Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	PHYSICAL CHEMISTRY
COURSE CODE	:	BWD 11203
PROGRAMME CODE	:	BWD
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 A gas (A) in a closed container has a volume of 0.25 L at a temperature of 273 K.

(a) Write down the relationship between volume and temperature for ideal gas.

(4 marks)

(b) If the temperature of the gas is then increased to 10 °C, what will be the new volume of the balloon.

(6 marks)

(c) Later, another gas component (B) was added into the same container. Calculate the total pressure. Refer **Table Q1(c)**. ($R = 0.08205$ L.atm.mol^{-1}.K^{-1})

Table Q1(c): Details for gas A and B

Gas sample/ Details	Gas A	Gas B
No. of mole, *n*	0.15	0.05

(10 marks)

Q2 Consider the following reversible reaction.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(a) State the equilibrium constant for the reversible reaction.

(4 marks)

(b) In a 3.00 L container, 0.0420 mole N_2, 0.5160 mole H_2 and 0.0357 mole NH_3 are found in equilibrium at 400 °C. Calculate K_c.

(8 marks)

(c) According to le Chatelier's principle, identify the reaction that occurs when…

(i) NH_3 is removed.

(4 marks)

(ii) Volume of the container is reduced.

(4 marks)

Q3 For a reaction of $H_2O_2(aq) \rightarrow H_2O(g) + \frac{1}{2}O_2(g)$;

(a) Write the rate expression in terms of each reactant and product.

(6 marks)

(b) Identify **THREE (3)** potential rate laws for the reaction. For each proposed rate law, determine the overall order.

(6 marks)

(c) At 20 °C, the half-life for a first-order reaction is 3.92×10^4 s. If the initial concentration of hydrogen peroxide is 0.52 M, determine the concentration after 7 days.

(8 marks)

Q4 For the cell notation, $Al(s) \mid Al^{3+}(aq, 1\ M) \parallel Cu^{2+}(aq, 1\ M) \mid Cu(s)$,

(a) Write which is the anode, the cathode and determine the half-reaction at the anode and the cathode.

(4 marks)

(b) By referring to the standard reduction potential, calculate E°_{cell} and determine the spontaneity.

(6 marks)

(c) Calculate the mass of palladium produced by the reduction of palladium (II) ions during the passage of 3.20 amperes of current through a solution of palladium (II) sulfate for 30 minutes. (Relative atomic mass (Pd) = 106.42 u)

(10 marks)

- END OF QUESTIONS -

APPENDIX A

Standard reduction potential at 1 atm, 1 M, 298 K

Half Reaction	Potential E^o
$Li^+(aq) + e^- \rightarrow Li(s)$	-3.05
$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$	-2.36
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	-1.67
$H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$	-0.83
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	-0.76
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	-0.44
$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$	-0.23
$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$	-0.13
$Fe^{3+}(aq) + 3e^- \rightarrow Fe(s)$	-0.036
$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	0.34
$Cu^+(aq) + e^- \rightarrow Cu(s)$	0.52
$Hg^{2+}(aq) + 2e^- \rightarrow Hg(l)$	0.8
$Ag^{2+}(aq) + 2e^- \rightarrow Ag(s)$	0.8
$Pt^{2+}(aq) + 2e^- \rightarrow Pt(s)$	1.2
$O_2(g) + 4H^+(aq) + 4e^- \rightarrow H_2O(l)$	1.23
$Au^{3+}(aq) + 3e^- \rightarrow Au(s)$	1.5
$F_2(g) + 2e^- \rightarrow 2F^-(aq)$	2.87