



SIR ARTHUR LEWIS COMMUNITY COLLEGE
ACADEMIC YEAR (2024/2025) - SEMESTER ONE
END OF SEMESTER EXAMINATION

COURSE CODE : CHM003
COURSE TITLE : Fundamentals in Chemistry II
LECTURER(S) : Shirniah Emmanuel, Chantal Winter-Felix
DATE : 12th December 2024
TIME : 1 p.m. – 3 p.m.
DURATION : 2 Hours
STUDENT ID # : _____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- This is a Two-hour examination consisting of TWO sections; A and B
Section A has 60 multiple choice questions and Section B has 1 structured question.
- For Section A, shade the letter corresponding with the correct answer on the ANSWER SHEET provided. For Section B, write your answer in the spaces provided on your QUESTION paper.
- Answer ALL questions.
- For numerical problems, ALL working must be shown for full marks.
- Use of pocket electronic calculators is permitted.

Section	Marks Earned	Maximum Marks
A		60
B		30
Total		90

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

SECTION A

Instructions: Read each question carefully then select the most appropriate answer. Shade the corresponding letter (a), (b), (c) or (d) to the answer on the **ANSWER SHEET** provided.

- The formula that gives the simplest ratio of atoms in a compound is the
 - structural formula
 - molecular formula
 - empirical formula
 - molar ratio
- What is the percentage of oxygen in H_2O ?
 - 80%
 - 88.8%
 - 8.8%
 - 9.8%
- In a chemical reaction the limiting reactant is one
 - which is present in least amount
 - determines the number of moles of product formed
 - determines the identity of the product
 - does not effect the amount of product
- Which of the following chemical equations are balanced?
 - $\text{Rb}_2\text{CO}_3 (\text{s}) + 2\text{HNO}_3 (\text{aq}) \rightarrow 2\text{RbNO}_3 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + 2\text{CO}_2 (\text{g})$
 - $\text{Rb}_2\text{CO}_3 (\text{s}) + 2\text{HNO}_3 (\text{aq}) \rightarrow 2 \text{RbNO}_3 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$
 - $\text{Rb}_2\text{CO}_3 (\text{s}) + 2\text{HNO}_3 (\text{aq}) \rightarrow \text{RbNO}_3 (\text{aq}) + 2\text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$
 - $2\text{Rb}_2\text{CO}_3 (\text{s}) + \text{HNO}_3 (\text{aq}) \rightarrow 2\text{RbNO}_3 (\text{aq}) + \text{H}_2\text{O} (\text{l}) + 2\text{CO}_2 (\text{g})$
- What is the name of the salt that is formed from the reaction between hydrochloric acid and potassium hydroxide?
 - Hydrogen hydroxide
 - Potassium chloride
 - Potassium hydrochloride
 - Potassium Hydride
- The reaction, $\text{C}_3\text{H}_8(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 3 \text{CO}_2 (\text{g}) + 4\text{H}_2\text{O}(\text{g})$ is an example of which type of reaction?
 - Synthesis
 - Displacement
 - Acid-Base
 - Combustion
- In the following reaction: $2 \text{C}_2\text{H}_6 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$, what is the ratio of oxygen to carbon dioxide?
 - 2:7
 - 4:7
 - 7:4
 - 7:6

8. 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 = $\frac{\text{molar mass}}{\text{mass}}$

C. Moles = $\frac{\text{volume}}{\text{molar mass}}$

D. Moles = $\frac{\text{mass}}{\text{molar mass}}$

9. In which of the following substances will electrolysis **not** occur if an electrical current is passed through it?

- A. Concentrated hydrochloric acid solution
- B. Silver chloride liquid
- C. Solid sodium chloride
- D. Dilute hydrochloric acid solution

