

NAME:..... INDEX NO.

Signature.....

P525/1
Chemistry
Paper 1
July/Aug/2024
2 $\frac{3}{4}$ hours

KANUNGU DISTRICT JOINT MOCK EXAMINATIONS BOARD 2024

UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY (THEORY)

PAPER ONE

2 HOURS 45 MINUTES

INSTRUCTIONS TO CANDIDATES:

- Answer all questions in section A and any 6 in section B.
- All questions must be answered in spaces provided.
- Illustrate your answers with equations where applicable.

Molar gas constant, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

Molar volume of a gas at s.t.p is 22400 cm^3

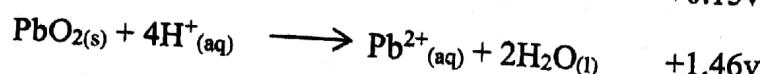
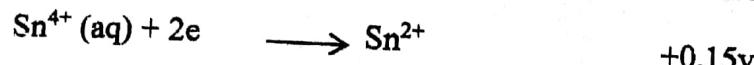
Standard temperature = 273 K

Standard pressure = 101325 N m^{-2}

For Examiners' use only

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| | | | | | | | | | | | | | | | | |

1. The standard reduction potentials for some half cell reactions are shown below



Write the overall equation for the cell reaction that would occur when the half cells are combined. (1 ½ mks)

(b)(i) Calculate the e.m.f of the cell. (1 ½ mks)

(ii) State whether the reaction is feasible or not and give a reason for your answer.(1mk)

2. A compound B has an empirical formula of C_3H_6O , oxygen diffuses 1.345 times faster than B;

(i) Determine the molecular mass of B. (3mks)

(ii) Write the structural formulae of all possible isomers of B. (2mks)

3. The table below shows the information from a mass spectrum sample of lead.

| Isotope | Detector current /mA |
|---------|----------------------|
| 204 | 0.16 |
| 206 | 2.72 |
| 207 | 2.50 |
| 208 | 5.92 |

Calculate:

(i) The relative abundance of different isotopes of lead in the sample used (4mks)

(ii) Relative atomic mass of lead (2mks)

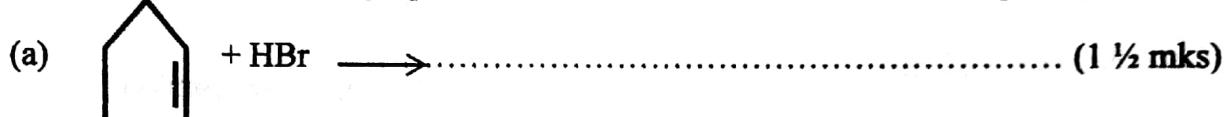
4. (a) State the trend in the acidity of the hydrides of elements in group (vII) of the periodic table. (1mk)

.....
.....
.....
.....

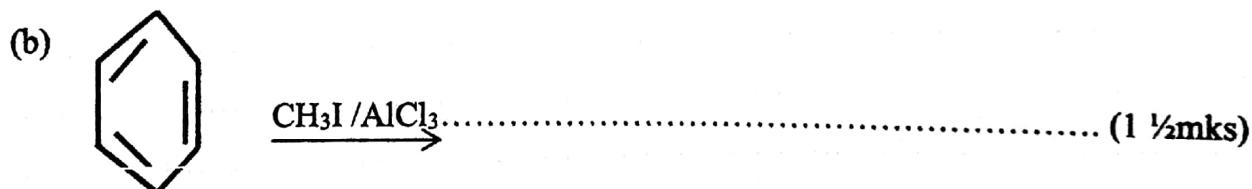
(b) Explain your answer (4mks)

.....
.....
.....
.....
.....
.....
.....
.....

