

REPUBLIQUE DU CAMEROUN

Paix-Travail-Patrie

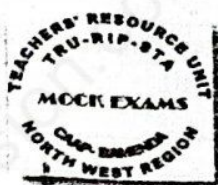
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CELLULE D'APPUI A L'ACTION PEDAGOGIQUE
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MINISTRY OF SECONDARY EDUCATION

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MARCH 2022

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.

You will be marked on your ability to use good English, to organize information clearly and to use specialist vocabulary where appropriate.

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.

Question I

a. (i) State Hess's law.

(ii) State the standard conditions for enthalpy measurement.

(iii) The heat of atomization of ethane and propane are +2824 KJ/mole and +3996KJ/mole respectively. Calculate the bond energies of C-C and C-H bonds

(6mks)

b. Oxidation and reduction take place simultaneously in many chemical processes.

i) Define Reduction in terms of electron transfer

(1mk)

c. Given the following half-cell reactions and their standard electrode potentials.

Half Cell	E^θ /Volts
A) $\text{Cu}^{2+} + 2\text{e}^- \leftrightarrow \text{Cu}_{(\text{s})}$	+ 0.34
B) $\text{Zn}^{2+}_{(\text{aq})} + 2\text{e}^- \leftrightarrow \text{Zn}_{(\text{s})}$	- 0.76
C) $\text{MnO}_4^-_{(\text{aq})} + 8\text{H}^+ + 5\text{e}^- \leftrightarrow \text{Mn}^{2+}_{(\text{aq})} + 4\text{H}_2\text{O}_{(\text{l})}$	+ 1.52
D) $\text{Cl}_2_{(\text{aq})} + 2\text{e}^- \leftrightarrow 2\text{Cl}^-_{(\text{aq})}$	+ 1.36
E) $\text{Fe}^{3+}_{(\text{aq})} + \text{e}^- \leftrightarrow \text{Fe}^{2+}_{(\text{aq})}$	+ 0.77

i) Write the cell diagram and calculate the cell emf of the cell formed between C and D

ii) Which species above is the strongest oxidizing agent? Give a reason for your answer.

iii) Write a balanced ionic equation for the reaction taking place when electrodes C and E are connected.

iv) What indicator is used for a titration involving the reaction in ciii) above

v) state the colour change at the end point if the species in cell C is in the burette.

vi) Why is hydrochloric acid not used for the titration?

(8mks)

d. i) Define Relative Atomic mass.

ii) Name the steps in order of execution in the determination of relative atomic mass using a mass spectrometer.

iii) Use the data from the mass spectrum below to calculate the relative atomic mass of lead.

Isotope	Detector current
204	0.16
206	2.72
207	2.50
208	5.92

(5mks)

(Total 20marks)

QUESTION 2

Explain the following:

a)(i) Saturated vapour pressure of a liquid

ii) An azeotropic mixture

(2mks)

b) A mixture of hexane (C_6H_{14}) and heptane (C_7H_{16}) obey Raoul's law. Given that their saturated vapour pressures at $100^\circ C$ are respectively 790mmHg and 350mmHg. (Molar mass of hexane=86; heptane =100).

Calculate

i) The partial vapour pressure of each component in a mixture containing 50.0g of hexane and 70.0g of heptane

ii) The total pressure over the mixture.

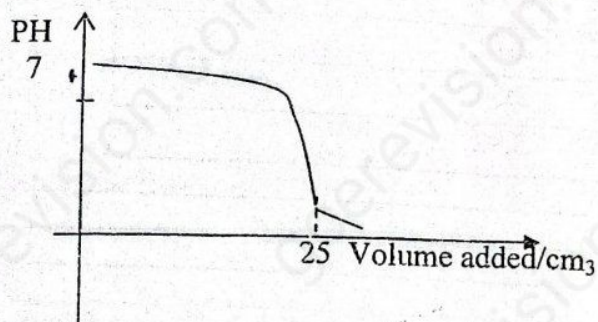
iii) Draw well labeled boiling point/composition curves for the mixture above.