10. An organic compound contains Carbon, Hydrogen and Oxygen. Its elemental analysis gave C 38.7%, and H 9.67%.

The empirical formula of the compound would be_____

- A. CH₄O
- B. CH₃O
- C. CH₂O
- D. C₂H₃O

11. The mass of 1 mole of the compound Al₂(SO₄)₃ is:

- A. 198.1 g
- B. 315.3 g
- C. 278.1 g
- D. 342.3 g

12. What is the percentage composition of oxygen in magnesium bicarbonate?

- A. 31%
- B. 48%
- C. 57%
- D. 66%

13. Which pair of molecular formula and empirical formula is CORRECT?

Molecular formula	Empirical formula
A. As ₂ O ₅	AsO ₃
B. C ₃ H ₆	C ₂ H ₃
C. C ₆ H ₁₂ O ₆	CH ₂ O
D. C ₁₂ H ₂₆	CH ₂

14. The value Avogadro's constant is

- A. 6.02×10^{24}
- B. 6.02×10^{-24}
- C. 6.02×10^{-23}
- D. 6.02×10^{23}

15. The number of moles of CO_2 which contains 8.0g of oxygen

- A. 0.25
- B. 0.50
- C. 1.0
- D. 1.50

16. The volume occupied by 1.4 gm of N_2 at stp is

- A. 224 dm³
- B. 22.4 dm³
- C. 1.12 dm³
- D. 112 cm³

17. Which of the following will have the same number of molecules at stp?

- A. 280 cm³ of CO_2 and 280 cm³ of N_2O
- B. 11.2 dm³ of O_2 and 32 g of O_2
- C. 44g of CO_2 and 11.2 dm³ of CO
- D. 28g of N_2 and 5.6 dm³ of oxygen

18. The mass of one dm³ of O_2 at stp is

- A. 1.43 g
- B. 1.53 g
- C. 1.63 g
- D. 1.33 g

19. A solution is prepared by mixing 1.00 g ethanol $\text{C}_2\text{H}_5\text{OH}$, with 100.0 g of water. What is the mass percent of ethanol in this solution.

- A. 0.990%
- B. 1%
- C. 0.0099%
- D. 0.01%

20. Calculate the concentration in gdm⁻³ of sodium carbonate Na_2CO_3 if 25 cm³ of the solution contains 0.5 g sodium carbonate.

- A. 20 gdm⁻³
- B. 0.20 gdm⁻³
- C. 200 gdm⁻³
- D. 2 gdm⁻³

21. Which one of these best describes a saturated solution

- A. A solution in which more solute can be dissolved at room temperature
- B. A solution which cannot dissolve anymore solute at room temperature
- C. A saturated solution which is only able to dissolve one more gram of solute at room temperature
- D. A solvent containing no solute

22. Which of the following is a solution?

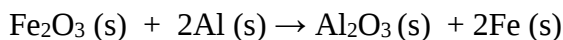
- A. Brass
- B. Mercury
- C. Toothpaste
- D. Liquid milk

23. Which of the following statements BEST describes Avogadro's law?
- A. Equal masses of gases at the same temperature and pressure contain the same number of molecules
 - B. Equal volumes of gases at the same temperature and pressure contain the same number of molecules
 - C. Equal volumes of gas with the same mass at the same temperature contain the same number of moles
 - D. Equal moles of gases at the same temperature and pressure have the same mass
24. The products of a combustion reaction include all the following EXCEPT ____.
- A. water
 - B. carbon dioxide
 - C. heat
 - D. oxygen
25. What is the number of moles found in a 125 cm³ sample of 0.25M nitric acid (HNO₃)?
- A. 0.00200 mols
 - B. 0.0313 mols
 - C. 1.98 mols
 - D. 15.8 mols
26. Determine the mass concentration in gdm⁻³ when 45g of sodium hydroxide was dissolved in 250 cm³ of solution.
- A. 3.37 g/dm³
 - B. 5.56 g/dm³
 - C. 74.1 g/dm³
 - D. 180 g/dm³
27. Which of the following can behave as **both** an oxidizing and reducing agent?
- A. Hydrogen gas
 - B. Sulphur Dioxide
 - C. Dilute Sulphuric acid
 - D. Acidified potassium permanganate (VII) solution
28. Which of the following represents the reduction half of a redox reaction?
- 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. $\text{Sn}^{2+} \text{ (aq)} \rightarrow \text{Sn}^{4+} \text{ (aq)}$
29. Which of the following statements is **true** for the following equation:
- $$\text{Mg(s)} + \text{H}_2\text{SO}_4\text{(aq)} \rightarrow \text{MgSO}_4\text{(aq)} + \text{H}_2 \text{ (g)}$$
- A. Hydrogen is oxidized from 0 to +1
 - B. Magnesium is oxidized from 0 to +2
 - C. Hydrogen is reduced from +2 to 0
 - D. Magnesium is reduced from +2 to zero

