

WARM UP

Find $f'(7)$ if $f(x) = \frac{3}{x}$

$$\text{use } f'(a) = \lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\frac{3}{7+h} - \frac{3}{7}}{h}$$

$$= \lim_{h \rightarrow 0} \frac{21 - 3(7+h)}{h(7+h)7}$$

$$= \lim_{h \rightarrow 0} \frac{21 - 21 - 3h}{h(7+h)7}$$

$$= \frac{-3}{7 \cdot 7} = -\frac{3}{49}$$

Section 2.6 The Second Derivative

The derivative of the derivative is the second derivative. It is notated by $f''(x)$
 "f double prime"

$$f''(x) = \frac{d^2y}{dx^2} \Rightarrow \frac{d}{dx} \left(\frac{dy}{dx} \right)$$

$$\frac{d}{dx} [x^n] = nx^{n-1}$$

$$\frac{d}{dx} [kx^n] = knx^{n-1}$$

$$\frac{d}{dx} [kx] = K$$

$$\frac{d}{dx} [k] = 0$$

ex: $f(x) = x^4$

$$f'(x) = 4x^3$$

$$f''(x) = 12x^2$$

ex: $\frac{d}{dx} (6x^2 - 5x) = 12x - 5$

ex: $f(x) = \frac{7}{x} = 7x^{-1}$

$$f'(x) = \underbrace{-7x^{-2}}_{x^{-2}} = -\frac{7}{x^2}$$

$$f''(x) = 14x^{-3} = \frac{14}{x^3}$$

When $f'(x) > 0$, $f(x)$ is increasing

so $f''(x) > 0$, $\underbrace{f'(x)}$ is increasing
slopes of tan lines are increasing

The graph of f

is concave up

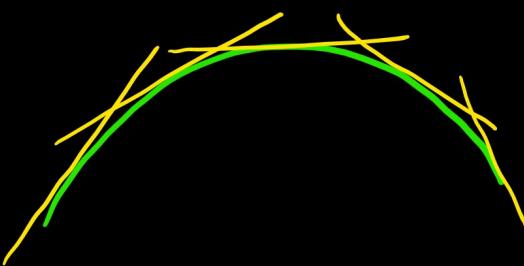
when $f''(x) > 0$



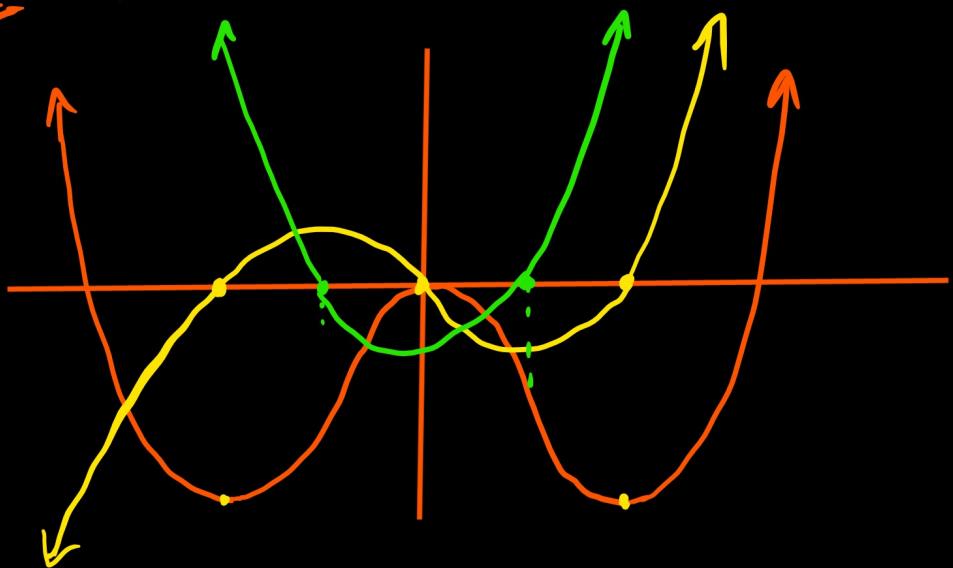
When $f'(x) < 0$, $f(x)$ is decreasing

so when $f''(x) < 0$, $f'(x)$ is decreasing

The graph of f
is concave down if
 $f''(x) < 0$.



