

**UNIVERSITY COLLEGE TATI (UC TATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	: FSC 1084
COURSE	: CHEMISTRY II
SEMESTER/SESSION	: 3 - 2024/2025
DURATION	: 3 HOURS

**Instructions:**

1. This booklet contains 4 questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

**DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO**

**THIS BOOKLET CONTAINS 8 PRINTED PAGES INCLUDING COVER PAGE**

## QUESTION 1

(25 MARKS)

- a) By applying Brønsted-Lowry theory, identify the conjugate acid-base pairs for the following chemical equation:

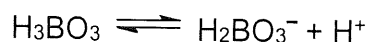


- b) Compute these values of strong acid and base: (6 marks)

(i) If  $[\text{H}_3\text{O}^+]$  is  $7.1 \times 10^{-2} \text{M}$ . Calculate  $[\text{OH}^-]$  concentration.

(ii) What is the pOH solution if the  $[\text{H}_3\text{O}^+]$  concentration is  $4.2 \times 10^{-3} \text{M}$ .

- c) Boric acid,  $\text{H}_3\text{BO}_3$  is a weak acid. The concentration of solution used for the experiment is 0.2 M and the  $K_a$  value is  $7.3 \times 10^{-10} \text{M}$ .

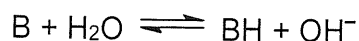


Solve the following:

(i)  $[\text{H}^+]$  (4 marks)

(ii) pH (3 marks)

- d) Solution B is a weak base. The pH of 0.024 M of solution B is 11.06.



Solve the following:

(i) pOH (2 marks)

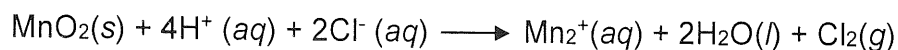
(ii)  $[\text{OH}^-]$  (3 marks)

(iii)  $K_b$  (3 marks)

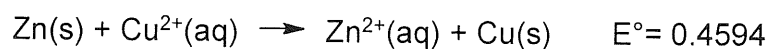
## QUESTION 2

(25 MARKS)

a) Given the redox reaction:



- (i) Predict the oxidation number for Mn in  $\text{MnO}_2$ . (4 marks)
- (ii) Choose the oxidizing agent and the reducing agent. (4 marks)
- b) For the following voltaic cell reaction (at standard condition), Zn and Cu are used as the electrodes in their respective ionic solution ( $\text{ZnSO}_4$  and  $\text{CuSO}_4$ ):
- (i) Construct the schematic diagram for the voltaic cell. (4 marks)
- (ii) Write two half-cell reactions that takes place at anode and cathode. (4 marks)
- (iii) State the total cell reaction. (3 marks)
- c) Calculate the cell potential ( $E_{\text{cell}}$ ) of this reaction at  $25^\circ\text{C}$ .



The concentration are  $[\text{Zn}^{2+}] = 0.020 \text{ M}$ ,  $[\text{Cu}^{2+}] = 0.004 \text{ M}$  (6 marks)

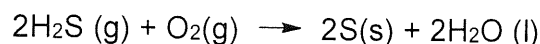
## QUESTION 3

(25 MARKS)

- a) A reaction below has a first order reaction. The rate constant of the reaction is  $4.5 \times 10^{-3} \text{ s}^{-1}$ .

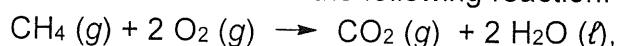


- (i) Write the rate expression for the reaction. (2 marks)
  - (ii) Find the rate of reaction if concentration of  $\text{N}_2\text{O}_5$  is 2.5 M. (3 marks)
  - (iii) Calculate the concentration of  $\text{N}_2\text{O}_5$  remaining after 450s if the initial concentration of  $\text{N}_2\text{O}_5$  is 2.0 M. (3 marks)
  - (iv) Discover the half-life ( $t_{1/2}$ ) of the reaction. (3 marks)
- b) The oxidation of hydrogen sulphide by oxygen is first order with respect to both  $\text{H}_2\text{S}$  and  $\text{O}_2$ .



Compute:

- (i) The rate expression for reaction. (2 marks)
  - (ii) The reaction rate if the concentration of  $\text{H}_2\text{S}$  and  $\text{O}_2$  are  $5 \times 10^{-6} \text{ M}$  and  $2.0 \times 10^{-4} \text{ M}$ , respectively. The rate constant,  $k$  is  $4.0 \times 10^{-5} \text{ mol}^{-1} \text{ s}^{-1}$ . (4 marks)
- c) The following data were obtained for the following reaction.



