



SIR ARTHUR LEWIS COMMUNITY COLLEGE
ACADEMIC YEAR (2024/2025) – SEMESTER TWO
END OF SEMESTER EXAMINATION

COURSE CODE : CHM113
COURSE TITLE : General Chemistry II
LECTURER(S) : Alberta William-Henry
DATE : April 30, 2025
TIME : 9 a.m.
DURATION : 2 Hours
STUDENT ID # : _____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID Number on *each* answer sheet.
- Please number your responses accurately.
- Write your answers on the foolscap provided
- This paper contains two sections. **Answer all questions in Section one and any two questions from Section two.**
- Show all working where necessary.
- You are also provided with a periodic table and data sheet for electrode potentials
- The number of marks is given in brackets [] at the end of each question or part question

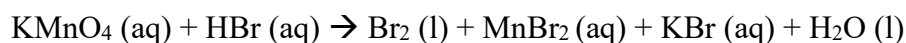
SECTION ONE - MULTIPLE CHOICE

Instruction: Write your answer on the foolscap provided

1. Which named element does not disproportionate in the reaction shown?

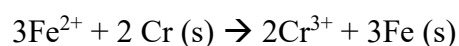
- (A) Carbon in $\text{H}_2\text{C}_2\text{O}_4 \rightarrow \text{H}_2\text{O} + \text{CO} + \text{CO}_2$
- (B) Chlorine in $3\text{ClO}^- \rightarrow \text{ClO}_3^- + 2\text{Cl}^-$
- (C) Nitrogen in $\text{H}_2\text{O} + 2\text{NO}_2 \rightarrow \text{HNO}_3 + \text{HNO}_2$
- (D) Sulphur in $2\text{FeSO}_4 \rightarrow \text{Fe}_2\text{O}_3 + \text{SO}_2 + \text{SO}_3$

2. In the following reaction



- (A) Mn is oxidized
- (B) Br is oxidized
- (C) HBr is the oxidizing agent
- (D) KMnO_4 is the reducing agent

3. E cell for the following reaction is



- (A) 1.31V
- (B) 0.30V
- (C) 0.060V
- (D) 1.18V

4. If a current of 2.0A were passed through an electrolytic cell for 30 minutes, how much zinc would be deposited at the cathode?

- (A) 1.50g
- (B) 1.22g
- (C) 2.44g
- (D) 3.00g

5. Which oxidation state is shown by chlorine in each of these three ions?

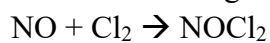
	ClO^-	ClO_3^-	Cl^-
(A)	+1	+3	-1
(B)	-1	+3	+1
(C)	+1	+5	-1
(D)	-1	+5	+1

6. What is the overall reaction order for the reaction that obeys the rate law:

$$\text{Rate} = k[\text{O}_3]^2 [\text{O}_2]^1$$

- (A) 2
- (B) 1
- (C) 3
- (D) 5

Use the following data for number 7-8



Initial concentrations M		Initial Rate $\text{molL}^{-1}\text{s}^{-1}$
[NO]	[Cl ₂]	
0.01	0.05	0.05
0.01	0.10	0.20
0.02	0.15	0.90
0.03	0.15	1.35