30. In a reaction between $\text{CuSO}_4(\text{aq})$ and $\text{Zn}(\text{s})$, what happens to zinc?

- A. Zinc experiences an increase in the oxidation state
- B. Zinc experiences a decrease in oxidation number
- C. Zinc undergoes reduction
- D. Zinc is a spectator ion

31. Which of the following ions is the spectator ion in the following redox reaction?



- A. Fe^{3+}
- B. O^{2-}
- C. Al^{3+}
- D. Cl^{1-}

32. Which of the following aqueous solutions contains 1 mole of hydrogen ions?

- A. 1 dm^3 of $1.0\text{ mol dm}^{-3}\text{ H}_2\text{SO}_4$
- B. 1 dm^{-3} of $1\text{ mol dm}^{-3}\text{ H}_3\text{PO}_4$
- C. 2 dm^{-3} of $0.5\text{ mol dm}^{-3}\text{ H}_2\text{S}$
- D. 2 dm^{-3} of $0.5\text{ mol dm}^{-3}\text{ HCl}$

33. Which of the following is FALSE about electrolysis?

- A. It involves passage of electricity through solid metals that serve as electrolytes
- B. It takes place in an electrolytic cell
- C. It involves the decomposition of electrolytes by electrical charge
- D. Electrodes can be inert or active

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

- A. Copper
- B. Oxygen
- C. Chlorine
- D. Carbon

35. Which of the following substances would serve as an active electrode in electrolysis?

- A. Copper
- B. Carbon
- C. Platinum
- D. Graphite

36. During a redox reaction, an oxidizing agent

- A. gains electrons
- B. is oxidized
- C. loses electrons
- D. is hydrolysed

37. An oxidizing agent is a substance which causes another substance to become

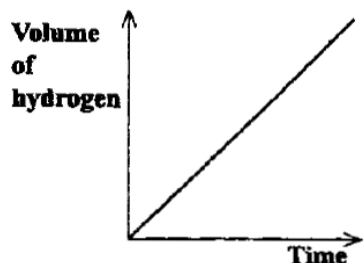
- A. reduced
- B. Oxidized
- C. reduced and oxidized
- D. Oxygen

38. In the electrolysis the process of oxidation occurs at
- anode
 - cathode
 - both cathode and anode
 - in electrolytic solution
39. In an oxidation process the oxidation number of the element
- increases
 - decreases
 - does not change
 - is always zero
40. A reducing agent is a substance which causes another substance to become
- reduced
 - Oxidized
 - reduced and oxidized
 - Oxygen
41. In the reduction process the oxidation number of the element
- increases
 - decreases
 - does not change
 - is always zero
42. The Oxidation state of oxygen in OF_2 is
- + 1
 - 1
 - + 2
 - 2
43. Which of the following can be used as definition of oxidation?
- gain of electrons
 - loss of electrons
 - addition of Hydrogen
 - removal of Oxygen
44. Which of the following can be used as definition of reduction?
- gain of electrons
 - loss of electrons
 - removal of Hydrogen
 - addition of Oxygen
45. When the current is passed through an electrolytic solution, which of the following process will occur
- anions move towards anode and cations move towards cathode
 - cations and anions both move towards anode
 - cations and anions both move towards cathode
 - no movement of the ions occur
46. Which of the following conduct electricity due to the migration of electrons only
- copper metal
 - NaCl molten
 - solid NaCl
 - NaCl solution

