

**THE UNITED REPUBLIC OF TANZANIA  
NATIONAL EXAMINATIONS COUNCIL  
ADVANCED CERTIFICATE OF SECONDARY EDUCATION  
EXAMINATION**

**132/2**

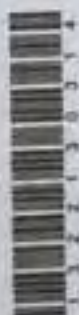
**CHEMISTRY 2**  
(For Both School and Private Candidates)

**Time: 3 Hours**

**Tuesday, 13<sup>th</sup> May, 2014 a.m.**

**Instructions**

1. This paper consists of **ten (10)** questions in sections A, B and C.
2. Answer **five (5)** questions choosing at least **one (1)** question from each section.
3. Each question carries **twenty (20)** marks.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. For calculations you may use the following constants:  
Gas constant,  $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$  or  $0.082 \text{ atm mol}^{-1} \text{ K}^{-1} \text{ dm}^3$   
 $\text{GMV} = 22.4 \text{ dm}^3$   
 $1 \text{ litre} = 1 \text{ dm}^3 = 1000 \text{ cm}^3$   
Atomic masses:  $\text{H} = 1, \text{N} = 14, \text{O} = 16, \text{S} = 32$



## SECTION A

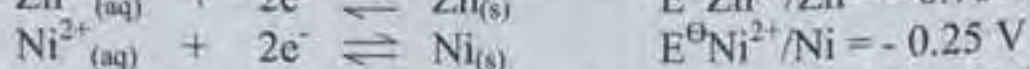
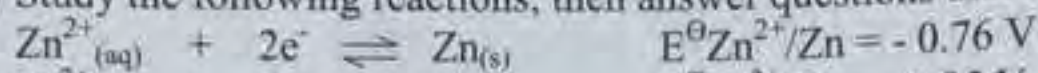
Answer at least **one (1)** question from this section.

1. (a) Give a brief explanation for each of the following terms:

- (i) Electrochemical series.
- (ii) Electrochemical equivalent.
- (iii) Redox series.
- (iv) Redox reaction.

(8 marks)

(b) Study the following reactions, then answer questions that follow:



(i) Which is the feasible reaction; the reduction of  $\text{Ni}^{2+}$  by zinc or the reduction of  $\text{Zn}^{2+}$  by nickel? Give reasons.

(ii) Write a balanced redox equation for the feasible reaction.

(iii) Determine the cell diagram.

(iv) Calculate the e.m.f. of the cell.

(8 marks)

(c) Sodium chlorate (I) is converted by heat to sodium chlorate (V) and sodium chloride according to

the equation  $3\text{NaOCl} \xrightarrow{\Delta} \text{NaClO}_3 + 2\text{NaCl}$ . By using oxidation numbers show which particles in the equation have undergone

- (i) oxidation
- (ii) reduction.

(4 marks)

2. (a) (i) Describe the term homogenous catalyst and give a typical reaction as an example to support your description.

(ii) Dinitrogen pentaoxide decomposes to nitrogen dioxide and oxygen as shown in the reaction  $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$ . Write the equation to show how the rate of change of concentration of  $\text{N}_2\text{O}_5$  is related to the rates of change of concentration of  $\text{NO}_2$  and  $\text{O}_2$ .

(iii) The rates of change in the concentration of reactants and products in a certain reaction are related as follows:

$$\frac{-d[\text{CH}_4]}{dt} = -\frac{1}{2} \frac{d[\text{O}_2]}{dt} = \frac{1}{2} \frac{d[\text{H}_2\text{O}]}{dt} = \frac{d[\text{CO}_2]}{dt}$$

Write a balanced equation for the reaction and show clearly how you obtained it.

(10 marks)

(b) At  $25^\circ \text{C}$  the rate constant of a certain reaction is  $4.7 \times 10^{-3} \text{ s}^{-1}$  and the activation energy is  $33.6 \text{ kJmol}^{-1}$ . Determine the following:

- (i) Order of the reaction.
- (ii) Rate constant of the reaction at  $75^\circ \text{C}$ .

