AOSC 431-Atmospheric Physics and Thermodynamics, Fall 2016, Dr. Kleist
Homework #2 (Points) – DUE: FRIDAY 23 September 2016 (5 PM)
Each question is worth 5 points. All work needs to be shown for full credit.

1. Using the table below, compute the apparent molecular weight (M_d) of dry air on Venus and Mars. Using this information, compute the gas constant for 1 kg of the Venusian and Martian atmospheres, respectively.

Gas	Atomic Weight	Venus	Mars
Carbon Dioxide	44 g/mole	96.4%	95.5%
Nitrogen	28 g/mole	3.5%	2.7%
Argon	40 g/mole	70 ppmv	1.6%
Oxygen	32 g/mole	N/A	0.2%

2. A previously evacuated tank with a capacity of 0.5 m^3 is pressurized with 2 kg each of helium (molar mass 4.0) and nitrogen (molar mass 28.0) at room temperature (20^o C). What is the final pressure of the mixture?

3. If water vapor comprises 2% of the volume of the air (as in it accounts for 2% of the molecules in the air), what is the virtual temperature correction? Using specific humidity (q) instead, what is the virtual temperature correction for a tropical air mass (~20 g/kg water vapor) versus arctic air mass (~3 g/kg water vapor)?

4. If the specific humidity (q) in a sample of air is 15 g/kg at 25^o C:
    a. Find the virtual temperature (Tv) expressed in both Kelvins and degrees Celcius.
    b. If the pressure is 1012 hPa, find the density (ρ).
    c. By what percentage is the above density greater or less than that for dry air at the same pressure and temperature?

5. What is the air pressure for dry air given T=70^o F and ρ=1.15 kg m^{-3}? Give two combinations of pressure and density for dry air that has a temperature of 0^o C. Finally, how might one determine the density of air without a "density meter"?

6. Describe why the gas constant for moist air is greater than that for dry air.

7. Typical hot air balloons used on sightseeing flights attain volumes of 3000 m^3. A typical gross weight (balloon, basket, fuel and passengers, but not the air in the balloon) on such a balloon flight is 600 kg. If the ground temperature is 20°C, the lapse rate is zero, and the balloon is in hydrostatic equilibrium at a cruising altitude of 850 hPa, determine the temperature of air inside the balloon.

8. The lowest point on Earth, the Dead Sea, is 420m below sea level.
    a. If the lapse rate in the lowest few hundred meters is 8 ^{o}C/km, the *surface pressure (p_s)* at the Dead Sea is 1060 mb, and the surface temperature (T_s) is 32 ^{o}C, find a reasonable estimate for the mean temperature between the surface and sea level. Ignore any effects from humidity.
    b. Find the pressure at sea level (p_0) under the above conditions.
    c. By how many millibars would your answer to (b) be in error if you made a one degree error in the layer mean temperature?