UNIVERSITI KUALA LUMPUR
UNIKL ROYAL COLLEGE OF MEDICINE PERAK

FINAL EXAMINATION
JULY 2025 SEMESTER

COURSE CODE	: RPD11202
COURSE NAME	: BASIC INORGANIC CHEMISTRY
PROGRAMME NAME	: DIPLOMA IN PHARMACY
DATE	: 17 SEPTEMBER 2025
TIME	: 2.00 PM – 4.00 PM
DURATION	: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of TWO (2) sections; Section A and Section B.
4. Answer ALL questions in Section A. For Section B, answer THREE (3) questions where Question 1 and Question 2 are COMPULSORY, answer either Question 3 or Question 4.
5. Please write your answers on the OMR answer script and answer booklet provided.
6. Answer all questions in English language ONLY.

THERE ARE 13 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 25 marks)

INSTRUCTION: Answer ALL questions.
Please use the objective answer sheet provided.

1. What type of bond holds molecules together in a compound?
   A. Covalent bond
   B. Ionic bond
   C. Metallic bond
   D. Hydrogen bond

2. What is the charge on an anion?
   A. Positive
   B. Neutral
   C. Negative
   D. Electron

3. Which of the following statements is true about mixtures?
   A. Mixtures are always heterogeneous
   B. Mixtures cannot be separated by physical methods
   C. Mixtures can be separated by physical methods
   D. Mixtures are chemically bonded substances

4. Select the location of protons in an atom.
   A. In the electron cloud
   B. In the nucleus
   C. In the outer shell
   D. Surrounding the nucleus

5. What is the relative charge of a neutron?
   A. +1
   B. -1
   C. 0
   D. +2

6. Which of the following statements about subatomic particles is correct?
   A. Protons have a negative charge and are found in the nucleus.
   B. Neutrons have no charge and are found in the nucleus
   C. Electrons have a positive charge and orbit in the nucleus.
   D. Protons and electrons have the same mass.

7. Which numerical prefix indicates two atoms in a covalent compound?
   A. Tetra-
   B. Mono-
   C. Di-
   D. Tri-

8. Which is the **CORRECT** formula for phosphorus pentachloride?
   A. PCl
   B. P_5Cl
   C. PCl_5
   D. P_5Cl_5

9. If 4.0 grams of H_2 react with excess O_2, what is the mass of H_2O formed?
   A. 36 g
   B. 72 g
   C. 18 g
   D. 9 g

10. Which element is found in Group 17 of the Periodic Table?
   A. Manganese
   B. Fluorine
   C. Neon
   D. Oxygen

11. What is the D-block of Periodic Table called?
   A. Alkali metals
   B. Alkaline earth metals
   C. Transition elements
   D. Inner transition elements

12. Which statement best describes the "sea of electrons" in metallic bonding?
    A. Electrons are fixed in place between atoms.
    B. Electrons are shared between two specific atoms.
    C. Electrons move freely among all the metal ions.
    D. Electrons form isolated clouds around atoms.

13. Select a **CORRECT** description regarding the dative bond.
    A. A bond where both shared electrons come from the same atom
    B. A bond where electrons are transferred
    C. A bond where electrons are equally shared
    D. A metallic bond

14. Select a **CORRECT** description regarding the covalent bond.
    A. A bond where both shared electrons come from the same atom
    B. A bond where electrons are transferred
    C. A bond where electrons are equally shared
    D. A metallic bond

15. Which pair of elements is most likely to form an ionic bond?
    A. Oxygen and nitrogen
    B. Sodium and chlorine
    C. Hydrogen and carbon
    D. Silicon and oxygen

16. What happens when a saturated solution is stirred?
    A. More solute dissolves
    B. No effect
    C. Solution becomes unsaturated
    D. Solution evaporates

17. What volume is needed to dilute 1 M to 0.25 M in 500 mL?
    A. 125 mL
    B. 250 mL
    C. 500 mL
    D. 1000 mL

18. Calculate the cell potential for the reaction below using standard electrode potentials.

$$Cu + Fe^{2+} \rightarrow Cu^{2+} + Fe$$

($E°Fe^{2+}/Fe = -0.44\,V$, $E°Cu^{2+}/Cu = +0.34\,V$)

A. - 0.78 V
B. 0.78 V
C. 1.22 V
D. -1.22 V

19. What is enthalpy (H) used to quantify?

A. The rate of chemical reactions
B. The heat flow in a process at constant pressure
C. The volume change during a reaction
D. The mass of reactants

20. What does a negative ΔH indicate?

A. The reaction is exothermic.
B. The reaction is endothermic.
C. The system gains energy.
D. The process absorbs heat from the surroundings.