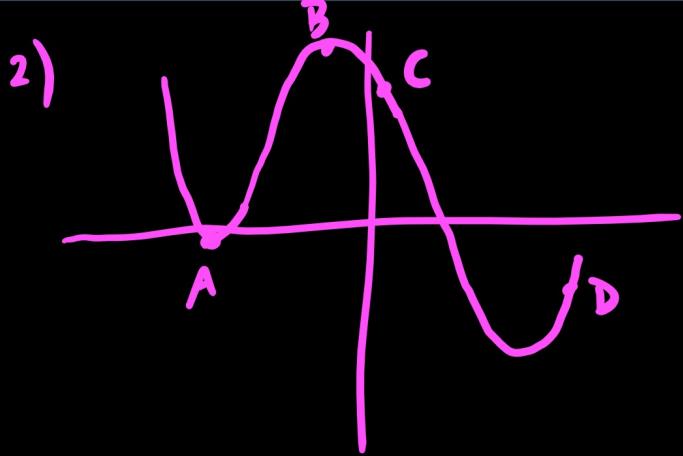
Ex: Sketch $f'(x)$ and $f''(x)$ for $f(x)$:



P 93-94
1-3, 5, 12, 16,
22, 23

3) $\frac{dy}{dx} > 0$ increasing Point B

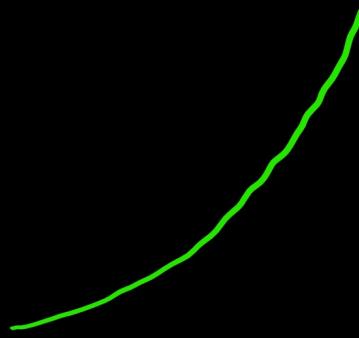
$\frac{d^2y}{dx^2} > 0$ Concave up



Point	f	f'	f''
A	-	0	+
B	+	0	-
C	+	-	-
D	-	+	+

5) $f'(x) > 0$ increase

$f''(x) > 0$ concave up

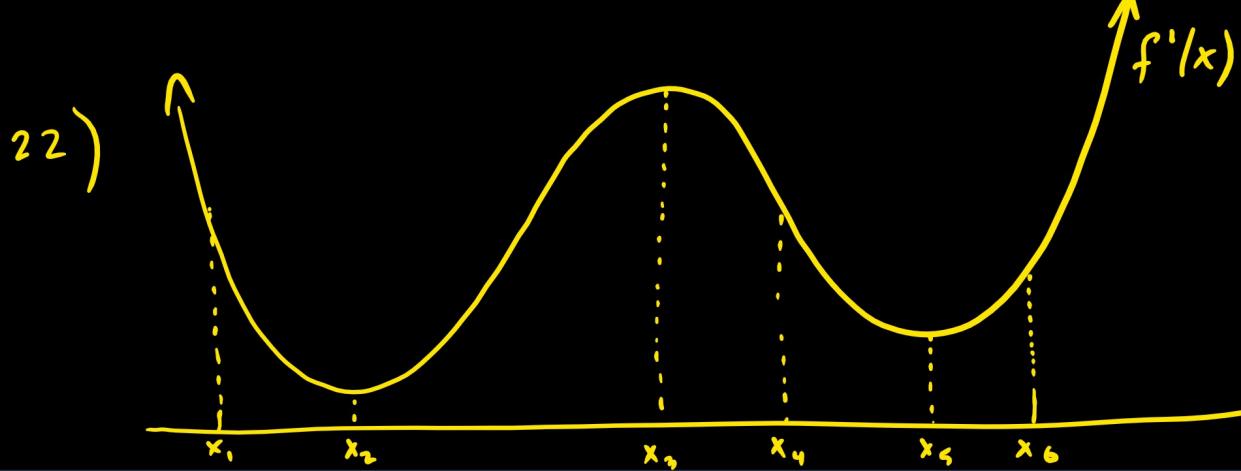
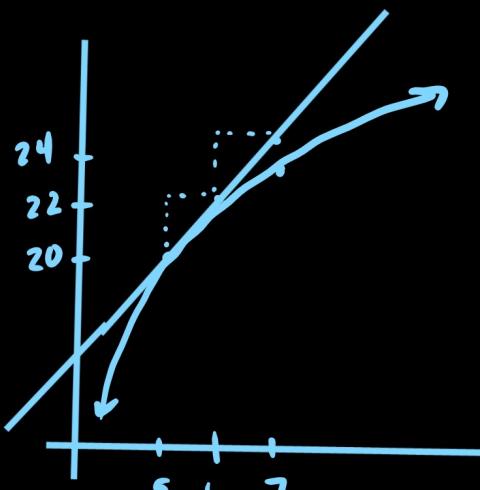


16) $f(5) = 20$

$f'(5) = 2$

$f''(x) < 0$ for $x \geq 5$

(c)



- a) $f(x)$ greatest at x_6
- b) $f(x)$ least at x_1
- c) $f'(x)$ greatest at x_3
- d) $f'(x)$ least at x_2
- e) $f''(x)$ greatest at x_6
- f) $f''(x)$ least at x_1