1. Find the limits for the following indeterminate forms of the type "$\infty - \infty$".

a) $\lim_{x\to 0} \frac{1}{\sin x} - \frac{1}{x}$.

b) $\lim_{x\to 0} \frac{1}{x^2} - \frac{1}{x}$.

c) $\lim_{x\to 0} \frac{1+x}{x} - \frac{1-x}{x}$.

2. Questions about asymptotic growth "near" ∞ occur naturally when computer scientists analyze algorithms. One seemingly simple problem is sorting. How many comparisons are required to sort a list of n numbers? *Sorting and Searching*, volume 3 of *The Art of Computer Programming*, by D. Knuth, gives the following average running times for several sorting algorithms as a function of n:

Name	**Running time**
Comparison	$4n^2 + 10n$
Merge exchange	$3.7n(\ln n)^2$
Heapsort	$23.08n \ln n + 0.2n$

Which sorting method would you rather use if, in your application, $10 \le n \le 20$ (e.g., sorting a bridge hand)? Which would you rather use if $100 \le n \le 150$ (e.g., sorting grades in a lecture course)? Which would you rather use if $n \approx 10^6$ (e.g., sorting license plate numbers in New Jersey)? What happens to these functions as $n \to \infty$?

3. A charged particle moves along the x-axis under the influence of an electric field. The field strength varies with time, and as a result the velocity of the particle is complicated. The position of the particle at time t is written as $x = x(t)$ and the velocity of the particle at time t is written as $v = v(t)$.
Suppose we know that $x(0) = 0$, and also that

$$v(t) = \begin{cases} 2t - 1, & \text{if } 0 \le t \le 1 \\ 4t - 3, & \text{if } 1 \le t \le 2 \\ 6t - 7, & \text{if } 2 \le t \le 3 \end{cases}.$$

What is $x(1)$? What is $x(2)$? What is $x(3)$? Sketch the graphs of $x = x(t)$ and $v = v(t)$.

4. a) A car is traveling at 50 mi/h when the brakes are fully applied, producing a constant deceleration of 40 ft/s^2. What is the distance covered before the car comes to a stop?

b) A car braked with a constant deceleration of 40 ft/s^2 and produced skid marks measuring 160 feet before coming to a stop. How fast was the car traveling when the brakes were first applied?

One problem will be selected for a writeup to be handed in at the next recitation meeting. Please see Professor Greenfield's Math 153 webpage to learn which problem to hand in.