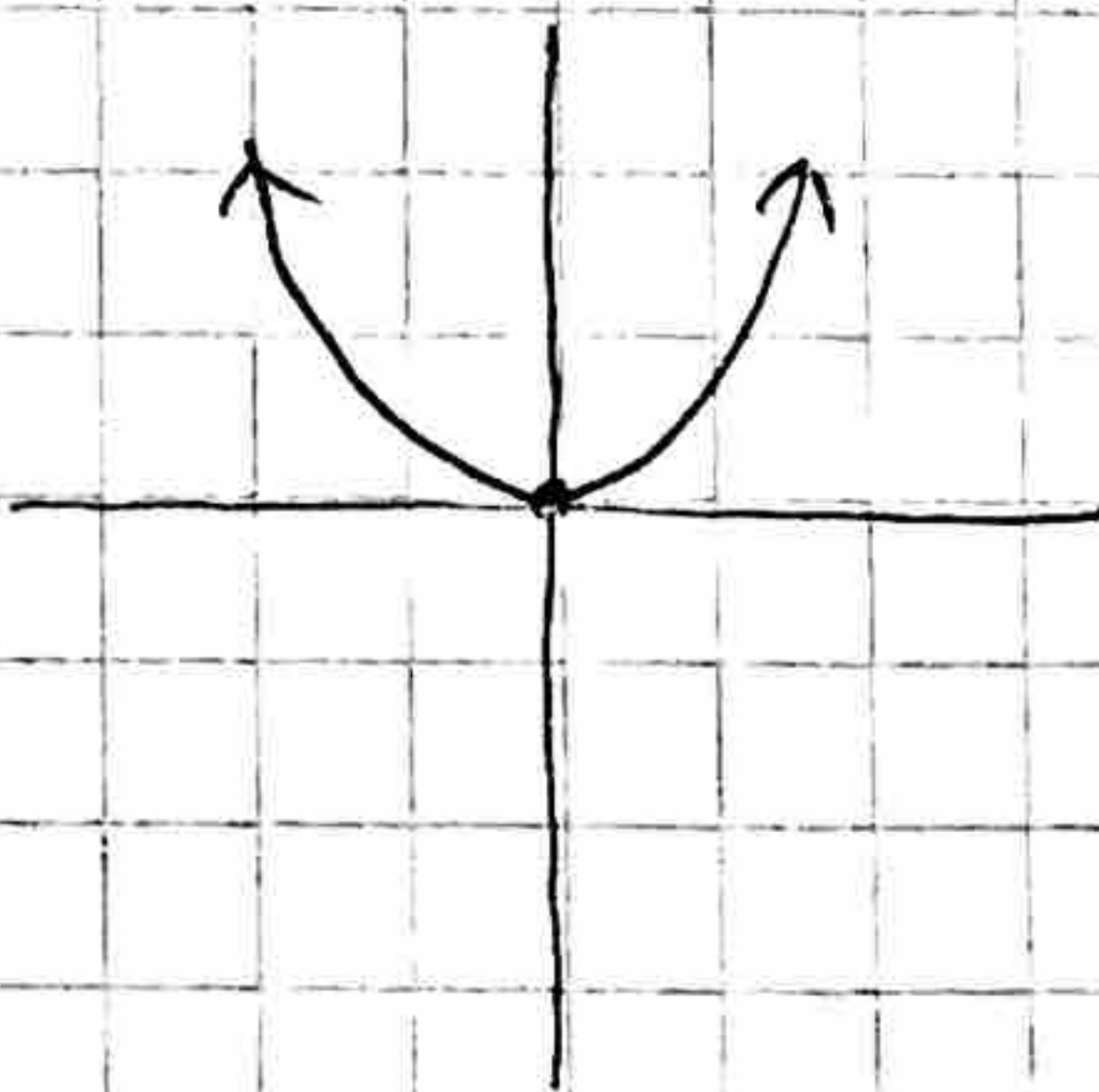
$$2 \cdot 1 \cdot 1$$

"

$$\boxed{f''(x) = 2}$$

Determine the intervals in which $f(x) = x^2$ is concave upward and the intervals in which $f(x) = x^2$ is concave downward.

$f(x) = x^2$ is concave upward on $(-\infty, \infty)$



Example 8

Determine the intervals in which $f(x) = x^3$ is concave upward and the intervals in which $f(x) = x^3$ is concave downward

① Get $f'(x)$

$$f'(x) = \frac{d}{dx} [x^3]$$

$$3x^{3-1}$$

$$\boxed{f'(x) = 3x^2}$$

$$f''(x) = \frac{d}{dx} [3x^2]$$

$$3 \cdot \frac{d}{dx} [x^2]$$

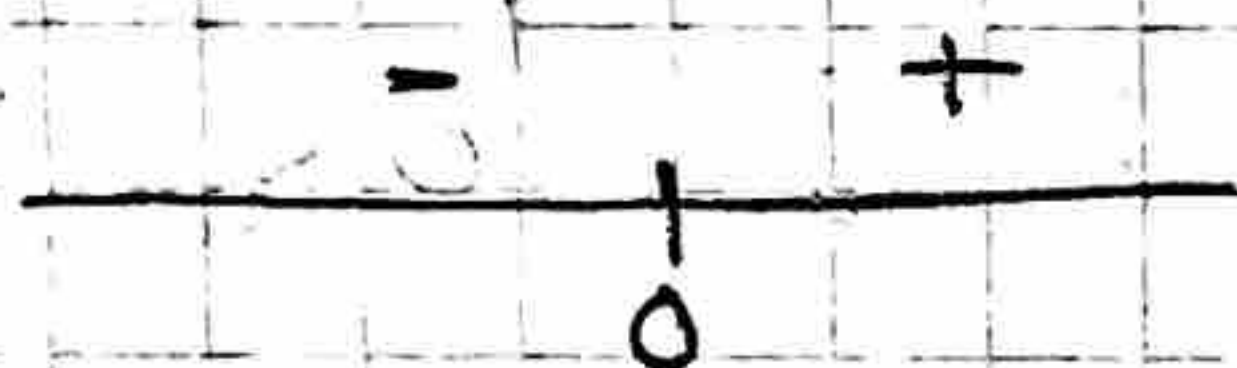
$$3 \cdot 2x^{2-1}$$

$$3 \cdot 2x^1$$

$$\boxed{f''(x) = 6x}$$

② Determine Intervals

$$f''(x) = 6x$$



$$(-1) : 6(-1)$$
$$\textcircled{-6}$$

$$(1) : 6(1)$$
$$\textcircled{+6}$$

③ Summary

From $(-\infty, 0)$ $f(x) = x^3$ concave downward.

From $(0, \infty)$ $f(x) = x^3$ concave upward

