

**APRIL 1995 CHEMISTRY 12 PROVINCIAL EXAMINATION
ANSWER KEY / SCORING GUIDE**

- TOPICS**
1. Kinetics
 2. Equilibrium
 3. Solubility
 4. Acids, Bases, Salts
 5. Oxidation – Reduction

PART A: MULTIPLE-CHOICE

Q	C	T	K	S	CGR	Q	C	T	K	S	CGR
1.	K	1	A	1	I-D-2	25.	H	4	A	1	IV-D-12
2.	U	1	B	1	I-A-4	26.	U	4	A	1	IV-F-13
3.	U	1	D	1	I-B-1	27.	U	4	A	1	IV-G-3
4.	U	1	C	1	I-C-1	28.	K	4	C	1	IV-H-2
5.	U	1	C	1	I-B-3	29.	U	4	B	1	IV-H-9
6.	K	2	B	1	II-A-1	30.	U	4	B	1	IV-H-15
7.	U	2	A	1	II-C-4	31.	U	4	D	1	IV-J-1
8.	U	2	B	1	II-D-3	32.	H	4	A	1	IV-I-2, 3
9.	U	2	C	1	II-E-3	33.	U	4	C	1	IV-K-2
10.	U	2	B	1	II-I-2	34.	K	4	B	1	IV-L-5
11.	H	2	A	1	II-F-2	35.	H	4	C	1	IV-J-3
12.	K	2	A	1	II-H-1	36.	U	4	B	1	IV-L-2
13.	U	2	D	1	II-G-1, J-1	37.	U	5	B	1	V-A-4, 6
14.	U	3	D	1	III-A-8	38.	U	5	D	1	V-B-3
15.	U	3	A	1	III-B-3	39.	H	5	D	1	V-B-2
16.	U	3	B	1	III-B-4	40.	U	5	A	1	V-C-1
17.	H	3	D	1	III-B-6	41.	U	5	C	1	V-D-1
18.	U	3	A	1	III-D-2	42.	U	5	D	1	V-E-1
19.	U	3	B	1	III-D-3	43.	U	5	D	1	V-G-2
20.	U	3	C	1	III-E-1	44.	U	5	A	1	V-G-5
21.	K	4	C	1	IV-A-5, V-H-1	45.	U	5	B	1	V-G-7
22.	U	4	B	1	IV-B-2	46.	U	5	D	1	V-H-3
23.	K	4	C	1	IV-D-8	47.	U	5	A	1	V-J-4
24.	U	4	C	1	IV-D-7	48.	U	5	B	1	V-J-2

PART B: WRITTEN-RESPONSE

Q	B	C	T	S	CGR	Q	B	C	T	S	CGR
1.	1	U	1	4	I-E-2	7.	7	U	4	2	IV-B-3, F-8, 11
2.	2	U	2	2	II-B-2, II-C-1	8.	8	U	4	2	IV-H-9
3.	3	U	2	3	II-J-3	9.	9	U	4	4	IV-J-5
4.	4	U	3	2	III-E-2	10.	10	U	5	3	V-D-2, 3
5.	5	U	4	4	III-D-7	11.	11	U	5	4	V-F-1
6.	6	U	4	2	IV-C-2						

Multiple-choice = 48 (48 questions)

Written-response = 32 (11 questions)

Total = 80 marks

LEGEND:

Q = Question

K = Keyed response

B = Score box number

C = Cognitive level

S = Score

T = Topic

CGR = Curriculum Guide Reference

PART B: WRITTEN-RESPONSE

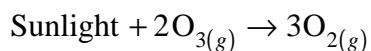
1. Nitric oxide (NO) is involved in the decomposition of ozone (O_3) by the following mechanism:

Step 1	$O_3 + \text{sunlight} \rightarrow O_2 + O$
Step 2	$O_3 + NO \rightarrow NO_2 + O_2$
Step 3	$NO_2 + O \rightarrow NO + O_2$

a) Write the net equation for the decomposition reaction.

(1 mark)

Response:



b) Identify a catalyst.

(1 mark)

Response:

NO is the catalyst.

c) Identify a reaction intermediate.

(1 mark)

Response:

NO_2 or O are reaction intermediates.

d) What is the function of sunlight in this reaction?

(1 mark)

Response:

For example:

To supply activation energy.

2. a) Why are chemical equilibria referred to as dynamic?

(1 mark)

Response:

Both the forward and reversed reactions continue to occur.

b) How is a chemical system at equilibrium recognized?

(1 mark)

Response:

A chemical system at equilibrium is recognized by its constant macroscopic properties.

3. Consider the following equilibrium system:



A student places 4.5 mol of carbon, 3.6×10^{-3} mol of hydrogen and 5.1 mol of methane in a 1.0 L flask. The student predicts that the $[\text{CH}_4]$ increases as equilibrium is established. Do you agree? Explain your answer using appropriate calculations. **(3 marks)**

Response:

$$\text{Trial } K_{eq} = \frac{[\text{CH}_4]}{[\text{H}_2]^2} \quad \leftarrow \frac{1}{2} \text{ mark}$$

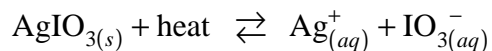
$$= \frac{5.1}{(3.6 \times 10^{-3})^2} \quad \leftarrow \text{1 mark}$$

$$= 3.9 \times 10^5$$

Since Trial K_{eq} is less than the Actual K_{eq} , the forward reaction is favoured and the $[\text{CH}_4]$ increases. \leftarrow **1 mark**

Yes, I agree with the student. \leftarrow $\frac{1}{2}$ **mark**

4. Consider the following solubility equilibrium:



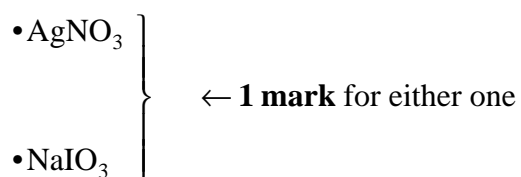
State **two** methods by which more AgIO_3 solid may be precipitated out of solution. **(2 marks)**

Response:

For example:

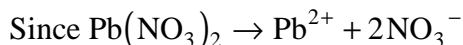
Decrease temperature. ← **1 mark**

Add a soluble compound with a common ion.



