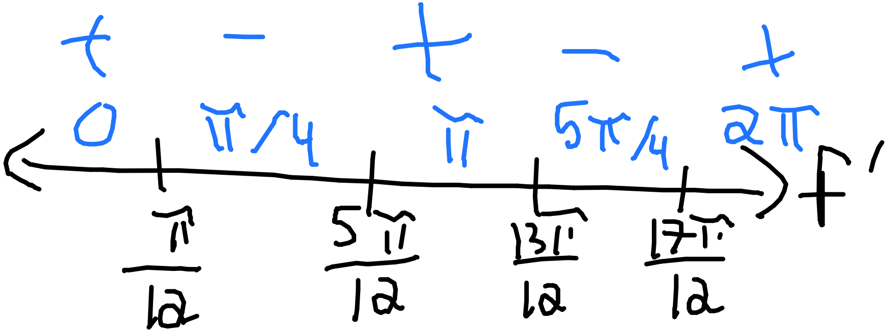
HW 18 #7

$f(x) = 9\cos(2x) + 9x \quad [0, 2\pi]$

Relative Max



$$f'(x) = 9(-\sin(2x))\cdot 2 + 9$$

$$= -18\sin(2x) + 9$$

$$\frac{5\pi}{2} = 2\pi + \frac{\pi}{2}$$

HW 18 #7

$f(x) = 9\cos(2x) + 9x \quad (0, 2\pi)$

Relative Max

$+$	$-$	$+$	$-$	$+$
0	$\pi/4$	π	$5\pi/4$	2π

f'

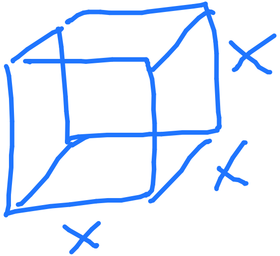
$\frac{\pi}{12} \qquad \cancel{\frac{5\pi}{12}} \qquad \frac{13\pi}{12} \qquad \cancel{\frac{17\pi}{12}}$

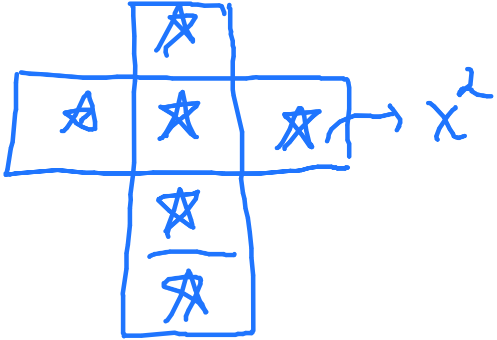
$\frac{\pi}{12}$ & $\frac{13\pi}{12}$

Related Rates

Shrinking @ 2 cm/sec = dx/dt

How fast is SA decreasing when edge 13 cm?



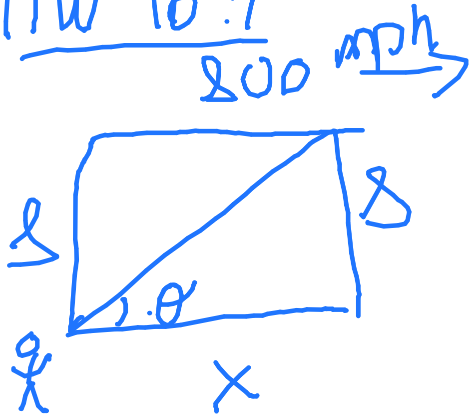


$$SA = 6x^2$$

$$\frac{d(SA)}{dt} = 12x\frac{dx}{dt}$$

$$= 12(13)(2) = 312$$

HW 16.7



$$\tan\theta = \frac{8}{x} = 8x^{-1}$$

$$\frac{dx}{dt} = 800 \qquad \left.\frac{d\theta}{dt}\right|_{\theta=\pi/6}$$

$$\sec^2\theta\,\frac{d\theta}{dt} = -8x^{-2}\,\frac{dx}{dt}$$

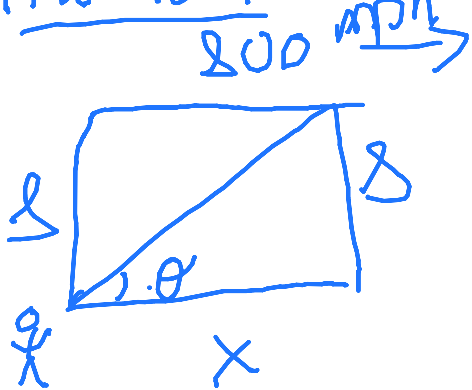
$$\sec^2\theta\,\frac{d\theta}{dt} = -\frac{8}{x^2}\cdot(800)$$

