UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	HGD10903
COURSE TITLE	:	CHEMISTRY
PROGRAMME NAME	:	DIPLOMA IN ENVIRONMENTAL HEALTH
DATE	:	24 JANUARY 2026
TIME	:	2:00PM - 5:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Section A consist 25 MCQ or EMQ questions. Answer ALL questions.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

THERE ARE 21 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 25 marks)

Answer ALL questions.

Please use the objective answer sheet provided.

1. Based on the following reaction, what is the value of K_p for this reaction at 1100 L?
Refer Below - Figure1 : Chemical reaction .

$$C(s) + CO_2(g) \leftrightarrow 2\,CO\,(g),\ K_c = 0.122 \text{ mol } L^{-1} \text{ at } 1100K$$

Figure 1: Chemical reaction

A. 11.0 atm

B. 0.122 atm

C. 945 atm

D. 1.35×10^3 atm

2. Which of the following is the correct statement for a chemical reaction at equilibrium?

A. At equilibrium, the rate of forward and reverse reaction is the same.

B. The rate constant of forward reaction is equal to the rate constant for the reverse reaction.

C. There is a set of equilibrium concentration that equals the K_c value.

D. At equilibrium, the total concentration of products equals the total concentration of the reactants.

3. Which of the following molecular formula is an example of a Lewis acid?

A. NH_3

B. H_2O

C. CH_4

D. BF_3

4. Consider the following thermochemical equations:
Refer Below - Figure2 : Thermochemical equations .

$$S_{(s)} + {}^{1}/_{2}\, O_{2\,(g)} \rightarrow SO_{(g)} \quad \Delta H = -140.0\ kJmol^{-1}$$

$$SO_{(g)} + {}^{1}/_{2}\, O_{2\,(g)} \rightarrow SO_{2\,(g)} \quad \Delta H = -295.5\ kJmol^{-1}$$

Calculate ΔH for the reaction $S(s) + O_{2\,(g)} \rightarrow SO_{2\,(g)}$

Figure 2: Thermochemical equations

A. 412.4 kJ mol^{-1}

B. -435.5 kJ mol^{-1}

C. -444.3 kJ mol^{-1}

D. -393.5 kJ mol^{-1}

5. What is the oxidation number of sulfur in sulfuric acid (H_2SO_4)?

A. +2

B. -2

C. +4

D. +6

6. What is the standard enthalpy change of formation for any element in its standard state?

A. 50 kJ/mol

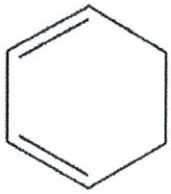
B. 25 kJ/mol

C. 0 kJ/mol

D. 100 kJ/mol

7. Which of the following pairs of compounds contains two aromatic hydrocarbons?
Refer Below - Figure3 : Answer options .

A.

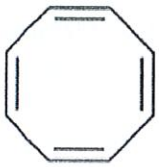


cyclohexadiene

benzene

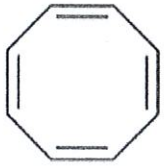
B.

benzene

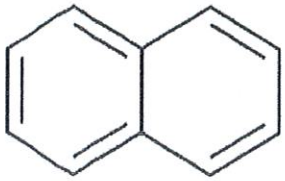


cyclooctatetraene

C.

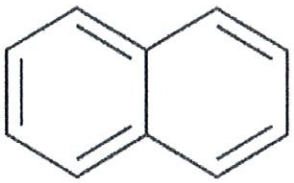


cyclooctatetraene

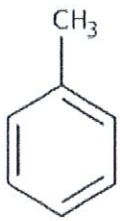


naphtalene

D.



naphtalene



toluene

Figure 3: Answer options

A. D

B. C

C. B

D. A

8. Which law states that the pressure of a gas is inversely proportional to its volume at constant temperature?

   A. Avogadro's Law

   B. Boyle's Law

   C. Charles's Law

   D. Gay-Lussac's Law

9. The empirical formula of a compound that composed of is 40% carbon, 6.7% hydrogen and 53.3% oxygen by mass is _____.

   A. CHO

   B. CH_2O

   C. CH_4O

   D. $C_2H_4O_2$

10. What is the mass of CO_2 produced when 10 g of $C_6H_{12}O_6$ (glucose) is completely combusted in oxygen?

    A. 10.5 g

    B. 14.7 g

    C. 22.0 g

    D. 26.4 g

11. Given the reaction as Figure 1.
Calculate the enthalpy change for the following reaction in the following figure.

Refer Below - Figure4 : Chemical reaction . Figure5 : Water dissociation .

