Centre No. & Name

Candidate No.

Candidate Name

## ORDINARY LEVEL

## 515 CHEMISTRY. 2

### Time Allowed: two hours 30 minutes

Open wide the flap attached to this booklet and enter the information required in the boxes of the flap. This paper is arranged in three sections, **A, B and C**. Section A, B and C carries equal marks.

**Section A**: You are advised to attempt **ALL FIVE** questions; the mark awarded will be the total for your best **FOUR** answers.

**Section B**: Answer **ONLY ONE** questions. **ONE** objective of this section is to give you the opportunity to organize material and present ideas, including calculations and diagrams where appropriate, in a clear and logical form. If you attempt more than **ONE** question in this section, marks will be awarded only for the **FIRST ONE**.

**Section C**: This section is referred to as the **ALTERNATIVE TO PRACTICAL** and consists of **TWO COMPULSORY** questions

In calculation you are advised to show all the steps in your working, giving your answer at each stage. Non-programmable calculators are allowed.

*You are reminded of the necessity of good English and orderly presentation in your answers.*

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## USEFUL DATA

Relative Atomic Masses

1 Faraday =96000 coulombs

Hydrogen (H) = 1.0

G.M.V of any gas at r.t.p = 24000cm$^3$

Carbon (C)     = 12.0    specific heat capacity of water = 4.2J/g/

Oxygen (O)     = 16.0    Avogadro number = $6.02 \times 10^{23}$

Copper (Cu)     = 64.0

Sulphur (S) = 32.0

1) A) complete the table below (3mks)

b) To which of the period of the periodic table does (3mks)

|  | Element X | Element Y | Element Z |
|---|---|---|---|
| Atomic number | 11 | 6 |  |
| Number of protons |  |  | 16 |
| Number of neutrons | 12 | 6 | 16 |
| Mass number |  | 12 | 32 |
| Electronic configuration | 2,8,1 |  |  |

i) Y belong ...............................................................................................

ii) Z belong ...............................................................................................

c) Which of the above element X, Y and Z is a metal? .................................

d) Element X combines with element Z to form a compound.

i) Give the most likely formula of the compound using X and Z as symbol ...................

ii) Draw diagrams to show the formation of the compound between X and Y (3mks)

e) The relative atomic mass of Z is accurately quoted as 32.1. Suggest why it is not a whole number ...............................................................................................
.................................................................................................... (1mk)

2) (a) Define the following terms:

i) The mole
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.................................................................................................................
.................................................................................................................

ii) Empirical formula
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iii) Molecular formula
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.................................................................................................. (3mks)

(b) In one experiment, it was found that exactly 0.64g of oxygen reacted with 0.64g of Sulphur to form a compound. Determine the formula of this compound.

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.............................................................................................................(3mks)

(c) Calculate the percentage by mass of carbon in Sodium hydrogen Carbonate ($NaHCO_3$)

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(d) A solution is made by dissolving 0.025 mole of hydrogen chloride gas and making up the solution to exactly $250cm^3$. Find the concentration of the solution in $mole/dm^3$.

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.............................................................................................................(2mks)

3) An aqueous solution of copper(II)sulphate was electrolysed using a copper cathode and platinum anode.

a) What is meant by an inert electrode? ........................................................................... (1mk)

b) I) what would you observe at the anode ...............................................................,(2mk)

i) Write an equation for the reaction at the anode.............................................................

c) A steady current of 2A was passed through the solution for 16 minutes. Calculate

i) The quantity of electricity passed during the time interval.....................................

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ii) The mass of copper deposited at the cathode ..........................................................

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iii) The number of moles of copper atoms deposited ...................................................