21. If the standard enthalpy of formation ($\Delta H_f°$) of CO_2 is -393.5 kJ/mol, what does this indicate?

A. The formation of CO_2 is endothermic.
B. The formation of CO_2 releases 393.5 kJ/mol of energy.
C. The formation of CO_2 requires 393.5 kJ/mol of energy.
D. The reaction is nonspontaneous.

22. Which of the following is a colligative property?

A. Density of the solution
B. Freezing point depression
C. Solubility of solutes
D. Color of the solution

23. When a solute is added to a solvent, what happens to its boiling point?

A. It decreases
B. It increases
C. It remains unchanged
D. It depends on the solvent

24. Which colligative property is most useful for determining molar mass of an unknown solute?

A. Boiling point elevation
B. Freezing point depression
C. Osmotic pressure
D. Vapor pressure lowering

25. Which electrolyte solution will cause the greatest freezing point depression per mole of solute?

A. NaCl
B. $CaCl_2$
C. KBr
D. $Al(NO_3)_3$

SECTION B (Total: 75 marks)

INSTRUCTION: This section consists of FOUR (4) modified essay questions (MEQ).
You are required to answer THREE questions in the answer booklet provided.
Question 1 and Question 2 are COMPULSORY.
Answer either Question 3 OR Question 4.

Question 1

(a) Determine the type of mixture in a glass of oil and gas. Justify your answer.

(3 marks)

(b) Define what a decomposition reaction is and give its general reaction.

(2 marks)

(c) Balance the following reaction involving aluminium and iron oxide:

$$Al + Fe_2O_3 \rightarrow Al_2O_3 + Fe$$

(1 mark)

(d) For the combustion of methanol (CH_3OH):

$$2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$$

If 64 g of CH_3OH and 64 g of O_2 are reacted, determine:

i. The limiting reactant.

(2 marks)

ii The mass of H_2O produced.

(3 marks)

(e) Name the element with electron configuration $1s^2\ 2s^2$.

(1 mark)

(f) Give the shorthand electron configuration for sodium.

(2 marks)

(g) Determine the amount of glucose needed to prepare 250 mL of a 0.2 M glucose solution.
(Molecular weight of glucose $C_6H_{12}O_6$: 180 g/mol)

(3 marks)

(h) i. State the definition of standard enthalpy of formation and its symbol.

(2 marks)

ii. The reaction between potassium chloride (KCl) and water is represented as follows:

$$KCl\ (s) + H_2O\ (l) \rightarrow KCl\ (aq)$$

The standard enthalpy of formation for the substances involved are as follows:

- $\Delta H°_f$ for KCl(s) = -436.7 kJ/mol
- $\Delta H°_f$ for KCl(aq) = -408.0 kJ/mol
- $\Delta H°_f$ for H_2O(l) = -285.8kJ/mol

Using the above data, calculate the enthalpy change (ΔH).

(3 marks)

iii. Draw the energy level diagram.

(3 marks)

Question 2

(a) Define empirical formula.

(1 mark)

(b) A sample contains 36.84% nitrogen and 63.16% oxygen.
Calculate its empirical formula.

(4 marks)

(c) In a chemical reaction, the theoretical yield of water is 18 g, but only 15 g is produced.
Calculate the percentage yield.

(2 marks)

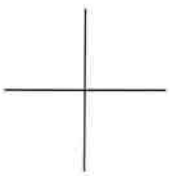
(d) List **TWO (2)** molecules that form hydrogen bonding.

(2 marks)

(e) Draw the Lewis dot structures for NaCl.

(3 marks)

(f) Arrange the following molecules according to the ascending order of boiling points.
Explain the factor that affects intermolecular forces and contribute to the observed trends.

Molecules	Structural Formula
Pentane	
Dimethylpropane	
Methyl butane	

(4 marks)

(g) i. State the number of particles of non-electrolytes.

(1 mark)

ii. List **THREE (3)** examples of non-electrolytes.

(3 marks)

(h) An aqueous solution is prepared by dissolving 3.42 g of sucrose in enough water to make 500 cm^3 of solution at 27 °C.

($C_{12}H_{22}O_{11}$, M = 342 g mol^{-1})

Calculate the osmotic pressure of the solution at 27°C.

(5 marks)

Answer either Question 3 OR Question 4

Question 3

(a) State the formula to calculate the number of neutrons in an atom.

(2 marks)

(b) State **THREE (3)** elements in the alkali metal group of the Periodic Table.

(3 marks)

(c) Draw and label the shapes of P and D orbitals.