Experiment	$[\text{CH}_4]$	$[\text{O}_2]$	Rate of reaction ( $\text{mol L}^{-1} \text{ s}^{-1}$ )
A	0.20	0.30	$6.73 \times 10^{-3}$
B	0.20	0.40	$8.97 \times 10^{-3}$
C	0.40	0.30	$2.69 \times 10^{-2}$

- (i) Identify the order of the reaction with respect to  $\text{CH}_4$ ,  $\text{O}_2$  and overall. (6 marks)
- (ii) Write the rate expression for the reaction. (2 marks)

## QUESTION 4

(25 MARKS)

- a) Show **three (3)** steps in free radical polymerization process by using ethylene as monomer. (6 marks)
- b) Differentiate the properties of High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE). (6 marks)
- c) Describe composite material in term of definition and give **two (2)** examples of composite materials. (5 marks)
- d) Water pollution is a serious problem in Malaysia and impacts negatively on the sustainability of water resources. Analyze **two (2)** causes that might contribute to water pollution and justify **two (2)** ways to overcome this issue. (4 marks)
- e) Nitrogen and phosphorus are needed by plants and animals for growth. Discover the effect of the excessive release of these nutrients to the water? (2 marks)
- f) Identify **two (2)** global tragedies related to radioactive waste (2 marks)

-----End of question-----

THE PERIODIC TABLE

1 <b>H</b> 1.008 Hydrogen												18 <b>He</b> 4.00 Helium	
2 <b>Li</b> 6.94 Lithium												17 <b>F</b> 19.00 Fluorine	
3 <b>Na</b> 22.99 Sodium												16 <b>O</b> 16.00 Oxygen	
4 <b>K</b> 39.10 Potassium												15 <b>N</b> 14.01 Nitrogen	
5 <b>Rb</b> 85.47 Rubidium												14 <b>C</b> 12.01 Carbon	
6 <b>Cs</b> 132.91 Cesium												13 <b>B</b> 10.81 Boron	
7 <b>Fr</b> 223.02 Francium												12 <b>Zn</b> 65.39 Zinc	
												11 <b>Cu</b> 63.55 Copper	
												10 <b>Ni</b> 58.69 Nickel	
												9 <b>Co</b> 58.93 Cobalt	
												8 <b>Fe</b> 55.85 Iron	
												7 <b>Mn</b> 54.94 Manganese	
												6 <b>Cr</b> 52.00 Chromium	
												5 <b>V</b> 50.94 Vanadium	
												4 <b>Ti</b> 47.88 Titanium	
												3 <b>Sc</b> 44.96 Scandium	
												2 <b>Ca</b> 40.08 Calcium	
												1 <b>Mg</b> 24.31 Magnesium	
												1 <b>Be</b> 9.01 Beryllium	
												1 <b>H</b> 1.008 Hydrogen	

( ) = ESTIMATES  
 SYMBOL  
 ATOMIC NUMBER  
 ATOMIC WEIGHT  
 NAME

APPENDIX I

HAYDEN  
 McNEIL  
 SPECIALTY  
 PRODUCTS  
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LANTHANIDES										ACTINIDES																	
<b>Ce</b> 58 Cerium	<b>Pr</b> 59 Praseodymium	<b>Nd</b> 60 Neodymium	<b>Pm</b> 61 Promethium	<b>Sm</b> 62 Samarium	<b>Eu</b> 63 Europium	<b>Gd</b> 64 Gadolinium	<b>Tb</b> 65 Terbium	<b>Dy</b> 66 Dysprosium	<b>Ho</b> 67 Holmium	<b>Er</b> 68 Erbium	<b>Tm</b> 69 Thulium	<b>Yb</b> 70 Ytterbium	<b>Lu</b> 71 Lutetium	<b>Th</b> 90 Thorium	<b>Pa</b> 91 Protactinium	<b>U</b> 92 Uranium	<b>Np</b> 93 Neptunium	<b>Pu</b> 94 Plutonium	<b>Am</b> 95 Americium	<b>Cm</b> 96 Curium	<b>Bk</b> 97 Berkelium	<b>Cf</b> 98 Californium	<b>Es</b> 99 Einsteinium	<b>Fm</b> 100 Fermium	<b>Md</b> 101 Mendelevium	<b>No</b> 102 Nobelium	<b>Lr</b> 103 Lawrencium