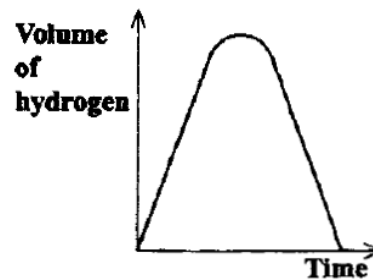
47. Substances through which electric current can pass are called
- A. insulators
 - B. conductors
 - C. cathode
 - D. anode
48. Substances through which electric current cannot pass are called
- A. insulators
 - B. conductors
 - C. anode
 - D. cathode
49. Metallic conduction is due to the
- A. movement of electrons
 - B. movement of ions
 - C. both (a) and (b)
 - D. none of these
50. A substance which in molten state or in solution form allows electric current to pass through it is called
- A. electrolyte
 - B. insulator
 - C. anode
 - D. cathode
51. In electrochemical cells, the electrode at which the reduction occurs is called
- A. anode
 - B. cathode
 - C. electrolyte
 - D. electrolysis
52. Pick out the FALSE statement below
- A. Molecules in a reaction mixture are constantly moving randomly in different directions
 - B. A catalyst influences the threshold energy of a reaction
 - 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
53. Which of the following factors will increase the rate of a chemical reaction involving gases?
- A. Decreasing the temperature
 - B. Adding less reactants to the mixture
 - C. Adding a catalyst
 - D. Increasing the volume of the container

54. An excess of magnesium powder was added to 50cm³ of dilute sulphuric acid, and the reaction was allowed to continue until no more hydrogen evolved. Which of the following graphs BEST represents the complete reaction?

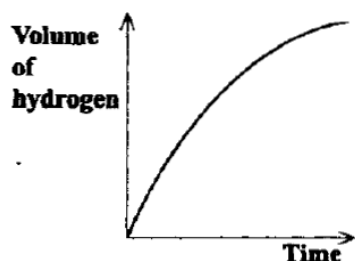
A.



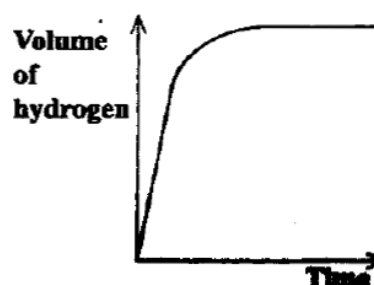
B.



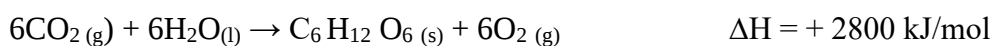
C.



D.



55. Consider the following reaction showing photosynthesis:



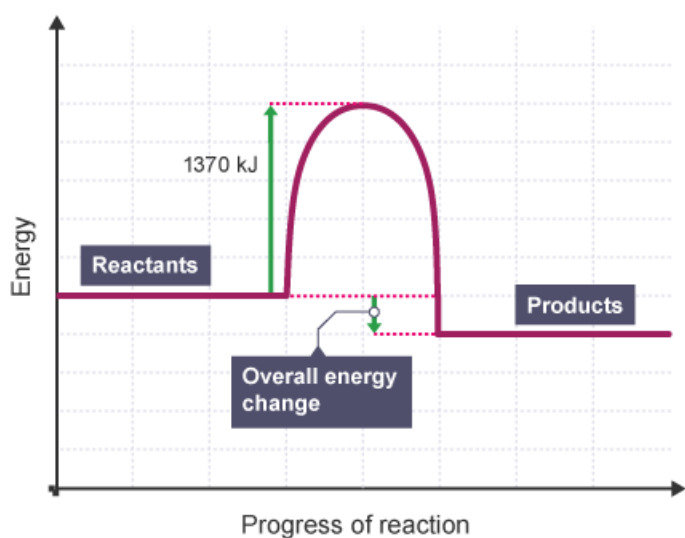
Which of the following is true regarding the thermal energy in this system?

- A. It is transferred from the surroundings to the reaction.
- B. It is transferred from the reaction to the surroundings.
- C. It is transferred from the reactants to the products.
- D. It is transferred from the products to the reactants.

56. 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

57. The diagram shows the Energy profile diagram of an exothermic reaction.



What does the energy value of 1370 kJ represent?