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d) After passing the current for a longer time, it was observe that the blue colour of the copper (II) sulphate had faded away and the solution tested to have become more acidic. Explain (4mks)
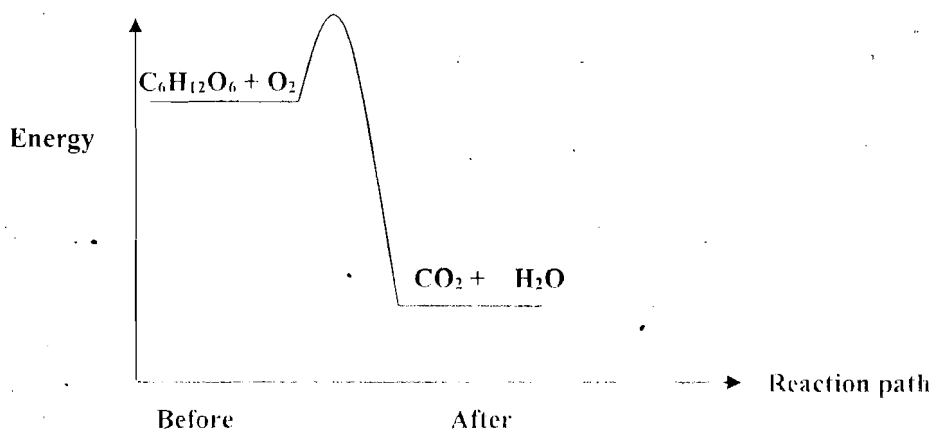
i) The change in the colour of the solution .....................................................................

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ii) The change in the acidity of the solution ...................................................................

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e) Explain why the aqueous solution of copper (II) sulphate conducts electricity while the crystalline copper (II) sulphate does not ..................................................................................

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4) (a) The oxidation of glucose in the tissue of organisms is represented as:



(i) State whether the process is exothermic or endothermic?

....................................................................................................(1mk)

(ii) State two bonds that are broken during this process? ...................................................................................
....................................................................................................(1mk)

(iii) There is both bond breaking and bond formation in this process. Which of these processes involves more energy? Give a reason for your answer ..............................................................................
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....................................................................................(2 mks)

(iv) What is the name given to the reverse reaction for the oxidation of glucose? ......................................................................................(1mk)

(b)An ethanol lamp contains some ethanol of weight 36.78 g. when the ethanol burnt for some time, it was found that the new mass of the lamp and ethanol was 35.78 g and 29.70 kJmol⁻¹ of heat energy was evolved.

(i) define heat of combustion? .....................................................................
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..................................................................................................... (1 mk)

(ii) what mass of ethanol was burnt? ....................................................................
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(iii)Calculate the heat of combustion of ethanol ($C_2H_5OH$) of molar mass 46 g

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.................................................................................................(2 mks).

5) Elements such as carbon and sulphur exhibit the phenomenon allotropy.
   (a) (i) What is allotropy?
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   .......................................................................................................
   .................................................................................................(1 mk)

(ii) Differentiate between allotropy and polymorphism.

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(iii) list two crystalline allotropes of carbon and one non-crystalline
allotrope? .............................................................................................
..............................................................................................................
.................................................................................................(1 mk)

(iv)Outline a simple chemical test to prove that the allotropes given in (iii) above are all made
of carbon?

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.................................................................................................(3 mks)

   (b) (i)Write an equation for the reaction between magnesium and carbon dioxide

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   .................................................................................................(1 mark)

(iii) Give a simple test to identify carbon dioxide

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.................................................................................................(2 mks)

## SECTION B: Alternative to practicals

6. (a) Draw each of the following equipment used in volumetric analysis
   (i)     Pipette


(ii) Conical flask


(iii) Burette

(iv) Volumetric flask

(4 mks)

(c) i) What is a standard
solution?.................................................................................................................................
.................................................................................................................................

ii) State three important steps involved in the preparation of a standard solution

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.................................................................................................... ( 4 mks)

(c) In an experiment to determine the concentration of a solution of hydrochloric acid using a
Standard solution of sodium carbonate, 20cm³ of a solution of the acid was completely
neutralised by 25cm³ of a solution of 0.2M Na₂CO₃ solution.

