$$\lim_{x\to 0}\frac{\sin(x)}{x}=1 \qquad \lim_{x\to 0}\frac{\cos(x)-1}{x}=0$$

Evaluate the limits:

$$\lim_{x\to 0}\frac{\sin(6x)}{\sin(9x)}$$

$$\lim_{x\to 0}\frac{\sin(x^7)}{x}$$

$$\lim_{\theta\to 0}\frac{\cos(7\theta)-1}{sin(9\theta)}$$

$$\lim_{x\to 2}\frac{\sin(x-2)}{x^2+6x-16}$$

$$\lim_{t\to 0}\frac{\tan(16t)}{\sin(4t)}$$

$$\lim_{x\to 2}\frac{3-3\tan(x)}{\sin(x)-\cos(x)}$$

Use both the derivatives of $\sin(x)$ and $\cos(x)$ and the quotient rule to show:

$$\frac{d}{dx}\left(\tan(x)\right) = \sec^2(x)$$

and

$$\frac{d}{dx}\left(\sec(x)\right) = \sec(x)\tan(x)$$

Find $f'(x)$:

$$f(x) = 5x^2 + 7\sin(x)$$

Find $F'(x)$:

$$F(x) = \frac{3 - \sec(x)}{\tan(x)}$$

Find $g'(\theta)$:

$$g(\theta) = \sec(\theta)\tan(\theta)$$

Evaluate:

$$\frac{d^2}{d\theta^2}\left(\theta \sin(\theta)\right)$$

Find the equation of the tangent line to the curve $y = 14x\sin(x)$ at $x = \pi/2$.

Find

$$\frac{d^{103}}{dx^{103}}(\sin(x)) \text{ and } \frac{d^{201}}{dx^{201}}(\cos(x))$$

Step into your teacher's shoes. What is wrong (if anything) with the following calculations? Explain any errors and correct for them.

Find all values of x in the interval $[0, 4\pi)$ that satisfy the equation

$$\sin(2x) = \cos(x).$$

Solution: Since $\sin(2x) = 2\sin(x)\cos(x)$,

$$\sin(2x) = \cos(x) \quad \Rightarrow \quad 2\sin(x)\cancel{\cos}(x) = \cancel{\cos}(x)$$

$$\Rightarrow \quad 2\sin(x) = 1 \quad \Rightarrow \quad \sin(x) = \frac{1}{2}$$

Therefore, $x = \frac{\pi}{3}$ or $x = \frac{5\pi}{3}$.

What does $\lim_{x \to 0} \dfrac{\sin(x)}{x} = 1$ mean? Explain why three of the options are false and one is true.

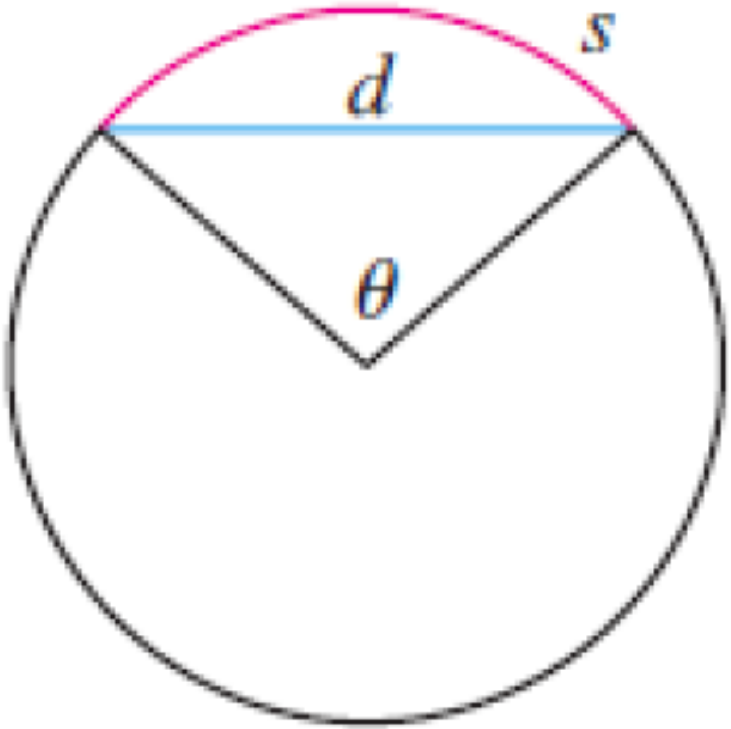
a) $\frac{0}{0} = 1$.

b) The tangent to the graph of $y = \sin(x)$ at $(0, 0)$ is the line $y = x$.

c) You can cancel the x's.

d) $\sin(x) = x$ for x near 0.

The figure shows a circular arc of length s and a chord of length d, both subtended by a central angle θ. Find $\lim_{\theta \to 0^+} \frac{s}{d}$.



It may be helpful to review the formulas associated to arcs and isosceles triangles. Further, why would the limit $\lim_{\theta \to 0} \frac{s}{d}$ not exist?