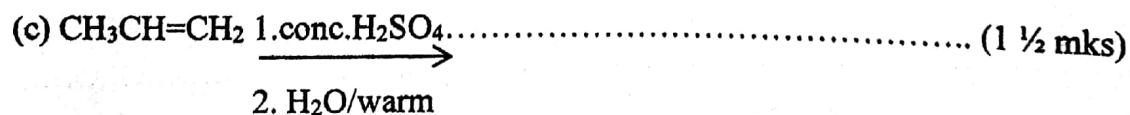
5. Complete the following equations and in each case name the main organic product.



Name of product



Name of product



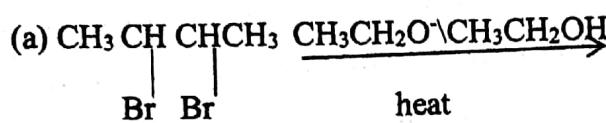
Name of product

6. State what would be observed and write equation for the reaction that would take place if dilute sodium hydroxide was added drop wise until in excess to the solutions containing the following cations.

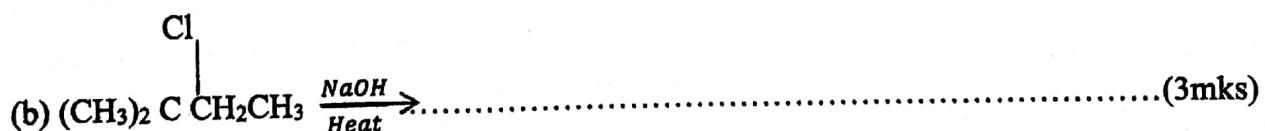
(i) Iron (II) ions

(ii) Chromium (111) ions

7. Complete the following equations and in each case outline the mechanism for the reaction.



(3mks)



8. The first four ionization energies of some elements are below.

| Element | Ionization Energies | | | |
|---------|---------------------|-----------------|-----------------|-----------------|
| | 1 st | 2 nd | 3 rd | 4 th |
| A | 500 | 4600 | 6900 | 9500 |
| B | 740 | 1500 | 7700 | 10500 |
| C | 630 | 1600 | 3000 | 4800 |
| D | 900 | 1800 | 14800 | 21000 |
| E | 580 | 1800 | 2700 | 11600 |

(a) What is meant by the term ionization energy? (1mk)

(b) (i) State the element that is most likely to form an ion with a unit positive charge.

Give a reason for your answer. (1 ½ mk)

(ii) Identify two elements that are in the same group of the periodic table. (1mk)

9. The kinetic data for the reaction between X and Y are shown in the table below.

| Experiment | [X]/mol dm ⁻³ | [Y]/mol dm ⁻³ | Rate /mol dm ⁻³ s ⁻¹ |
|------------|--------------------------|--------------------------|--|
| 1 | 0.30 | 0.15 | 1.5×10^{-2} |
| 2 | 0.30 | 0.30 | 3.0×10^{-2} |
| 3 | 0.60 | 0.30 | 6.0×10^{-2} |
| 4 | 0.60 | 0.60 | 12.0×10^{-2} |

(a) Determine the order of reaction with respect to

(i) X (1mk)

.....
.....
.....
.....
.....
.....

(ii) Y (1mk)

.....
.....
.....
.....
.....
.....

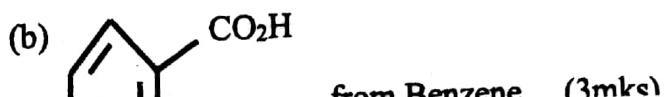
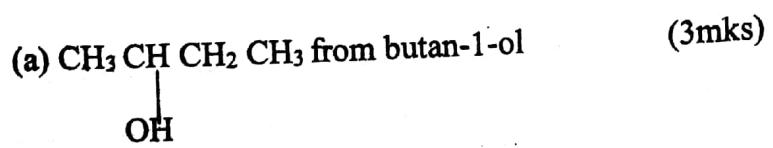
(b) Determine the overall order of the reaction (1mk)

.....
.....
.....
.....
.....

