

**JANUARY 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**

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

**PART B: WRITTEN-RESPONSE**

<b>Q</b>	<b>B</b>	<b>C</b>	<b>T</b>	<b>S</b>	<b>CGR</b>	<b>Q</b>	<b>B</b>	<b>C</b>	<b>T</b>	<b>S</b>	<b>CGR</b>
1.	1	K	1	2	I-C-1	8.	8	U	4	2	IV-F-14, G-2
2.	2	H	1	2	I-D-3	9.	9	U	4	2	IV-F-7, H-9
3.	3	U	2	2	II-B-2	10.	10	U	4	4	IV-H-15
4.	4	U	2	2	II-J-3	11.	11	H	5	2	V-D-1, 4
5.	5	U	3	3	III-B-4, 5	12.	12	U	5	2	V-E-1
6.	6	U	3	4	III-D-6	13.	13	K	5	3	V-J-4
7.	7	U	4	2	IV-C-3						

Multiple-choice = 48 (48 questions)

Written-response = 32 (13 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. State **two** reasons why some collisions may **not** result in a chemical reaction. **(2 marks)**

Reason I:

Reason II:

**Response:**

**For example:**

Reason I: unfavourable collision geometry/orientation ← **1 mark**

Reason II: insufficient collision energy/low KE ← **1 mark**

2. Describe the relationship between activation energy and the rate of a chemical reaction. (2 marks)

**Response:**

**For example:**

If the activation energy is lower, then the rate of reaction is greater.

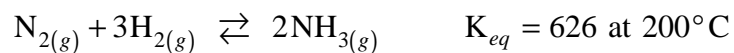
3. What is “equal” in a chemical reaction that has reached a state of equilibrium?

**(2 marks)**

**Response:**

The rates of the forward and reverse reactions.

4. Consider the following equilibrium:



At equilibrium,  $[\text{N}_2]$  is 1.06 mol/L and  $[\text{H}_2]$  is 0.456 mol/L. Calculate  $[\text{NH}_3]$  in the equilibrium mixture. **(2 marks)**

**Response:**

$$K_{eq} = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$626 = \frac{[\text{NH}_3]^2}{(1.06)(0.456)^3} \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$[\text{NH}_3] = 7.93 \quad \leftarrow 1 \text{ mark}$$

5. A 1.0 M solution of sodium sulphite is added to a 1.0 M solution of copper(II) chloride resulting in the formation of a precipitate.

a) Identify the precipitate.

(1 mark)

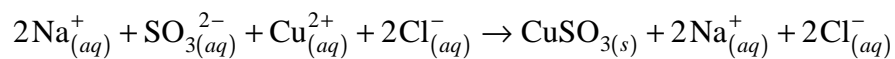
**Response:**

Copper(II) sulphite or  $\text{CuSO}_3$

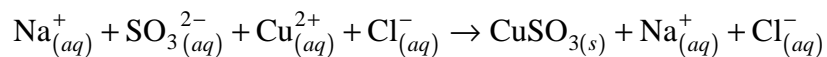
b) Write the complete ionic equation for the reaction.

(1 mark)

**Response:**



**or**



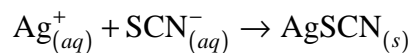
c) Identify all spectator ions.

(1 mark)

**Response:**

$\text{Na}^+$ ,  $\text{Cl}^-$

6. In an experiment, 100.0 mL samples containing silver ions are titrated with 0.200 M KSCN. The equation for the reaction is



The following data are recorded.

Trial	Volume KSCN (mL)
1	23.10
2	22.62
3	22.58

Calculate the concentration of the silver ion in the solution.

**(4 marks)**

**Response:**

$$\text{Average volume} = \frac{22.62 + 22.58}{2} = 22.60 \text{ mL} \quad \leftarrow \text{1 mark}$$

$$\begin{aligned} \text{mol SCN}^{-} &= 0.02260 \text{ L} \times \frac{0.200 \text{ mol}}{\text{L}} \quad \leftarrow \text{1 mark} \\ &= 0.00452 \text{ mol} \end{aligned}$$

$$\text{mol Ag}^{+} = 0.00452 \text{ mol} \quad \leftarrow \text{1 mark}$$

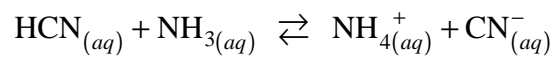
$$\therefore [\text{Ag}^{+}] = \frac{0.00452 \text{ mol}}{0.1000 \text{ L}} = 0.0452 \text{ M} \quad \leftarrow \text{1 mark}$$

**NOTE:** Deduct  $\frac{1}{2}$  point for incorrect significant figures.



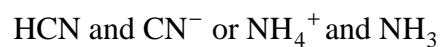
7. a) Write the Brønsted-Lowry acid-base equation for the reaction between  $\text{HCN}_{(aq)}$  and  $\text{NH}_{3(aq)}$ .  
(1 mark)

**Response:**



b) Write a conjugate acid-base pair from the equation above. (1 mark)

**Response:**

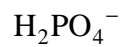


8. a) Write the formula of an amphiprotic anion that will act as an acid when added to water.