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \quad \Delta H_f = -286\ kJ\ mol^{-1}$$

Figure 4: Chemical reaction

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

Figure 5: Water dissociation

A. +572 kJ

B. -572 kJ

C. +286 kJ

D. -286 kJ

12. What is the equilibrium constant expression for the reaction. Option for answers.

Refer Below - Figure6 : Chemical reaction . Figure7 : Answer options .

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)?$$

Figure 6: Chemical reaction

A. $\frac{[NH_3]^2}{[N_2][H_2]^3}$

B. $\frac{[N_2][H_2]^3}{[NH_3]^2}$

C. $\frac{[NH_3]}{[N_2][H_2]}$

D. $\frac{[N_2][NH_3]}{[H_2]}$

Figure 7: Answer options

A. A

B. B

C. D

D. C

13. Which of the following is a saturated hydrocarbon?

A. Ethylene

B. Acetylene

C. Propane

D. Benzene

14. What is the balanced equation for the combustion of propane (C_3H_8)?
Refer Below - Figure8 : Answer options .

A. $C_3H_8 + 2O_2 \rightarrow 3CO + 4H_2O$

B. $C_3H_8 + 3O_2 \rightarrow 3CO_2 + 4H_2O$

C. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

D. $C_3H_8 + 4O_2 \rightarrow 3CO_2 + 4H_2O$

Figure 8: Answer options

A. D

B. A

C. C

D. B

15. Which of the following is a strong acid?

A. HCl

B. NaOH

C. H_2O

D. NH_3

16. What is the molar mass of NaCl?

A. 60.0 g/mol

B. 35.5 g/mol

C. 58.5 g/mol

D. 23.0 g/mol

17. Which acid would be expected to have the lowest boiling point?

A. Stearic acid, $CH_3(CH_2)_{16}COOH$

B. Benzoic acid, C_6H_5COOH

C. Acetic acid, CH_3COOH

D. Formic acid, HCOOH

18. Which element is the most electronegative?

A. Nitrogen

B. Oxygen

C. Fluorine

D. Chlorine

19. The [H] of a solution is 3. What is the concentration of H^+ ions?

A. 1×10^{-7} M

B. 3 M

C. 1×10^{-3} M

D. 3×10^{-7} M

20. Which type of bond involves the sharing of electron pairs between atoms?

A. Ionic bond

B. Metallic bond

C. Hydrogen bond

D. Covalent bond

21. Radioactive decay is a first order reaction. The half-life of a radioactive element, astatine, is 8.3 hours. Starting with 2.0 g astatine, how much of it remains after 33.2 hours?

A. 0.250 g

B. 0.125 g

C. 0.75 g

D. 0.500 g

22. Which of the following is a noble gas?

A. Hydrogen

B. Helium

C. Nitrogen

D. Oxygen

23. What is the atomic number of Carbon?

A. 8

B. 12

C. 14

D. 6

24. What is the molar mass of sulfuric acid (H_2SO_4)?

A. 98.08 g/mol

B. 102.08 g/mol

C. 104.08 g/mol

D. 100.08 g/mol

25. Which equation represents the integrated rate equation for a first order reaction?

Refer Below - Figure9 : Options for answer .

A. $ln\frac{[A]_0}{[A]_t} = kt$

B. $\log [A]_0 - \log [A]_t = kt$

C. $[A]_0 - [A]_t = kt$

D. $\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$

Figure 9: Options for answer

A. C

B. A

C. D

D. B

SECTION B (Total: 75 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Please answer all the following questions.

(a) Discover the systematic names (IUPAC nomenclatures) for the alkanes with the following formula:

i. $(CH_3CH_2)_2CHCH_3$

(1 marks)

ii. $CH_3(CH_2)_8CH_3$

(1 marks)

(b) Demonstrate the structural formula of:

i. 2-methyl-2-butene.

(1 marks)

ii. 3-methyl-2-hexene

(1 marks)

(c) Calculate the molarity of a solution prepared by dissolving 5.85 g of sodium chloride (NaCl) in enough water to make 250 mL of solution.

