Chem 10113, Quiz 4 **Answer Key**

October 10, 2018

	IA (1)																VIIIA (18)
1	1 **H** 1.0080	IIA (2)											IIIA (13)	IVA (14)	VA (15)	VIA (16)	VIIA (17)	2 **He** 4.0026
2	3 **Li** 6.9410	4 **Be** 9.0122											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.179
3	11 **Na** 22.990	12 **Mg** 24.305	IIIB (3)	IVB (4)	VB (5)	VIB (6)	VIIB (7)	(8)	VIIIB (9)	(10)	IB (11)	IIB (12)	13 **Al** 26.982	14 **Si** 28.086	15 **P** 30.974	16 **S** 32.066	17 **Cl** 35.453	18 **Ar** 39.948
4	19 **K** 39.098	20 **Ca** 40.078	21 **Sc** 44.956	22 **Ti** 47.880	23 **V** 50.942	24 **Cr** 51.996	25 **Mn** 54.938	26 **Fe** 55.847	27 **Co** 58.933	28 **Ni** 58.690	29 **Cu** 63.546	30 **Zn** 65.380	31 **Ga** 69.723	32 **Ge** 72.610	33 **As** 74.922	34 **Se** 78.960	35 **Br** 79.904	36 **Kr** 83.800
5	37 **Rb** 85.468	38 **Sr** 87.620	39 **Y** 88.906	40 **Zr** 91.224	41 **Nb** 92.906	42 **Mo** 95.940	43 **Tc** 98.907	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
6	55 **Cs** 132.91	56 **Ba** 137.33	57 **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.20	77 **Ir** 192.22	78 **Pt** 195.09	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.20	83 **Bi** 208.98	84 **Po** 208.98	85 **At** 209.99	86 **Rn** 222.02
7	87 **Fr** 223.02	88 **Ra** 226.03	89 **Ac** 227.03	104 Unq 261.11	105 Unp 262.11	106 Unh 263.12	107 Uns 262.12											

1. (5 points) Write a ***balanced chemical equation*** for the process that occurs when each of the following substances are mixed with water. (***Note***: Use equilibrium arrows where appropriate.)

   (a) $Br_2O_5 + H_2O \longrightarrow 2\ HBrO_{3(aq)}$

   (b) $C_2H_5NH_2 + H_2O \rightleftharpoons C_2H_5NH_3^+{}_{(aq)} + OH^-{}_{(aq)}$

   (c) $Rb_2O + H_2O \longrightarrow 2\ RbOH_{(aq)}$

   (d) $HOCN + H_2O \rightleftharpoons OCN^-{}_{(aq)} + H_3O^+{}_{(aq)}$

2. (2 points) In $Fe_2(Cr_2O_7)_3$, the oxidation states are: Fe = +3 and Cr = +6

3. (6 points) For each of the following, clearly write the ***balanced, <u>net ionic</u> equation***. (***Only the <u>net ionic</u> equation will be graded!***) Use subscripts [(s), (aq), etc.] to indicate the phase of each compound or ion. If no reaction occurs, write No Rx.

   (a) $(NH_4)_3BO_{3(aq)} + KOH_{(aq)} \longrightarrow$

   $NH_4^+{}_{(aq)} + OH^-{}_{(aq)} \longrightarrow H_2O + NH_{3(g)}$

   (b) $HNO_{3(aq)} + (NH_4)_2CO_{3(aq)} \longrightarrow$

   $2\ H^+{}_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow H_2O + CO_{2(g)}$

   (c) $Au(C_2H_3O_2)_{3(aq)} + (NH_4)_2S_{(aq)} \longrightarrow$

   $2\ Au^{3+}{}_{(aq)} + 3\ S^{2-}{}_{(aq)} \longrightarrow Au_2S_{3(s)}$

4. (7 points) **SHOW ALL WORK.** Dimethylsulfoxide (DMSO) is a liquid organosulfur compound, $(CH_3)_2SO$ (molar mass = 78.13), that is used in veterinary medicine as a liniment for horses but can be harmful to humans. DMSO has a density of 1.10 g/mL and it is completely miscible with water. In a simple lab experiment, 27.0 g of ice (i.e., solid H_2O) at 0.0 °C was added to 0.300 L of DMSO at 27.5 °C in a well-insulated container. After stirring for some time, all of the ice had melted and the final temperature of the water-DMSO mixture was 11.6 °C. Determine the ***molar heat capacity*** of DMSO in J/mole·°C. (***Note***: The heat of fusion of H_2O is 6.00 kJ/mole.)

heat lost by DMSO = heat required to melt the ice + heat gained by H_2O

heat to melt ice = (27.0 g) (1 mole / 18.0 g) (6,000 J/mole) = 9,000 J

mass of DMSO = (300 mL) (1.10 g/ml) = 330 g

let SpH = specific heat of DMSO

(SpH)(330 g)(27.5 °C - 11.6 °C) = 9,000 J + (4.184 J/g·°C)(27.0 g)(11.6 °C - 0 °C)

SpH = 1.97 J/g·°C

molar heat capacity = (1.97 J/g·°C) (78.13 g/mole) = 154 J/mole·°C

5. (6 points) **SHOW ALL WORK.** Given the thermochemical equation,

$$2\ N_2O_{(g)} + 2\ H_2O_{(g)} \longrightarrow N_2H_{4(l)} + N_2O_{4(g)} \qquad \Delta H° = 382.1\ kJ$$

and the following standard heats of formation ($\Delta H°_f$),

compound	$H_2O_{(g)}$	$N_2O_{(g)}$	$N_2O_{4(g)}$
$\Delta H°_f$ (kJ/mole)	- 241.8	81.6	11.1

determine the standard heat of formation ($\Delta H°_f$) of $N_2H_{4(l)}$ in kJ/mole.

$\Delta H°_{rxn} = \sum \Delta H°_f$ (products) - $\sum \Delta H°_f$ (reactants)

382.1 kJ = [(1 mole) $\Delta H°_f$ (N_2H_4) + (1 mole) (11.1 kJ/mole)]

- [(2 mole) (81.6 kJ/mole) + (2 mole) (-241.8 kJ/mole)]

$\Delta H°_f$ (N_2H_4) = 50.6 kJ/mole