$$\frac{d\theta}{dt} = -\frac{8}{x^2}\cos^2\theta\,(800)$$

$$= -\frac{8}{x^2}\left(\cos\left(\frac{\pi}{6}\right)\right)^2(800)$$

$$= -\frac{8}{x^2}\left(\frac{\sqrt{3}}{2}\right)^2(800)$$

HW 16.7



$$\tan\theta = \frac{8}{x} = 8x^{-1}$$

$$\frac{dx}{dt} = 800 \qquad \left.\frac{d\theta}{dt}\right|_{\theta = \pi/6}$$

$$\tan\left(\frac{\pi}{6}\right) = \frac{8}{x}$$

$$\frac{1}{\sqrt{3}} = \frac{8}{x}$$

$$x = 8\sqrt{3}$$

$$x^2 = 64(3)$$

$$\frac{d\theta}{dt} = \frac{\cancel{8}}{64(\cancel{3})} \cdot \frac{\cancel{3}}{4} \cdot \overset{1}{\cancel{8}00}$$

$$= 25$$

$$y = \cancel{\ln}(\cancel{\ln}(\cancel{\ln}(\cancel{\ln}(\sin x))))$$

$$y' = \frac{1}{\ln(\ln(\ln(\sin x)))} \cdot \frac{1}{\ln(\ln(\sin x))} \cdot \frac{1}{\ln(\sin x)}$$

$$\cdot \frac{1}{\sin x} \cdot \cos x$$

$$y = \sec(\tan(3x + e^3))$$

$$y' = \sec(\tan(3x+e^3))\tan(\tan(3x+e^3)) \cdot \sec^2(3x+e^3) \cdot 3$$

$$\frac{d}{dx}(e^x) = e^x \qquad \frac{d}{dx}(e^{4x+4}) = 4e^{4x+4}$$

$$\frac{d}{dx}(e^4) = 0$$

$$e^{xy} = 8x - 8y$$

$$\frac{d}{dx}(e^{xy}) = \frac{d}{dx}(8x - 8y)$$

$$e^{xy}\frac{d}{dx}(xy) = 8 - 8\frac{dy}{dx}$$

$$e^{xy}\left[y + x\frac{dy}{dx}\right] = 8 - 8\frac{dy}{dx}$$

$$ye^{xy} + xe^{xy}\frac{dy}{dx} = 8 - 8\frac{dy}{dx}$$

$$ye^{xy} + xe^{xy}\frac{dy}{dx} = 8 - 8\frac{dy}{dx}$$

$$xe^{xy}\frac{dy}{dx} + 8\frac{dy}{dx} = 8 - ye^{xy}$$

$$\frac{dy}{dx}\left(xe^{xy} + 8\right) = 8 - ye^{xy}$$

$$\cancel{\frac{dx}{dx}}^{\,1} y + x\frac{dy}{dx} \qquad \frac{dy}{dx} = \frac{8 - ye^{xy}}{xe^{xy} + 8}$$

$$\frac{d}{dx}(xy) = \frac{d}{dx}(x)\cdot y + x\cdot\frac{d}{dx}(y)$$

$$= 1\cdot\frac{dx}{dx}\cdot y + x\cdot 1\cdot\frac{dy}{dx}$$

$$= y + x\frac{dy}{dx}$$

Practice Exam #12

$g'(x)$ when $g(x) = \tan^2(3x^2+2)$

$$= (\cancel{\tan}(3x^2+2))^{\cancel{2}}$$

$$g'(x) = 2\tan(3x^2+2)\sec^2(3x^2+2)\,6x$$

Practice Exam #18

$$f(x) = \ln \sqrt[3]{\frac{3+3x}{3-x}} \qquad f'(1)$$

$$= \frac{1}{3}\ln\left(\frac{3+3x}{3-x}\right) = \frac{1}{3}\ln(3+3x) - \frac{1}{3}\ln(3-x)$$

$$f'(x) = \frac{1}{\cancel{3}} \cdot \frac{1}{3+3x} \cdot \cancel{3} + \frac{1}{3} \cdot \frac{1}{3-x} \cdot +1$$

$$= \frac{1}{3+3x} + \frac{1}{3(3-x)} \qquad f'(1) = \frac{1}{6} + \frac{1}{6} = \frac{1}{3}$$

