1. Find the linear approximation for the function $f(x) = \sin x$ at $a = \pi/6$.

2. Use differentials to approximate $(1.97)^6$.

3. The radius of a sphere was measured to be 14 cm with a possible error of 0.5 cm.

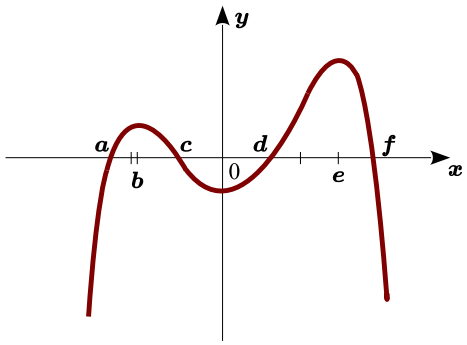
   (a) Use differentials to estimate the maximum error in the calculated surface area.

   (b) What is the relative error?

   (c) Use differentials to estimate the maximum error in the calculated volume.

   (d) What is the relative error?

4. The graph of the derivative, $f'(x)$, is shown below. Use the graph to answer these questions.



(a) On what intervals is f increasing? decreasing?

(b) On what intervals is f concave up? concave down?

(c) At what values of x does f have a local maximum or minimum?

(d) At what values of x does f have an inflection point?

(e) Assuming that f is continuous and $f(0) = 0$, sketch a graph of f.

5. Find all absolute and local extrema for the following functions by graphing.

(a) $f(x) = x^2 - 3$, $-1 \leq x \leq 2$.

(b) $f(x) = \begin{cases} x^2, & \text{if } -1 \leq x < 0 \\ 2 - x^2, & \text{if } 0 \leq x \leq 1 \end{cases}$

6. Find all critical numbers for the following functions.

(a) $f(x) = \sqrt[3]{x}(x-1)^2$

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

(c) $f(x) = xe^{-2x}$

7. Find the absolute maximum and absolute minimum of the given function on the given interval.

   (a) $f(x) = x^3 - 12x + 1$, $[-3, 5]$

(b) $f(x) = \dfrac{\ln x}{x}$, $[1, 3]$

(c) $f(t) = 16\cos t + 8\sin 2t,\ \left[0, \frac{\pi}{2}\right]$

8. Find the number(s) c that satisfies the conclusion of the Mean Value Theorem on the given interval.

   (a) $f(x) = 2x^3 + 1$, $[1, 2]$

   (b) $f(x) = \ln x$, $[1, 4]$

9. Suppose the function $f(x)$ has a domain of all real numbers except $x = 7$. The first derivative of $f(x)$ is

$$f'(x) = \frac{-2(x-3)e^{8x}}{(x-7)^7}.$$

(a) Find the interval(s) where $f(x)$ is increasing.

(b) Find the interval(s) where $f(x)$ is decreasing.

(c) Find the x-coordinates of all local extrema on the graph of $f(x)$.

10. Suppose the function $g(x)$ has a domain of all real numbers. The second derivative of $g(x)$ is

$$g''(x) = (x-2)^5(x+4)(x+8)^4.$$

(a) Find the interval(s) where $g(x)$ is concave up.

(b) Find the interval(s) where $g(x)$ is concave up.

(c) Find the x-coordinates of the inflection points of $g(x)$.