

Chemistry 12
 August 2006 — Form A
 Provincial Examination — Answer Key

Cognitive Processes

K = Knowledge
U = Understanding
H = Higher Mental Processes

Question Types

50 = Multiple Choice (MC)
8 = Written Response (WR)

Topics	Prescribed Learning Outcomes (PLOs)	Weightings
1. Reaction Kinetics	A, B, C	12%
2. Dynamic Equilibrium	D, E, F	16%
3. Solubility Equilibria	G, H, I	16%
4. Acids, Bases, and Salts	J, K, L, M, N, O, P, Q, R	33%
5. Oxidation – Reduction	S, T, U, V, W	23%

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	C	K	1	1	A2	MC
2.	A	U	1	1	A3	MC
3.	D	U	1	1	B5	MC
4.	A	U	1	1	C2	MC
5.	B	U	1	1	C5	MC
6.	C	U	1	2	D2	MC
7.	B	H	1	2	D9	MC
8.	A	U	1	2	D7	MC
9.	C	U	1	2	E2	MC
10.	C	U	1	2	E5	MC
11.	D	H	1	2	F3, F5	MC
12.	B	U	1	2	F5	MC
13.	B	U	1	2	F6	MC
14.	A	U	1	2	F8	MC
15.	A	K	1	3	G2	MC
16.	D	U	1	3	H1	MC
17.	B	U	1	3	H3	MC
18.	C	H	1	3	H5	MC
19.	C	U	1	3	I2	MC
20.	B	U	1	3	I3	MC
21.	D	U	1	3	I4, H1	MC
22.	A	K	1	4	J6	MC
23.	B	U	1	4	J8	MC
24.	C	U	1	4	K6	MC
25.	D	U	1	4	K9, N3	MC
26.	B	U	1	4	K11	MC

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
27.	D	U	1	4	L4	MC
28.	C	K	1	4	L9	MC
29.	C	H	1	4	L12	MC
30.	B	U	1	4	M2, K2	MC
31.	C	U	1	4	N2	MC
32.	B	U	1	4	N3	MC
33.	A	U	1	4	O3	MC
34.	C	U	1	4	O4	MC
35.	B	K	1	4	P1	MC
36.	C	H	1	4	P4, H3	MC
37.	B	U	1	4	Q3	MC
38.	B	U	1	4	R2	MC
39.	D	K	1	5	S1	MC
40.	C	U	1	5	S2	MC
41.	A	U	1	5	S6	MC
42.	D	U	1	5	T1	MC
43.	C	U	1	5	T5	MC
44.	C	U	1	5	T6	MC
45.	B	U	1	5	U2	MC
46.	D	U	1	5	U3, 4	MC
47.	C	U	1	5	U9	MC
48.	C	H	1	5	U7	MC
49.	B	K	1	5	V1	MC
50.	B	U	1	5	W3	MC

Chemistry 12

August 2006

Provincial Examination — Written-Response Answer Key / Scoring Guide

Cognitive Processes
K = Knowledge

U = Understanding

H = Higher Mental Processes

Question Types
8 = Written Response (WR)

Topics	Prescribed Learning Outcomes (PLOs)	Weightings
1. Reaction Kinetics	A, B, C	12%
2. Dynamic Equilibrium	D, E, F	16%
3. Solubility Equilibria	G, H, I	16%
4. Acids, Bases, and Salts	J, K, L, M, N, O, P, Q, R	33%
5. Oxidation – Reduction	S, T, U, V, W	23%

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	–	U	4	1	A5, B9	WR
2.	–	U	4	2	F7	WR
3.	–	U	4	3	I4, 6	WR
4.	–	U	3	4	K8, J11	WR
5.	–	U	5	4	M3	WR
6.	–	U	3	4	P2	WR
7.	–	U	4	5	T2	WR
8.	–	U	3	5	W3, 5, 9	WR

1. Consider the reaction: $2\text{Zn}(s) + \text{O}_2(g) \rightarrow 2\text{ZnO}(s)$

State two different methods that would increase the rate of this reaction.

Explain each in terms of collision theory.

(4 marks)

Method 1: _____

Explanation: _____

Method 2: _____

Explanation: _____

For Example:

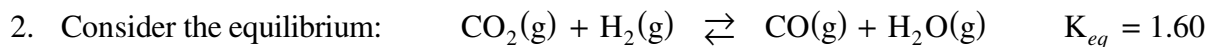
Method: Increase surface area of Zn.

Explanation: There are more sites for successful collisions between reactants.

Method: Increase temperature.

Explanation: A larger fraction of collisions has sufficient energy to react.

