



JINJA MODERN SENIOR SECONDARY SCHOOL

Uganda Advanced Certificate of Education

S5 MIDTERM TWO 2024

CHEMISTRY

Paper 1

P525/1

2 hours 45 minutes

Name.....

Combination.....

INSTRUCTIONS :

Answer **all** questions in section **A** and **six** questions in section **B**

All questions must be answered in the spaces provided

The Periodic Table, with relative atomic masses, is supplied.

Mathematical tables (3 – figure tables) are adequate or non-programmable scientific electronic calculators may be used

Illustrate your answers with equations where applicable.

Where necessary, use the following:

Molar gas constant $R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$

Molar volume of a gas at s.t.p is 22.4 litres.

Standard temperature = 273 K

Standard pressure = 101325 N m^{-2}

| For Examiner's Use Only | | | | | | | | | | | | | | | | | |
|-------------------------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|-------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | Total |
| | | | | | | | | | | | | | | | | | |

SECTION A (46 MARKS)

1. (a) Name **three** types of radiation emitted by a radioactive substance.

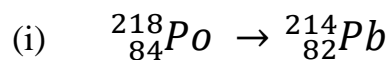
(1½ marks)

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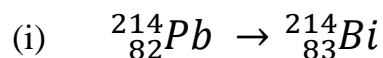
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- (b) Identify the particles emitted in



(1 mark)

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(1 mark)

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- (c) Complete the following nuclear reaction.

(1 mark)



2. (a) Write the half equations for the oxidation of manganate(VII) ion in

- (i) alkaline media

(1 mark)

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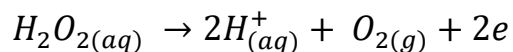
- (ii) acidic media

(1 mark)

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- (b) The half equation for the oxidation of hydrogen peroxide is



Write down the overall ionic equation for the reaction between hydrogen peroxide and manganate(VII) ions in acidic media. *(1½ marks)*

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- (c) 25.00 cm³ of a solution of acidified hydrogen peroxide required 19.00 cm³ of 0.02 M manganate(VII) ions for complete reaction. Calculate the molar concentration of hydrogen peroxide in solution. *(2½ marks)*

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3. (a) Define the term **enthalpy of solution**. *(01 mark)*

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(b) When 8.0 g of ammonium nitrate was dissolved in 50.0 g of water in a plastic beaker the temperature fell by 10.1°C.

(i) Calculate the enthalpy of solution of ammonium nitrate.

[*density of water* = 1 g cm⁻³,

specific heat capacity of water = 4.2 J g⁻¹K⁻¹] (03 marks)

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(ii) How does the lattice energy of ammonium nitrate compare with its hydration energy. Give a reason for your answer. (1½ marks)

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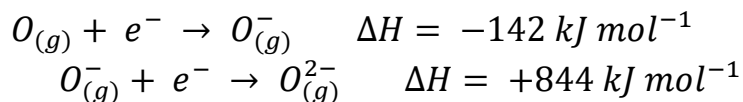
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4. (a) Define the term **first electron affinity** (1 mark)

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(b) The first and second electron affinities of oxygen are shown by the equations below



- (i) Explain the difference in the observed enthalpies for the first and second electron affinities. (3 marks)

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5. The enthalpies of combustion of glucose and ethanol are -2820 and -1368 kJ mol⁻¹ respectively.

- (a) Write equation for complete combustion of;

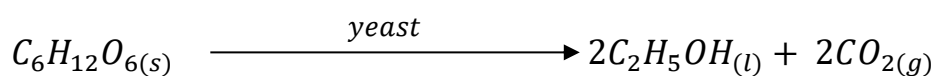
- (i) glucose (1½ marks)

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- (ii) ethanol (1½ marks)

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- (b) Glucose ferments according to the following reaction;



- Calculate the enthalpy change for the reaction. (1½ marks)

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6. Draw the structures and name the shapes for the following species.
(4½ marks)

| Species | Structure | Name |
|------------------|-----------|------|
| (i) SO_2 | | |
| (ii) H_2S | | |
| (iv) SO_4^{2-} | | |

7. (a) Explain why inert pair effect increases down group(IV) elements.
(03 marks)

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(b) Write equations for the reactions between concentrated sulphuric acid and

(i) Carbon (1 ½ marks)

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(ii) Tin (1 ½ marks)

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8. (a) Combustion of 0.260g of compound **X** produced 0.880g of carbon dioxide CO₂, 0.180g of water H₂O at s.t.p.
Calculate the empirical formula of the compound (3 marks).