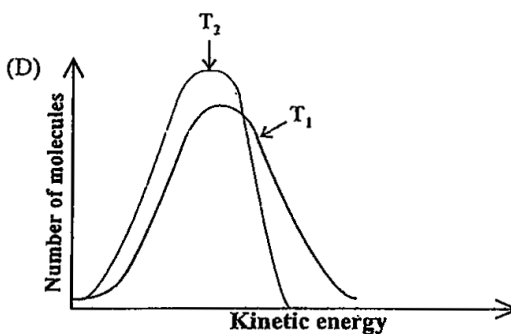
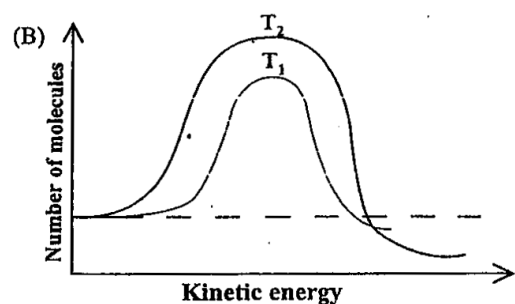
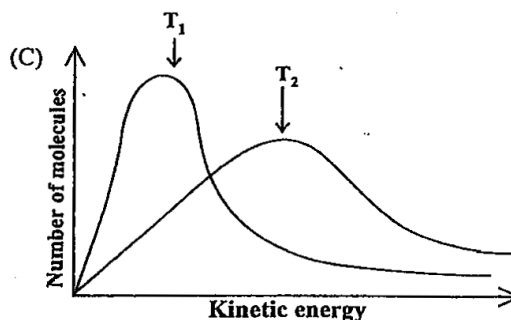
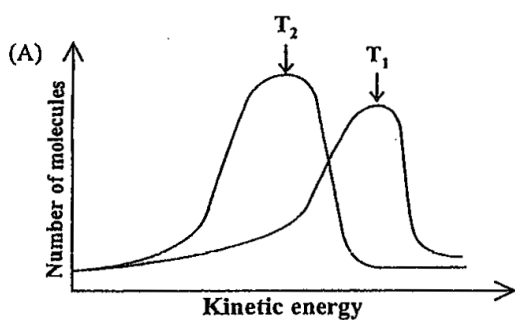
7. The order with respect to NO is:

- (A) 1
- (B) 2
- (C) 3
- (D) 0

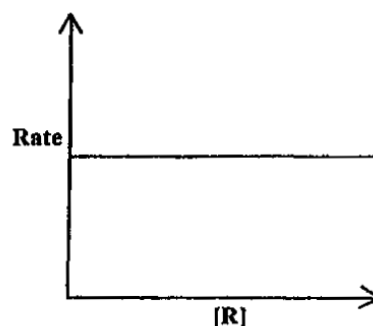
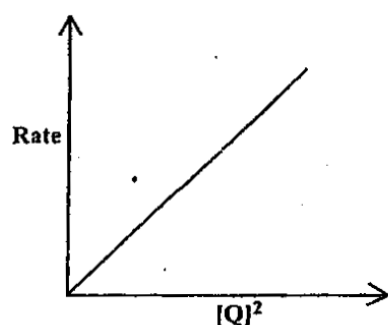
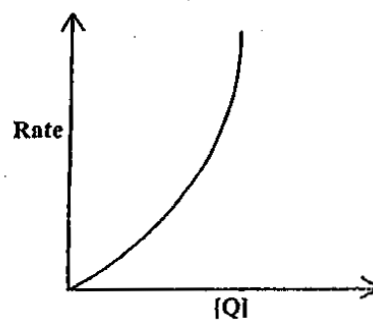
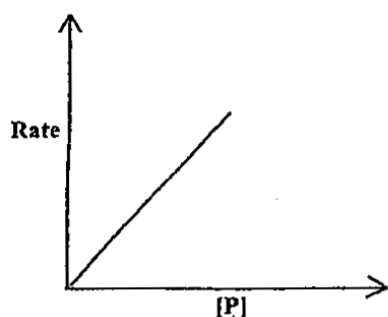
8. The order with respect to Cl₂ is:

- (A) 1
- (B) 2
- (C) 3
- (D) 0

9. Which diagram below correctly shows the Boltzmann distribution which represents the effect of a temperature increase from T₁ (70 °C) to T₂ (80 °C)?



