

REPUBLIQUE DU CAMEROUN
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REPUBLIQUE DU CAMEROUN
Peace-Work-Fatherland

MINISTRY OF SECONDARY EDUCATION

TEACHERS' RESOURCE UNIT
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The Teachers' Resource Unit and the Regional Inspectorate of Pedagogy in collaboration with NWCTA	SUBJECT CODE NUMBER 0715	PAPER NUMBER 2
GENERAL CERTIFICATE OF EDUCATION REGIONAL MOCK EXAMINATION	SUBJECT TITLE CHEMISTRY	
ADVANCED LEVEL		

Time Allowed: THREE hours
INSTRUCTIONS TO CANDIDATES

Mobile phones are NOT ALLOWED in the examination room.

Answer All SIX questions

- The mark allocated is indicated for each question. Each question carries 20 Marks.
- Calculators may be used.

Useful Data

One atmosphere (1 atm) = 1 pa = $1.01 \times 10^5 \text{ NM}^{-2}$

Relative atomic masses (RAM) C = 12.0, O = 16.0.

In calculations, you are advised to show all the steps in your working, giving your answer at each stage.

You are reminded of the necessity for good English and orderly presentation in your answers.

SECTION A: PHYSICAL AND GENERAL CHEMISTRY

(a) Define the term "Relative atomic mass" (1mark)

(b) A carbonate of a metal X has a formula X_2CO_3 . 0.245 g of X_2CO_3 was found to completely neutralize 23.6 cm³ of hydrochloric acid of concentration 0.15 M.

(i) Write a balanced equation for the reaction

(ii) Calculate the number of moles of hydrochloric acid

(iii) Calculate the number of moles of the carbonate used up in the reaction

(iv) Determine the Relative molecular mass of X_2CO_3

(v) Calculate the RAM of X. (5marks)

(c) ${}_{92}^{238}\text{Th}$ decays to a radioactive isotope of the element Thorium (Th) by emission of an alpha particle. (i). Write a balanced equation to represent this changes

(ii) How many neutrons are there in the nucleus of the Thorium atom?

(iii) The half-life of this Thorium is 24 days. Calculate how long (in days) will it take for the activity of a sample of this isotope to decrease to 3 % of its original value

..... (4marks)

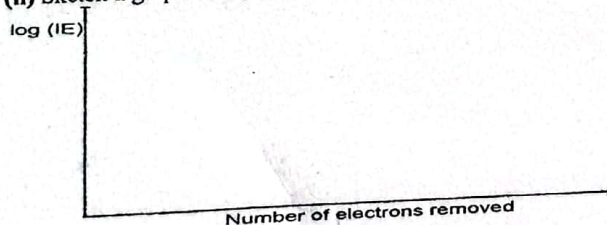
(d) From the Rutherford experiment, what observations lead to the following conclusions?

(i) That the nucleus is present in the atom

(ii) That most of the atom is voluminous and comprises mostly of negatively charged particles of negligible mass

(e) (i). Sketch a diagram of the line emission spectrum of atomic hydrogen (2marks)

(ii) Sketch a graph of log (IE) against number of electrons removed for chloride ion



(f) (i). What is a chemical bond?

(ii) Identify all the different types of bonds in $(NH_4)_3PO_4$ and show where they are found in the compound

(iii) Draw dot and cross diagram for the formation of ClO_4^-

(g) A mixture of ethanol (B.pt 78.5 °C) and water (B.pt 100 °C) show a positive deviation from Raoult's law and form an azeotropic mixture of boiling point 78.2 °C at a composition of 96 % ethanol.

(i) What do you understand by positive deviation from Raoult's law?

(ii) Draw a well labelled diagram of the boiling point against composition of the water-ethanol mixture. (3 marks)

(iii) Write the cell diagram when the two half cells are coupled (3marks)
 (Total = 20 marks)

SECTION B: INORGANIC CHEMISTRY

3. This question is on Group (VII) elements (F – I), s-block elements (Group I and II), and period 3 elements of the periodic table.

- (a). (i). State and explain the change in physical state of the Group VII elements (F₂ to I₂) as the group is descended.

