



EXAMINATION SESSION : **End of Semester Final Examination**

SEMESTER : **Two (2025)**

PROGRAMME TITLE : **Kickstart**

COURSE TITLE : **Fundamentals of Chemistry II**

COURSE CODE : **CHM003**

LEVEL : **Access**

PAPER : **Two**

DATE : **May 02, 2025**

TIME : **1:00 pm**

DURATION : **2 Hours**

STUDENT ID NO: _____

INSTRUCTIONS

1. This is a TWO hour examination consisting of TWO Sections and a Periodic Table.

Section A – 25 Multiple Choice Questions

Section B – 3 Structured Questions

2. Answer ALL questions for each section in the SPACES provided.
3. For numerical problems, ALL working must be shown for full marks.
4. Use of pocket electronic calculators is permitted.

Section	Number	Marks Earned	Maximum Marks
Section A Multiple choice	1 – 25		25 marks
Section B Structured Questions	1		25 marks
	2		25 marks
	3		15 marks
	TOTAL		90 marks

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A – MULTIPLE CHOICE

Shade the letter that corresponds to the correct answer for each question. All working should be done on the examination paper.

- Which of the following is a *decomposition* reaction?
(A) $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
(B) $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$
(C) $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$
(D) $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- Name the products formed from the reaction of sodium carbonate and hydrochloric acid.
(A) Sodium chloride and hydrogen
(B) Sodium hydrogen acid, water and chlorine
(C) Sodium chloride, water and carbon dioxide
(D) Sodium, hydrogen and chlorine
- Which of the following chemical equations is NOT balanced?
(A) $2\text{Mg (s)} + \text{FeCl}_2 \text{ (aq)} \rightarrow \text{MgCl}_2 \text{ (aq)} + \text{Fe (s)}$
(B) $\text{Fe}_2\text{O}_3 \text{ (s)} + 2\text{Al (s)} \rightarrow \text{Al}_2\text{O}_3 \text{ (s)} + 2\text{Fe (s)}$
(C) $\text{Fe}_2\text{O}_3 \text{ (s)} + 3\text{C (s)} \rightarrow 2\text{Fe (s)} + 3\text{CO (g)}$
(D) $\text{CH}_4 \text{ (g)} + 2\text{O}_2 \text{ (g)} \rightarrow \text{CO}_2 \text{ (g)} + 2\text{H}_2\text{O (g)}$
- Which formula is the correct one for finding the number of moles of a substance?
(A) Moles = $\frac{\text{molar mass}}{\text{volume}}$
(B) Moles = $\frac{\text{volume}}{\text{molar mass}}$
(C) Moles = $\frac{\text{molar mass}}{\text{mass}}$
(D) Moles = $\frac{\text{mass}}{\text{molar mass}}$
- What is the molar mass of the compound $(\text{CH}_3\text{COO})_2\text{Mg}$?
(A) 83.3 g/mol
(B) 91.0 g/mol
(C) 115.3 g/mol
(D) 142.3 g/mol
- Which of the following is the BEST definition for Molarity?
(A) The mass of solute dissolved in 1dm^3 (or 1000cm^3) of solution.
(B) The volume of solute dissolved in a given volume of solvent.
(C) The number of moles of solute dissolved in 1dm^3 (or 1000cm^3) of solution.
(D) The concentration of a solution

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7. Determine the number of moles present in a 725 cm^3 sample of sulfur dioxide gas at RTP.
(Molar volume at RTP = $24.0\text{ dm}^3\text{mol}^{-1}$)
- (A) 0.0302 mols
(B) 30.2 mols
(C) 17400 mols
(D) 11.3 mols
8. If the empirical formula of a compound is P_2O_3 , what could be a possible molar mass of the compound?
- (A) 165 g/mol
(B) 275 g/mol
(C) 550 g/mol
(D) 210 g/mol
9. Determine the mass concentration in gdm^{-3} when 45g of sodium hydroxide was dissolved in 250 cm^3 of solution.
- (A) 3.37 g/dm^3
(B) 5.56 g/dm^3
(C) 74.1 g/dm^3
(D) 180 g/dm^3
10. Table 1 below shows the burette readings and volume of acid delivered during a titration experiment. Which of the volumes should be used to calculate the average acid volume?

Titre	1	2	3	4
Final burette reading (cm^3)	30.95	30.40	44.30	21.15
Initial burette reading (cm^3)	12.65	9.10	26.10	2.55
Volume of acid delivered (cm^3)	18.30	21.30	18.20	18.60

Table 1

- (A) 18.30, 18.20 and 18.60
(B) 18.20 and 18.30
(C) 18.30, 21.30, 18.20 and 18.60
(D) 18.30 and 18.60
11. Which of the following apparatus is NOT used in making a standard solution of sodium hydroxide?
- (A) Volumetric flask
(B) Pipette
(C) Balance
(D) Spatula

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12. Pick out the FALSE statement below.

- (A) Molecules in a reaction mixture are constantly moving randomly in different directions.
- (B) Reactant molecules must collide for a chemical reaction to take place.
- (C) Reactant molecules react when they have the right amount of energy and the right orientation.
- (D) All collisions are effective and result in a chemical reaction taking place.