(5 marks)

(c) The following table contains data which were collected at  $298 \text{ K}$  for the reaction  $4\text{H}_2(\text{g}) + 2\text{NO}_2(\text{g}) \rightarrow 4\text{H}_2\text{O}(\text{l}) + \text{N}_2(\text{g})$ .

| [H <sub>2</sub> ] | [NO <sub>2</sub> ] | Rate (mols <sup>-1</sup> ) |
|-------------------|--------------------|----------------------------|
| 0.6               | 0.37               |                            |
| 0.6               | 0.74               | 0.18                       |
| 1.2               | 0.74               | 0.72                       |
|                   |                    | 0.72                       |

- (i) Write down the rate expression for the reaction. (5 marks)  
 (ii) Calculate the order of reaction with respect to each reactant.
3. (a) Given that the dissociation constant  $K_a$  for propanoic acid is  $1.35 \times 10^{-5} \text{ mol/dm}^3$ , calculate the pH of the following solutions:  
 (i) Propanoic acid solution of molarity of  $0.05 \text{ mol/dm}^3$ .  
 (ii) A solution containing  $0.05 \text{ mol/dm}^3$  propanoic acid and  $0.05 \text{ mol/dm}^3$  sodium propanoate. (6 marks)
- (b) For each of the following reactions write the formula of the acid and its conjugate base:  
 (i)  $\text{NH}_3 + \text{HCl} \rightleftharpoons \text{NH}_4^+ + \text{Cl}^-$   
 (ii)  $\text{H}_2\text{SO}_4 + \text{HNO}_3 \rightleftharpoons \text{HSO}_4^- + \text{H}_2\text{NO}_3^+$   
 (iii)  $\text{NaNH}_2 + \text{NH}_4\text{Cl} \rightleftharpoons \text{NaCl} + 2\text{NH}_3$  (6 marks)
- (c) Calculate the amount of ammonium sulphate in grams which has to be added to  $500 \text{ cm}^3$  of  $0.2 \text{ M}$   $\text{NH}_3$  to yield a solution of  $\text{pH} = 9.35$ , given that  $K_b$  for  $\text{NH}_3 = 1.78 \times 10^{-5} \text{ mol/dm}^3$ . (5 marks)
- (d) Predict whether the following salt solutions will be acidic, basic or nearly neutral. Explain briefly your prediction.  
 (i)  $\text{NH}_4\text{Br}$  (ii)  $\text{CaCl}_2$  (iii)  $\text{KCN}$  (3 marks)
4. (a) Briefly explain:  
 (i) Five factors that affect ionization energy of elements.  
 (ii) Four causes of anomalous behaviour of the first element in a group of the periodic table. (9 marks)  
 (iii) The cause of the diagonal relationship.
- (b) Give four reactions which show how beryllium of group IIA is related to aluminium in group IIIA. (8 marks)
- (c) Discuss briefly the trends of oxides of elements of period three (3) in the periodic table. (3 marks)

## SECTION B

Answer at least **one (1)** question from this section.

5. (a) Differentiate the following terms:  
 (i) Electrolytic cell and electrochemical cell.  
 (ii) Molarity and molality.  
 (iii) Anode and cathode.  
 (iv) Positive pole and negative pole. (8 marks)
- (b)  $200 \text{ cm}^3$  of  $0.0040 \text{ M}$   $\text{BaCl}_2$  are added to  $600 \text{ cm}^3$  of  $0.0080 \text{ M}$   $\text{K}_2\text{SO}_4$ . Find out whether there will be formation of a precipitate given that  $K_{sp}(\text{BaSO}_4) = 1.1 \times 10^{-10}$ . (6 marks)
- (c) Calculate the number of moles of silver chloride ( $\text{AgCl}$ ) which will saturate  $250 \text{ cm}^3$  of  $0.0001 \text{ M}$  sodium chloride solution, given that  $K_{sp}(\text{AgCl}) = 1.6 \times 10^{-10} \text{ mol}^2 \text{ m}^{-6}$ . (6 marks)

6. (a) Explain briefly why transition elements:

- (i) have variable oxidation states
- (ii) form coloured compounds
- (iii) exhibit magnetic properties.

