Derivative of the Derivative

→We can find the derivative of $f'(x)$:

$f''(x)$ = the second derivative of f

$$y = f(x) \qquad f(x)$$
$$f'(x) = \frac{dy}{dx} \qquad f'(x)$$
$$f''(x) = \frac{d^2y}{dx^2} \qquad f''(x)$$
$$f'''(x)$$
$$f^{(4)}(x)$$

If $s(t)$ = position, then

$s'(t) = v(t) =$ velocity

$s''(t) = a(t) =$ acceleration

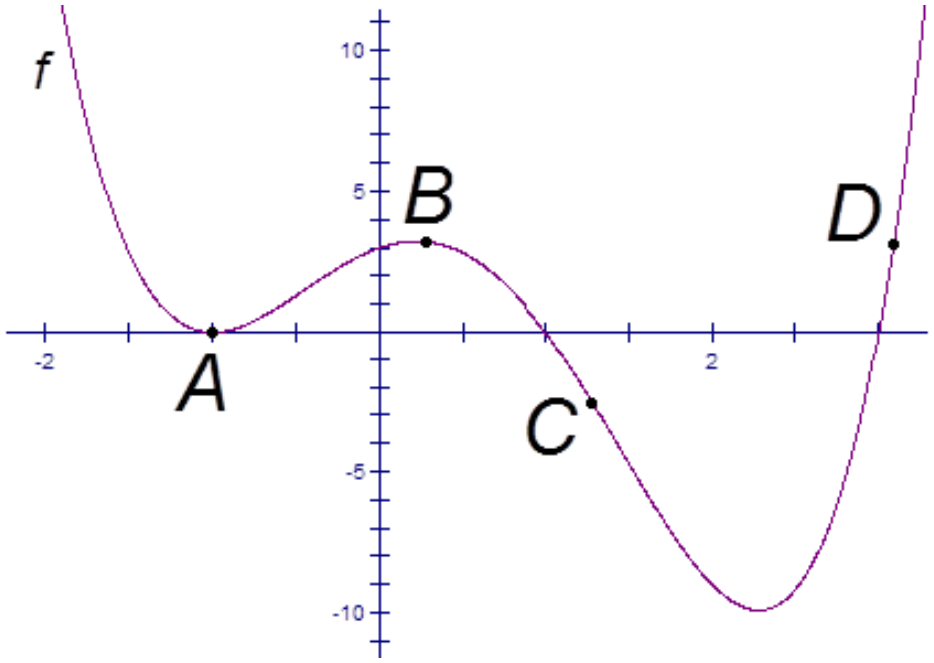
Note: If $f' > 0$, then f is increasing.
If $f' < 0$, then f is decreasing.

Thm. If $f'' > 0$, then f is concave up.

If $f'' < 0$, then f is concave down.

Concave up means that the graph lies above its tangent line and below its secant line

Ex. Given the graph of f, determine if each is positive, negative, or zero.

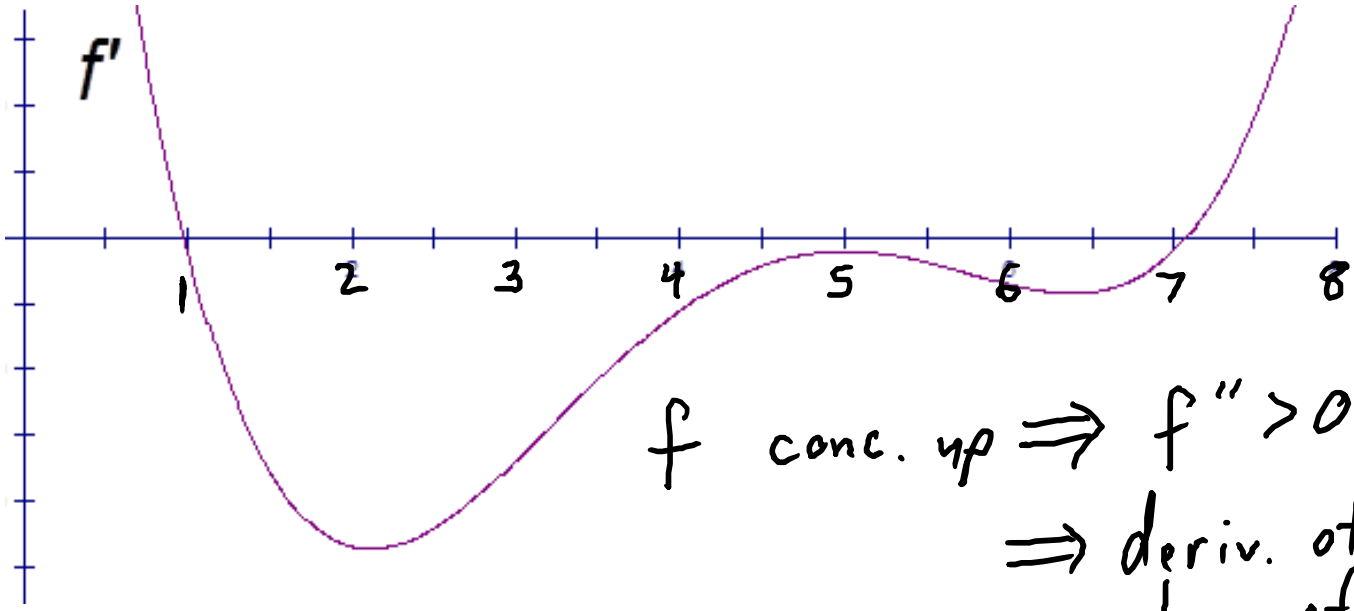


	f	f'	f''
A	0	0	+
B	+	0	−
C	−	−	0
D	+	+	+

Ex. Given the graph of f', answer the following:

a) Where is f decreasing? $(1, 7)$; f' is neg.

b) Where is f concave up? $(2, 5)$, $(6.5, \infty)$; f' inc.



f conc. up $\Rightarrow f'' > 0$

$\Rightarrow$ deriv. of $f' > 0$

$\Rightarrow$ slope of $f' > 0$

$\Rightarrow f'$ is inc.

Ex. Minions are removing bananas from a farmers market vendor at a rate modeled by $b(t) = t^3$, where $b(t)$ is measured in pounds per hour and t is hours since the minions arrived.

a) Find $b'(7)$.

$b'(t) = 3t^2$

$b'(7) = 3(7)^2 = 147$

b) Using correct units, explain the meaning of $b'(7)$ in the context of the problem.

$b'(t) = \frac{db}{dt} = \frac{\text{lbs./hr.}}{\text{hr.}}$

After 7 hrs., the rate at which bananas are removed is changing at a rate of 147 lbs./hr. per hr.