Name: _____
Section 002 (Neeland)

CHEMISTRY 121 MIDTERM 3

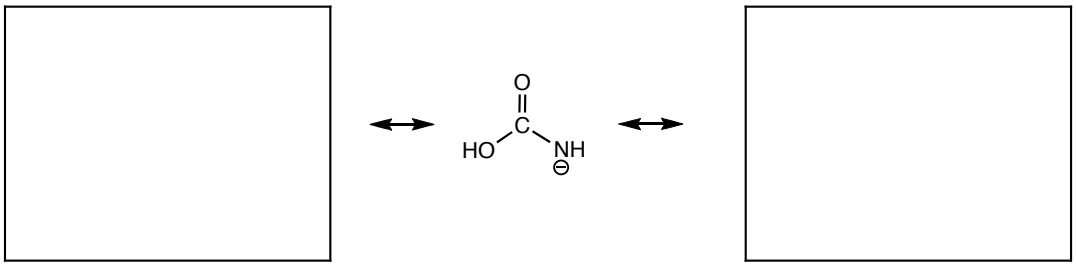
Nov. 19, 2012

For full marks, show all your reasoning/calculations in your answers.

(4) 1) Draw the Lewis structure for Br_2S^{2-}, name its molecular geometry, indicate the AO hybridization of the central atom.

(2) 2) Give a formal charge (+, -, 2+, 2- etc) to BeO so that it will be attracted to a magnetic field. Explain your answer using MO theory.

(2) 3) Draw any two resonance hybrids of the molecule below.



(4) 4) Consider the molecules PN^{2+} and PN^{3+}. Discuss the relative energy needed to separate P from N (BO calculation) for both molecules. How would your answer change for the molecule PN?

(1) 5) The MO theory is considered superior to the VB theory. What do the abbreviations MO and VB stand for?

(3) 6) A bubble of gas at the bottom of Okanagan Lake has a volume of 1.00×10^{-3} mL, at a pressure of 5.00 atm (50 m down), at 4°C, rises to the surface where the pressure is 0.95 atm and the temperature is 24°C. What is the volume of the bubble when it reaches the surface?

(4) 7) Equal masses of gaseous N_2 and Ar are placed in separate flasks of equal volume at the same temperature. State whether each of the following is true or false. Molar Mass (g mol^{-1}): N_2 28.02, Ar 39.95

a) There are more molecules of N_2 present than atoms of Ar. _____
b) The pressure is greater in the Ar flask. _____
c) The Ar atoms have a greater average speed than the N_2 molecules. _____
d) The N_2 molecules collide more frequently with the walls of the flask than do the Ar atoms. _____

(1) 8) An unknown gas that is **not** CO exits a pinhole at exactly the same speed as CO gas. What is the likely identity of this unknown gas?

_____

(3) 9) Sodium azide, the explosive compound in automobile airbags decomposes according to the following equation:
What mass of sodium azide is required to provide the nitrogen needed to inflate a 75.0 L bag to a pressure of 1.32 atm at 25°C? Molar Mass (g mol^{-1}) NaN_3 65.02

$$2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$$

(5) 10) What is the mole fraction and partial pressure of SO_2 in a mixture containing 0.267 g NO, 4.3 g of Ar and 0.872 g SO_2? Total pressure in the flask is 2.50 atm. At 273.15 °C, what is the volume of the flask?

Molar masses (g mol^{-1}): NO = 30.01, Ar = 39.95, SO_2 = 64.07

(5) 11) Ammonia and hydrogen chloride react to form solid ammonium chloride:

$$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$$

Two 2.00 L flasks at 25 °C are connected by a valve. One flask contains 5.00 g $NH_3(g)$ and the other contains 5.00 g HCl(g). When the valve is opened the gases react until one is completely consumed. The temperature does not change during the reaction. Molar Mass (g mol^{-1}) NH_3 17.03 HCl 36.46

a) Which gas will remain after the reaction is completed?
b) What will be the final pressure of the system after the reaction is complete? (Neglect the volume of the NH_4Cl)
c) What mass of ammonium chloride will be formed?