10. $P + Q + R \rightarrow \text{products}$



The rate equation is

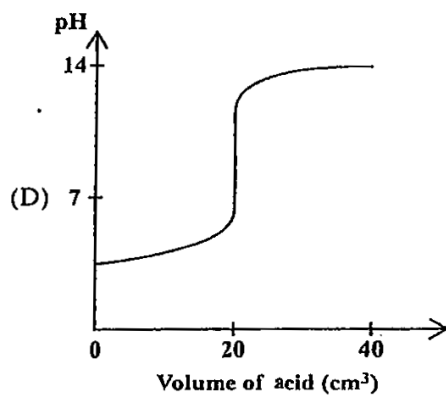
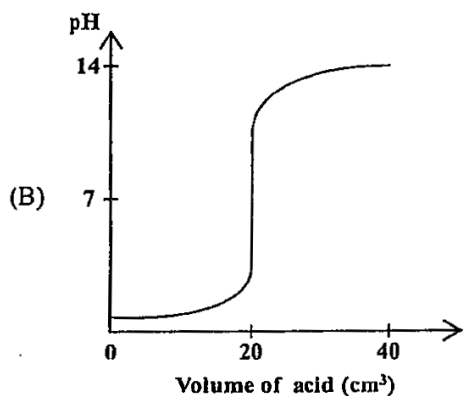
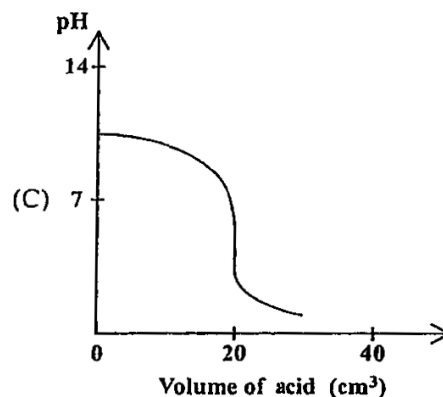
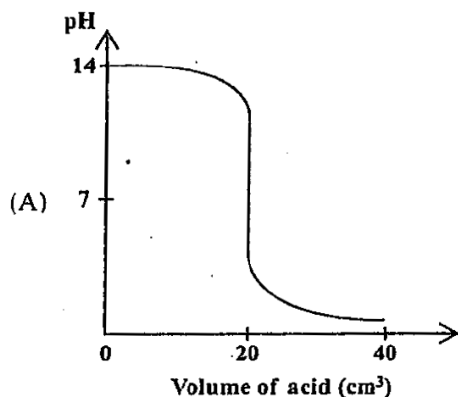
- (A) $\text{Rate} = k [P] [Q]$
(B) $\text{Rate} = k [P] [Q]^2$
(C) $\text{Rate} = k [P] [Q] [R]$
(D) $\text{Rate} = k [P] [Q]^2 [R]$
11. Which of the following statement(s) about a catalyst is (are) true?
I. It increases the equilibrium constant for the forward reaction only
II. It increases the equilibrium constant for both the forward and backward reactions
III. It has no effect on the position of equilibrium
- (A) I only
(B) III only
(C) I and III only
(D) II and III only
12. Which of the following statements does NOT refer to a system in dynamic equilibrium?
(A) The reaction is reversible
(B) The amounts of all specie in the system remain constant
(C) The concentrations of all reactants and products are equal
(D) The rate of the forward reaction is equal to the rate of the backward reaction
13. Equilibrium is established in the reaction $X(\text{aq}) + Y(\text{aq}) \leftrightarrow Z(\text{aq})$. If the equilibrium concentrations are $[X] = 0.2 \text{ mol dm}^{-3}$, $[Y] = 0.3 \text{ mol dm}^{-3}$ and $[Z] = 0.6 \text{ mol dm}^{-3}$, which of the following is the value of the equilibrium constant K_c ?
(A) 0.1 mol dm^3
(B) $0.1 \text{ mol}^{-1} \text{ dm}^{-3}$
(C) 10.0 mol dm^{-3}
(D) $10.0 \text{ mol}^{-1} \text{ dm}^3$

14. Which of the following describes the function of NH_4^+ and $\text{C}_2\text{H}_5\text{OH}$ according to the Bronsted-Lowry theory?



	NH_4^+	$\text{C}_2\text{H}_5\text{OH}$
(A)	Acid	Base
(B)	Base	Acid
(C)	Conj acid	Base
(D)	Acid	Conj Base

15. Which of the following graphs shows the change in pH when 0.1M HCl (aq) is gradually added to 20 cm³ of 0.1M NaOH (aq)?