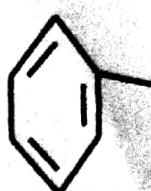
(c) Calculate the rate constant for the reaction and indicate the units. (2mks)

SECTION B

Write the equations to show how the following compounds can be synthesized and in each case indicate the conditions for the reaction.



(c)



OH from benzene and sulphuric acid (3mks)

.....
.....
.....
.....
.....
.....
.....
.....
.....

11.(a) 25.0cm³ of a 0.30m sodium hydroxide was added to 225cm³ of water. Calculate the PH of the resulting solution. (2mks)

.....
.....
.....
.....
.....
.....
.....
.....
.....

(b) Calculate the mass of sodium ethanoate that should be added to 1dm³ of a 1.0m ethanoic acid at 25°C to give a solution whose PH is 5.5. State any assumptions made. (The acid dissociation constant for ethanoic acid, $K_a = 1.8 \times 10^{-5}$ at 25°C) (5mks)

.....
.....
.....
.....
.....
.....
.....
.....
.....

(c) Few drops of dilute hydrochloric acid were added to the solution.

(i) State what happened to the PH of the solution (1mk)

(ii) Give a reason for your answer in (c) (i) (1mk)

12. Compound R contains cobalt 24.8%, chlorine 29.8% and water 45.4%.

(a) (i) Calculate the empirical formula of R (2mks)

(ii) Determine the molecular formula of R. (RFM of R = 237.9) (1mk)

(b) To the solution of R in water was added concentrated hydrochloric acid drop wise until in excess.

(i) State what was observed (1mk)

.....
.....

(ii) Write the equation for the reaction that took place (1 ½ mks)

.....
.....
.....

(c) The resultant solution in (b) was diluted.

(i) State what was observed (1mk)

.....
.....

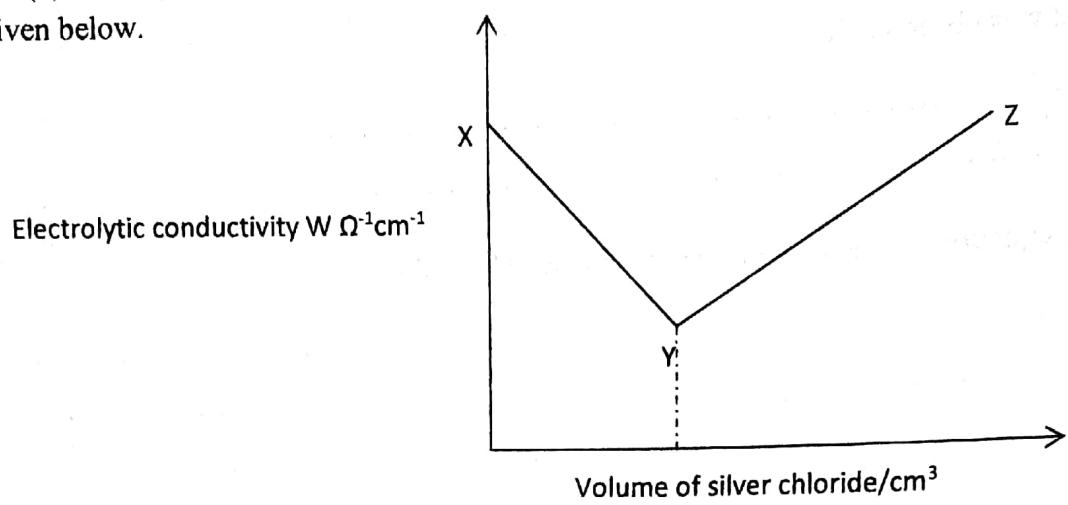
(ii) Write the equation for the reaction that took place. (1 ½ mks)

.....
.....
.....

(d) State what would be observed when ammonia solution is added drop wise until in excess to the solution of R in water? (1mk)

.....
.....
.....
.....
.....
.....
.....