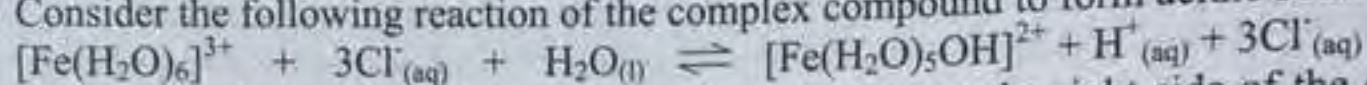
(6 marks)

(b) Give IUPAC name for each of the following compounds and state the oxidation state of the central metal atom:

- (i)  $K_3[Co(NO_2)Cl_3Br_2]$
- (ii)  $[Ag(NH_3)_2]^+$
- (iii)  $[AuCl_4]^-$
- (iv)  $[Pd(CN)_6]^{2-}$

(8 marks)

(c) Consider the following reaction of the complex compound to form acidic solution:



- (i) Name the two ligands in the complex structure on the right side of the equation above and explain how they act as ligands.
- (ii) Draw a diagram showing shape of the complex ion on the right side of the equation and name its shape.
- (iii) Explain why it is more difficult to remove a proton from  $[Fe(H_2O)_5OH]^{2+}$  than from  $[Fe(H_2O)_6]^{3+}$ .

(6 marks)

7. (a) (i) What does the term froth flotation mean as used in metal extraction?

- (ii) Write down processes which occur after froth flotation of copper pyrites ( $CuFeS_2$ ) ore from which bluster copper (impure) is obtained. Support with equation(s) where necessary.

(9 marks)

(b) Analyse the stages involved in the purification of bauxite ore and explain why it is necessary to purify before electrolysis.

(11 marks)

### SECTION C

Answer at least **one (1)** question from this section.

8. (a) Briefly explain six advantages and four disadvantages of using manures.

(10 marks)

(b) (i) Differentiate immobilization from ammonification.

- (ii) Describe how farm manure should be handled and stored.

(6 marks)

(c) A certain soil requires 80 kg N per hectre so as to fulfill plant requirements of nitrogen. Calculate in kilogram the quantity of ammonium sulphate fertilizer required to meet this demand.

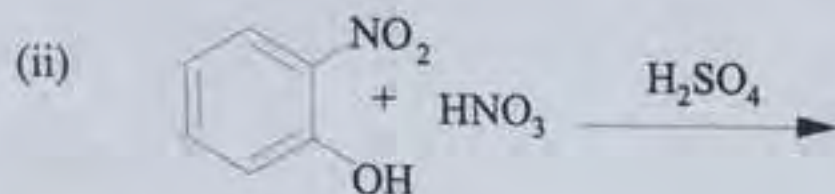
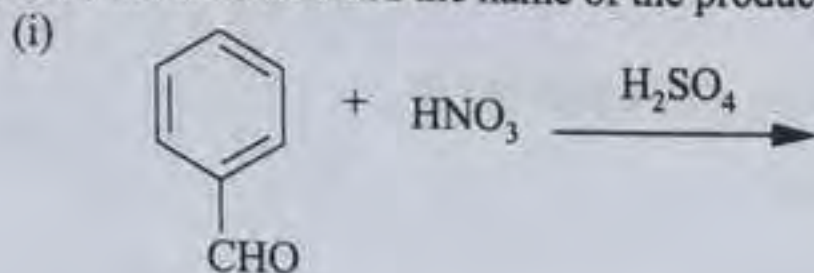
(4 marks)

9. (a) Give the structural formulae of the following compounds:

- (i) Methylphenyl ether
- (ii) Methanol
- (iii) Propanone
- (iv) Methyl ethanoate
- (v) 3-phenyl-1-pentene.

