Homework #1 Solutions:

1.) As we know ozone is responsible for blocking dangerous UV radiation coming from the sun. It does this by absorbing the radiation. Where does the energy carried by this radiation go? It goes to heating up the ozone layer! The ozone layer is found exactly where the temperature stops decreasing with height above the earth and starts to increase. This increase is due to the absorption due to the ozone layer. If the ozone were to disappear, the temperature would not increase in the stratosphere. The sketch on the left is the normal vertical profile of atmospheric temperature, and the one on the left is the one without ozone.

2.) If you start at the bottom of a mountain and start to walk up, common sense tells you that the higher you go the colder it gets. This is due to the lapse rate of the atmosphere. A typical lapse rate would be 3.6°F/1000ft. This says that for every 1000ft you go up in altitude, the temperature will decrease by 3.6°F. In our case we are trying to find how high you need to go to have a change in temperature of 38°F. To solve this you know the following two quantities are proportional, and then simply solve for x:

$$\frac{3.6^\circ F}{1000 \text{ ft}} = \frac{38^\circ F}{x}$$

$$38^\circ F + \left(\frac{3.6^\circ F}{1000 \text{ ft}}\right) = 10555.5 \text{ ft}$$

3.) In this problem you are given that a cubic inch of water weighs .036 pounds. We learned in class that pressure is essentially the weight of the air/liquid column above you. We know that the column of air above you exerts a pressure of 14.7psi (lbs per square inch), so we need to find how tall
the column of water is that will exert an additional 14.7psi on you for a total of 19.4psi. We can do this by simple logic. If you had 1in of water above you it would exert a pressure of .036psi on you, 2in would be (2 x .036)psi, and so on. So how many inches of water are needed to equal 14.7psi? If you rewrite this question mathematically it would look like this:

\[ x \times 0.036 \text{ (lb/in}^3) = 14.7 \text{ psi} \]

solve this equation for \( x \) (which will be in inches) and convert to feet:

\[ x = \frac{14.7 \text{ (lb/in}^2)}{0.036 \text{ (lb/in}^3)} = 408.3 \text{ in} \]

\[ 408.3 \text{ in} / 12 \text{ (in/ft)} = 34.03 \text{ ft} \]

4.) The primary way these two heating options differ, is in the fact that while burning fossil fuels is purely putting \( \text{CO}_2 \) into the atmosphere, planting an acre of corn harvesting it and then burning it in a stove puts \( \text{CO}_2 \) in the atmosphere, the process also takes some out. Harvesting corn removes \( \text{CO}_2 \) through photosynthesis, which occurs while the corn is growing. Photosynthesis changes \( \text{CO}_2 \) into glucose which gives the plant energy. \( \text{CO}_2 \) is then released when the plant is burned.