1. A box with an open top is to be constructed from a square piece of cardboard, 3 ft wide, by cutting a square from each of the four corners and bending up the sides. Find the largest volume that such a box can have.

2. A rectangular storage container with an open top is to have a volume of 10 m^3. The length of the base is twice the width. Material for the base costs \$10 per square meter. Material for the sides costs \$ 6 per square meter. Find the costs of materials for the cheapest such container.

3. Find the point on the line $y = 3x$ that is closest to the point $(1, 0)$.

4. Consider the function $G(x) = x^3 - x^2$.

a. On what intervals is G increasing or decreasing?

b. Find the locations of any local maximum and minimum values of G.

c. Find the intervals of concavity and the inflection points.

5. A paper cup has the shape of a cone with height 10 cm and radius 3 cm (at the top). If water is poured into the cup at a rate of $2\,\mathrm{cm}^3/\mathrm{sec}$, how fast is the water level rising when the water is 5 cm deep?

6. Find the linearization of $f(x) = \sqrt{x}$ at $a = 4$ and use it to estimate $\sqrt{4.1}$.

7. The position of a mass on the x axis is given by $x(t) = t(e^t - 2)$ for $t \geq 0$. Find an equation involving a derivative to solve to determine the time when $x(t)$ is at a minimum. You will not be able to solve the equation by hand, so don't sweat it.

8. We can use Newton's method in the previous problem to find an approximate solution.

a. Explain why you expect the minimum to occur somewhere between $t = 0$ and $t = \ln(2) \approx 0.7$.

b. Apply one round of Newton's method to determine an approximate solution starting with $t = 1/2$.