(3 marks)

(d) Calculate the volume occupied by 0.5 mol of an ideal gas at a temperature of 300 K and a pressure of 2 atm. (R=0.0821 Latm/molK).

(3 marks)

(e) Calculate moles of H_2 that are required to react completely with 10 moles of N_2 in the reaction $N_2 + 3H_2 \rightarrow 2NH_3$?

(3 marks)

(f) Given the reaction as in the following figure. If you start with 50.0 g of Al and 100.0 g of Cl_2, calculate the

Refer Below - Figure10 : Chemical reaction .

$$2Al + 3Cl \rightarrow 2AlCl_3$$

Figure 10: Chemical reaction

i. Limiting reactant.

(4 marks)

ii. Amount of $AlCl_3$ formed.

(4 marks)

iii. Amount of excess reactant remaining.

(4 marks)

Question 2

Please answer all the following questions.

(a) Answer all the following questions.

i. Write the differential rate equation from the following reaction.
Refer Below - Figure11 : Production of ammonia .

(1 marks)

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

Figure 11: Production of ammonia

ii. Consider the reaction between magnesium and hydrochloric acid to form magnesium chloride and hydrogen gas as per figure. When the concentration of hydrogen is increasing at 0.32 mol dm^{-3} s^{-1}, calculate the rate of decreasing of hydrochloric acid.
Refer Below - Figure12 : Formation of magnesium chloride .

(2 marks)

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

Figure 12: Formation of magnesium chloride

(b) The decomposition of hydrogen peroxide is a first order reaction as in the following figure. Sketch the graph of ln $[H_2O_2]$ against time.

(3 marks)

(c) For the reaction A → products, the rate equation as shown in the following figure. Calculate the concentration of A after 5.5 minutes if the initial concentration of A is 0.2 mol dm^{-3} and the rate constant is 0.40 min^{-1}?
Refer Below - Figure13 : Rate equation .

(3 marks)

$$\frac{-d\,[A]}{dt} = k\,[A]$$

Figure 13: Rate equation

(d) The results of a kinetic study of the reaction between aqueous solutions of chlorine dioxide and hydroxide ions are given in the table below. The chemical equation for the reaction as in the figure below.

Refer Below - Table1 : Results of a kinetic study . Figure14 : Chemical equation .

Table 1: Results of a kinetic study

Experiment	$[ClO_2]$ (mol dm^{-3})	$[OH^-]$ (mol dm^{-3})	Initial rate (mol dm^{-3} s^{-1})
1	0.0421	0.0185	8.21×10^{-3}
2	0.0522	0.0185	1.26×10^{-2}
3	0.0421	0.0285	1.26×10^{-2}

$$ClO_2(aq) + 2OH^-(aq) \rightarrow ClO_3^-(aq) + H_2O(l)$$

Figure 14: Chemical equation

i. Determine the overall order of reaction for this experiment.

(3 marks)

ii. Write the rate equation for this experiment.

(1 marks)

iii. Calculate the rate constant, k, for the reaction.

(3 marks)

(e) The rate of hydrolysis of sucrose to glucose and fructose is a first order reaction. If 10% of a sample of sucrose is hydrolyzed in 22 seconds.

i. Calculate the rate constant, k, for the reaction.

(2 marks)

ii. How long will it take for 50% of the sucrose to be hydrolyzed?

(3 marks)

(f) During a titration, 25.0 ml of 0.1 M HCl is completely neutralized by 30.0 mL of NaOH. Calculate the molarity of the NaOH solution.

(4 marks)

Question 3

Answer all the following questions.

(a) A bomb calorimeter was calibrated by burning 0.610 g benzoic acid. The temperature of the calorimeter was found to increase by 0.178 °C. The standard enthalpy of combustion of benzoic acid is known to be -3230 kJ mol^{-1} and the relative molar mass of benzoic acid is 122 g mol^{-1}. Calculate the heat capacity, *C* of the calorimeter.

(3 marks)

(b) A mixture of 0.100 g of H_2 and 0.800 g of O_2 were placed in the same calorimeter and ignited. The initial temperature of the calorimeter was measured to be 25.0°C. After the H_2 and O_2 reacted together to form water, the final temperature of the calorimeter was 25.155 °C. Calculate the heat of reaction in kJ mol^{-1}.

