1. Find $dy/dx$ for each of the following.

(a) $y = x^2 + 2^x + e^2 + e^{2x} + \ln 2 + \ln (2x) + \arctan 2$

(b) $y = \sqrt{x} \cdot \arctan (5x)$

(c) $y = \ln(\tan(2 \cos(x^2)))$

(d) $y = \sin^3 \left( \frac{x + e^\pi}{\ln 4 + \arcsin 6x} \right)$

2. Consider the curve defined by $x^3 + y^3 = 9 \frac{x}{2}y$ (known as the Folium of Descartes).

(a) Find $dy/dx$.

(b) Find the equation of the tangent line (the local linearization) at the point (1,2).

3. Use local linearization (tangent line approximation) to estimate $\sqrt{66}$. 
4. Evaluate the following limits.

(a) \[ \lim_{x \to 0} \frac{\sin 3x}{5x} \]

(b) \[ \lim_{x \to \infty} \frac{e^x}{\ln x} \]

(c) \[ \lim_{x \to 0} \frac{1 - \cos 2x}{3^x} \]

(d) \[ \lim_{x \to 1} \frac{x^3 - 1}{5 - 5x} \]

(e) \[ \lim_{x \to 0} \frac{1 - \cos 4x}{5x^2} \]

(f) \[ \lim_{x \to \infty} \frac{x^2}{2^x} \]

5. Consider the function \( f(x) = x^6 - 6x^4 \) with domain all real numbers.

(a) Find the \( x \)- and \( y \)-values of all critical points and identify each as a local max, local min, or neither.

(b) Find the \( x \)- and \( y \)-values of all global extrema and identify each as a global max or global min.

(c) Find the \( x \)-values of all inflection points.

(d) Sketch \( f \).
6. How would your answers to the previous question change if the domain of \( f \) were \([-3, 4]\)?

7. Decide if each statement is true or false and justify your answers.
   
   (a) If \( f'(1) = 0 \) then \( f \) has a critical point at \( x = 1 \).

   (b) If \( f'(2) = 0 \) then \( f \) has a local maximum or local minimum at \( x = 2 \).

   (c) If \( x = 3 \) is a critical point of \( f \), then \( f'(3) = 0 \).

   (d) If \( f''(4) = 0 \), then \( f \) has an inflection point at \( x = 4 \).

   (e) If \( f \) has a global maximum at \( x = 5 \), then \( f'(5) = 0 \).

   (f) If \( f'(6) = 0 \) and \( f''(6) = -2 \), then \( f \) has a local maximum at \( x = 6 \).

   (g) If \( f'(7) = 0 \) and \( f''(7) = 0 \), then \( f \) does not have a local extremum at \( x = 7 \).

8. Does the Mean Value Theorem apply to \( f(x) = |x| \) on the interval \((-2,3)\)?

9. Find the \( c \) specified in the Mean Value Theorem for \( f(x) = x^2 + x \) on the interval \((1,4)\).

10. Does the Extreme Value Theorem apply to \( f(x) = x^2 \) on the interval \([1,5)\)?
11. You have a 100 cm length of string which you can cut one time in any place or not cut at all. If you cut it, you will make a square out of one piece and a circle out of the other. If you don’t cut it, you can make either a square or a circle out of the entire string. What should you do in order to get the maximum area? the minimum area?

See old exams and quizzes at http://abacus.bates.edu/~etowne/mathresources.html