ALKALI METALS  
 ALKALI EARTH METALS  
 HALOGENS  
 NOBLE GASES

## CHEMISTRY II (FSC 1084)

## APPENDIX II

$$K_a = \frac{[A^-][H^+]}{[HA]}$$

$$E^0_{\text{cell}} = E^0_{\text{red}} - E^0_{\text{oxid}}$$

$$E = E^0 - \frac{0.0592}{n} \log Q_c$$

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$$

$$\text{pH} = -\log [H_3O^+]$$

$$\text{pOH} = -\log [OH^-]$$

$$\text{pH} + \text{pOH} = 14$$

Common Prefixes For Organic Chemistry Nomenclature	
Prefix	Carbon Atom Number
Meth-	1
Eth-	2
Prop-	3
But-	4
Pent-	5
Hex-	6
Hept-	7
Oct-	8
Non-	9
Dec-	10

## Summary of the Kinetics of Zero-Order, First-Order and Second-Order Reactions

Order	Rate Law	Concentration-Time Equation	Half-Life
0	rate = $k$	$[A] - [A]_0 = -kt$	$t_{1/2} = \frac{[A]_0}{2k}$
1	rate = $k[A]$	$\ln[A] - \ln[A]_0 = -kt$	$t_{1/2} = \frac{\ln 2}{k}$
2	rate = $k[A]^2$	$\frac{1}{[A]} - \frac{1}{[A]_0} = kt$	$t_{1/2} = \frac{1}{k[A]_0}$

CHEMISTRY II (FSC 1084)

APPENDIX III

13.5 STANDARD CELL emf's AND STANDARD ELECTRODE POTENTIALS 799

TABLE 19.1 Standard Electrode (Reduction) Potentials in Aqueous Solution at 25°C <sup>a</sup>	Cathode (Reduction) Half-Reaction	Standard Potential, E° (V)
	$\text{Li}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Li}(\text{s})$	-3.04
	$\text{Na}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Na}(\text{s})$	-2.71
	$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Mg}(\text{s})$	-2.38
	$\text{Al}^{3+}(\text{aq}) + 3\text{e}^- \rightleftharpoons \text{Al}(\text{s})$	-1.66
	$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$	-0.83
	$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Zn}(\text{s})$	-0.76
	$\text{Cr}^{3+}(\text{aq}) + 3\text{e}^- \rightleftharpoons \text{Cr}(\text{s})$	-0.74
	$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Fe}(\text{s})$	-0.41
	$\text{Cd}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Cd}(\text{s})$	-0.40
	$\text{Ni}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Ni}(\text{s})$	-0.23
	$\text{Sn}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Sn}(\text{s})$	-0.14
	$\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Pb}(\text{s})$	-0.13
	$\text{Fe}^{3+}(\text{aq}) + 3\text{e}^- \rightleftharpoons \text{Fe}(\text{s})$	-0.04
	$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{H}_2(\text{g})$	0.00
	$\text{Sn}^{4+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}(\text{aq})$	0.15
	$\text{Cu}^{2+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Cu}^+(\text{aq})$	0.16
	$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Cu}(\text{s})$	0.34
	$\text{IO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightleftharpoons \text{I}^-(\text{aq}) + 2\text{OH}^-(\text{aq})$	0.49
	$\text{Cu}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Cu}(\text{s})$	0.52
	$\text{I}_2(\text{s}) + 2\text{e}^- \rightleftharpoons 2\text{I}^-(\text{aq})$	0.54
	$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Fe}^{2+}(\text{aq})$	0.77
	$\text{Hg}_2^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons 2\text{Hg}(\text{l})$	0.80
	$\text{Ag}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{Ag}(\text{s})$	0.80
	$\text{Hg}_2^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Hg}_2(\text{l})$	0.85
	$\text{ClO}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightleftharpoons \text{Cl}^-(\text{aq}) + 2\text{OH}^-(\text{aq})$	0.90
	$2\text{H}_2\text{O}_2(\text{aq}) + 2\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}(\text{l})$	0.90
	$\text{NO}_3^-(\text{aq}) + 4\text{H}^+(\text{aq}) + 3\text{e}^- \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}(\text{l})$	0.96
	$\text{Br}_2(\text{l}) + 2\text{e}^- \rightleftharpoons 2\text{Br}^-(\text{aq})$	1.07
	$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}(\text{l})$	1.23
	$\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$	1.33
	$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-(\text{aq})$	1.36
	$\text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \rightleftharpoons \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	1.49
	$\text{H}_2\text{C}_2\text{O}_4(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{e}^- \rightleftharpoons 2\text{H}_2\text{O}(\text{l})$	1.78
	$\text{S}_2\text{O}_8^{2-}(\text{aq}) + 2\text{e}^- \rightleftharpoons 2\text{SO}_4^{2-}(\text{aq})$	2.01
	$\text{F}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{F}^-(\text{aq})$	2.87

<sup>a</sup>See Appendix 1 for a more extensive table.