(3 marks)

(d) Define the term 'normal solution'.

(1 mark)

(e) A student prepares 250 mL of 0.5 M NaCl solution.
Calculate the mass of NaCl needed. (Molecular weight of NaCl = 58.44 g/mol)

(2 marks)

(f) Calculate the molality of a solution with 0.1 mol of solute dissolved in 0.2 kg of solvent.

(2 marks)

(g) You need to prepare 100 mL of 0.1 N NaOH.
Given the equivalent weight is 40.0 g/mol, calculate the mass required.

(2 marks)

(h) Consider the reaction below occurring in a galvanic cell and answer the following questions:

$$\mathrm{Fe\ (s) + Ni^{2+}(aq) \rightarrow Fe^{2+}(aq) + Ni\ (s)}$$

i. Define electrochemistry.

(1 mark)

ii. Identify the anode and cathode in the reaction.

(2 marks)

iii. Write the half-reactions for the anode and cathode.

(4 marks)

iv. Calculate the standard potential of the cell by referring to the value in the standard reduction potential table (refer to **Appendix 2**).

(3 marks)

Question 4

(a) Identify the number of neutrons and electrons present in the ion I^-.

(2 marks)

(b) State **THREE (3)** elements in the halogen group of the Periodic Table.

(3 marks)

(c) Draw and label the shapes of S and P orbitals.

(3 marks)

(d) Define the term 'solute'.

(1 mark)

(e) Calculate the mass of $CaCl_2$ needed to prepare 750 mL of 0.05 M solution. ($CaCl_2$ = 110.98 g/mol)

(2 marks)

(f) Determine the molality of a solution with 1.2 mol of glucose ($C_6H_{12}O_6$) dissolved in 0.8 kg of water.

(2 marks)

(g) You need to prepare 150 mL of 0.05 N Na_2CO_3.
Given the equivalent weight is 53.00 g/mol, calculate the mass required.

(2 marks)

(h) Given the cell reaction:

$$Sn^{2+} \mid Sn^{4+} \parallel Cu^{2+} \mid Cu$$

i. State the function of a salt bridge.

(1 mark)

ii. Identify which is the anode and the cathode.

(2 marks)

iii. Write the half-reactions that occur in the anode and cathode.

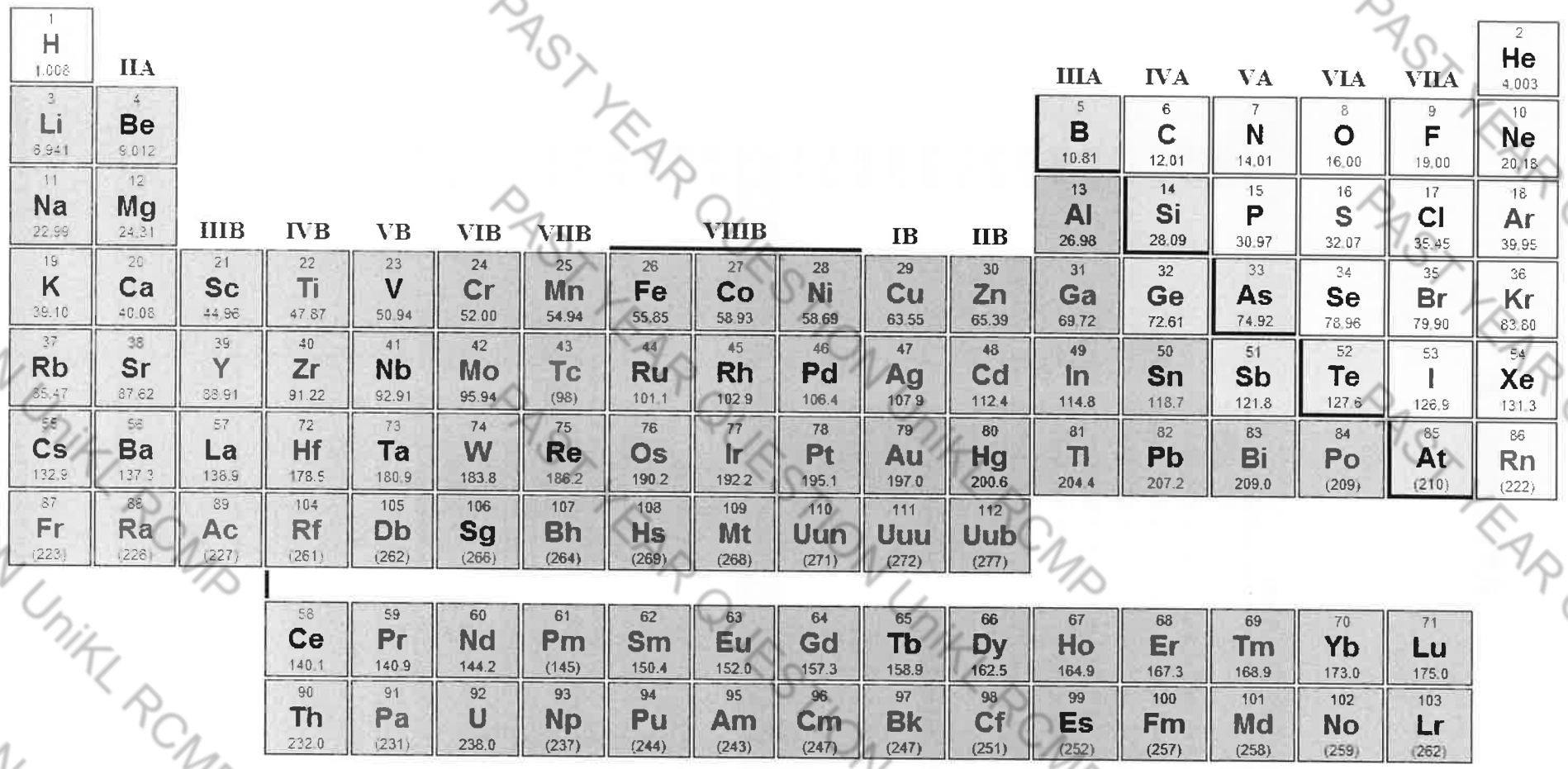
(4 marks)