HW 17 #11 $y = 2\cos(5x) + 5x$ on $(0, 2\pi)$

A B ~~C~~ D E F

$$y' = 2(-\sin(5x)) \cdot 5 + 5$$
$$= -10\sin(5x) + 5$$

Critical #

1. Find y'
2. Plug your answer choices in y'
3. Your answer $= 0$

HW 18.3 Inc/Dec $f(x) = 2x^3 + 2x^2 + \frac{1}{2}x$

$$f'(x) = 6x^2 + 4x + \frac{1}{2} = 0$$

12
$\wedge$
$2 + 6 = 8$

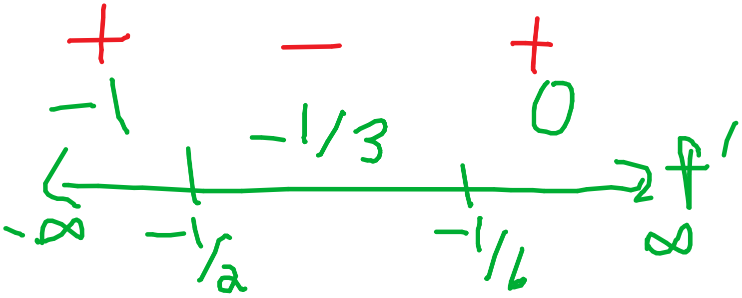
$$12x^2 + 8x + 1 = 2 \cdot 0 = 0$$

$$12x^2 + 2x + 6x + 1 = 0$$

$$2x(6x+1) + 1(6x+1) = 0$$

$$(2x+1)(6x+1) = 0$$

$x = -\frac{1}{2}$ $\quad$ $x = -\frac{1}{6}$



dne: $(-\infty, -\frac{1}{2}) \cup (-\frac{1}{6}, \infty)$

Dec: $(-\frac{1}{2}, -\frac{1}{6})$

$f'(x) = (2x+1)(6x+1)$

$f'(-1) = (-2+1)(-6+1)$

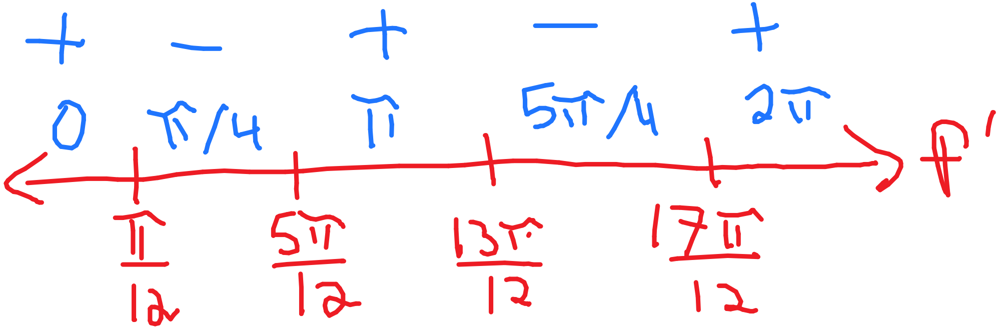
$- \cdot - = +$

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

$+ \cdot - = -$

$f'(0) = 1 \cdot 1$

HW 13 #7 $f(x) = 9\cos(2x) + 9x$ $(0, 2\pi)$ Relative max



$$f'(x) = 9(-\sin(2x) \cdot 2) + 9$$
$$= -18\sin(2x) + 9$$

$$\frac{5\pi}{2} = 2\pi + \frac{\pi}{2}$$

HW 13 #7 $f(x) = 9\cos(2x) + 9x$ $(0, 2\pi)$ Relative max

$+$		$-$		$+$		$-$		$+$

0 $\pi/4$ π $5\pi/4$ 2π

f': $\frac{\pi}{12}$, $\cancel{\frac{5\pi}{12}}$, $\frac{13\pi}{12}$, $\cancel{\frac{17\pi}{12}}$

