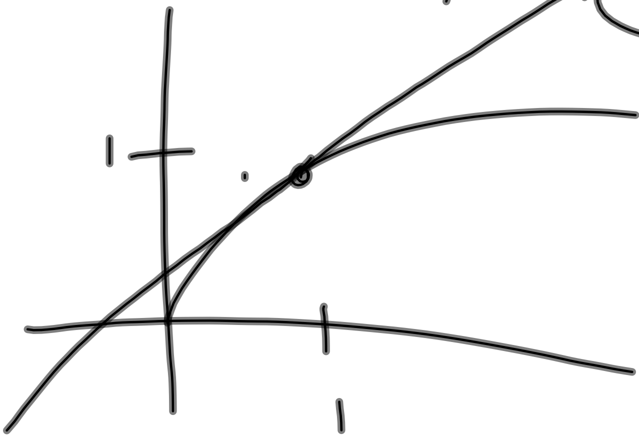
2.2

1. $y = x^{1/2}$ $\qquad y' = \frac{1}{2}x^{-1/2}$

$f(x) = x^{1/2}$ $\qquad f'(x) = \frac{1}{2}x^{-1/2}$



$$m = f'(1) = \frac{1}{2}(1)^{-1/2}$$

$$= \boxed{\frac{1}{2}}$$

8. $y = \frac{1}{x^8} = x^{-8}$

$$y' = -8x^{-9} = -\frac{8}{x^9}$$

9. $f(x) = \sqrt[5]{x}$

$$= x^{1/5}$$

$$f'(x) = \frac{1}{5}x^{-4/5}$$

$$= \frac{1}{5\sqrt[5]{x^4}}$$

$$= \frac{1}{5x^{4/5}}$$

2.1

21. $f(x) = \dfrac{1}{x-1}$; $f(x+h) = \dfrac{1}{x+h-1}$

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

$$= \lim_{h \to 0} \frac{\frac{x-1}{x-1} \cdot \frac{1}{x+h-1} - \frac{1}{x-1} \cdot \frac{x+h-1}{x+h-1}}{\frac{h}{1}} =$$

$$= \lim_{h \to 0} \frac{x-1-(x+h-1)}{(x-1)(x+h-1)} \cdot \frac{1}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{x} \cancel{-1} \cancel{-x} - h \cancel{+1}}{h(x-1)(x+h-1)} = \lim_{h \to 0} \frac{-1}{(x-1)(x+h-1)}$$

$$= \frac{-1}{(x-1)(x+0-1)} = \boxed{\frac{-1}{(x-1)^2}}$$

1. difference quotient?

$$\frac{f(x+h)-f(x)}{h} \qquad \frac{f(x+\Delta x)-f(x)}{\Delta x}$$

2. $\frac{d}{dx}[5] = 0$ 3. $\frac{d}{dx}[x] = 1$

4. $\frac{d}{dx}[x^5] = 5x^4$

5. $\lim\limits_{h \to 0} \frac{3(x+h)^2 - 4(x+h) - (3x^2 - 4x)}{h} =$

$= 6x - 4$

constant multiple rule

$c \in \mathbb{R}$; $\frac{d}{dx}\left[c f(x)\right] = c \cdot \frac{d}{dx}\left[f(x)\right]$

e.g.

$f(x) = 3x^2$

$f'(x) = 3 \cdot (x^2)' = 3(2x^1) = 6x$

e.g.

$f(x) = \frac{3}{x} = 3x^{-1}$.

$f'(x) = 3(x^{-1})' = 3(-x^{-2}) = -3x^{-2}$

$= -3/x^2$

Sum & Difference

$$\frac{d}{dx}\left[f(x) \pm g(x)\right] = f'(x) \pm g'(x)$$

e.g.

$$f(x) = 2x^3 - x^2 + 3x^1$$

$$f'(x) = 6x^2 - 2x + 3$$

$$f(x) = 4x^{3/2} - 5x^4 + 2x^{1/3} - 7$$

$$f'(x) = 6x^{1/2} - 20x^3 + \frac{2}{3}x^{-2/3}$$

Sine & cosine

$$\frac{d}{dx}\left[\cos x\right] = -\sin x$$

$$\frac{d}{dx}\left[\sin x\right] = \cos x$$

2.2

22. $y = 5 + \sin x$

$y' = \cos x$

24. $y = \frac{5}{(2x)^3} + 2\cos x = \frac{5}{8}x^{-3} + 2\cos x$

$y' = \frac{-15}{8}x^{-4} - 2\sin x$

44. $h(x) = \frac{2x^3 - 3x + 1}{x} = \frac{2x^3}{x} - \frac{3x}{x} + \frac{1}{x} = 2x^2 - 3 + x^{-1}$

$h'(x) = 4x - x^{-2}$

46. $y = 3x(6x - 5x^2) = 18x^2 - 15x^3$

$y' = 36x - 45x^2$

52. $f(x) = \frac{2}{\sqrt[3]{x}} + 3\cos x$

$= 2x^{-1/3} + 3\cos x$

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

2.2 cont.

$s(t) =$ position

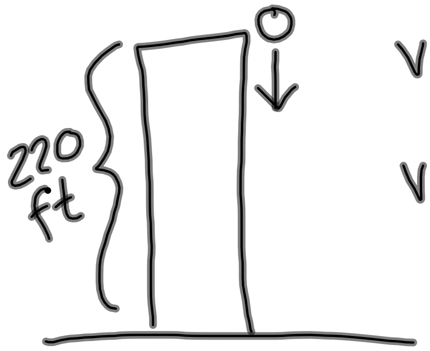
$v(t) = s'(t) =$ velocity

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

average velocity: $\frac{\Delta s}{\Delta t}$ (slope of secant)

instantaneous velocity $= s'(t)$ (slope of tangent)

92. initial velocity $V_0 = -22$ ft/s



$v(3) = ?$

$v(t) = ?$ after falling 108 ft

$g = -9.8\ m/s^2$

$= -32\ ft/s^2$

$$s(t) = \frac{1}{2}gt^2 + v_0 t + S_0$$

$$s(t) = -16t^2 - 22t + 220$$

$$v(t) = s'(t) = -32t - 22$$

$$v(3) = -32(3) - 22 = -118\ ft/s^2$$

$$220 - 108 = -16t^2 - 22t + 220$$

$$0 = -16t^2 - 22t + 108$$

$$t = m$$

$$v(m) = -32(m) - 22$$

sphere volume:

$$V = \frac{4}{3}\pi r^3$$

find the rate of change of volume w.r.t. radius when $r = 2$ cm.

$V'(r) = \frac{d}{dr}[V] = 4\pi r^2$ = surface area!

$V'(2) = 4\pi(2)^2 = 16\pi \text{ cm}^2$

2.2
#9-23, 39-51; 91-94, 101, 102