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(b) If the molecular mass of **X** is 78 what is the structure of the compound?
(2 marks)

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(c) Compound **X** will decolourise bromine only in the presence of iron filings. Suggest the type of bonding present in **X**. Give your reason.
(2marks)

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9. The first ionization energies of some group II metals of the Periodic table and the melting points of their chlorides are given in the table below:

| Metal | Mg | Ca | Sr | Ba |
|---|-----|-----|-----|-----|
| First Ionisation energy (kJ mol ⁻¹) | 738 | 590 | 549 | 505 |
| Melting points of chlorides (°C) | 708 | 772 | 873 | 967 |

Explain

- (a) Why ionization energy decreases with increasing atomic number.
(2 marks)

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- (c) Why the melting points of the chlorides of these metals increase with increase in atomic number.
(2 marks)

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SECTION B: (54 MARKS)

Answer **six** questions from this section.

Additional questions answered will **not** be marked.

10. The table below shows the rates of the reaction $\text{X} + \text{Y} \longrightarrow \text{Z}$ for different initial concentrations of **X** and **Y**

| experiment number | [X]/mol dm ⁻³ | [Y]/mol dm ⁻³ | relative initial rate/ mol dm ⁻³ sec ⁻¹ |
|-------------------|--------------------------|--------------------------|--|
| 1 | 0.05 | 0.05 | 2.0×10^{-5} |
| 2 | 0.10 | 0.05 | 8.0×10^{-5} |
| 3 | 0.10 | 0.10 | 1.6×10^{-4} |

(a) Determine

(i) the order of the reaction with respect to **X**. (01 mark)

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(ii) the overall order of reaction. (02 marks)

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(b) (i) Write an expression for the rate of the reaction between **X** and **Y**. (01 mark)

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- (ii) Calculate the rate constant for the reaction and state its units.
(02 marks)
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- (c) How does the rate of the reaction vary when
(i) the concentration of **X** is halved leaving that of **Y** constant?
(01 mark)
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- (ii) the concentration of **X** is halved and that of **Y** doubled? (01 mark)
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- (iii) the concentration of both **X** and **Y** are halved? (01 mark)
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11. The elements contained in the third short period of the Periodic table, given in alphabetical order, aluminium argon, chlorine, magnesium phosphorous, silicon, sodium and sulphur.

- (a) In the table given below, write the formula of the hydride formed by the elements listed, state the oxidation state(or valency) of the elements in these hydrides and classify the bonding in the hydride as ionic or covalent.
(5marks)

| Elements | Formula of the hydride | Oxidation state or valency of the element in the hydride | Type of bonding |
|------------|------------------------|--|-----------------|
| Aluminium | | | |
| Chlorine | | | |
| Magnesium | | | |
| Phosphorus | | | |
| Silicon | | | |

b) The hydrides formed by sodium and sulphur were separately shaken with water.

i) Write the equation to show the reaction, which took place, if any.
(3 marks)

Sodium hydride:

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Sulphur hydride:

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ii) In each case state whether the pH of the resultant solution will be less than or greater than 7.

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Give reasons for your answer. (1 mark)

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12. Explain each of the following observations.