16. Using standard electrode potentials, which of the following reactions is **MOST** feasible?

- (A) $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu(s)}$
 (B) $\text{Zn(s)} + \text{Pb}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Pb(s)}$
 (C) $\text{Pb(s)} + \text{Zn}^{2+}(\text{aq}) \rightarrow \text{Pb}^{2+}(\text{aq}) + \text{Zn(s)}$
 (D) $\text{Cu(s)} + \text{Zn}^{2+}(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{Zn(s)}$

17. When strong acid is titrated with a strong base, the equivalence point is reached when

- (A) The rate of the forward reaction equals the rate of the reverse
 (B) The pH of the solution becomes constant
 (C) The quantity of reactant called for by the equation has been added
 (D) One half of the acid and base has reacted

18. The concentration of OH^- (aq) ions in a solution is 0.1M. What is the pH of the solution?

- (A) 8
 (B) 13
 (C) 14
 (D) 15

19. Which of the following is true about a buffer solution?
- (A) Normally consists of a weak acid and its corresponding salt
 (B) Alters the pH of a solution to the desired pH
 (C) Does not change in pH on addition of large amounts of acid or alkali
 (D) Can act as a catalyst in a reaction
20. What is the oxidation state of chlorine in Cl_2O_7 ?
- (A) +1
 (B) +3
 (C) +6
 (D) +7

SECTION TWO

Instruction: This section contains FOUR QUESTIONS. **ANSWER ANY TWO questions**

QUESTION 1 - Electrochemistry

- (a) Consider an electrochemical cell with Cr(s) and $\text{Cr}^{3+}(\text{aq})$ in one half cell and Zn(s) and $\text{Zn}^{2+}(\text{aq})$ in the other half cell.
- (i) Draw and label a diagram of this cell. Include in your diagram the negative pole, positive pole and direction of electron flow. [5]
- (ii) Write down the feasible reaction [3]
- (iii) Calculate the standard cell potential for the feasible reaction [2]

QUESTION 2- Rates of Reaction

- (a) The table below shows data obtained from acid hydrolysis of methyl methanoate.

$$\text{HCO}_2\text{CH}_3 + \text{H}_2\text{O} \xrightarrow{\text{H}^+} \text{HCO}_2\text{H} + \text{CH}_3\text{OH}$$

$[\text{HCO}_2\text{CH}_3]/\text{mol dm}^{-3}$	$[\text{H}^+]/\text{mol dm}^{-3}$	Initial rate/ $\text{mol dm}^{-3}\text{s}^{-1}$
0.50	1.00	0.54×10^{-3}
1.00	1.00	1.10×10^{-3}
2.00	1.00	2.24×10^{-3}
2.00	2.00	4.48×10^{-3}

- (i) Define rate of reaction [2]
- (ii) Giving your reasoning, determine and explain
- a. the order with respect to HCO_2CH_3 [2]
- b. the order with respect to H^+ [2]
- (iii) Write the rate equation for the reaction [1]

(iv) Calculate a value for the rate constant, k , at this temperature [2]

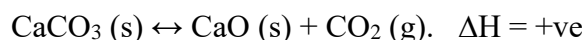
(v) State the units of k [1]

QUESTION 3- Chemical Equilibria

(a) (i) State Le Chatelier's principle [2]

(ii) State two factors that can disturb the equilibrium of a system [2]

(b) The equation for the decomposition of limestone can be represented as:



Applying Le Chatelier's principle, **explain** the effect on the equilibrium when:

(i) a small quantity of $\text{CaCO}_3 (\text{s})$ is added [2]

(ii) some $\text{CO}_2 (\text{g})$ is removed. [2]

(iii) temperature is increased [2]

QUESTION 4- Acid Base Equilibria

(a) A solution A is saturated of calcium hydroxide

(i) Write the equilibrium equation for this reaction [2]

(ii) Write an expression for the solubility product K_{sp} , of calcium hydroxide [1]

(b) A saturated solution of PbI_2 contains 0.076g PbI_2 in 100g of solution. Calculate K_{sp} for lead iodide. [3]

(c) Calculate the pH of a buffer solution made from 20.00cm³ of 0.10M propanoic acid and 40.00cm³ of 0.0500M sodium propanoate. K_a for propanoic acid is 1.22×10^{-5} [4]