13. _____ are biological catalysts, they speed up chemical reactions.

- | | |
|-----------------------|-------------------|
| (A) Substrate | (C) Enzymes |
| (B) Activation Energy | (D) Concentration |

14. When the concentration of reactant molecules increases, the rate of reaction increases.
The best explanation is: As the concentration of the reactant molecules increases,

_____.

- (A) the average kinetic energy of the molecules increases.
- (B) the frequency of molecular collisions increases.
- (C) the rate constant increases.
- (D) the activation energy increases

15. All of the following will decrease the rate of a chemical reaction involving gases EXCEPT

- (A) Decreasing the pressure of the system
- (B) Decreasing the concentration of the reactants
- (C) Decreasing the volume of the container
- (D) Decreasing the temperature of the system

16. Which of the following BEST defines oxidation?

- (A) Gain of electrons
- (B) Loss of oxygen
- (C) Gain in oxidation state
- (D) Loss of hydrogen

17. Which of the following substances underwent reduction?

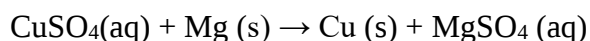
- (A) $\text{Na (s)} \rightarrow \text{Na}^+ \text{ (aq)}$
- (B) $\text{Fe}^{3+} \text{ (aq)} \rightarrow \text{Fe}^{2+} \text{ (aq)}$
- (C) $2\text{Cl}^- \text{ (aq)} \rightarrow \text{Cl}_2 \text{ (g)}$
- (D) $\text{Sn}^{2+} \text{ (aq)} \rightarrow \text{Sn}^{4+} \text{ (aq)}$

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18. In Na_2SO_4 , the oxidation number of sulfur is:

- (A) +2 (B) +4 (C) +6 (D) -2

19. Identify the oxidizing agent in this redox reaction:



- (A) Copper (II) sulfate
(B) Copper metal
(C) Magnesium metal
(D) Magnesium sulfate

20. In the electrolysis of molten copper (II) oxide using inert electrodes, the substance formed at the anode is

- (A) Copper (C) Oxygen
(B) Chlorine (D) Carbon

21. Identify the type of cell shown in Figure 1 below.

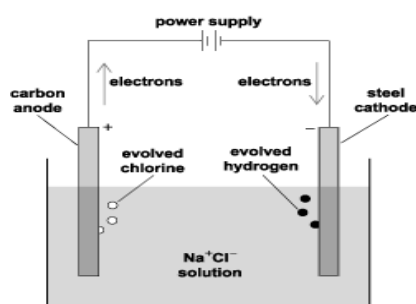


Figure 1

- (A) Photochemical (C) Voltaic
(B) Electrolytic (D) Galvanic

22. All of the following should be considered when determining the ions preferentially discharged at the electrodes of aqueous solutions EXCEPT

- (A) Volume of the electrolyte
(B) Concentration of the ions
(C) Position of the ions in the electrochemical series
(D) Active or inert electrode.

23. Which of the following substances would be the MOST suitable to serve as inert electrodes?

- (A) Copper (C) Platinum
(B) Iron (D) Sodium

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24. Which of the following reactions are endothermic?

- (A) The test tube feels cooler when ammonium nitrate dissolves in water
- (B) The temperature changes from -10°C to 0°C when a salt was added to the water
- (C) Magnesium ribbon when burnt in oxygen releases light energy
- (D) The test tube feels warmer when sodium chloride dissolves in water

25. A reaction energy profile diagram is shown in Figure 2 below.

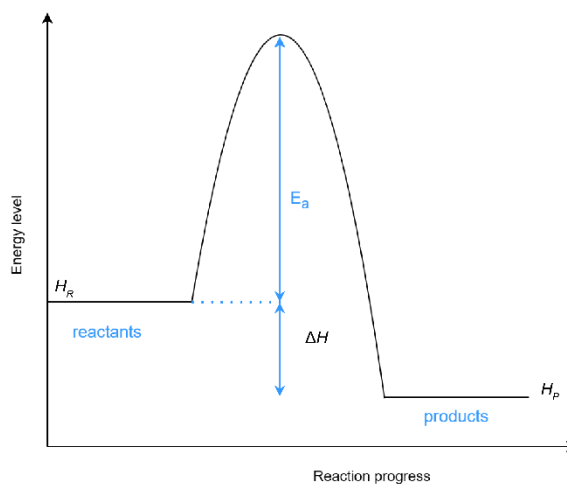


Figure 2

Which statement about this reaction is CORRECT?

- (A) The reaction rate increases during the reaction
- (B) The reaction is exothermic.
- (C) The reaction absorbs thermal energy from the surroundings.
- (D) The temperature of the reaction mixture decreases.

TOTAL 25 MARKS

END OF MULTIPLE-CHOICE QUESTIONS

MOVE ON TO SECTION B

SECTION B

Answer ALL questions in the spaces provided. Show ALL working to be awarded full marks.