 (ii) Arrange the Group VII elements in order of decreasing oxidizing strength. Explain the trend

 (iii) A and B are sodium chloride and sodium iodide respectively. What observations would be made when concentrated sulphuric acid is added to a little solid of

A:
 B:

(iv) Write down an equation for the disproportionation of bromine (Br₂) in hot concentrated sodium hydroxide

(v) For each of the oxidation states given below, give the formula and name of the oxoacid of chlorine

Oxidation state	Formula	Name
+5		
+7		

...(7marks)

- (b) Lithium shows diagonal relationship with magnesium. (i). What is meant by "diagonal relationship"?

 (ii) Suggest a reason why these elements are diagonally related

 (iii) Give one reaction in which Li and Mg show a diagonal relationship

 (iv) The group I and II elements are called s-block elements. State and explain how the first ionisation energy of the elements vary from Group I to Group II and down the group

A: from Group I to Group II

 B: Down the Groups

(6marks)

(c) This question concerns the elements Na to Ar of the periodic table.

- (i) Briefly explain the variation of the ionic size of the elements across the period Na to Ar

 (ii) Sketch a graph of melting point against atomic number for the elements Na – Ar

(iii) Write down the formulae of the typical oxides of these elements and state their acid-base character

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Oxide								
Acid-base character								

- (i) One of the oxide shows both acidic and basic character, Write balanced equation to show its acid/base nature
 Acidic character:
 Basic character: (7marks)

(Total = 20 marks)

(a). The d-block elements characteristically form complex ions and show variable oxidation states in their compounds.

- (i) What is a d-block element?

 (ii) Give one reason in each case to explain why d-block elements
 A: Form complexes:

 B: Show variable oxidation states:

1. (a) Define

(i) bond energy term.....

(ii) Write an equation to represent the lattice energy of calcium fluoride.....

(iii) Given the following data: $\Delta H_{latt}^{\circ} [NaCl(s)] = -783 \text{ kJ/mol}$
 $\Delta H_{hyd}^{\circ} [Na^{+}(g)] = -402 \text{ kJ/mol}$ $\Delta H_{hyd}^{\circ} [Cl^{-}(g)] = -377 \text{ kJ/mol}$

Calculate the heat of solution of sodium chloride and hence construct an energy cycle for the dissolution.

.....(5marks)

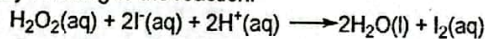
(b) Define

(i) Unit cell as applied to solid state chemistry

(ii) Name two closed packed structures giving an example of each

.....(3marks)

(c). By referring to the reaction:



(i) Define order of a reaction

(ii) State one method you would use to measure the rate of the reaction without quenching the reaction

(iii) In a series of experiments to determine the rate equation for the reaction, the following results were obtained

Run	Initial $[H_2O_2]/\text{mol dm}^{-3}$	Initial $[I^{-}]/\text{mol dm}^{-3}$	Initial $[H^{+}]/\text{mol dm}^{-3}$	Initial rate of formation of $I_2/\text{mol dm}^{-3} s^{-1}$
1	0.001	0.001	0.001	1.0×10^{-4}
2	0.001	0.002	0.001	2.0×10^{-4}
3	0.001	0.002	0.002	4.0×10^{-4}
4	0.002	0.002	0.002	8.0×10^{-4}

What is the order of the reaction with respect to

A: $H_2O_2(aq)$

B: $I^{-}(aq)$

C: $H^{+}(aq)$

(iv) Write the rate expression for the reaction

.....(6marks)

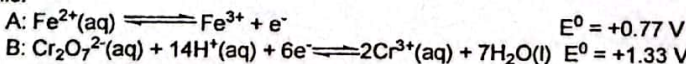
(d) (i). Calculate the pH of a solution containing 0.05 M benzoic acid, C_6H_5COOH and 0.05 M potassium benzoate, C_6H_5COOK . (K_a for benzoic acid = $6.4 \times 10^{-5} M$)

(i) How does the addition of a few drops of molar nitric acid affect the pH of this solution?

(iii) Methyl orange is an acid-base indicator with $K_a = 5.6 \times 10^{-5}$. What is the pH range of methyl orange?

.....(3marks)

(e). Given the following standard electrode potentials for the following half cells:



(i) Define "standard electrode potential"

.....(3marks)

(ii) Select the species which is the strongest reducing agent

(iii) Given the following complex compound $[\text{Cu}(\text{H}_2\text{O})_6]\text{Cl}_2$.

A: Identify the ligands in the complex compound.....

