

ERTH 260: Laboratory Exercise 4
Understanding the Concept of the Gas Law
100 points
(Due Friday 23 February)

The “simplified” or conceptual (explained in class) Ideal Gas Law (Equation of State) is:

$$p = \rho RT$$

or (1a,b)

$$p\alpha = RT$$

where p is pressure, ρ is density, R is a constant called the “gas constant”, T is temperature and α is specific volume. In 1(b) the specific volume is the volume a unit amount of gas, in this case 1 kilogram, occupies. You can just think of this as “volume”. In reality, specific volume and density are inversely related.

$$\alpha = \frac{1}{\rho} \quad (2)$$

As you can reason out, in the MKS system, the units of specific volume are $\text{m}^3 \text{kg}^{-1}$ and of density, kg m^{-3} . **Answer in complete sentences and on separate sheets.**

1. Examine equation 1(a). In a situation in which temperature remains constant, are pressure and density directly or inversely related? Explain? (Answer in complete sentences) (20 points)
2. Examine equation 1(b). In situation in which volume remains constant, are pressure and temperature directly or inversely related? Explain. (20points)
3. Consider a situation in which there are two air parcels side by side (Parcel A and Parcel B) at the 500 mb level. Say Parcel A has a temperature of -10°C and Parcel B has a temperature of 0°C . According to equation 1(a) which air parcel is less dense. (20 points)
4. Examine the weather map, given as Figure 1, below:

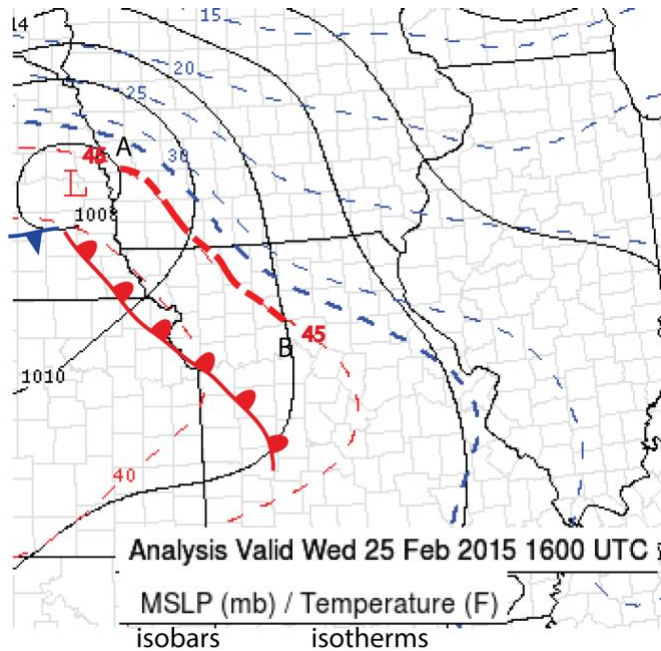


Figure 1: Sea level pressure (isobars, 2 mb intervals) and temperature (isotherms, 5F intervals), for 1600 UTC 25 February 2015

Notice the highlighted portion of the 45F isotherm, extending from point A where the pressure is 1008 mb to point B where the pressure is 1012 mb. You are going to be asked, below, to use the gas law to say something about the variation of density along the isotherm highlighted.

(a) Given the constraints of the problem, what is constant in Equation (1a) (give me the symbols and a short one sentence explanation); (20 pts)

(b) At which location, A or B is the density greater? Provide at least a COMPLETE one or two sentence explanation.(20 pts)