



Our country, our future

525/1

S6 CHEMISTRY

Exam 30

PAPER 1

DURATION: 2 HOUR 45 MINUTES

INSTRUCTIONS

Attempt all questions in section A and six questions in section B

SECTION A

1. Both lithium and magnesium exhibit diagonal relationship

(a) What is meant by the term diagonal relationship

.....

.....

.....

.....

(b) State two properties in which lithium and magnesium resemble.

.....

.....

.....

.....

.....

.....

.....

(c) Name two other pairs of elements that show diagonal relationship.

.....

.....

.....

2. The enthalpies of combustion of some substances are given below

Substance	ΔH combustion/ kJmol^{-1}
Hydrogen	- 285.9
Graphite	- 393.5
Ethanol	- 1366.7

Calculate the enthalpy of formation of ethanol.

.....

.....

.....

.....

.....

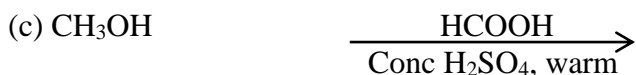
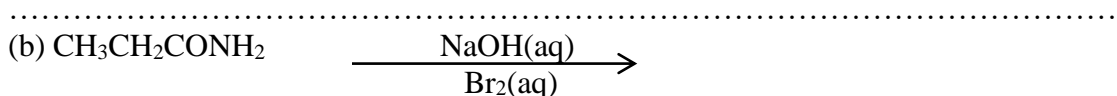
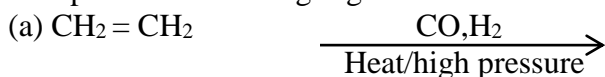
.....

.....

.....

.....

3. Complete the following organic reactions and in each case name the main organic product



4. A gas x diffuses four times as rapidly as sulphur dioxide under the same conditions
 Calculate the density of x
 (The density of sulphur dioxide at a given temperature and pressure is $2.88 \times 10^3 \text{ g/m}^3$)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

5. (a) State conditions under which osmotic pressure laws are valid.

.....

.....

.....

.....

(b) The osmotic pressure of an aqueous solution of a non-electrolyte containing 8.15g per 1.5dm³ of solution is $7.093 \times 10^4 \text{ Nm}^{-2}$ at 25°C. Calculate the freezing point of solution. (cryoscopic constant (K_f) of water is 1.86°C per 1000g mol⁻¹)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

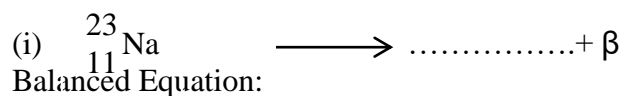
.....

.....

.....

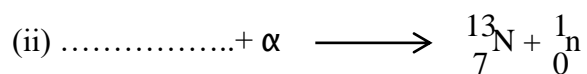
.....

6. (a) Complete the following nuclear reactions by writing balanced equations



.....

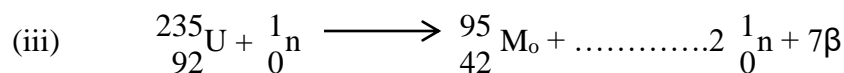
.....



Balanced equation:

.....

.....



Balanced equation:

.....

.....

(b) The half life of a radioactive sample is 529 minutes. After 30 minutes the activity of was found to be 285 counts per second. Calculate the initial activity of sample.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

7. Name the class of compounds that is distinguished by the following reagents in each case state what is observed when each of the compounds in the class is reacted with the reagent(s)

(a) aqueous sodium hydroxide and acidified silver nitrate

- class of compounds

.....

- observations,

.....

.....

.....

.....

(b) Anhydrous zinc chloride and concentrated hydrochloric acid

Class of compounds)

.....

Observations

.....

.....

.....

.....

.....

8. (a) Name the reagent that can be used to distinguish between Ca^{2+} and Mg^{2+} ions. State what is observed when the aqueous solution of each ion is separately treated with the reagent.
- Reagent(s)

.....

.....

.....

.....

(i) Determine the empirical formula of the compound.

[illegible]

.....

.....

.....

.....

.....

.....

.....

(c) Name the reagent(s) that can be used to confirm the ions present in the compound. In each case state what is observed.

.....

.....

.....

.....

.....

.....

.....

.....

9. A is a black powder, when fused with a mixture of potassium hydroxide and potassium nitrate and then treated with water yields a green solution. The green solution turns purple when acidified with dilute sulphuric acid

(a) identify the compound A and the ions responsible the green and purple color of solution(s)

(i) A:.....

(ii) ion in green solutions.

.....

(iii) ion in purple solution

.....