$\frac{\pi}{12}$, $\frac{13\pi}{12}$

Practice Exam #11

$$p(t) = (t^2 + 2t)^2 + 160000 \quad @\ 2000 \text{ yr}$$

rate of change @ 2010

$$p'(10)$$

$$p'(t) = 2(t^2 + 2t)(2t + 2)$$

$$p'(10) = 2(100 + 20)(20 + 2) = 5280$$

Q7 #1

$$\tan\left(\frac{x}{y}\right) = 10x$$

$$\frac{1}{\sec x} = \cos x$$

$$\sec^2\left(\frac{x}{y}\right)\left[\frac{y - x\frac{dy}{dx}}{y^2}\right] = 10$$

$$\frac{y - x\frac{dy}{dx}}{y^2} = 10\cos^2\left(\frac{x}{y}\right)$$

$$y - x\frac{dy}{dx} = 10y^2\cos^2\left(\frac{x}{y}\right)$$

$$-x\frac{dy}{dx} = 10y^2\cos^2\left(\frac{x}{y}\right) - y$$

$$-x\frac{dy}{dx} = 10y^2\cos^2\left(\frac{x}{y}\right) - y$$

$$\frac{dy}{dx} = \frac{10y^2\cos^2\left(\frac{x}{y}\right) - y}{-x}$$

Rewrite the logs

① $y = \ln\sqrt{(x+1)(2x+3)}$

$= \frac{1}{2}\ln[(x+1)(2x+3)]$

$= \frac{1}{2}\ln(x+1) + \frac{1}{2}\ln(2x+3)$

Find y':

① $y' = \frac{1}{2}\cdot\frac{1}{x+1}\cdot 1 + \frac{1}{\cancel{2}}\,\frac{1}{2x+3}\cdot\cancel{2} = \frac{1}{2(x+1)} + \frac{1}{2x+3}$

With Chain Rule $y = \cancel{\ln}\sqrt{(x+1)(2x+3)}$

$$y' = \frac{1}{\sqrt{(x+1)(2x+3)}} \cdot \frac{1}{2}\left((x+1)(2x+3)\right)^{-1/2}$$

$$\cdot\left[1\cdot(2x+3) + (x+1)\cdot 2\right]$$

$$y = \ln \sqrt[3]{\frac{3x+1}{3-x}}$$

$$= \frac{1}{3}\ln(3x+1) - \frac{1}{3}\ln(3-x)$$

$$y' = \frac{1}{\cancel{3}} \cdot \frac{1}{3x+1} \cdot \cancel{3} + \frac{1}{3} \cdot \frac{1}{3-x} \cdot (+1)$$

$$= \frac{1}{3x+1} + \frac{1}{3(3-x)}$$

Hard Chain Rule Problem

$$y = \cancel{\sec}(\cancel{\tan}(3x + e^2))$$

$$y' = \sec(\tan(3x+e^2))\tan(\tan(3x+e^2)) \cdot \sec^2(3x+e^2) \cdot 3$$

$$\frac{d}{dx}(e^{\pi}) = 0 \qquad \frac{d}{dx}(e^x) = e^x$$

Practice Exam #20

$$e^{xy} = 8x - 8y \qquad \text{Find } dy/dx$$

$$\frac{d}{dx}(e^{xy}) = \frac{d}{dx}(8x - 8y)$$

$$e^{xy}\left[\frac{dx}{dx}y + x\frac{dy}{dx}\right] = 8 - 8\frac{dy}{dx}$$

$$ye^{xy} + xe^{xy}\frac{dy}{dx} = 8 - 8\frac{dy}{dx}$$

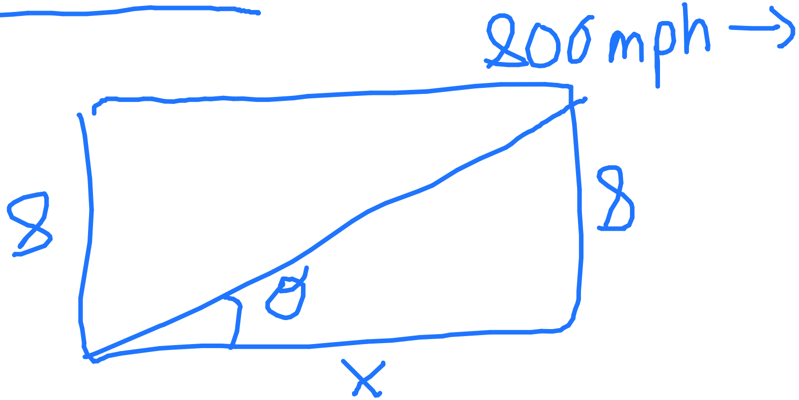
$$ye^{xy} + xe^{xy}\frac{dy}{dx} = 8 - 8\frac{dy}{dx}$$

