SECTION 3-3: DERIVATIVE RULES (DAY 2)

1. Review: Write the Product Rule and the Quotient Rule for differentiation.

$\frac{d}{dx}[f \cdot g] = f' \cdot g + f \cdot g'$

$\frac{d}{dx}\left[\frac{f}{g}\right] = \frac{g \cdot f' - f \cdot g'}{(g)^2}$

2. Find the derivative of each of the following. Use whatever rule you choose. Simplify if you have time.

(a) $v(\theta) = \sqrt{\theta}\cos(\theta) = \theta^{1/2}\cos\theta$

$$V'(\theta) = \frac{1}{2}\theta^{-1/2}\cos(\theta) + \theta^{1/2}(-\sin\theta) = \boxed{\frac{1}{2}\theta^{-1/2}\cos\theta - \theta^{1/2}\sin\theta}$$

(b) $H(x) = \frac{1}{3x}(8 + x^2) = \frac{1}{3}(8x^{-1} + x)$

$$H'(x) = \frac{1}{3}(-8x^{-2} + 1) = \boxed{\frac{1}{3}\left(1 - \frac{8}{x^2}\right)}$$

(c) $G(x) = \frac{x^2}{8+x^2}$

$$G'(x) = \frac{(8+x^2)(2x) - x^2(2x)}{(8+x^2)^2} = \frac{2x(8+x^2-x^2)}{(8+x^2)^2} = \boxed{\frac{16x}{(8+x^2)^2}}$$

(d) $K(x) = \frac{8+x^2}{x^2} = \frac{8}{x^2} + \frac{x^2}{x^2} = 8x^{-2} + 1$

$$\boxed{K'(x) = -16x^{-3}}$$

(e) $f(x) = 5e^2 + 4x^{3/4} + 5x\sin(x)$

$$f'(x) = 0 + 4\left(\frac{3}{4}\right)x^{-1/4} + 5\left(1 \cdot \sin(x) + x\cos(x)\right)$$

$$= \boxed{3x^{-\frac{1}{4}} + 5(\sin(x) + x\cos(x))}$$

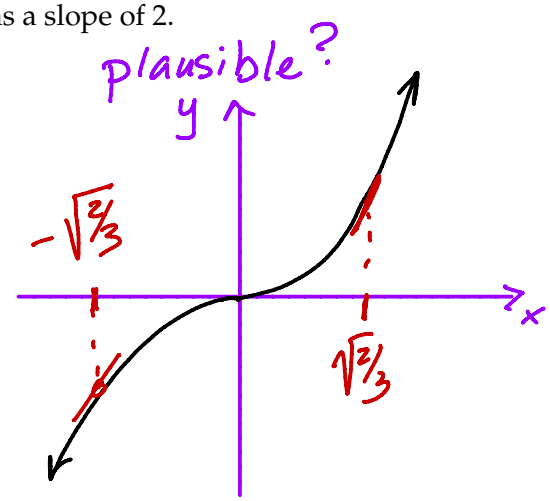
3. Determine the x-value (or values) where the graph $f(x) = x^3$ has a slope of 2.

Find x-values where $f'(x) = 2$.

Since $f'(x) = 3x^2$, we want x-values so that

$3x^2 = 2$ or

$x = \pm\sqrt{2/3}$



4. An ant walking along a sidewalk has traveled $s(t) = t^4 - 2t^2$ inches in t minutes. Find the velocity and acceleration of the ant (with units).

Velocity $= \frac{\Delta \text{position}}{\Delta \text{time}} = s'(t) = 4t^3 - 4t$ inches/min

acceleration $= \frac{\Delta \text{velocity}}{\Delta \text{time}} = s''(t) = 12t^2 - 4$ inches/min/min

or

inches/min^2

5. The concentration of an antibiotic in the bloodstream t hours after being injected is given by $C(t) = \dfrac{2t^2 + t}{t^3 + 50}$ where C is measured in milligrams per liter of blood.

(a) It is a fact that $C(0) = 0$ and $C(10) = 0.20$. Explain what these numbers mean in the context of the problem.

At first (when t=0), the concentration of drug is 0 mg/L.
Ten hours later, the concentration of drug is 0.2 mg/L.

(b) It is a fact that $C'(10) = -0.018$. Interpret this fact in the context of the problem. Use language a Precalculus student could understand.

units: $C' = \frac{\Delta C}{\Delta t} = \frac{\text{mg/L}}{\text{hr}}$. Ten hours after injection, the concentration of drug in the blood is decreasing at a rate of 0.018 mg/L/hr.

(c) Use the fact from parts (a) and (c) to estimate $C(11)$.

$C(11) \approx C(10) + C'(10) = 0.2 - 0.018 = 0.182$ mg/L