1. Iron (III) oxide is a crucial raw material in the production of iron and steel. It is used as a pigment in paints, stains, enamels, and other coatings, known for its colour stability and durability. It can be used as a catalyst in certain chemical processes.

(A) 119.7g of solid iron (III) oxide can be produced from the reaction of iron metal and oxygen gas.

- (i) Write a balanced chemical equation including state symbols for the production of iron (III) oxide. (3 marks)

- (ii) What type of reaction is this? _____ (1 mark)

- (iii) Calculate the number of moles of iron (III) oxide produced. (3 marks)

- (iv) Using your answer in (A) (iii), determine the number of moles of oxygen gas required to produce the 119.7g of iron (III) oxide. (3 marks)

- (v) If the reaction took place at STP, determine the volume of oxygen gas in cm^3 required. (*Molar volume: $22.4 \text{ dm}^3/\text{mol}$*) (3 marks)

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- (B) Iron is produced from iron (III) oxide according to the following equation:
 $\text{Fe}_2\text{O}_3 (\text{s}) + 3\text{CO} (\text{g}) \rightarrow 2\text{Fe} (\text{s}) + 3\text{CO}_2 (\text{g})$ This reaction is a redox reaction.

- (i) What are redox reactions? (1 mark)

- (ii) What is the oxidation state of **carbon** in
a) CO (2 marks)

- b) CO₂ (2 marks)

- (iii) Using changes in oxidation state or otherwise, identify the substance reduced and the substance oxidised in this reaction (4 marks)

Substance reduced: _____

Reason: _____

Substance oxidised: _____

Reason: _____

- (iv) What is the percent composition of iron in iron (III) oxide? (3 marks)

TOTAL 25 MARKS

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2. Marble chips (calcium carbonate) react with 1.0 mol dm^{-3} hydrochloric acid according to the equation:



- (A) (i) Write the complete ionic equation for this reaction. (2 marks)

- (ii) Hence, determine the net ionic equation for the reaction (2 marks)

- (B) (i) What is the rate of a chemical reaction? (1 mark)

- (ii) Explain the collision theory of reactivity (2 marks)

- (iii) Explain, using the collision theory, how the rate of the reaction will be affected by using a 0.01 mol dm^{-3} concentration of hydrochloric acid instead. (3 marks)

Factor/change: _____

Rate would _____

Reason: _____

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- (iv) Using a mortar and pestle, the marble chips were crushed and used instead. Explain using the collision theory how the rate of reaction would be affected. (3 marks)

Factor/change: _____

Rate would _____

Reason: _____

- (C) 2.002 g of marble chips were reacted with 50 cm³ of the 0.1 mol dm⁻³ hydrochloric acid in a calorimeter. The temperature rose from 26°C to 34.5°C.

- (i) State whether the reaction is endothermic or exothermic (1 mark)

- (ii) Calculate the heat transferred, Q, in Kilojoules.
($C = 4.2 J g^{-1} C^{-1}$; $Q = mc\Delta T$) (4 marks)

- (iii) Determine ΔH , the enthalpy change per mol of CaCO₃. (4 marks)

- (iv) Draw an energy profile diagram for the reaction. Include your ΔH value. (3 marks)

TOTAL 25 MARKS

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3. Electrochemistry is the branch of chemistry that investigates electrical current and chemical reactions.

(A) Define the following terms as they relate to electrochemistry. (2 marks)

(i) Electrolysis

(ii) Electrolyte

(B) During a laboratory experiment 235 amperes of current was passed through an electrochemical cell containing molten magnesium chloride (MgCl_2) for half an hour and solid magnesium was deposited at one of the electrodes.

(i) Identify the electrode where magnesium was deposited. (1 mark)

(ii) Write a half equation to show how magnesium is formed from magnesium ions. (2 marks)

(iii) Name the substance produced at the other electrode. (1 mark)

(iv) Write a half reaction to show how this substance was produced. (2 marks)

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(v) Calculate the quantity of electrical charge in coulombs that was passed through the cell . ($Q = It$) (2 marks)

(vi) Calculate the mass of magnesium deposited ($1F = 96500C$) (5 marks)

TOTAL 15 MARKS

END OF EXAMINATION!!

The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
																	4.0 He helium 2
6.9 Li lithium 3	9.0 Be beryllium 4											10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12											27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	– Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	– Po polonium 84	– At astatine 85	– Rn radon 86
– Fr francium 87	– Ra radium 88	– Ac actinium 89	– Rf rutherfordium 104	– Db dubnium 105	– Sg seaborgium 106	– Bh bohrium 107	– Hs hassium 108	– Mt meitnerium 109	– Unu ununillium 110	– Uuu unununium 111	– Uub ununbium 112		– Uuq ununquadium 114		– Uuh ununhexium 116		– Uuo ununoctium 118

lanthanides *	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	– Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
actinides *	– Th thorium 90	– Pa protactinium 91	– U uranium 92	– Np neptunium 93	– Pu plutonium 94	– Am americium 95	– Cm curium 96	– Bk berkelium 97	– Cf californium 98	– Es einsteinium 99	– Fm fermium 100	– Md mendelevium 101	– No nobelium 102	– Lw lawrencium 103