Homework 1

Homework #1:

(1) A regular scuba tank holds 10 L or air at a pressure of 300 bar. The potential energy of that compressed gas is the pressure times the volume. How many Joules are in a scuba tank? (Watch those units/conversions). (You have to get this right to get the rest of the questions right – try checking you work carefully).

(2) How much energy is that anyway? If you converted it all to kinetic energy ($\frac{1}{2}m\mathbf{v}^2$) how fast could it make a tennis ball (0.1 kg) go? Cool huh!

(3) How many liters of automotive gasoline is a scuba tank of air equivalent to? Search on the web for some numbers you might need.

(4) A car engine is about 35% efficient and a scuba tank engine is closer to 90% efficient. Now how much gasoline is equivalent to one scuba tank? Now you know why gasoline is an addictive energy source.

(5) A small pickup truck gets about 20 miles to a gallon of gas. If you want a scuba tank truck that can go at least 100 miles before it needs another fill up of air, how many scuba tanks do you need in the back of the truck? (No fractional scuba tanks people!). (Use the numbers from question 4 that include the efficiencies).

(6) The scuba tank (the metal part) weighs about 16kg. Figure out how much the air inside the tank weighs when it is at room temperature. The perfect gas law is OK for air. In Thermo we use $pv = R_{air}T$ where $v = 1/\rho$ (specific volume or volume/mass, is the inverse of density). The one you learned in physics is essentially the same – but presented slightly differently. (The constant R_{air} is on page 343 of your book).

(7) If you slowly (so the temperature doesn't change) put all that air into a big balloon that is at regular atmospheric pressure (1 bar), how big would the balloon need to be? Hint: Energy is conserved. So is the total mass.