Chemistry 12
August 2008 — Form A
Provincial Examination — Answer Key

Cognitive Processes	Weightings	Question Types
K = Knowledge	11%	50 = Multiple Choice (MC)
U = Understanding	78%	8 = Written Response (WR)
H = Higher Mental Processes	11%	

Topics	Prescribed Learning Outcomes (PLOs)	Weightings
1. Reaction Kinetics	A1–8	12%
2. Dynamic Equilibrium	B1–6	16%
3. Solubility Equilibria	C1–8	16%
4. Acids, Bases, and Salts	D1–6, E, F1–8	33%
5. Oxidation – Reduction	G1–4, H1–5	23%

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	C	U	1	1	A2	MC
2.	B	U	1	1	A3	MC
3.	B	U	1	1	A4	MC
4.	D	U	1	1	A7	MC
5.	D	U	1	1	A6	MC
6.	C	U	1	2	B1	MC
7.	A	K	1	2	B2	MC
8.	B	U	1	2	B3	MC
9.	C	U	1	2	B3	MC
10.	A	H	1	2	B3	MC
11.	D	U	1	2	B5	MC
12.	B	U	1	2	B6	MC
13.	C	U	1	2	B6	MC
14.	A	H	1	2	B6,3	MC
15.	B	H	1	3	C1/D4	MC
16.	A	U	1	3	C3	MC
17.	B	U	1	3	C4	MC
18.	A	H	1	3	C5/F1	MC
19.	B	U	1	3	C6	MC
20.	A	U	1	3	C7	MC
21.	C	U	1	3	C7	MC
22.	A	U	1	4	D1/F3	MC
23.	D	K	1	4	D3	MC
24.	A	K	1	4	D4	MC
25.	B	U	1	4	D5	MC
26.	C	U	1	4	D6,5	MC

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
27.	B	K	1	4	E1	MC
28.	C	H	1	4	E1, 2	MC
29.	D	U	1	4	E2	MC
30.	A	H	1	4	E3/F5	MC
31.	C	U	1	4	E3, 2	MC
32.	D	U	1	4	F4	MC
33.	D	U	1	4	F5	MC
34.	A	K	1	4	F2	MC
35.	B	U	1	4	F3	MC
36.	A	U	1	4	F1	MC
37.	A	U	1	4	F6	MC
38.	D	U	1	4	F8	MC
39.	A	K	1	5	G1	MC
40.	D	U	1	5	G1	MC
41.	C	U	1	5	G1	MC
42.	C	H	1	5	G2	MC
43.	C	U	1	5	G3	MC
44.	A	U	1	5	G4	MC
45.	A	K	1	5	H1	MC
46.	A	U	1	5	H1	MC
47.	B	U	1	5	H1	MC
48.	C	H	1	5	H1/C4	MC
49.	C	U	1	5	H3	MC
50.	B	U	1	5	H4	MC

Question Number	Keyed Response	Cognitive Process	Mark	Topic	PLO	Question Type
1.	–	U	4	1	A2	WR
2.	–	U	4	2	B6	WR
3.	–	U	4	3	C7	WR
4.	–	U	3	4	D5	WR
5.	–	U	5	4	F5	WR
6.	–	U	3	4	F1	WR
7.	–	U	4	5	G3	WR
8.	–	U	3	5	H4	WR

Chemistry 12
2007/08 Released Exam
August 2008
Provincial Examination — Scoring Guide

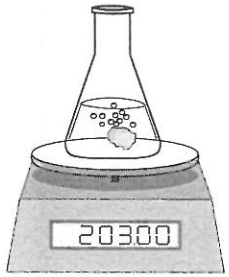
1. **(4 marks)**

Solid sodium bicarbonate and acetic acid were reacted in an open flask as follows:

$$NaHCO_3(s) + CH_3COOH(aq) \rightarrow NaCH_3COO(aq) + H_2O(\ell) + CO_2(g)$$

The following data was recorded:

Time (s)	Mass of Flask and Contents (g)
0.00	203.00 g
30.0	202.95 g
60.0	202.93 g
90.0	202.92 g



Calculate the overall rate of reaction in grams of $NaHCO_3$ per minute.

