ENV 407 – Atmospheric Processes: From Clouds to Global Scales Hydrostatic Equilibrium – Hypsometric Equation

1. Using the equation we derived for barometric pressure as a function of altitude calculate H for a dry atmosphere with an effective temperature of 273°K.

a) sure isothermal, dy atmosphere
$$\frac{dp}{dz} = -\frac{Pg}{R_{0}T} \Rightarrow lu\frac{P}{P_{0}} = -\frac{gz}{R_{0}T} \Rightarrow H = \frac{8.314}{9.81} = \frac{8.314}{9.81} = \frac{1.314}{9.81}$$

2. For the value of H calculated above determine the altitude where P = 0.5 atm.

3. For the value of H calculated above what is the air pressure in atmospheres at the top of Mt Everest (8.85km)?

$$l_{\frac{1}{1}} = -\frac{2}{4} = -\frac{8.85}{7.98} \Rightarrow P = P_0 \exp(-1.1) = P_0 0.33 = 0$$

4. On Mars the atmosphere is mainly CO2, the temperature is 220°K and the acceleration of gravity is 3.7 m/s2. What is the scale height of the Martian atmosphere? Compare the scale height to the Earth's atmosphere and explain why they scale heights are different.

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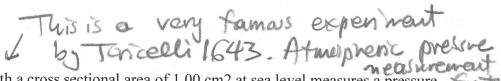
$$H = \frac{8.314}{44 \times 10^{-3}} = 11.24 \text{ km}$$

$$3.4$$

So P drops less with altitude for Mars

(H=11,24km) compared to Earth (7.98km).

That is mot likely because of the reduced grand of Mars, because it atmosphere has "heavier" molecules (cor vs N2/02).



5. A barometer with a cross sectional area of 1.00 cm2 at sea level measures a pressure of 76.0 cm of mercury. The pressure exerted by this column of mercury is equal to the pressure exerted all the air on 1 cm2 of earth's surface. Given the density of mercury of 13.6 g/cm3 and the average radius of the earth of 6371 km, calculate the total mass of the Earth's atmosphere in kilograms.

Surfave area 1cm²
= 13.6×103 kg m-3 × 0.76m × 9.81m s-2
= 1.014×105 Pa

So Matmosphere = 1.014 ×105 × [471 (6371×103)2] = 5.27 ×1018 kg

6. An air bubble with a radius of 1.5 cm at the bottom of a lake where the temperature is 8.4° C and the pressure is 2.8 atm rises to the surface, where the temperature is 25° C and the pressure is 1.0 atm. Calculate the radius of the bubble when it reaches the surface. Assume ideal gas behavior. The volume of a sphere is $(4/3)\pi r^3$ where r is the radius.

don't have to do this.