B: Give the structural formulae of two isomers of the compound and state the systematic names

.....(6marks)

(b) The hydrated copper ion is $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$

(i) Using the box below write out the electronic configuration of copper (i) ions ($\text{Cu} = 29$)

29Cu^+ : Ar

--	--	--	--	--	--

^{3d}

--	--	--	--

^{4s}

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(ii) Draw the shape of the ion $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$

.....(2marks)

(c) This question concerns the Group (IV) elements (carbon to lead). (i). Name one element in each case from the group which is:

A: a typical metal:

B: a metalloid:

C: a typical non-metal:

(ii) Catenation and "inert pair effect" are two phenomena that characterize the chemistry of Group (IV) elements. What do you understand by inert pair effect?

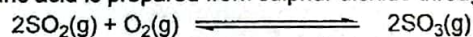
(iii) Explain why the catenated compounds of carbon are more stable than those of silicon.

(iv) From the compounds of Group (IV) elements (C - Pb), choose an appropriate example for each of the following

	Type of compound	Name or formula of example
A	A covalent chloride which is not hydrolysed by water	
B	A strong reducing oxide	

(7marks)

(e). Sulphuric acid is prepared from sulphur dioxide through the reaction;



(i) Why is a pressure of one atmosphere maintained taking into consideration that increasing the pressure will favour the production of more sulphur trioxide?

(ii) Which catalyst is used in the process?

(iii) What is observed when $\text{SO}_2(\text{g})$ is bubbled through a solution of Fe^{3+} ions?

.....(3marks)

(f) Give an example of a named nitrogen compound used in each of the following;

(i) Agriculture:

(ii) Nutrition:

(2marks)
(Total= 20 marks)

SECTION C: ORGANIC CHEMISTRY

5. (a). A sample of compound W of molecular weight 86, on analysis was found to contain 69.8% of carbon, 11.6% of H.

(i) Determine the empirical formula of compound W

(ii) Determine the molecular formula of compound W

(iii) Write out the structural formula and name of all the isomers of W

(iv) Suggest the structural formula of compound W, given that it reacts with $\text{I}_2(\text{aq})/\text{NaOH}(\text{aq})$ on warming to form a yellow precipitate.....

(v) State the technique that could be used to identify the functional group in compound W

.....(3marks)

(b) Nitrobenzene is obtained by reacting benzene with a nitrating mixture.

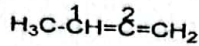
(i) Give the composition of the nitrating mixture

(v) What is/are the condition(s) of the reaction

(iii) State and illustrate the mechanism of the nitration of benzene

(c) (i). What is hybridization?

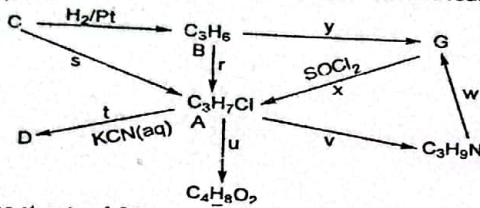
(ii). Identify the hybridizations exhibited by the carbon atoms labelled 1 and 2 in the compound below;



Carbon 1:

Carbon 2:

(d) The reaction scheme below is for the preparation and reactions of chloropropane.



(i) Give the structural formulae and names of the compounds C, D and G

(ii) Give the reagent(s) and reaction conditions for the stages labelled v and w

	Reagent(s)	Reaction conditions
v		
w		

(i) What type of organic reaction occurs in the conversion of A to D?

5. The amino group, $-\text{NH}_2$, is present in amides, amino acids and amines.

(Total = 20 marks)

(a). Give the name and structural formula of a member from each of the classes of compounds.

Class	Name	Formula
Amide		
Amine		
Amino acid		

(b) Using equations, show how you would prepare starting from suitable materials the named

.....(6marks)

(i) Amide

(ii) Amine

(iii) Amino acid

(c) Suggest a chemical test which could be used to distinguish between amides and amines

.....(6marks)

(d) Amino acids are amphoteric unlike amines and amides.

.....(3marks)

(i) Explain this difference in behaviour

(ii) Write equations to illustrate the amphoteric nature of the amino acid.

(e) Amino acids generally form dipeptide through condensation reaction.

.....(3marks)

(i) What is a dipeptide?

(ii) Write an equation for the formation of a dipeptide from $\text{CH}_3\text{CH}(\text{NH}_2)\text{COOH}$

.....(2marks)

..(Total = 20 marks)

END