SC111 Foundations of Chemistry I 2 November 2015

Hour Exam 2 Review Name: _____

Chapter 5 and Experiment 12M

1. A coffee-cup calorimeter is being used to investigate the heat of reaction for

$$\mathbf{HCl\ (aq) + NaOH\ (aq) \rightarrow H_2O\ (l) + NaCl\ (aq)}$$

50.0 mL of 1.00 M HCl are placed in the cup, and the initial temperature is 22.3°C.
When 50.0 mL of 1.00 M NaOH are poured into the cup and mixed, the temperature of the contents is 29.0°C.

(a) Is this reaction endothermic or exothermic ?

(b) Calculate the $q_{water}$ for the contents, assuming C = 4.18 J/g °C and density = 1.00 g/mL.

(c) What is $q_{reaction}$ for the amounts used in the reaction ?

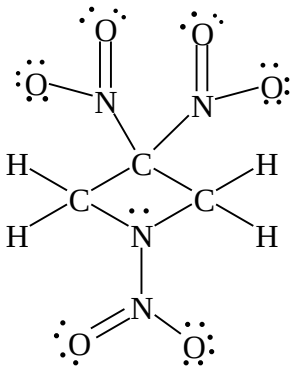
(d) Calculate the heat of reaction PER MOLE ( $\Delta_r H^o$ ).

(e) What would be the final temperature if 100.0 mL of 1.00 M NaOH are added instead of 50.0 mL ?

(f) What quantity is measured in a coffee-cup calorimeter, $\Delta U$ or $\Delta H$ ?

2. Explosives

We studied the reaction of the explosive TNAZ , which explodes as follows :



$$C_3H_4N_4O_6\ (s) \rightarrow CO_2\ (g) + 2\ CO\ (g) + 2\ H_2O\ (g) + 2\ N_2\ (g)$$

(a) Is TNAZ a **HIGH EXPLOSIVE** or a **LOW EXPLOSIVE** ?

(b) How many single _____ and double _____ bonds are there in TNAZ ?

(c) What is the **molecular geometry** around N in the $NO_2$ groups ? _____

(d) What is the **hydridization** of the N atoms in the $NO_2$ groups ? ____ the C atoms ? _____

(e) What is the approximate **bond angle** for the O N O bonds ? _____ the C C N bonds ? _____

(f) What is the **formal charge** on the atoms in the $NO_2$ groups ? N ____ O= _____ O- _____

(g) Calculate the **heat of reaction** for the explosion using heats of formation. $\Delta_f H^o$ TNAZ = +177 kJ/mol

(h) Calculate the **heat of reaction** for the explosion using bond dissociation enthalpies (p. 329), and N=O +607 kJ/mol.

Chapter 6

3. Lines at $\lambda$ = 486.2 nm and $\lambda$ = 656.3 nm appear in the emission spectrum of a H atom.

   (a) Which line has the higher frequency ?

   (b) Calculate the energy of one photon, and of one mole of photons, for the 656.3 nm radiation.

   (c) For a Bohr atom, which transition involves emission of the HIGHEST amount of energy ?

   n = 1 to n = 4 n = 5 to n = 4 n = 5 to n = 1

   (d) How do the energies of the H emission lines compare with those of

   radio waves X-rays microwaves infrared

4. What is the maximum number of electrons which can be accommodated in the

   n = 1 level ? n = 2 level ? n = 3 level ?

5. Which of the following are NOT possible quantum number sets ?

   3, 2, 1, 0 3, 2, 2, ½ 3, 1, -1, ½ 3, 0, 1, - ½

Chapter 7

6. Write ground-state electron configurations for the following species : Are they dia- or paramagnetic ?

   (a) Al

   (b) Be

   (c) $Mn^{2+}$

   (d) $S^{2-}$

7. Which of the following species has the **SMALLER** radius ?
   (a) $Cl^-$ or $Br^-$ (b) Ne or $Na^+$ (c) C or F (d) C or Sn

8. Which of the following species has the **LARGER** first ionization energy ?
   (a) He or Kr (b) B or F (c) Si or O

9. For the following molecules, give

   (i) the Lewis structure
   (ii) the electron-pair arrangement
   (iii) the molecular geometry
   (iv) polar molecule ? ( yes or no ) Draw individual bond vectors in the molecule !
   (v) hybridization of the central atom
   (vi) formal charges on all atoms

| Lewis structure | electron-pair arrangement | molecular geometry | polar (Y/N) | hybridization of central atom | formal charges |
|---|---|---|---|---|---|

**$BF_4^-$**

**$SOCl_2$**

**$I_3^-$**