(5mks)

c) A) Calculate the p^H of a solution containing 2.88g of sodium benzoate (MM 144grams) in $1dm^3$ of 0.02M benzoic acid. ($K_a = 1.6 \times 10^{-5} M$)

(3mks)

B) The sketch below shows the variation of p^H during an acid-base titration.



i) What solution is in the burette?

ii) What base could be used if the acid were hydrochloric acid of concentration 1.00 mol dm^{-3}

iii) Explain why the P^H at the equivalence point is less than 7

iv) Which of the indicators A(P^H range 6-10) or B(P^H range 3.3 – 6.8) would be suitable for the titration? Explain.

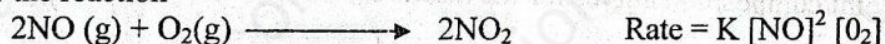
(5mks)

d) i) Explain the terms:

A) Rate equation

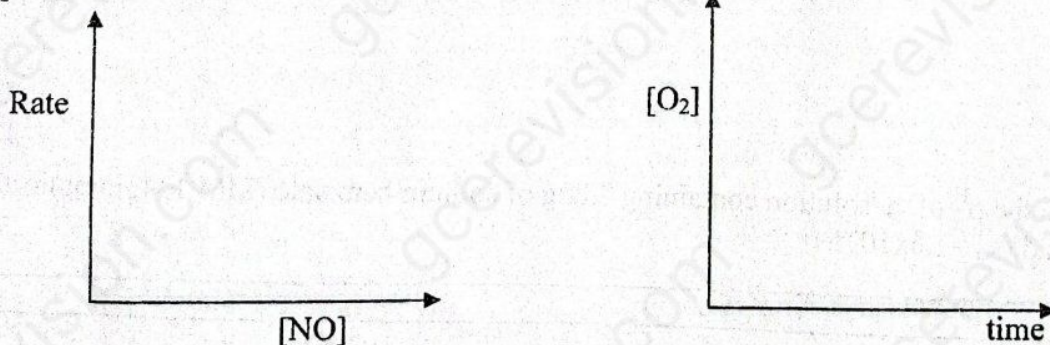
B) Half life

ii) For the reaction



A) What is the order of the reaction?

B) Sketch a graph in the grid below that shows the variation of rate of reaction with $[\text{NO}]$ and Change in $[\text{O}_2]$ with time.



(5mks)

(Total 20marks)

SECTION B: INORGANIC CHEMISTRY

Question 3

- a) The elements in period 2 (Li, Be, B, C, N, O, F, Ne) of the periodic table show periodic trends in their properties
- i) What do you understand by periodic trend?

ii) The ions of Li^+ and Be^{2+} have identical electronic configuration, yet the ionic radius of Li^+ is larger than that of Be^{2+} . Explain

iii) How does the first ionization energy vary across the period Li to Ne?

Explain:

iv) Give the formulae of the oxides of the element Li to Ne stating their acid base properties.

Formula of oxide(s)								
Acid/base property								

(7mks)

b) (i) State any two characteristics of s-block elements.

ii) Why is the melting point of group (II) elements higher than that of group (I)?

iii) Li and Mg show a diagonal relationship. Using equations give two examples to illustrate this behavior.

iv) Give the name of the crystal structure adopted by group (I) metal compounds.

(6mks)

c) The group IV elements are C, Si, Ge, Sn, and Pb.

i) Give the trend in structure of the elements Carbon to Lead.

ii) Give the general outer electronic configuration of these elements.

iii) State and explain the trend in the stability of the oxidation states of the elements down the group.

Trend:

Explanation:

iv) Give the molecular formulae of the stable chlorides of these elements.

(7mks)

(Total 20 marks)

QUESTION 4

a) i) Nickel and Zinc are in the same period of the periodic table. Give one similarity and one difference between the two elements.

ii) List two typical properties of transition metals.

(iii) During the reactions of a transition metal ion, there could be a colour change. Give two reasons why there may be a change in colour.

(iv) For each of the observations described below state which change or changes you have given above is responsible for the change in colour.

A: A pale blue aqueous solution of Copper (II) Sulphate turns yellow on addition of excess concentrated hydrochloric acid.