$$xe^{xy}\frac{dy}{dx} + 8\frac{dy}{dx} = 8 - ye^{xy}$$

$$\frac{dy}{dx}\left(xe^{xy} + 8\right) = 8 - ye^{xy}$$

$$\frac{dy}{dx} = \frac{8 - ye^{xy}}{xe^{xy} + 8}$$

Hw 16 #7:



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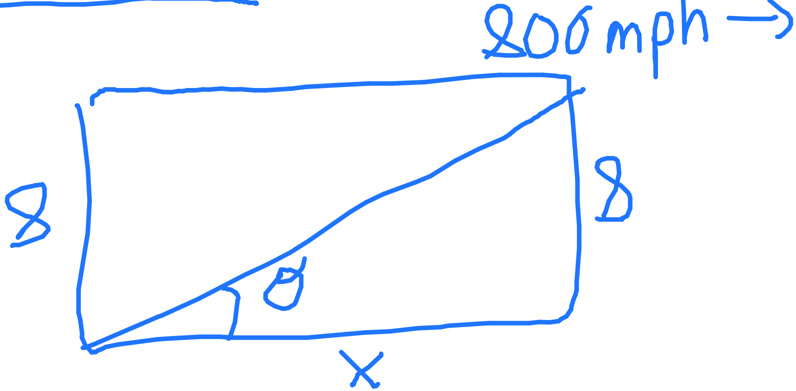
$$\sec^2\theta \frac{d\theta}{dt} = -\frac{8}{x^2}\frac{dx}{dt}$$

$$\frac{1}{\sec\theta} = \cos\theta$$

$$\frac{d\theta}{dt} = -\frac{8}{x^2}\cos^2\theta\frac{dx}{dt}$$

$$\frac{d\theta}{dt} = -\frac{8}{x^2}\left(\cos\left(\frac{\pi}{6}\right)\right)^2(800)$$

HW 16 #7:



$\tan\theta = \frac{8}{x} = 8x^{-1}$

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$\tan\left(\frac{\pi}{6}\right) = \frac{8}{x}$

$\frac{1}{\sqrt{3}} = \frac{8}{x}$

$x = 8\sqrt{3}$

$x^2 = 64 \cdot 3$

$\frac{d\theta}{dt} = \frac{-\cancel{8}}{\cancel{64}\cdot 3} \cdot \left(\frac{\sqrt{3}}{2}\right)^2 \cdot \cancel{800}$

$= -\frac{100}{\cancel{3}} \cdot \frac{\cancel{3}}{4} = -25$

HW 18.4 Inc/Dec $y = 2x^4 - 2x^3$

$$y' = 8x^3 - 6x^2 = 0$$

$$2x^2(4x-3) = 0$$

$$x = 0, \quad x = 3/4$$

$y'(-1) = +(-4-3)$

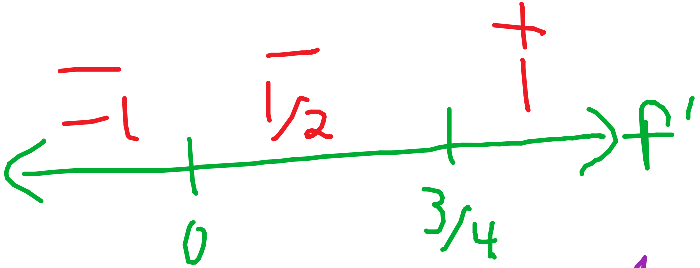
$+ \cdot - = -$

$y'(1/2) = +(4(\tfrac{1}{2}) - 3)$

$+ \cdot - = -$

$y'(1) = +(4-3)$

$+ \cdot + = +$



Inc: $(3/4, \infty)$ Dec: $(-\infty, 3/4)$