13. (a) The conductimetric curve for the titration of hydrochloric acid and silver hydroxide is given below.



Explain the shape of the curve XYZ. (4mks)

(b) The molar conductivities of silver nitrate, potassium nitrate and potassium chloride are 134.0, 143.2 and $140.8\Omega^{-1}\text{cm}^2\text{mol}^{-1}$ respectively at infinite dilution at 25°C . Calculate the;

(i) Molar conductivity of silver chloride at infinite dilution at 25°C (1 ½ mks)

(ii) Solubility product K_{sp} of silver chloride at 25°C . (the electrolytic conductivity of water and that of saturated solution of silver chloride are 5.5×10^{-8} and

$1.934 \times 10^{-6} \Omega^{-1} \text{ cm}^{-1}$ respectively) (3 ½ mks)

-
.....
.....
.....
.....
.....
.....
.....
14. During the manufacture of sulphuric acid by the contact process, sulphur dioxide is catalytically oxidized to sulphur trioxide according to the following equation.



The sulphur trioxide formed is then observed in 98% sulphuric acid.

- (a) Name two major sources of sulphur dioxide used in the contact process. (1mk)

.....
.....
.....
.....
.....

- (b) State the industrial conditions used to obtain maximum yield of sulphur trioxide (1 ½ mks)

.....
.....
.....
.....
.....
.....
.....
.....

- (c) State the conditions under which sulphuric acid reacts with carbon and copper (1mk)

.....
.....
.....
.....

- (d) Write the equation for the reaction between sulphuric acid and

- (i) Carbon (1 ½ mks)

(ii) Copper (1 ½ mks)

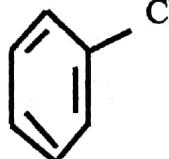
(e) Sulphuric acid is used in the manufacture of calcium dihydrogen phosphate from calcium phosphate.

(i) Write the equation for the reaction leading to the formation of calcium dihydrogen phosphate (1 ½ mks)

(ii) State one use of calcium dihydrogen phosphate (1mk)

15. Name one reagent that can be used to distinguish between each of the following pairs of compounds. In each case state what is observed if each member of the pair is treated with the reagent.

(a)



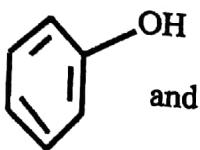
and $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$

(3mks)

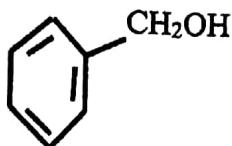
(i) Reagent

(ii) Observation

(b)



and



(3mks)

(i) Reagent

(ii) Observation

(c) $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$ (3mks)

(i) Reagent

(ii) Observation

16. Beryllium is in group (II) of the periodic table but shows some similarities with aluminium which is in group (III) of the periodic table.

(a) Give a reason why aluminium shows some similarities in the periodic table with beryllium (1mk)

(b) Write the equation for the reaction between water and

(i) Beryllium carbide (1 ½ mks)

.....
.....
.....
.....

(ii) Beryllium (1 ½ mks)

.....
.....
.....
.....

(c) Tallium and aluminium are both in group (111) of the periodic table. State one difference between aluminium oxide and thallium oxide (1mk)

.....
.....
.....
.....

(d) Write the equation for the reaction between sodium hydroxide and

(i) aluminium (2mks)

.....
.....
.....
.....

(ii) Beryllium (2mks)

.....
.....
.....
.....

7. Give reasons for each of the following procedures used in analytical chemistry. Illustrate your answers with equations.

a) Sodium hydroxide solutions should be prepared using freshly prepared distilled water (3mks)

(b) Titrations involving thiosulphate solutions should be carried out in acidic medium (3mks)

(c) Phenolphthalein indicator is more suitable than methyl orange indicator for the titration of ethanoic acid with sodium hydroxide (3mks)

END