1. [9 points] Find all of the critical numbers of each function.
   (a) $f(x) = (x - 1)(x - 5)^3$
   (b) $f(x) = 10x^{4/5} - 5x^{9/5}$

2. [9 points] Evaluate each limit at infinity.
   (a) $\lim_{x \to \infty} \frac{3x^2 - 8x + 4}{6x^2 + 7x - 4}$
   (b) $\lim_{x \to -\infty} \frac{7x + 1}{2x^2 - 3x - 7}$
   (c) $\lim_{x \to \infty} \frac{x^2 + 7}{2x + 3}$

3. [10 points] Find the absolute maximum and minimum values of $f(x) = x\sqrt{12 - x}$ on the interval $[3, 11]$.

4. [12 points] Sand is being poured onto a conical pile at a rate of 40 cubic feet per minute. The diameter of the pile is 4 times the height. How quickly (in feet per minute) is the radius of the pile increasing, when the radius is equal to 20 feet?
   (The volume of a cone with height $h$ and radius $r$ is $\frac{1}{3}\pi r^2 h$.)

5. [20 points] Consider the function
   $$f(x) = \frac{x^2 + 4}{x^2 + 12}.$$  
   The first two derivatives of this function are as follows. You do not need to compute these.
   $$f'(x) = \frac{16x}{(x^2 + 12)^2},$$
   $$f''(x) = -\frac{48(x^2 - 4)}{(12 + x^2)^3}.$$ 
   (a) On which intervals is $f(x)$ increasing on which intervals is it decreasing?
   (b) Using your answer to part (a), determine any local max(s) and/or local min(s) of $f(x)$. Give both the $x$ and $y$ coordinates.
   (c) On which intervals is $f(x)$ concave up and on which intervals is it concave down?
   (d) Using your answer to part (c), determine any point(s) of inflection of $f(x)$. Give both the $x$ and the $y$ coordinates.
   (e) Determine any horizontal asymptotes of the function $f(x) = \frac{x^2 + 4}{x^2 + 12}$.
   (f) Draw a rough sketch of the graph $y = f(x)$, incorporating the information you found in parts (a) through (e).