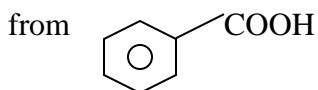
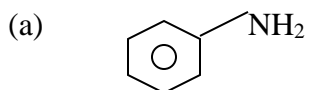
(b) Write an ionic equation to show the reaction leading to the formation of a purple solution,

.....

.....

SECTION B:

10. By means of equations only and reaction condition show how the following conversions can be effected



.....

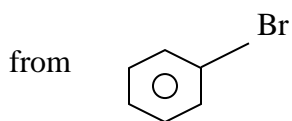
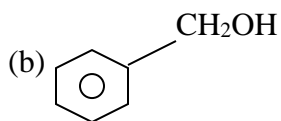
.....

.....

.....

.....

.....



.....

.....

.....

.....

.....

.....



.....

.....

.....

.....

.....

.....

11. The data below are for elements P,Q,R and S which belong to the same group in the periodic table.

Element	First ionization energy/ kJmol^{-1}	Mpt/ $^{\circ}\text{C}$
P	495	920
Q	580	2300
R	790	1610
S	1255	-20

(a) Which of the element(s) P,Q,R and S is a metal? Give a reason for your answer

.....

(b) State the type of bonding and structure of the oxides of elements P and S.

.....

(c) The second, third and fourth ionization energies of element Q are 1500, 7700 and $10,500 \text{ kJmol}^{-1}$ respectively.

To what group in the periodic table does Q belong? .Give reasons for your answer

.....

.....
.....

12. (a) Explain the principle of solvent extraction

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

(b) 50cm^3 of 1.5M ammonia solution was shaken with 50cm^3 of trichloromethane in a separating funnel. After the layers had settled, 20cm^3 of trichloromethane layer was pipetted and titrated with 0.05M hydrochloric acid. 22.9cm^3 of the acid were required for complete neutralization.

(c) Write the expression for the partition coefficient (K_D) for ammonia between water and trichloromethane.

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

(i) Calculate the partition coefficient (K_D) (State any assumptions made)

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

.....

.....

.....

.....

This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

.....

.....

.....

.....

.....
.....
(ii) Deduce the molecular formula of Y

.....
.....
.....
.....
(iii) Write down the structural formulae and systematic names of five isomers of Y

.....
.....
.....
.....
.....
.....
(c) One of the named isomers of Y in b(iii) above does not react with acidified solution of potassium dichromate (VII), but reacts readily with a mixture of anhydrous zinc chloride and concentrated hydrochloric acid to form a turbid solution within 0 – 5 minutes.

(i) identify Y

.....
.....
(ii) Write equation and indicate the mechanism for conversion of Y to an alkene.

.....
.....
14. (a) Silver carbonate is sparingly soluble in water
Write

(i) the equation for solubility of silver carbonate in water.

.....

(ii) the expression for K_{sp} (solubility product) for silver carbonate

.....

.....

.....

(b) The solubility of silver carbonate at 15°C is 0.03g dm^{-3}

Calculate the solubility product of silver

Carbonate at 15°C .

.....

.....

.....

.....

.....

.....

.....

(c) State what would happen to the solubility of silver carbonate when a 0.1M solution of silver nitrate is added to the saturated solution. Explain your answer.

.....

.....

.....

.....

.....

.....

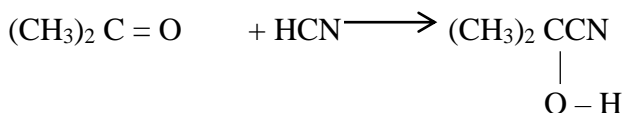
15. (a) What is meant by the term bond energy?

.....

.....

.....

(b) The bond energy of $\text{C}=\text{O}$, $\text{C}-\text{H}$, $\text{C}-\text{O}$, $\text{C}-\text{C}$ and $\text{O}-\text{H}$ bonds respectively are 743, 412, 360, 348 and 463. Calculate the enthalpy change for the reaction below



(c) For each of the following compounds state the type of bonding and structure adopted

Compound	Bonding type	Structure
Iodine		
Calcium fluoride		
Silicon (IV) oxide		

16. The table below shows the melting points of period three elements

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Mpt /°C	371	923	933	1680	317	392	172	84

Explain why:

(i) magnesium has a higher melting point than sodium. (3 marks)

.....

.....

.....

.....

(ii) Silicon has the highest melting point (3 marks)

.....

.....

(3 marks)

.....

.....

.....

.....

.....

(Kb for carbon disulphide = $2.35^{\circ}\text{C mol}^{-1} 1000\text{g}^{-1}$)

[illegible][illegible]

(i) State any two assumptions made in the calculation in (a) above

.....

.....

.....

.....

(ii) comment on the result in (a) above.

.....

.....

.....

.....

End