5. Calculate the maximum moles of Br^{-} that can exist in 0.500 L of 0.10 M $\text{Pb}(\text{NO}_3)_2$. **(4 marks)**

Response:



$$[\text{Pb}^{2+}] = 0.10 \text{ M} \quad \leftarrow \frac{1}{2} \text{ mark}$$



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

$$6.6 \times 10^{-6} = (0.10 \text{ M})[\text{Br}^{-}]^2 \quad \leftarrow \frac{1}{2} \text{ mark}$$

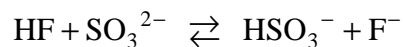
$$[\text{Br}^{-}] = 8.1 \times 10^{-3} \text{ M} \quad \leftarrow \text{1 mark}$$

$$\text{mol Br}^{-} = 8.1 \times 10^{-3} \text{ M} \times 0.500 \text{ L} = 4.1 \times 10^{-3} \text{ mol} \quad \leftarrow \text{1 mark}$$

($-\frac{1}{2}$ mark for incorrect sig. figs.)

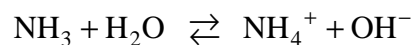
6. In an acid-base reaction, the **two Brønsted-Lowry acids** are hydrofluoric acid (HF) and the hydrogen sulphite ion (HSO_3^-). Write the equation for this reaction. **(2 marks)**

Response:



7. a) Write an equilibrium equation to represent the hydrolysis of ammonia in water. **(1 mark)**

Response:



b) Calculate the value of the equilibrium constant. **(1 mark)**

Response:

$$K_b = \frac{1.0 \times 10^{-14}}{5.7 \times 10^{-10}} = 1.8 \times 10^{-5}$$

8. Tomato juice has a pH of 4.20. Calculate the $[\text{H}_3\text{O}^+]$ and $[\text{OH}^-]$ in tomato juice. (2 marks)

Response:

$$4.20 = -\log[\text{H}_3\text{O}^+] \quad 6.3 \times 10^{-5} \text{ M} = [\text{H}_3\text{O}^+] \quad \leftarrow \text{1 mark}$$

$$1.0 \times 10^{-14} = [\text{H}_3\text{O}^+][\text{OH}^-], \quad [\text{OH}^-] = 1.6 \times 10^{-10} \text{ M} \quad \leftarrow \text{1 mark}$$

($-\frac{1}{2}$ mark for incorrect sig. figs.)

9. Calculate the pH of a solution prepared by adding 60.0 mL of 0.150 M HCl to 140.0 mL of 0.100 M KOH. (4 marks)

Response:

$$\text{mol HCl} = (0.0600 \text{ L})(0.150 \text{ M}) = 0.00900 \text{ mol} \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$\text{mol KOH} = (0.1400 \text{ L})(0.100 \text{ M}) = 0.0140 \text{ mol} \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$\text{mol excess KOH} = 0.0050 \text{ mol} \quad \leftarrow \text{1 mark}$$

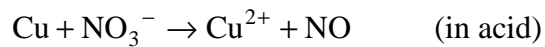
$$[\text{KOH}] = 0.0050 \text{ mol} / 0.2000 \text{ L} = 0.025 \text{ M} \quad \leftarrow \text{1 mark}$$

$$\text{pOH} = -\log[\text{OH}^-] = 1.60 \quad \leftarrow \frac{1}{2} \text{ mark}$$

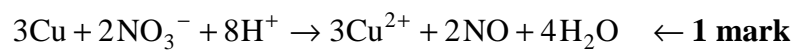
$$\text{pH} = 14.00 - \text{pOH} = 12.40 \quad \leftarrow \frac{1}{2} \text{ mark}$$

10. Balance the following redox reaction.

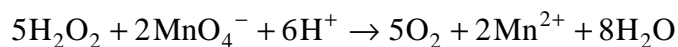
(3 marks)



Response:



11. In a titration, a 1.00 mL sample of an antiseptic solution containing hydrogen peroxide required 17.6 mL of a 0.0200 M solution of KMnO_4 to reach the endpoint. The equation for the reaction is



a) Identify the reducing agent.

(1 mark)

Response:



b) Calculate the concentration of H_2O_2 in the antiseptic solution.

(3 marks)

Response:

$$\text{mol MnO}_4^- = 0.0200 \text{ M} \times 0.0176 \text{ L} = 0.000352 \text{ mol} \quad \leftarrow \text{1 mark}$$

$$\text{mol H}_2\text{O}_2 = 0.000352 \text{ mol MnO}_4^- \times 5 \text{ mol H}_2\text{O}_2 / 2 \text{ mol MnO}_4^- = 0.000880 \text{ mol} \quad \leftarrow \text{1 mark}$$

$$[\text{H}_2\text{O}_2] = \frac{0.000880 \text{ mol}}{0.00100 \text{ L}} = 0.880 \text{ M} \quad \leftarrow \text{1 mark}$$

END OF KEY