ELECTRODE POTENTIAL DATA

Half-reaction		$E^0(\text{V})$	#
$\text{F}_2(\text{g}) + 2\text{e}^-$	\rightarrow 2F^-	2.87	1
$\text{Co}^{3+} + \text{e}^-$	\rightarrow Co^{2+}	1.82	2
$\text{Au}^{3+} + 3\text{e}^-$	\rightarrow $\text{Au}(\text{s})$	1.50	3
$\text{Cl}_2(\text{g}) + 2\text{e}^-$	\rightarrow 2Cl^-	1.36	4
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4\text{e}^-$	\rightarrow $2\text{H}_2\text{O}(\text{l})$	1.23	5
$\text{Br}_2(\text{l}) + 2\text{e}^-$	\rightarrow 2Br^-	1.07	6
$2\text{Hg}^{2+} + 2\text{e}^-$	\rightarrow Hg_2^{2+}	0.92	7
$\text{Hg}^{2+} + 2\text{e}^-$	\rightarrow $\text{Hg}(\text{l})$	0.85	8
$\text{Ag}^+ + \text{e}^-$	\rightarrow $\text{Ag}(\text{s})$	0.80	9
$\text{Hg}_2^{2+} + 2\text{e}^-$	\rightarrow $2\text{Hg}(\text{l})$	0.79	10
$\text{Fe}^{3+} + \text{e}^-$	\rightarrow Fe^{2+}	0.77	11
$\text{I}_2(\text{s}) + 2\text{e}^-$	\rightarrow 2I^-	0.53	12
$\text{Cu}^+ + \text{e}^-$	\rightarrow $\text{Cu}(\text{s})$	0.52	13
$\text{Cu}^{2+} + 2\text{e}^-$	\rightarrow $\text{Cu}(\text{s})$	0.34	14
$\text{Cu}^{2+} + \text{e}^-$	\rightarrow Cu^+	0.15	15
$\text{Sn}^{4+} + 2\text{e}^-$	\rightarrow Sn^{2+}	0.15	16
$2\text{H}^+ + 2\text{e}^-$	\rightarrow $\text{H}_2(\text{g})$	0.00	17
$\text{Pb}^{2+} + 2\text{e}^-$	\rightarrow $\text{Pb}(\text{s})$	-0.13	18
$\text{Sn}^{2+} + 2\text{e}^-$	\rightarrow $\text{Sn}(\text{s})$	-0.14	19
$\text{Ni}^{2+} + 2\text{e}^-$	\rightarrow $\text{Ni}(\text{s})$	-0.25	20
$\text{Co}^{2+} + 2\text{e}^-$	\rightarrow $\text{Co}(\text{s})$	-0.28	21
$\text{Cd}^{2+} + 2\text{e}^-$	\rightarrow $\text{Cd}(\text{s})$	-0.40	22
$\text{Cr}^{3+} + \text{e}^-$	\rightarrow Cr^{2+}	-0.41	23
$\text{Fe}^{2+} + 2\text{e}^-$	\rightarrow $\text{Fe}(\text{s})$	-0.44	24
$\text{Cr}^{3+} + 3\text{e}^-$	\rightarrow $\text{Cr}(\text{s})$	-0.74	25
$\text{Zn}^{2+} + 2\text{e}^-$	\rightarrow $\text{Zn}(\text{s})$	-0.76	26
$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^-$	\rightarrow $\text{H}_2(\text{g}) + 2\text{OH}^-$	-0.83	27
$\text{Mn}^{2+} + 2\text{e}^-$	\rightarrow $\text{Mn}(\text{s})$	-1.18	28
$\text{Al}^{3+} + 3\text{e}^-$	\rightarrow $\text{Al}(\text{s})$	-1.66	29
$\text{Mg}^{2+} + 2\text{e}^-$	\rightarrow $\text{Mg}(\text{s})$	-2.37	30
$\text{Na}^+ + \text{e}^-$	\rightarrow $\text{Na}(\text{s})$	-2.71	31
$\text{Ca}^{2+} + 2\text{e}^-$	\rightarrow $\text{Ca}(\text{s})$	-2.87	32
$\text{Ba}^{2+} + 2\text{e}^-$	\rightarrow $\text{Ba}(\text{s})$	-2.90	33
$\text{K}^+ + \text{e}^-$	\rightarrow $\text{K}(\text{s})$	-2.92	34
$\text{Cs}^+ + \text{e}^-$	\rightarrow $\text{Cs}(\text{s})$	-2.92	35
$\text{Li}^+ + \text{e}^-$	\rightarrow $\text{Li}(\text{s})$	-3.05	36

END OF EXAMINATION

