Homework Problem 3 – Due January 31

14.42

On a perfectly still Fall day, you are hovering at low altitude in a hot-air balloon, accelerated neither upward nor downward. The total weight of the balloon, including its load and the hot air in it, is 20,000 N.

a) What is the weight of the displaced air?
b) Show that the volume of the displaced air is 1700 m^3.

14.64

Would it be slightly more difficult to drink soda through a straw at sea level or on top of a very high mountain? Explain your answer.
EXTRA: As you open your soda can on top of that mountain, will the bubbles be the same size as they would be at sea level?

14.66

A little girl sits in a car at a traffic light holding a helium-filled balloon. The windows are closed and the car is relatively airtight. When the light turns green and the car accelerates forward, her head pitches backward but the balloon pitches forward. Explain why!

Q1

We observe that a NASA balloon filled with helium increases in volume 3-fold as it rises to a height of 10,000 m (33,000 ft). Assuming its temperature stays constant (and it doesn't leak), what does that tell you about air pressure at 10,000 m height? (Give a numerical answer in Pa and explain how you got it). What does THAT in turn tell you about the density of air at 10,000 m height?

14.80

Why does the fire in a fireplace burn more briskly on a windy day, even though the actual fire box is inside a house and hence sheltered from the wind? *Hint:* How does the wind blowing over the top of the chimney cause an increase in the flow of oxygen to the fire?

Q2

Which has more internal energy: an iceberg the size of the Titanic, or a hot cup of coffee? Defend your answer (Careful!).

Q3

Copper has a specific heat capacity of 390 J/kg/ºC. It also has a linear coefficient of expansion of $\alpha = 17 \times 10^{-6}$/ºC. Assume a 5 m long rod of copper has a mass of 3 kg and is initially at a temperature of 20 ºC. Now we transfer (somehow) 4680 J of heat to the rod.

A) What is the new temperature of the rod?

B) By how much does its length increase?

Show your math!