(4 marks)

(c) The specific heat capacity of copper is 0.385 kJ kg^{-1} $°C^{-1}$. Calculate the initial temperature of a copper block of mass 40 g if the amount of heat supplied to it was 105 J and the maximum temperature reached by the copper block was 40 °C.

(3 marks)

(d) 100 mL of 0.5 M HCl is mixed with 100 mL of 0.5 M NaOH in a polystyrene beaker. Both the HCl and NaOH solutions have the same initial temperature of 22.50 °C. The final temperature of the reaction mixture is 25.90 °C. The heat capacity of the calorimeter is negligible and can be ignored. Calculate the heat change for the neutralization reaction in kJ mol^{-1}.
(Hint: heat of neutralization has a negative value because heat is released by the reaction. Density of water = 1.00 g mL^{-1}; specific heat capacity of water = 4.184 $Jg^{-1}°C^{-1}$)

(4 marks)

(e) Interpret Hess's law.

(2 marks)

(f) Calculate the standard enthalpy change for the following reaction. The standard enthalpies of combustion of C_2H_2 and C_6H_6 are -1300 and -3270 kJ mol^{-1}.
Refer Below - Figure15 : Chemical reaction .

(4 marks)

$$3C_2H_2(g) \rightarrow C_6H_6(l)$$

Figure 15: Chemical reaction

(g) The enthalpy changes for the following reactions are as follows:
Refer Below - Figure16 : Enthalpy change for the chemical reactions .

(5 marks)

$$C(s) + O_2(g) \rightarrow CO_2(g) \quad \Delta H_f = -393.5\ kJ\ mol^{-1}$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \quad \Delta H_f = -285.9\ kJ\ mol^{-1}$$

$$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l) \quad \Delta H_c = -1299.6\ kJ\ mol^{-1}$$

Calculate ΔH for the reaction $2C(s) + H_2(g) \rightarrow C_2H_2(g)$.

Figure 16: Enthalpy change for the chemical reactions

Question 4

Answer all the following questions.

(a) The correct name of each of the following compunds in the figure are
Refer Below - Figure17 : Chemical compounds .

(2 marks)

i.

ii.

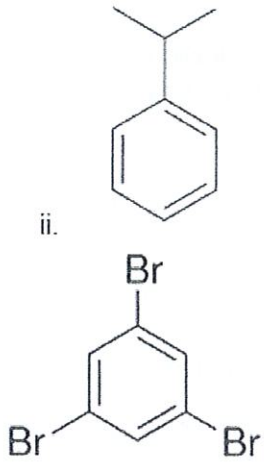


Figure 17: Chemical compounds

(b) Discover the basic requirement for cis-trans (geometrical) isomerism to occur.

(2 marks)

(c) From the following molecular structures, examine whether they exhibit cis-trans isomerism.

i. $CH_3CH_2CH{=}CCl_2$

(1 marks)

ii. $CH_2CHCH{=}CH_2$

(1 marks)

iii. $CH_3(CH_2)_7CH{=}(CH_2)_{12}CH_3$

(1 marks)

iv. Cyclic compound, $CHBrCH_2CHBr$

(1 marks)

(d) An organic acid has the structural as $CH_3(CH_2)_4CH{=}CH(CH_2)_4COOH$
Show the cis and trans isomers of this acid.

(4 marks)

(e) Examine types of reaction for the following questions:

i. Reaction I.
Refer Below - Figure18 : Reaction I .

(1 marks)

$$CH_3CH_2CH_2CH_3 \rightarrow CH_3CH(CH_3)CH_3$$

Figure 18: Reaction I

ii. Reaction II.
Refer Below - Figure19 : Reaction II .

(1 marks)

$$CH_3C \equiv CH + Br_2 \rightarrow CH_3CBr = CHBr$$

Figure 19: Reaction II

iii. Reaction III.
Refer Below - Figure20 : Reaction III .

(1 marks)

$$CH_2BrCH_2Br + Zn \rightarrow CH_2 = CH_2 + ZnBr_2$$

Figure 20: Reaction III

(f) Show the structural formula for the following compounds and classify them as primary, secondary or tertiary alcohols.

i. Isopropyl alcohol

(2 marks)

ii. 2,2 – dimethyl propanol

(2 marks)

iii. 2-phenyl-2-propanol

(2 marks)

iv. Cis-3-pentenol

(2 marks)

v. 2-methyl-2-butanol

(2 marks)

END OF EXAMINATION PAPER