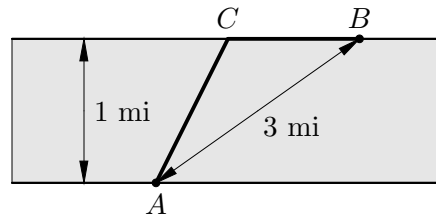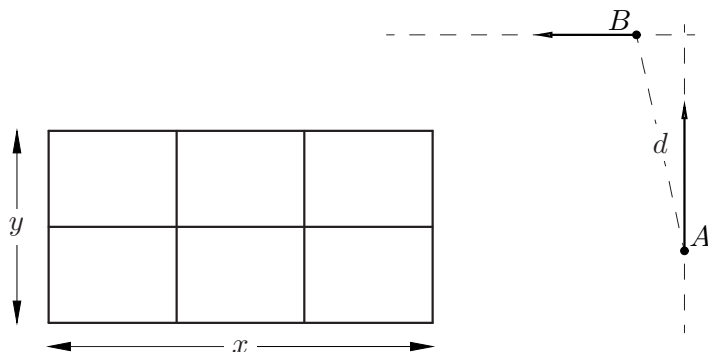**College of the Holy Cross, Fall Semester, 2004**
Math 131 Supplementary Review Problems

1. One thousand feet of fence will be used to construct six enclosed fields (left-hand figure). Find the dimensions that maximize the enclosed area.

2. At 1 PM, Ship A is 30 miles due south of Ship B and is sailing north at 15 mph. If Ship B is sailing west at 10 mph, find the time at which the distance d between the ships is smallest (middle figure).

3. A pipeline is to be built between two pumping stations 3 miles apart on opposite sides of a river 1 mile wide (right-hand figure). The cost of running a pipeline over water is four times the cost of running it over land. Find the location C that minimizes the total cost.

4. A page of a book is to have area 90 in^2, with 1 in margins along the bottom and sides and a $1/2$ in margin at the top. Find the page dimensions that maximize the printed area.

5. Find the point on the graph $y = x^3$ that is closest to the point $(4, 0)$.

6. A window has the shape of a rectangle surmounted by an equilateral triangle. If the perimeter of the window is 12 ft, find the dimensions of the rectangle so that the window admits as much light as possible.

7. A real estate company owns 180 apartments that are fully occupied when the rent is \$300/week. The company estimates that for each \$10 increase in weekly rent, 5 apartments will become unoccupied. What rent should be charged to maximize the gross income?

8. A package can be sent by parcel post only if the sum of its length and girth (the perimeter of the base) is at most 108 inches. Find the dimensions of the box of maximum volume that can be sent. You may assume the base of the box is square.

9. Evaluate the following indeterminate limits:

$$\lim_{x \to 0} \frac{\sin 2x}{\sin 3x}, \quad \lim_{x \to 0} \frac{1 + x - e^x}{x^2}, \quad \lim_{x \to 5} \frac{\sqrt{x - 1} - 2}{x^2 - 25}, \quad \lim_{x \to \infty} \frac{x^{14}}{1.01^x}, \quad \lim_{x \to \infty} \frac{x\sqrt{x} + \ln x}{x^2}, \quad \lim_{x \to \infty} \frac{e^x}{x - e^x}$$