iv. Calculate the standard potential of the cell by referring to the value in the standard reduction potential table (refer to **Appendix 2**).

(3 marks)

END OF EXAMINATION PAPER

APPENDIX 1



APPENDIX 2

Reduction Half-Reaction		E° (V)
$F_2(g) + 2e^-$	$\longrightarrow 2F^-(aq)$	2.87
$H_2O_2(aq) + 2H^+(aq) + 2e^-$	$\longrightarrow 2H_2O(l)$	1.78
$MnO_4^-(aq) + 8H^+(aq) + 5e^-$	$\longrightarrow Mn^{2+}(aq) + 4H_2O(l)$	1.51
$Cl_2(g) + 2e^-$	$\longrightarrow 2Cl^-(aq)$	1.36
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^-$	$\longrightarrow 2Cr^{3+}(aq) + 7H_2O(l)$	1.33
$O_2(g) + 4H^+(aq) + 4e^-$	$\longrightarrow 2H_2O(l)$	1.23
$Br_2(aq) + 2e^-$	$\longrightarrow 2Br^-(aq)$	1.09
$Ag^+(aq) + e^-$	$\longrightarrow Ag(s)$	0.80
$Fe^{3+}(aq) + e^-$	$\longrightarrow Fe^{2+}(aq)$	0.77
$O_2(g) + 2H^+(aq) + 2e^-$	$\longrightarrow H_2O_2(aq)$	0.70
$I_2(s) + 2e^-$	$\longrightarrow 2I^-(aq)$	0.54
$O_2(g) + 2H_2O(l) + 4e^-$	$\longrightarrow 4OH^-(aq)$	0.40
$Cu^{2+}(aq) + 2e^-$	$\longrightarrow Cu(s)$	0.34
$Sn^{4+}(aq) + 2e^-$	$\longrightarrow Sn^{2+}(aq)$	0.15
$2H^+(aq) + 2e^-$	$\longrightarrow H_2(g)$	0
$Pb^{2+}(aq) + 2e^-$	$\longrightarrow Pb(s)$	- 0.13
$Ni^{2+}(aq) + 2e^-$	$\longrightarrow Ni(s)$	- 0.26
$Cd^{2+}(aq) + 2e^-$	$\longrightarrow Cd(s)$	- 0.40
$Fe^{2+}(aq) + 2e^-$	$\longrightarrow Fe(s)$	- 0.45
$Zn^{2+}(aq) + 2e^-$	$\longrightarrow Zn(s)$	- 0.76
$2H_2O(l) + 2e^-$	$\longrightarrow H_2(g) + 2OH^-(aq)$	- 0.83
$Al^{3+}(aq) + 3e^-$	$\longrightarrow Al(s)$	- 1.66
$Mg^{2+}(aq) + 2e^-$	$\longrightarrow Mg(s)$	- 2.37
$Na^+(aq) + e^-$	$\longrightarrow Na(s)$	- 2.71
$Li^+(aq) + e^-$	$\longrightarrow Li(s)$	- 3.04