(1 mark)

**Response:**

**For example:**



**or**

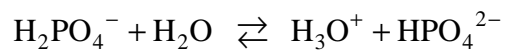


b) Write a hydrolysis equation to represent the anion selected in part (a) above behaving as an acid.

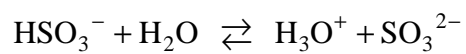
(1 mark)

**Response:**

**For example:**



**or**



9. Calculate the pH of a solution prepared by dissolving 0.050 mol of NaOH in enough water to make 500.0 mL of solution. (2 marks)

**Response:**

**For example:**

$$[\text{OH}^-] = 0.050 \text{ mol} / 0.500 \text{ L} = 0.100 \text{ M} \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] \quad \leftarrow \frac{1}{2} \text{ mark}$$

$$(0.10\text{M})[\text{H}_3\text{O}^+] = 1.0 \times 10^{-14}$$

$$[\text{H}_3\text{O}^+] = 1.0 \times 10^{-13} \text{ M}$$

}  $\leftarrow \frac{1}{2} \text{ mark}$

$$\text{pH} = 13.00 \quad \leftarrow \frac{1}{2} \text{ mark}$$

**NOTE:** Deduct  $\frac{1}{2}$  point for incorrect significant figures.

10. Calculate the pH of 0.50 M H<sub>2</sub>S.

(4 marks)

**Response:**

**For example:**

	H <sub>2</sub> S	⇌	H <sup>+</sup>	+	HS <sup>-</sup>	} ← 1½ marks
I	0.50		0		0	
Δ C	-x		x		x	
E	0.50 - x		x		x	

(x is small, therefore 0.50 - x ≈ 0.50) ← ½ mark

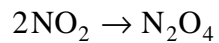
$$K_a = \frac{[\text{H}^+][\text{HS}^-]}{[\text{H}_2\text{S}]} \quad \leftarrow \frac{1}{2} \text{ mark for expression}$$

$$9.1 \times 10^{-8} = \frac{x^2}{0.50} \quad \leftarrow \frac{1}{2} \text{ mark for substitution}$$

$$x = 2.13 \times 10^{-4} \text{ M} = [\text{H}^+] \quad \leftarrow \frac{1}{2} \text{ mark for solving } [\text{H}^+]$$

$$\text{pH} = -\log[\text{H}^+] = 3.67 \quad \leftarrow \frac{1}{2} \text{ mark for calculating pH}$$

11. Consider the following equation:



a) Does the above represent a redox reaction? \_\_\_\_\_

( $\frac{1}{2}$  mark)

**Response:**

No.

b) Explain.

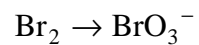
( $1\frac{1}{2}$  marks)

**Response:**

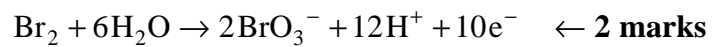
The oxidation number of nitrogen in  $\text{NO}_2$  and in  $\text{N}_2\text{O}_4$  is +4. With no change in the oxidation number there is no loss or gain of electrons.

12. Balance the following half-reaction in acidic conditions.

(2 marks)



**Response:**



**One-half mark** for each step: balancing bromine  
balancing oxygen  
balancing hydrogen  
balancing charge

13. Consider the electrolysis of **molten** magnesium chloride.

a) Identify the product formed at the anode.

**(1 mark)**

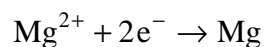
**Response:**

Chlorine gas or  $\text{Cl}_2$

b) Write the equation for the reduction half-reaction.

**(1 mark)**

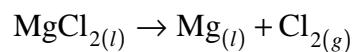
**Response:**



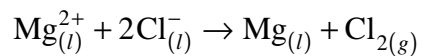
c) Write the equation for the overall reaction.

**(1 mark)**

**Response:**



**or**



**END OF KEY**