

## SCH4U Unit 4 - Practice Questions B

### SECTION 1: Short Answer

1. For each of the following systems:
- Write the expression for the equilibrium constant. [A, 1 each]
  - 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)	$\text{Pb}^{2+}(\text{aq}) + \text{CrO}_4^{2-}(\text{aq}) \rightleftharpoons \text{PbCrO}_4(\text{s})$		Increasing pressure will shift the equilibrium to the...  <b>Left / Right</b>
b)	$2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{CO}_2(\text{g}) + \text{heat}$		Cooling down the reaction will shift the equilibrium to the...  <b>Left / Right</b>
c)	$4\text{NH}_3(\text{s}) + 5\text{O}_2(\text{g}) \rightleftharpoons 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{l})$		Adding water to dilute the solution will shift the equilibrium to the...  <b>Left / Right</b>
d)	$\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$		Increasing $\text{NO}_2$ will shift the equilibrium to the...  <b>Left / Right</b>
e)	$\text{P}_4\text{O}_{10}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{PO}_4(\text{aq}) + \text{heat}$		Removing phosphoric acid will shift the equilibrium to the...  <b>Left / Right</b>

**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  $\text{SO}_2\text{Cl}_2$  as  $\text{SO}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons \text{SO}_2\text{Cl}_2(\text{g})$

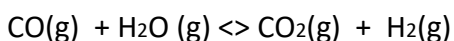
At equilibrium, the concentration values of compounds are:

Compound	$\text{SO}_2(\text{g})$	$\text{Cl}_2(\text{g})$	$\text{SO}_2\text{Cl}_2(\text{g})$
Equilibrium Concentration	1.78 mol/L	0.90 mol/L	1.20 mol/L

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

[T/I, 3]

3. Carbon monoxide reacts with water vapour to produce carbon dioxide and hydrogen. At 900 °C, the  $K_{\text{eq}}$  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:



[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<sub>3</sub>(aq), to the endpoint. What is the molarity of the nitric acid solution? [T/I, 3]

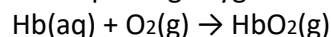
8. 15.52 mL of 0.100 mol/L hydrochloric acid is required to titrate 25.00 mL of a barium hydroxide solution to a bromothymol blue endpoint. Calculate the molarity of the barium hydroxide solution. [T/I, 3]

### SECTION 3: Long Answer

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

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

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:



- 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																	18 VIIIA
1 <b>H</b> 1.01	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 <b>He</b> 4.00
3 <b>Li</b> 6.94	4 <b>Be</b> 9.01											5 <b>B</b> 10.81	6 <b>C</b> 12.01	7 <b>N</b> 14.01	8 <b>O</b> 16.00	9 <b>F</b> 19.00	10 <b>Ne</b> 20.18
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 <b>Al</b> 26.98	14 <b>Si</b> 28.09	15 <b>P</b> 30.97	16 <b>S</b> 32.07	17 <b>Cl</b> 35.45	18 <b>Ar</b> 39.95
19 <b>K</b> 39.1	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.96	22 <b>Ti</b> 47.88	23 <b>V</b> 50.94	24 <b>Cr</b> 52.00	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.69	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.39	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.61	33 <b>As</b> 74.92	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.80
37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> (98)	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.42	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.41	49 <b>In</b> 114.82	50 <b>Sn</b> 118.71	51 <b>Sb</b> 121.76	52 <b>Te</b> 127.6	53 <b>I</b> 126.9	54 <b>Xe</b> 131.29
55 <b>Cs</b> 132.9	56 <b>Ba</b> 137.3	57 <b>La*</b> 138.9	72 <b>Hf</b> 178.5	73 <b>Ta</b> 180.9	74 <b>W</b> 183.9	75 <b>Re</b> 186.2	76 <b>Os</b> 190.2	77 <b>Ir</b> 192.2	78 <b>Pt</b> 195.1	79 <b>Au</b> 197.0	80 <b>Hg</b> 200.6	81 <b>Tl</b> 204.4	82 <b>Pb</b> 207.2	83 <b>Bi</b> 209	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> (222)
87 <b>Fr</b> (223)	88 <b>Ra</b> (226)	89 <b>Ac^</b> (227)	104 <b>Rf</b> (261)	105 <b>Db</b> (262)	106 <b>Sg</b> (263)	107 <b>Bh</b> (264)	108 <b>Hs</b> (265)	109 <b>Mt</b> (268)	110 <b>Ds</b> (271)	111 <b>Rg</b> (272)							

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