

ACDB4011 CHEMISTRY QUIZ 3

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5p 1. (6 points) Indicate whether each of the following statements is true or false:

✓ ☒ T ☐ F

Toxic gases are liberated when the oxygen balance for a given explosive substance is large and negative.

___ ☒ ☐

Supercritical fluid is a highly compressed fluid that combines the properties of gases and liquids.

✓ ___ ☒ ☐

Dipole-dipole forces are stronger than network covalent bonds

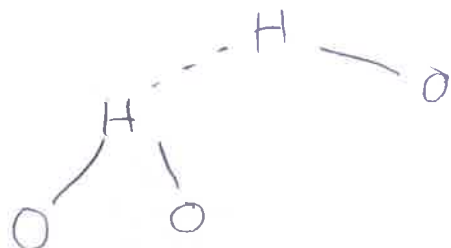
✓ ___ ☒ ☐0.5 mol of nitrogen gas, N_2 , will occupy less space than 0.5 mol of methane gas, CH_4 , at the same temperature and pressure.✓ ___ ☒ ☐

According to Boyle's law, the volume of a gas is directly proportional to the temperature.

✓ ___ ☒ ☐

Heavier gas molecules have higher kinetic energy than lighter gases at the same temperature and pressure.

1p 2. (4 points) Explain in terms of intermolecular forces why does ice float in water? Support your answer with a drawing.

London dispersion forces (LDF)Hydrogen bonds

LDF exist everywhere
 As H_2O mol^s pass each other temporary LDFs are formed.

3. a) (4 points) θ How many moles of oxygen gas will react with 0.5 mol of $C_4H_{10}O$ in incomplete combustion to carbon monoxide and water?

$$n = m \times MM$$



$$MM = 74 \text{ g/mol}$$

$$0.5 = 37 \text{ g/mol}$$

$$32 \text{ g/mol}$$

$$28 \text{ g/mol}$$

$$18 \text{ g/mol}$$

1.16 moles O_2 gas

$$C = 12 \times 4 = 48$$

$$H = 1 \times 10 = 10$$

$$O = 16 = 16$$

$$MW = 74$$

$$O_2 = 16 \times 2$$

- b) (6 points) γ Calculate the volume occupied by the moles of oxygen gas calculated in a) at a pressure 220.0 kPa and a temperature of 21.0 deg C.

$$P = 220.0 \text{ kPa}$$

$$T = 21.0^\circ\text{C} = 294 \text{ K}$$

$$V = ?$$

$$R = 0.0821 \text{ L-atm/mol-K}$$

Gay-Lussac

$$P \uparrow \quad T \uparrow$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$PV = nRT$$

at STP = 22.4 L but not STP

I don't know so using this vol.

- c) (6 points) $2p$ What will be the volume occupied by the moles of oxygen gas calculated in a) if the pressure decreased to 100.0 kPa and temperature increased to 50.0 deg C. DO NOT use the ideal gas equation!

$$P_1 V_1 = P_2 V_2$$

$$220.0 \text{ kPa} \times V_1 = 100.0 \text{ kPa} \times V_2$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{22.4}{294} = \frac{V_2}{323}$$

$$V_2 = \frac{22.4}{323} \times 294 \text{ L}$$

$$P \downarrow \quad T \uparrow$$

Boyle's Law

$$50^\circ\text{C} = 323 \text{ K}$$

$$\rightarrow \text{Charles} \quad T \uparrow \quad V \uparrow$$

$$P \uparrow \quad T \uparrow$$

$$P \downarrow \quad T \downarrow$$

$$P_1 V_1 = P_2 V_2 \quad \checkmark \quad = 0.069 \times 294 = 20.389 \text{ L}$$

$$100,000 \times 22.4 = 100,000 \times V_2 \quad \checkmark \quad = 220,000 \times 22.4$$

$$V_2 = (220,000 \times 22.4) / 100,000 = 49.28 \text{ L}$$

$$C = A, H = B, N = C, O = D$$

4. a) (4 points) ^{2p} For a high explosive substance HMX ($C_4H_8N_8O_8$, 296.5 g/mol) calculate the oxygen balance.

$$\frac{16}{MW} \left[b - \left(\frac{d}{2} \right) \right] \times 100 = \frac{16}{296} \left[8 - \left(\frac{8}{2} \right) \right] \times 100$$

$$mm = 29.86$$

$$0.054 [8 - 4] \times 100 = 21.6\%$$

$$C = 4 \times 12 = 48$$

$$H = 8$$

$$N = 14 \times 8 = 112$$

$$O_8 = 128$$

- b) (4 points) ^{4p} Using Kistiakowsky-Wilson rules determine the decomposition products of HMX.



① $C = 4CO$

② $O = 4H_2O$

③ $O = X$

④ $N = 4N_2$

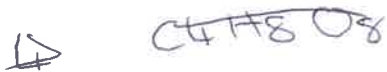
$$40 = 11 \times 2 + 0$$

$$11 \times 2 + 0$$

$$11 \times 2 + 0$$

$$11 \times 2 + 0$$

$$8 \quad 4$$



- c) (2 points) ^{0p} What is the volume of all gaseous products formed upon decomposition of 1 mol of HMX at STP?

$$STP = 0^\circ C / 273K$$

$$= 1 \text{ atm}$$

$$1 \text{ mol} = 22.4L$$

$$1:1 \text{ at STP}$$

$$22.4L \text{ of all gaseous products}$$

$$\text{or}$$

$$22.4 \text{ dm}^3$$