WARMUP

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

for $f(x) = 3x^2 + 5x - 7$

$$f'(x) = \lim_{h \to 0} \frac{\left(3(x+h)^2 + 5(x+h) - 7\right) - \left(3x^2 + 5x - 7\right)}{h}$$

$$= \lim_{h \to 0} \frac{3(x^2 + 2xh + h^2) + 5x + 5h - 7 - 3x^2 - 5x + 7}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{3x^2} + 6xh + 3h^2 + \cancel{5x} + 5h \cancel{-7} \cancel{-3x^2} \cancel{-5x} \cancel{+7}}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{h}(6x + 3h + 5)}{\cancel{h}}$$

$$= 6x + 5$$

$$\lim_{h \to 0} \frac{\left(4\sqrt{x+h} - 4\sqrt{x}\right)}{h} \cdot \frac{\left(4\sqrt{x+h} + 4\sqrt{x}\right)}{\left(4\sqrt{x+h} + 4\sqrt{x}\right)}$$

$$= \lim_{h \to 0} \frac{16(x+h) - 16x}{h\left(4\sqrt{x+h} + 4\sqrt{x}\right)} = \lim_{h \to 0} \frac{\cancel{16x} + 16\cancel{h} - \cancel{16x}}{\cancel{h}\left(4\sqrt{x+h} + 4\sqrt{x}\right)}$$

$$= \frac{16}{4\sqrt{x} + 4\sqrt{x}} = \frac{16}{8\sqrt{x}} = \frac{2}{\sqrt{x}}$$

Section 2.5 Intrepretations of the Derivative

One notation for derivative of a function is $f'(x)$.

There are other notations:

If $y = f(x)$, then $\frac{dy}{dx} = f'(x)$

derivative of y with respect to x

If s is the position function of an object, then $\frac{ds}{dt}$ is instantaneous, or velocity so $v = \frac{ds}{dt}$

$$h(t) = -16t^2 + v_0 t + h_0$$

$$v(t) = -32t + v_0 \Rightarrow v_f = at + v_i$$

$$\frac{d}{dx}\left(f(x)\right), \quad \frac{d}{dx}(y), \quad \left.\frac{dy}{dx}\right|_{x=2}$$

derivative evaluated at $x = 2$, so it means $f'(2)$

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$T = f(t)$ — t: time in minutes; T: temperature in °F

a) What is the sign of $f'(t)$?

$$\frac{dT}{dt} > 0$$

T is increasing so $T' > 0$

b) $f'(20) = \left.\frac{dT}{dt}\right|_{t=20}$ units are °F/min

$f'(20) = 2$ At 20 mins yam's temp is increasing at 2°F/min

$f(20) = 150$

In 20 min, temp = 150° F

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price = \$p

quantity = q

$q = f(p)$

$$\frac{dq}{dp} = f'(p)$$

a) $f(150) = 2000$

At \$150, sell 2000 units

b) $f'(150) = -25$

$\frac{dq}{dp} = \frac{\#\text{ of items}}{\$}$

At \$150, quantity sold decreases by $25 \frac{\text{items}}{\$}$

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