1: (20 points) Compute the following derivatives.

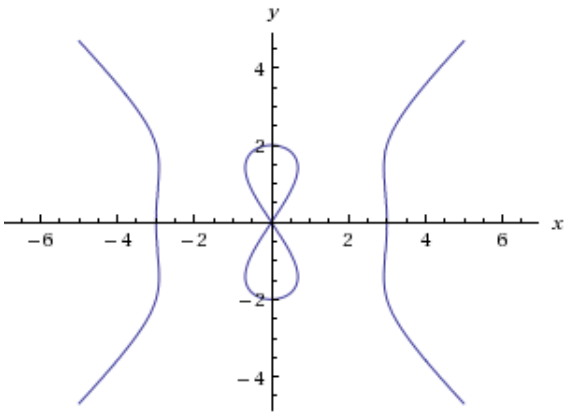
(a) $\dfrac{d}{dt}\left(\dfrac{\sin(t)}{1-\cos(t)}\right)$

(b) $\dfrac{d}{dx}\left(\sqrt{3x+\sqrt{5+\sqrt{1-x^2}}}\right)$

(c) $\dfrac{d}{dx}\left(cos^4(x)\sin(x^2e^x)\right)$

(d) $\dfrac{d}{dz}\left(\dfrac{\ln(z^2+5)}{2^z+3z^2}\right)$

2: (20 points) Find the tangent lines of the curve $y^4 - 4y^2 = x^4 - 9x^2$ a the points $(-3, 2)$ and $(3, 2)$.



3: (20 points) Solve the following *related rates* problems.

(a) The radius of a circle is changing at the rate of $\frac{-2}{\pi}$ m/sec. At what rate is the circle's area changing when $r = 12$ m?

(b) The volume of a curve is increasing at the rate of 1300 cm^3/min at the instant its edges are 20cm long. At what rate are the lengths of the edges changing at that instant?

4: (20 points) Consider the following function.

$$f(x) = x^2(x^2 - 5)$$

On what open intervals is f increasing or decreasing? At what points does f assume local maximum and minimum values? Identify the coordinates of any critical points and points of inflection. Using this information, sketch the graph of f.

5: (20 points) Compute the following limits.

(a) $\lim_{x\to 0} \dfrac{\sin(x^2)}{x}$

(b) $\lim_{t\to\infty} \dfrac{\ln(t^2+2t)}{\ln(t)}$

(c) $\lim_{x\to 0} \dfrac{5^x-1}{4^x-1}$

(d) $\lim_{x\to\infty} (\ln(2x) - \ln(x+1))$