- A. Released energy
- B. Products energy
- C. Activation energy
- D. Reactants energy

58. The change in heat energy of a chemical reaction at constant temperature and pressure is called

- A. enthalpy change
- B. bond energy
- C. heat of sublimation
- D. reactivity

59. An endothermic reaction is one in which

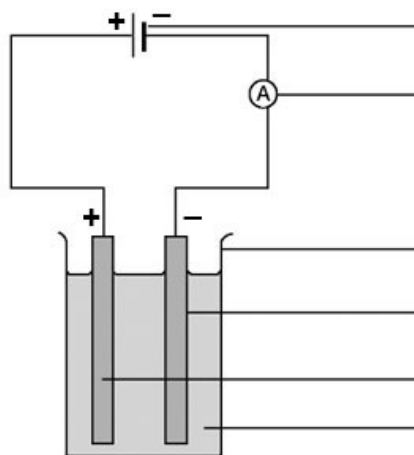
- A. enthalpy of reactants and products are same
- B. enthalpy of products is greater than reactant
- C. enthalpy of products is lesser than reactants
- D. heat evolves from system

60. An exothermic reaction is one in which

- A. enthalpy of reactants and products are same
- B. heat is absorbed by system
- C. enthalpy of products is less than reactants
- D. enthalpy of reactants is lesser than products

SECTION B
Answer ALL questions in the spaces provided

1. The figure below shows a simplified diagram of the apparatus used for the electrolysis of copper chloride solution using inert electrodes.



- (a) Label the parts of the electrolytic cell above. The label lines have been provided for you. (6 marks)

- (b) (i) Identify the ions that are produced from copper chloride solution during electrolysis.

(4 marks)

- (ii) Predict which ion from (b)(i) will be discharged at the cathode.

(1 mark)

- (iii) Predict which ion from (b)(i) will be discharged at the anode.

(1 mark)

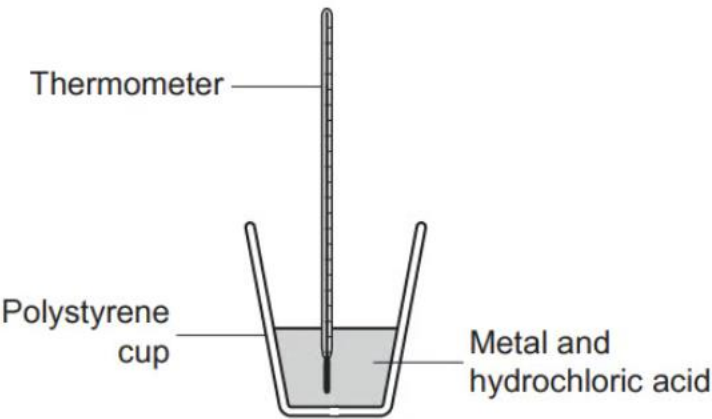
- (iv) Labelling each appropriately write the ionic half equations for the reactions at the anode and cathode.

(5 marks)

(e) If 2.5A of current was passed through the electrolytic cell containing the aqueous copper chloride solution for one hour fifteen minutes, determine the mass of product formed at the cathode.

(5marks)

(d) In an insulated calorimeter 20.0g of solid ammonium chloride at 23.4°C was dissolved in 125 grams of water also at 23.4°C, after which the final temperature of the mixed solution was 14.3°C.



(i) If the specific heat capacity of the mixed solution was 4.18 J/g°C, calculate the heat transferred for the reaction using $q = mc\Delta T$

(3marks)

(ii) 20.0g of ammonium chloride is equivalent to 0.347moles of ammonium chloride. using the information given and your answer in c (i) above, determine ΔH in kJ/mol NH_4Cl for the dissolving process: $\text{NH}_4\text{Cl (s)} \rightarrow \text{NH}_4\text{Cl (aq)}$

(2marks)

- iv. Complete the energy profile diagram below for the reaction between solid ammonium chloride and water. Fill in the information indicating enthalpy change, activation energy, reactant and product chemical formula. (3 marks)