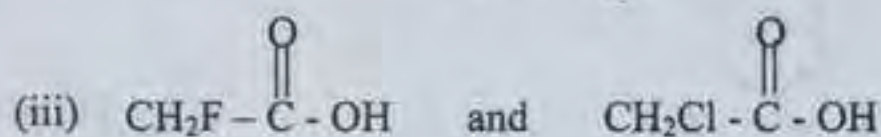
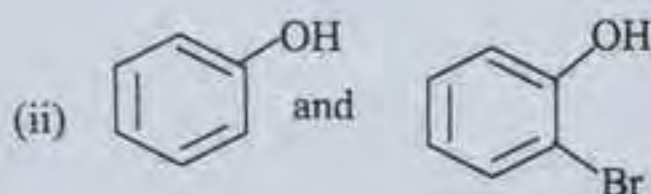
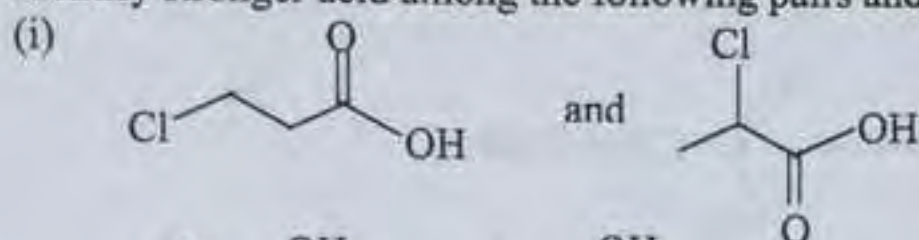
(5 marks)

(b) Give the structure and the name of the product(s) formed in the following reactions:

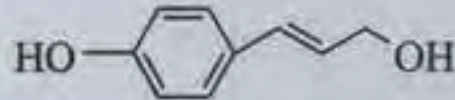


(5 marks)

(c) Identify stronger acid among the following pairs and give reason(s) for your choice.



(6 marks)

(d) Write balanced chemical equation for the reaction of  with each of the following:

- Sodium metal
- Dilute  $\text{KMnO}_4$
- Acetic acid
- Hydrogen under finely divided nickel.

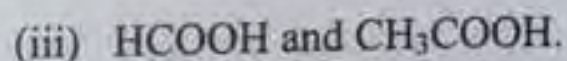
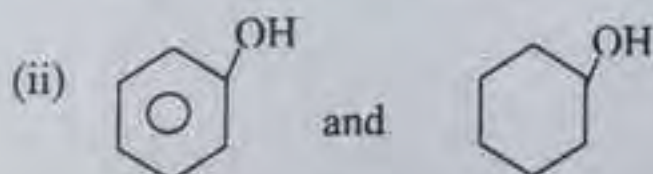
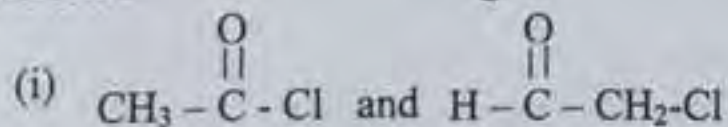
(4 marks)

10. (a) (i) Describe aldol condensation.

(ii) Explain why  $(\text{CH}_3)_2\text{CO}$  and  $\text{CH}_3\text{CHO}$  can undergo aldol condensation, whereas  $(\text{CH}_3)_3\text{C}-\text{CHO}$  and  $(\text{CH}_3)_3\text{C}-\text{CHO}$  cannot.

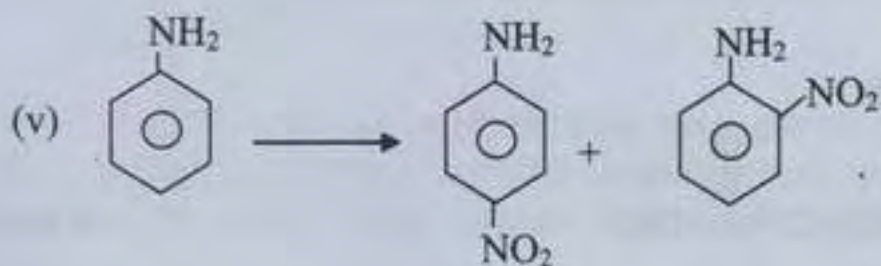
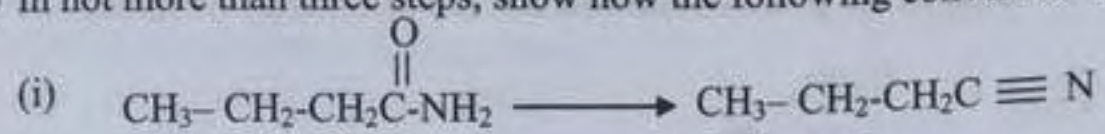
(4 marks)

(b) Describe how the following molecules can be distinguished from each other:



(6 marks)

(c) In not more than three steps, show how the following conversions can be achieved:



(10 marks)