} ← 4 marks



Initially, 8.2 mol of CO and 8.2 mol of H_2O are placed in a 2.0 L container and allowed to react. Calculate the equilibrium concentrations of CO_2 and CO . (4 marks)

Solution:

For Example:

$$[\text{CO}] = [\text{H}_2\text{O}] = \frac{8.2 \text{ mol}}{2.0 \text{ L}} = 4.1 \text{ M}$$

	$\text{CO}_2(\text{g})$	+	$\text{H}_2(\text{g})$	\rightleftharpoons	$\text{CO}(\text{g})$	+	$\text{H}_2\text{O}(\text{g})$
[I]	0		0		4.1		4.1
[C]	+x		+x		-x		-x
[E]	x		x		4.1 - x		4.1 - x

← 1 mark

$$K_{eq} = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{CO}_2][\text{H}_2]}$$

$$\sqrt{1.60} = \sqrt{\frac{(4.1-x)^2}{x^2}}$$

← 1 mark

$$x = 1.8$$

← 1 mark

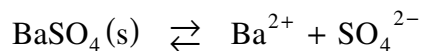
$$[\text{CO}_2] = 1.8 \text{ M}, [\text{CO}] = 4.1 - x = 2.3 \text{ M}$$

← 1 mark

3. What is the maximum $[\text{Pb}^{2+}]$ that can exist in a saturated solution of BaSO_4 without causing precipitate formation? **(4 marks)**

Solution:

For Example:



$$K_{sp} = [\text{Ba}^{2+}][\text{SO}_4^{2-}] = 1.1 \times 10^{-10} \quad \leftarrow \text{1 mark}$$

$$x^2 = 1.1 \times 10^{-10}$$

$$x = 1.05 \times 10^{-5} = [\text{SO}_4^{2-}] \quad \leftarrow \text{1 mark}$$

$$[\text{Pb}^{2+}] = \frac{K_{sp}}{[\text{SO}_4^{2-}]} \quad \leftarrow \text{1 mark}$$

$$= \frac{1.8 \times 10^{-8}}{1.05 \times 10^{-5}}$$

$$= 1.7 \times 10^{-3} \text{ M} \quad \leftarrow \text{1 mark}$$

4. Given the reactants:

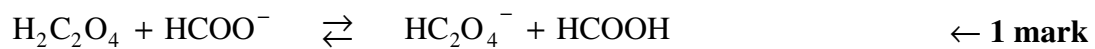


Complete the acid-base equilibrium equation in the box above.
Determine whether reactants or products will be favoured and explain why.

(3 marks)

Solution:

For Example:



The equilibrium favours the products because $\text{H}_2\text{C}_2\text{O}_4$ is a stronger acid than HCOOH . ← 2 marks

5. Calculate the pH of a 0.30 M H₂S solution. Begin by writing the equation for the predominant reaction.

(5 marks)

Solution:

For Example:

	$\text{H}_2\text{S}(\text{aq}) + \text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{HS}^-(\text{aq})$	\leftarrow 1 mark
[I]	0.30 0 0	
[C]	-x +x +x	
[E]	0.30-x x x	\leftarrow 1 mark

(assume x is negligible)

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{HS}^-]}{[\text{H}_2\text{S}]}$$

$$9.1 \times 10^{-8} = \frac{(x)(x)}{0.30} \qquad \leftarrow 1 \text{ mark}$$

$$x = 1.65 \times 10^{-4} \text{ M} = [\text{H}_3\text{O}^+] \qquad \leftarrow 1 \text{ mark}$$

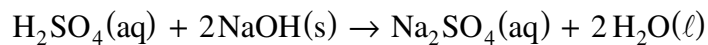
$$\text{pH} = 3.78 \qquad \leftarrow 1 \text{ mark}$$

6. What mass of NaOH(s) is required to just neutralize 50.0 mL of 2.0 M H₂SO₄?
Begin by writing the balanced equation for the neutralization reaction.

(3 marks)

Solution:

For Example:



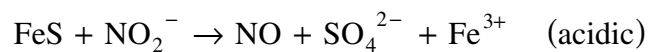
← **1 mark**

$$\text{Mass of NaOH} = \frac{2.0 \text{ mol}}{\text{L}} \text{H}_2\text{SO}_4 \times 0.0500 \text{ L} \times \frac{2 \text{ mol NaOH}}{1 \text{ mol H}_2\text{SO}_4} \times \frac{40.0 \text{ g}}{\text{mol NaOH}}$$

← **2 marks**

$$= 8.0 \text{ g}$$

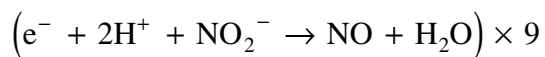
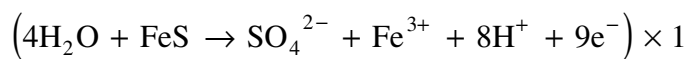
7. Balance the following in acidic solution.



(4 marks)

Solution:

For Example:



} ← **3 marks**

← **1 mark**

8. The electrolysis of copper(II) sulphate solution using copper electrodes is used in the refining of copper. Write the anode and cathode half-reactions and describe what would be observed at each electrode as the cell operates. **(3 marks)**

Anode Half-Reaction: _____

Cathode Half-Reaction: _____

Observations:

anode: _____

cathode: _____

Solution:

For Example:

Anode half-reaction: $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^{-}$ ← **1 mark**

Cathode half-reaction: $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu}$ ← **1 mark**

Observations: The anode would decrease in size and the cathode would increase in size. ← **1 mark**

END OF KEY