AP exam question # 2 NAME_____

This question was taken from the 2006 free response section of the AP exam. If the question requires problem solving, please show your work and express your answer with the correct number of significant figures. If the question requires you to explain something, please do so in clear concise sentences using appropriate chemical principles.

A) A compound containing the elements C, H, N, and O is analyzed. When a 1.2359 g sample is burned in excess oxygen, 2.241 g of CO_2 is formed. The combustion analysis also shows the sample contained 0.0648 g of H.

i) Determine the mass, in grams, of C in the 1.2359 g sample of the compound.

$$2.241\ g\ CO_2 \left|\frac{1\ mol\ CO_2}{44.01\ g\ CO_2}\right|\frac{1\ mol\ C}{1\ mol\ CO_2}\left|\frac{12.01\ g\ C}{1\ mol\ C}\right| = \boxed{0.6116\ g\ C}$$

ii) When the compound is analyzed for N content only, the percent mass of N is found to be 28.84%. Determine the mass, in grams, of N in the original 1.2359 g sample of the compound.

$$1.2359\ g \cdot 0.2884 = \boxed{0.3564\ g\ N}$$

iii) Determine the mass, in grams, of O in the original 1.2359 g sample of the compound.

$$1.2359\ g - (0.6116\ g\ C + 0.3564\ g\ N + 0.0648\ g\ H)$$

$$= \boxed{0.2031\ g\ O}$$

iv) Determine the empirical formula of the compound.

$$0.6116\ g\ C \left|\frac{1\ mol\ C}{12.01\ g\ C}\right| = 0.05092\ mol\ C = 4$$

$$0.0648\ g\ H \left|\frac{1\ mol\ H}{1.01\ g\ H}\right| = 0.06416\ mol\ H = 5$$

$$0.3564\ g\ N \left|\frac{1\ mol\ N}{14.01\ g\ N}\right| = 0.02544\ mol\ N = 2$$

$$0.2031\ g\ O \left|\frac{1\ mol\ O}{16.00\ g\ O}\right| = 0.01269\ mol\ O^{\star} = 1$$

$$\boxed{C_4H_5N_2O}$$

B) A different compound, which has an empirical formula of CH_2Br, has a vapor density of 6.00g/L at 375 K and 0.983 atm of pressure. If the molar mass of the compound is 188 g/mol, calculate its molecular formula.

$CH_2Br \approx 94$ g/mol (×2)

$= C_2H_4Br_2$