SCH4U Unit 4 - Practice Questions B

SECTION 1: Short Answer

1. For each of the following systems:
   i. Write the expression for the equilibrium constant. *[A, 1 each]*
   ii. Apply Le Châtelier's principle to determine the direction the reaction will tend to go towards when the indicated changes are done to the indicated systems. *[A, 1 each]*

	Equilibrium Reaction	**i. Equilibrium Constant Expression**	**ii. Direction of reaction in response to change** ***(Circle left or right)***
a)	$Pb^{2+}(aq) + CrO_4^{2-}(aq) \Leftrightarrow PbCrO_4(s)$		**Increasing pressure** *will shift the equilibrium to the…* **Left / Right**
b)	$2CO(g) + O_2(g) \Leftrightarrow 2CO_2(g) + heat$		**Cooling down the reaction** *will shift the equilibrium to the…* **Left / Right**
c)	$4NH_3(s) + 5O_2(g) \Leftrightarrow 4NO(g) + 6H_2O(l)$		**Adding water to dilute the solution** *will shift the equilibrium to the…* **Left / Right**
d)	$N_2O_4(g) \Leftrightarrow 2NO_2(g)$		**Increasing NO_2** *will shift the equilibrium to the…* **Left / Right**
e)	$P_4O_{10(s)} + H_2O_{(l)} \Leftrightarrow H_3PO_{4(aq)} + heat$		**Removing phosphoric acid** *will shift the equilibrium to the…* **Left / Right**

SECTION 2: Calculations

Equilibrium Constant (Questions 12-13)

2. Sulfur dioxide is a colourless gas, which smells like burnt matches. When sulfur dioxide and chlorine react with each other, they form SO_2Cl_2 as $SO_2(g) + Cl_2(g) \Leftrightarrow SO_2Cl_2(g)$
   At equilibrium, the concentration values of compounds are:

Compound	$SO_2(g)$	$Cl_2(g)$	$SO_2Cl_2(g)$
Equilibrium Concentration	1.78 mol/L	0.90 mol/L	1.20 mol/L

Calculate the value of equilibrium constant $K_{eq,}$ for the above reaction?

[T/I, 3]

3. Carbon monoxide reacts with water vapour to produce carbon dioxide and hydrogen. At 900 ^oC, the Keq is 4.2. Calculate the concentration of hydrogen gas at equilibrium if 4 mol of each chemical was initially placed in a 1 litre closed container. The equation for this reaction is:
   $CO(g) + H_2O(g) <> CO_2(g) + H_2(g)$ *[T/I, 5]*

pH and pOH (Questions 14-16)(g)

4. A solution of ethanoic acid has a pH of 5.30. What is its hydrogen ion concentration? *[T/I, 1]*

5. What is the pH of a solution with pOH of 8.50? *[T/I, 1]*

6. What is the pOH of a 0.045 M HCl solution?

[T/I, 4]

Titration (Question 17-18)

7. 50.00 mL of 0.200 mol/L sodium hydroxide, NaOH(aq), is required to titrate 20.00 mL of a nitric acid solution, $HNO_3(aq)$, to the endpoint. What is the molarity of the nitric acid solution? *[T/I, 3]*

8. 15.52 mL of 0.100 mol/L hydrochloric acid is required to titrate 25.00 mL of a barium hydroxide solution to a bromothymol blue endpoint. Calculate the molarity of the barium hydroxide solution. *[T/I, 3]*

SECTION 3: Long Answer

The following questions will be graded according to the following rubric:

Criteria	Level 4	Level 3	Level 2	Level 1
APPLICATION Making connections between science, technology, society, and environment	makes connections between science, technology, society, and the environment with a high degree of effectiveness **(3 marks)**	makes connections between science, technology, society, and the environment with considerable effectiveness **(2 marks)**	makes connections between science, technology, society, and the environment with some effectiveness **(1 mark)**	makes connections between science, technology, society, and the environment with limited effectiveness **(0 - 0.5 mark)**
COMMUNICATION Information and ideas are communicated with complete and correct answers	Information and ideas are communicated clearly and precisely **(2 mark)**	Information and ideas are communicated with considerable clarity and precision **(0.1 marks)**	Information and ideas are communicated with some clarity and precision **(0.5 marks)**	Information and ideas are communicated limited clarity and precision **(0 marks)**

9. Mountain climbers must take several weeks to get used to the reduced oxygen at high altitudes. The reduced oxygen is a result of the following equilibrium, where Hb represents hemoglobin, the protein that is responsible for transporting oxygen to the cells in the body:

$$Hb(aq) + O_2(g) \rightarrow HbO_2(g)$$

a) What happens to the equilibrium when a mountain climber is first introduced to the reduced oxygen? How does this affect the physical condition of the climber?

b) Over time, a mountain climber's body adjusts by producing more hemoglobin. How does this affect the equilibrium? *[A, 3; C, 2]*

10. a) What would be more efficient for a titration; a weak acid with a weak base; a weak acid with a strong base, or a strong acid with a strong base? Give reasons for your answer.

a) How could you determine through experimentation if you had a strong acid and strong base to work with in a titration?

[A, 3; C, 2]

Periodic Table

Atomic masses are listed underneath each element

1 IA												13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 **H** 1.01	2 IIA																2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.1	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	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** 121.76	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.29
55 **Cs** 132.9	56 **Ba** 137.3	57 **La*** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac^** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (264)	108 **Hs** (265)	109 **Mt** (268)	110 **Ds** (271)	111 **Rg** (272)							

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
^	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)