

ACDB4011 CHEMISTRY QUIZ 3

28

NAME

don barney

DATE: Nov 08, 2022

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

5p
✓ 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.

✓ ✓

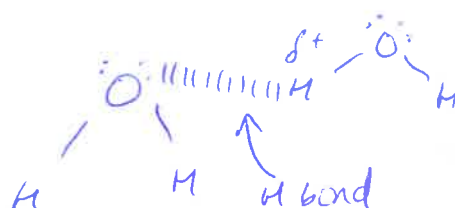
According to Boyle's law, the volume of a gas is directly proportional to the temperature.

✓ ✓

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

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

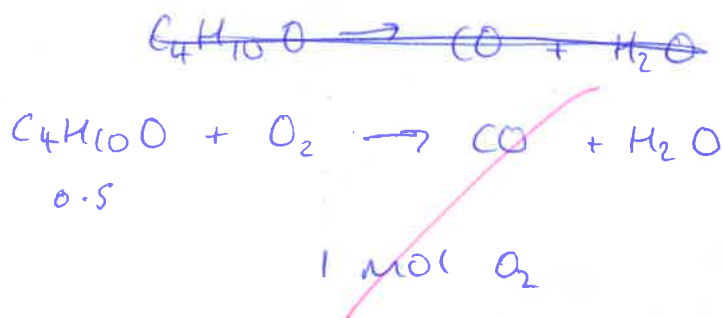
4p
water forms hydrogen bonds with other water molecules. The lone pairs of electrons on O are attracted to the δ^+ charge on the Hydrogens, as shown below:



solid H_2O forms 4 H bonds, whereas liquid H_2O only forms 2-3 H bonds. This makes solid H_2O more dense than liquid and hence floats.

✓/9

3. a) (4 points) 4p 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?



- b) (6 points) 6p 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.

$$PV = \frac{nRT}{P}$$

$$V = \frac{1 \times 0.0821 \times 294}{2.17} \quad \checkmark$$

$$V = 11.12 \text{ L}$$

$$21^\circ\text{C} = 294 \text{ K} \quad \checkmark$$

$$1 \text{ atm} = 101.3 \text{ kPa} \quad \checkmark$$

$$2.17 \text{ atm} = 220 \text{ kPa}$$

- c) (6 points) 3p 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!

GL laws

~~GL~~ $P \uparrow T \uparrow$

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

$$273 \text{ K } 1 \text{ atm}$$

$$101.3 \text{ kPa} = 1 \text{ atm}$$

$$100 \text{ kPa} = 0.987 \text{ atm}$$

$$\text{old temp} = 273 \text{ K}$$

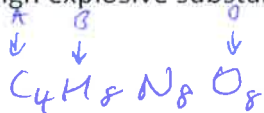
$$\text{New temp} = 323 \text{ K}$$

$$V = 11.12 \times \frac{1}{0.987} \times \frac{323}{273}$$

$$V = 13.33 \text{ L}$$

$$V = 11.12 \times \frac{0.987}{2.17} \times \frac{323}{273} = 5.98 \text{ L}$$

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



$$\Omega = \frac{16}{M_r} \times \left[d - (2a) - \left(\frac{b}{2}\right) \right] \times 100$$

$$\Omega = \frac{16}{296.5} \times \left[8 - (2 \times 4) - \left(\frac{8}{2}\right) \right] \times 100 = -21.59\% \quad \checkmark$$

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



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

$$\text{Total moles of gas products} = 4 + 4 + 4 = 12 \text{ moles}$$

$$12 \text{ mol} \times 22.4 \text{ L mol}^{-1} (\text{dm}^3 \text{ mol}^{-1})$$

$$= 268.8 \text{ L} \quad \checkmark$$