Submit your solutions to the following problems in lecture on the due date above. Present your work in a clean and organized fashion, either on a printed copy of this document (preferred) or a separate sheet of paper. As stated in the syllabus, late submissions will not be accepted.

1. Suppose you want to build a jewelry box with a square bottom and open top. If you have 12 ft² of building material, what are the dimensions of the box with the maximum volume?

   \[ x = \text{width} \quad A = \text{surface area} = 12 \]
   \[ y = \text{height} \quad V = \text{volume} \]
   \[ 12 = x^2 + 4xy \]
   \[ 12 - x^2 = 4xy \]
   \[ y = \frac{12-x^2}{4x} \]
   \[ V = x^2y \]
   \[ V = x^2 \left( \frac{12-x^2}{4x} \right) \]
   \[ V = \frac{3x - x^3}{4} \]

   To find the critical points, we set \( V'(x) = 0 \):
   \[ V'(x) = 3 - \frac{3}{4}x^2 = 0 \]
   \[ x = \sqrt{\frac{4}{3}} \]
   \[ y = \frac{12 - x^2}{4x} \]
   \[ x = 2, \ y = \sqrt{3} \]

2. Suppose you are swimming 20 ft/sec in a 20ft by 48ft pool, long-ways in the middle lane (i.e., 10 ft from each of the longer sides). There is a lifeguard standing at the corner of the pool, watching you swim away. How fast is your distance from the lifeguard changing when you are halfway across the pool?

   \[ x = \text{dist to swimmer} \quad y = \text{dist to lifeguard} \]
   \[ 10^2 + (x(t))^2 = (y(t))^2 \]
   \[ 0 + 2x(t) \frac{dx}{dt} = 2y(t) \frac{dy}{dt} \]
   \[ 2(20)(20) = 2(26) \frac{dy}{dt} \]
   \[ \frac{dy}{dt} = \frac{2(20)(20)}{2(26)} \text{ ft/sec} \]