1. **(a)** [5] Give the linear approximation $L(x)$ of the function $f(x) = (1+x)^{12}$ at $a = 0$.

(b) [5] Use the linear approximation to estimate $(1.002)^{12}$.

2. [15] What are the absolute maximum and minimum values of the function $g(x) = x - x^{1/3}$ on the interval [-2,8]?

3. [20] Sketch the graph of the function f with the following properties.
Label significant points and lines.
- f is defined and differentiable for all real numbers.
- $f(0) = 0$, $f'(0) = 0$ and $f(2) = -3$.
- $f'(x) > 0$ for x in the interval $(2, \infty)$.
- $f'(x) < 0$ for x in the interval $(-\infty, 2)$.
- $f''(x) > 0$ for x in the intervals $(-\infty, 0)$ and $(1, 3)$
- $f''(x) < 0$ for x in the intervals $(0, 1)$ ans $(3, \infty)$.

4. **(a)** [5] State the Mean Value Theorem.

(b) [10] Verify that the conclusion of the Mean Value Theorem holds for the function $f(x) = 2x^2 - 1$ on the interval [1,2].

5. Find the intervals on which the graph of the function $f(x) = 2x^4 - 4x^2 + 3$ is

(a) [5] Increasing_____

Decreasing_____

(b) [5] Concave up_____

Concave down_____

(c) [3] Locate points at which the graph of f has
local extrema(max or mins)_____

(d) [2] Find any inflection points_____

6. [10] A rectangle has its base on the x-axis and its upper two vertices on the parabola $y = 27 - x^2$. What is the largest area the rectangle can have and what are its dimensions?

7. (6 pts) A function f has the following properties: $f(0) = 7$ and $f'(0) = -9$.
If $G(x) = f(3x^5 + 2x)$ find $G'(0)$.

8. (10 pts) Find the line tangent to the graph of $y^4 - 3 = -x^2y^2$ at the point $(\sqrt{2}, 1)$.

9. (10 pts) A cannon ball is shot straight up into the sky so that its height in feet at time t is given by $s = f(t) = -32t^2 + 128t + 5$. How high does the cannon ball go before it falls back down?

10. (10 pts) A stone dropped into a pool of water creates a ripple which has the shape of an expanding circle. If the radius of the circle increases at a rate of 3 feet per second, find how fast the area of the circle is increasing after 5 seconds.

11. A manufacturer wants to design a box with an open top, a square base and a surface area of 108 in^2. What dimensions will produce a box with the maximum volume?

12. [10]A girl flies a kite at a height of 300 ft. The wind carries the kite horizontally away from her at a rate of 25 ft/sec. How fast must she let out string when the kite is 500 ft away from her?

13. Does $f(x) = x^4 + 1$ have an inflection point? Explain.