Solution:

For Example:

$$\text{rate} = \frac{0.08\,\text{g } CO_2}{90\,\text{s}} \times \frac{60\,\text{s}}{\text{min}} = 0.053\,\text{g } CO_2/\text{min} \qquad \leftarrow \textbf{2 marks}$$

$$\text{rate} = \frac{0.053\,\text{g } CO_2}{\text{min}} \times \frac{1\,\text{mol } CO_2}{44\,\text{g } CO_2} \times \frac{1\,\text{mol } NaHCO_3}{1\,\text{mol } CO_2} \times \frac{84\,\text{g } NaHCO_3}{\text{mol}}$$

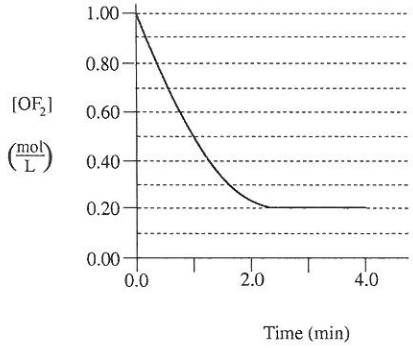
$$= 0.1\,\text{g } NaHCO_3/\text{min} \qquad \leftarrow \textbf{2 marks}$$

2. **(4 marks)**

Consider the following equilibrium:

$$O_2(g) + 2F_2(g) \rightleftarrows 2OF_2(g)$$

Initially, OF_2 was placed in a 1.00 L container and allowed to react. The amount of OF_2 was monitored over 4.0 minutes and the following graph was produced:



Calculate the value of K_{eq}.

Solution:

For Example:

	$O_2(g)$	+	$2F_2(g)$	$\rightleftarrows$	$2OF_2(g)$
[I]	0		0		1.00 M
[C]	+0.40		+0.80 M		−0.80 M
[E]	0.40		0.80		0.20

← **2 marks**

$$K_{eq} = \frac{[OF_2]^2}{[O_2][F_2]^2}$$

$$= \frac{(0.20)^2}{(0.40)(0.80)^2} \qquad \leftarrow \textbf{1 mark}$$

$$= 0.16 \qquad \leftarrow \textbf{1 mark}$$

3. **(4 marks)**

Consider the equilibrium for a saturated solution of PbI_2:

$$PbI_2(s) \rightleftarrows Pb^{2+}(aq) + 2I^-(aq)$$

What is the maximum $[Ag^+]$ that can exist in a saturated solution of PbI_2 without causing a precipitate to form?

Solution:

For Example:

For the PbI_2:

$K_{sp} = [Pb^{2+}][I^-]^2 = 8.5 \times 10^{-9}$

s = solubility

$4s^3 = 8.5 \times 10^{-9}$ } ← **1 mark**

$s = \sqrt[3]{\frac{8.5 \times 10^{-9}}{4}} = \sqrt[3]{2.1 \times 10^{-9}}$

$s = 1.286 \times 10^{-3}$ M

$[I^-] = 2s = 2.57 \times 10^{-3}$ M ← **1 mark**

For AgI:

$K_{sp} = [Ag^+][I^-] = 8.5 \times 10^{-17}$ } ← **1 mark**

$[Ag^+] = \frac{8.5 \times 10^{-17}}{2.57 \times 10^{-3}}$

$[Ag^+] = 3.3 \times 10^{-14}$ M ← **1 mark**

4. **(3 marks)**

Complete the following equilibrium, then predict whether the reactants or products will be favoured and explain why.

$$HSO_4^- + HSO_3^- \rightleftarrows \_\_\_\_\_$$

Solution:

For Example:

$HSO_4^- + HSO_3^- \rightleftarrows H_2SO_3 + SO_4^{2-}$ ← **1 mark**

The equilibrium favours the reactants ← **1 mark**

since the K_a H_2SO_3 > K_a HSO_4^- ← **1 mark**

7. **(4 marks)**

Balance the following redox equation in basic solution:

$$O_2 + Co(NH_3)_6^{2+} \rightarrow Co(NH_3)_6^{3+} \quad \text{(basic)}$$

Solution:

For Example:

$$(4e^- + 4H^+ + O_2 \rightarrow 2H_2O) \times 1$$
$$(Co(NH_3)_6^{2+} \rightarrow Co(NH_3)_6^{3+} + e^-) \times 4$$
$$4e^- + 4H^+ + O_2 + 4Co(NH_3)_6^{2+} \rightarrow 2H_2O + 4Co(NH_3)_6^{3+} + 4e^-$$
$$4\,OH^- \qquad\qquad 4\,OH^-$$
$$2H_2O + O_2 + 4Co(NH_3)_6^{2+} \rightarrow 4Co(NH_3)_6^{3+} + 4OH^-$$

8. **(3 marks)**

A solution of $MnSO_4$ is electrolyzed using inert electrodes. Write the anode and cathode half-reactions and describe any observations at the cathode.

Anode half-reaction: _____

Cathode half-reaction: _____

Cathode observation: _____

Solution:

For Example:

Anode half-reaction: $H_2O \rightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$ ← **1 mark**

Cathode half-reaction: $2\,H_2O + 2e^- \rightarrow H_2 + 2\,OH^-$ ← **1 mark**

Cathode observation: gas bubbles form ← **1 mark**

(Note: no mark for a conclusion such as "hydrogen is produced." Must be an observation.)