B: A pale green solution of ammonium iron (II) gradually turns brown on exposure to air.

(v) What are chelating ligands?

(vi) Give formula or name of a chromium complex ion containing a chelating ligand.

(10mks)

b) (i) Give the name and physical state of the halogens.

Halogen	Physical state

(ii) In the space below sketch the trend of acid strength of the hydrogen halides (HX) and give explanation.

Acid
Strength

Explanation:

(iii) Using Chlorine as an example write balanced equations for its disproportionation under the following conditions.

Cold alkali:

Hot alkali: _____

(vi) Why can hydrogen iodide not be prepared in the laboratory by reacting solid sodium iodide with concentrated sulphuric acid?

c) Using balanced equations show how nitric acid is manufactured from ammonia

(10mks)

(Total 20 marks)

SECTION C: ORGANIC CHEMISTRY

QUESTION 5

a) State the information about the structure of an organic compound that can be revealed by the following spectroscopic techniques.

Spectroscopic method	Information obtained
Mass spectroscopy	
Infra-Red spectroscopy	
NMR Spectroscopy	

(3mks)

b) An organic compound A on analysis was found to contain 48.65% Carbon and 8.11% hydrogen. A has a relative molecular mass of 74. (RAM of C = 12, H = 1, O = 16)

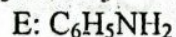
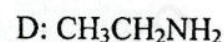
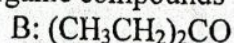
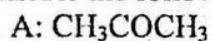
(i) Calculate the empirical formulae.

(ii) Deduce the molecular formulae of compound A.

(iii) Draw two possible structures of compound A.

(7mks)

c) Consider the following organic compounds



Select from the compounds above a compound that

(i) Gives a yellow precipitate with I_2/NaOH but no silver mirror with Tollens reagent.

(ii) Reacts with NaNO_2/HCl below 5°C to produce an alcohol.

(iii) Reacts with phenyldiazonium chloride to form an Azo-dye.

(iv) Gives an organic precipitate when reacted with 2, 4 – dinitrophenylhydrazine and no yellow precipitate with I_2/NaOH . (4mks)

d) An organic compound was discovered and purified.

(i) How can a chemist be sure that the compound is pure?

(ii) How will you show that the compound contains chlorine?

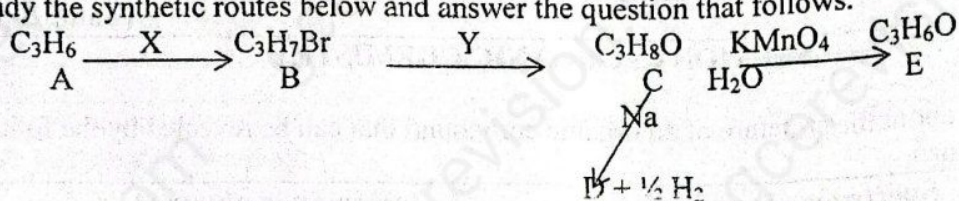
(4mks)

- e) Propose a mechanism for the reaction
 $\text{C}_6\text{H}_6 + \text{CH}_3\text{COCl} \rightarrow \text{C}_6\text{H}_5\text{COCH}_3 + \text{HCl}$

(2mks)
 (Total 20 marks)

QUESTION 6

- a) Study the synthetic routes below and answer the question that follows.



- (i) Identify compounds A, B, C, and E.

A: _____

B: _____

C: _____

E: _____

- (ii) Identify the reagent X and Y

X: _____

Y: _____

- (iii) What physical change is observed? When;

A: C is converted to D

B: C is converted to E

(8mks)

- b) i) The amino group NH_2 , is present in amides, amines and amino acids. Give the name and structural formula of a member of each of the classes of compounds

CLASS	NAME	FORMULA
Amide		
Amine		
Amino acid		

- ii) Stating reagents and reaction condition show how you would bring about the following conversions
 A: Ethanamide to methylamine

B: Ethanoic acid to aminoethanoic acid

- iii) Why are amino acids basic

- c) Describe briefly how you would distinguish between $\text{CH}_3\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

(9marks)

(3marks)
 (Total 20marks)