(a) Aluminium fluoride is purely ionic whereas aluminium bromide is covalent
(03 marks)

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- (b) Water is a liquid at room temperature and pressure whereas hydrogen sulphide is a gas under the same conditions. (3 marks)

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- (c) Lead forms stable compounds in which its oxidation state is +2 whereas carbon forms stable compounds only in the +4 oxidation state. (3 marks)

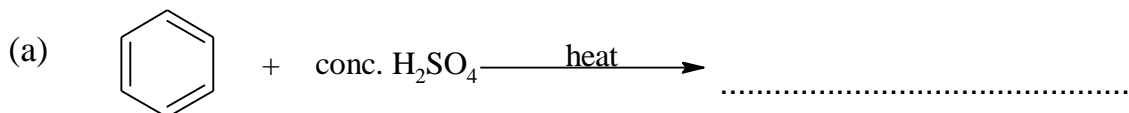
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13. Complete the following equations and in each case write the accepted mechanisms for the reactions



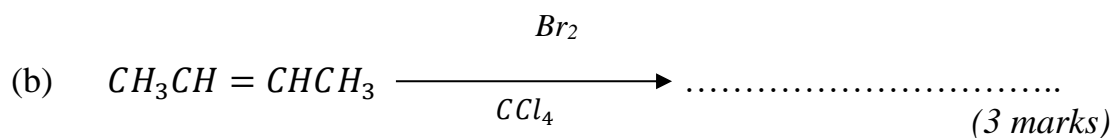
(03 marks)

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Mechanism

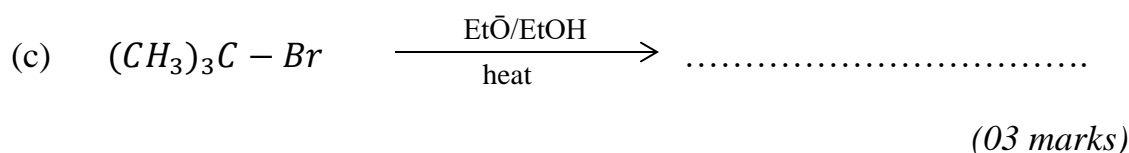
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14. Study the table below and answer the questions that follow:

| Element | Na | Mg | Al | Si | P | S | Cl |
|--------------------|-------|-------|-------|-------|-------|-------|-------|
| Atomic radius (nm) | 0.156 | 0.136 | 0.125 | 0.117 | 0.110 | 0.106 | 0.099 |
| Melting point /°C | 98 | 650 | 660 | 1423 | 44 | 120 | -101 |

(a) Define the term **atomic radius**. (01 mark)

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(b) Explain the trend in atomic radius.

(02 marks)

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(c) Write the formula of the hydrides of aluminium and silicon and state what is observed when each of the hydrides is reacted with water. In each case write an equation for the reaction.

(04 marks)

Aluminium

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Silicon:

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(d) (i) Define the term **melting point**.

(01 mark)

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(ii) State two factors that determine the melting point of a substance.

(01 mark)

15. Agricultural lime is manufactured by heating limestone strongly in a kiln. The product is allowed to cool and a calculated amount of water is added.

a) Write the equations for the reactions that take place (2 marks)

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b) Give one use of lime in agriculture. (1 mark)

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c) Explain the trend in the thermal stability of carbonates of group(II) metals. (2½ marks)

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d) The mineral “Dolomite” has formula $\text{Ca Mg}(\text{CO}_3)_2$. 2.5 g of Dolomite was reacted with excess hydrochloric acid. 230 cm^3 of carbon dioxide was evolved at room temperature.

i) Write the equation for the reaction.

(1 mark)

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ii) Calculate the percentage of ‘Dolomite’ in the sample.