(i) Name a suitable indicator for this
titration...............................................................................................

(ii) Determine the molarity of the solution of hydrochloric acid in
Moldm⁻³...............................................................................................................
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.................................................................................................... (4 mks)

(b) An experiment was carried out to determine the solubility of potassium chlorate at
different temperatures. The results obtained are shown in the table below

| Temp/$^{0}$C | 0 | 10 | 20 | 30 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|---|
| Solubility in g/100g of water | 14 | 17 | 20 | 24 | 29 | 34 | 40 |

(i) Draw on the grid below a graph to show the solubility of potassium chlorate
(on the y-axis) against temperature (on the x-axis).

(ii)  Use your graph to show the solubility of KClO₃ at 70⁰C.

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(iii)  What mass of salt will crystallize out when a saturated solution of the salt cools from 60⁰C to 30⁰C?

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**( TOTAL= 20MARKS)**

7.  Two solids, P and Q were analysed. P was copper(II) oxide. Tests were made on the solids. Some of the observations are in the following table. Write down the observations that are missing on the table.

| Test | Observation |
|------|-------------|
| Tests on solid P    Appearance of solid P | Black solid |
| Hydrogen peroxide was added to solid P in a test-tube. A glowing splint was inserted into the tube | Slow effervescence Splint rekindled |
| a)    Dilute sulphuric acid was added to solid P in | Blue solution formed. |

| a test-tube. The mixture was heated to boiling point. The solution was divided into three equal portions into test-tubes.<br><br>i) To the first portion of the solution, excess sodium hydroxide was added.<br><br>ii) To the second portion of the solution, about 1cm³ of aqueous ammonia solution was added. Excess ammonia was then added.<br><br>iii) To the third portion of the solution, dilute hydrochloric acid was added followed by barium chloride solution. | Equation: ...................................................................................(1mk)<br>Observation:........................................................................................................................(3mks)<br>Eqn:...................................................................................(1mk)<br>Observations:........................................................................................................................(2mks)<br>Observations:................................................................................................................................................(2mks)<br>Eqn:...................................................................................(1mk) |

| Tests on solid Q | |
|---|---|
| Appearance of solid Q | Black solid |
| Hydrogen peroxide was added to solid Q in a test-tube | Rapid effervescence |
| A glowing splint was inserted into the tube | Splint rekindled |

b) I) Compare the reactivity of solid P and Q with hydrogen peroxide.

...........................................................................................................................................................................................................................................................................................(1mk)

ii)Identify the gas given off ...................................................... ............(1mk)

iii)Write an equation for the chemical change in which the gas is formed.

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c) What conclusion can you draw about the identity of Q?

...........................................................................................................................(1mk)

d) I) Name a substance that can be used to reduce P to copper

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ii)Write an equation to show the conversion of P to copper

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...........................................................................................................................(3mks)

e) The following table contains some common gases and their tests. Fill in the missing information on the table. (4mks)

| Gas | Test for gas | |
|---|---|---|
| Ammonia | | |
| | Bleaches damp litmus paper | |
| Hydrogen | | |
| | Turns lime water milky | |

.( TOTAL – 20MARKS)

## SECTION C

Answer any two questions. All questions carry equal marks. Where appropriate. equations and diagrams should be used to illustrate your answer.

8. Temperature, concentration, surface area and light are factors that affect the rate of chemical reactions using a suitable example in each case, discuss how each of these factors affects the reaction rate.

9. Sodium hydroxide and nitric acid are important industrial chemicals.

      Describe how each is prepared from a named starting material.

      State one important use of each chemical in the industry.

10. Describe how the following conversions can be carried out;

    i.     Ethene to ethanol

    ii.    Ethanol to chloroethane

  (a) Write short notes on

    i.     Substitution reaction

    ii.    Polymerization

Homologous series