53) $y = 2x\sin x + x^2\cos x$

$y' = (2x)\cos x + \sin x(2) + (x^2)(-\sin x) + \cos x(2x)$

$y' = 4x\cos x + 2\sin x - x^2\sin x$

17.) $f(x) = x\cos x$ $\qquad c = \frac{\pi}{4}$

$f'(x) = x(-\sin x) + \cos x \cdot 1$

$f'\left(\frac{\pi}{4}\right) = \frac{\pi}{4}\left(-\sin\frac{\pi}{4}\right) + \left(\cos\frac{\pi}{4}\right)$

$= -\frac{\pi}{4}\left(\frac{\sqrt{2}}{2}\right) + \frac{\sqrt{2}}{2}$

$f'(c) = \frac{-\pi\sqrt{2}}{8} + \frac{\sqrt{2}}{2}$

Quotient Rule

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

$$\frac{d}{dx}\left(\frac{Hi}{Lo}\right) = \frac{Lo \cdot dHi - Hi \cdot dLo}{Lo^2}$$

#1 $y = \dfrac{1 - \cos x}{\sin x}$

$$y' = \frac{\sin x(\sin x) - (1-\cos x)\cos x}{\sin^2 x}$$

$$y' = \frac{\sin^2 x - \cos x + \cos^2 x}{\sin^2 x}$$

$\sin^2 x + \cos^2 x = 1$

$$y' = \frac{1-\cos x}{\sin^2 x}$$

#2

$$f(x) = \frac{x^3 + 5x + 3}{x^2 - 1}$$

$$f'(x) = \frac{(x^2-1)(3x^2+5) - (x^3+5x+3)(2x)}{(x^2-1)^2}$$

$$f'(x) = \frac{x^4 - 8x^2 - 6x - 5}{(x^2-1)^2}$$

#3 Find f'(c)

$$f(x) = \frac{x + 5}{x - 5} \qquad c = 4$$

$$f'(x) = \frac{(x-5)(1) - (x+5)(1)}{(x-5)^2}$$

$$f'(x) = \frac{-10}{(x-5)^2}$$

$$f'(4) = -10$$

#4 Find f'(c)

$$f(x) = \frac{\sin x}{x} \qquad c = \frac{\pi}{2}$$

$$f'(x) = \frac{x\cos x - \sin x \cdot 1}{x^2}$$

$$f'\left(\frac{\pi}{2}\right) = \frac{0 - 1}{\left(\frac{\pi}{2}\right)^2} = -\frac{4}{\pi^2}$$

#5 Find an equation of the tangent line to f(x) at the given point

$$f(x) = \frac{(x-1)}{(x+1)} \quad \left(2, \frac{1}{3}\right)$$

$$f'(x) = \frac{(x+1)\cdot 1 - (x-1)\cdot 1}{(x+1)^2}$$

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

$$f'(2) = \frac{2}{9}$$

$$y - \frac{1}{3} = \frac{2}{9}(x-2)$$

#7 Find the points where f(x) has a horizontal tangent

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

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

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

$$\frac{0}{1}=\frac{x^2+2x-3}{(x+1)^2}$$

$$0=x^2+2x-3$$

$$0=(x+3)(x-1)$$

$$x=1,-3$$

$(1, 0)$

$(-3, -8)$

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7, 11, 15, 29*, 37, 41, 65a, 76

* Quotient rule not necessary re-write the function