CHEMISTRY 302

ASSIGNMENT 1

DUE 4:30 PM, MONDAY 11 JANUARY 2010

1. The composition of the atmosphere below 100 km is:

Constituent	Molecular Mass (g mol ⁻¹)	Content (fraction of total molecules)
Nitrogen (N ₂)	28.016	0.7808
Oxygen (O ₂)	32.00	0.2095
Argon (Ar)	39.94	0.0093
Water Vapour (H ₂ O)	18.02	0 - 0.04
Carbon dioxide (CO ₂)	44.01	325 ppm
Neon (Ne)	20.18	18 ppm
Helium (He)	4.00	5 ppm
Krypton (Kr)	83.7	1 ppm
Hydrogen (H ₂)	2.02	0.5 ppm
Ozone (O ₃)	48.00	0-12 ppm

(a) To the nearest milligram, what is the average molar mass of dry (i.e. no water vapour present) air with no ozone present?

(b) Would an "ozone episode" (i.e. concentration of ozone at maximum) make a difference to the answer calculated in (a)?

(c) At 50% relative humidity, the water content of air is 0.020 as a fraction of the total molecules. What is the molar mass of this air?

(d) If the ozone concentration is 0.20 ppm at a pressure of 100 kPa at 14°C, what is the concentration of ozone in molecules cm⁻³?

(e) The total mass of the atmosphere below 100 km is 5.0×10^{15} tonnes. Assuming uniform composition, what is the total mass of each of the first three constituents listed in the table?

- 2. Do question 3, page 27 Bunce.
- 3. Do question 3, page 128 Bunce.
- 4. Chlorine dioxide is prepared for water treatment by the reaction below.

 $10 \text{ NaClO}_2 + 5 \text{ H}_2\text{SO}_4 \rightarrow 8 \text{ ClO}_2 + 5 \text{ Na}_2\text{SO}_4 + 2 \text{ HCl} + 4 \text{ H}_2\text{O}$

What mass of NaClO₂ is needed to generate enough ClO_2 to treat $1.7 \times 10^5 \text{ m}^3$ of water with 2.4 ppm of ClO_2 if the percent yield of the reaction is 84%?

5. A commercial gasoline mixture is 87% isooctane, 3% heptane, and 10% ethanol by weight. If the density of this gasoline is 0.755 g mL⁻¹, what is the mass of CO₂ produced by the combustion of one litre of this gasoline. If a vehicle is rated at 5.5 L of gasoline for each 100 km driven, how much CO₂ would be produced by a 13.2 km round trip from the University to Parkwood Mall?