(2½ marks)

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16. a) Both silicon tetra chloride and tetrachloromethane adopt the same molecular shape

(i) Name the shape adopted. (01 mark)

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(ii) In which of the two compounds is the bond angle greater? Explain. (03 marks)

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(b) State the condition(s) of reaction between tin and chlorine and write equation for the reaction. (2 1/2 marks)

Condition(s)

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Equation:

- (c) Explain what is observed when silicon(IV) chloride is exposed to moist air. (2 ½ marks)

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17. (a) 0.208 g of an organic compound **Y** containing carbon, hydrogen and oxygen only on complete combustion gave 0.609 g of carbon dioxide and 0.125 g of water. Calculate the empirical formula of **Y**. (3 marks)

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- (b) 0.53 g of **Y** in 22 g of ethanoic acid lowered the freezing point of ethanoic acid by 0.78 K.
[cryoscopic constant for ethanoic acid is $39 \text{ K mol}^{-1} \text{ per } 100 \text{ g}$]
Determine the molecular formula of **Y**. (3 marks)

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- (c) **Y** burns with a yellow sooty flame, gives a yellow precipitate with Brady's reagent but does not form a silver mirror with Tollen's reagent.

(i) Identify **Y**. (½ mark)

(ii) Write equations to show how **Y** can be synthesised from a known alcohol. (2½ marks)

PERIODIC TABLE

| | | | | | | | | | | | | | | | | | |
|-------------------|-------------------|-------------------|-------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|-------------------|--------------------|--------------------|--------------------|-------------------|
| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 H 1.0 | | | | | | | | | | | | | | | | 1 H 1.0 | 2 He 4.0 |
| 3 Li 6.9 | 4 Be 9.0 | | | | | | | | | | | 5 B 10.8 | 6 C 12.0 | 7 N 14.0 | 8 O 16.0 | 9 F 19.0 | 10 Ne 20.2 |
| 11 Na 23.0 | 12 Mg 24.3 | | | | | | | | | | | 13 Al 27.0 | 14 Si 28.1 | 15 P 31.0 | 16 S 32.1 | 17 Cl 35.4 | 18 Ar 40.0 |
| 19 K 39.1 | 20 Ca 40.1 | 21 Sc 45.0 | 22 Ti 47.9 | 23 V 50.9 | 24 Cr 52.0 | 25 Mn 54.9 | 26 Fe 55.8 | 27 Co 58.9 | 28 Ni 58.7 | 29 Cu 63.5 | 30 Zn 65. | 31 Ga 69.7 | 32 Ge 72.6 | 33 As 74.9 | 34 Se 79.0 | 35 Br 79.9 | 36 Kr 83.8 |
| 37 Rb 85.5 | 38 Sr 87.6 | 39 Y 88.9 | 40 Zr 91.2 | 41 Nb 92.9 | 42 Mo 95.9 | 43 Tc 98.9 | 44 Ru 101 | 45 Rh 103 | 46 Pd 103 | 47 Ag 108 | 48 Cd 112 | 49 In 115 | 50 Sn 119 | 51 Sb 122 | 52 Te 128 | 53 I 127 | 54 Xe 131 |
| 55 Cs 133 | 56 Ba 137 | 57 La 139 | 72 Hf 178 | 73 Ta 181 | 74 W 184 | 75 Re 186 | 76 Os 190 | 77 Ir 192 | 78 Pt 195 | 79 Au 197 | 80 Hg 201 | 81 Tl 204 | 82 Pb 207 | 83 Bi 209 | 84 Po (209) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra (226) | 89 Ac (227) | | | | | | | | | | | | | | | |
| | | | 57 La 139 | 58 Ce 140 | 59 Fr 141 | 60 Nd 144 | 61 Pm (145) | 62 Sm 150 | 63 Eu 152 | 64 Gd 157 | 65 Tb 159 | 66 Dy 162 | 67 Ho 165 | 68 Er 167 | 69 Tm 169 | 70 Yb 173 | 71 Lu 175 |
| | | | 89 Ac (227) | 90 Th 232 | 91 Pa 231 | 92 U 238 | 93 Np 237 | 94 Pu (244) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf 251 | 99 Ea (254) | 100 Fm (257) | 101 Mv (256) | 102 No (254) | 103 Lw 260 |

1. ¹H – indicates Atomic number
2. ¹H – indicates relative Atomic mass
1.0

END