**Candidate’s Name:**

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| **Random No.** | | | | | **Personal No.** | | |
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**………………………………………………...…**

**Signature: ………………………………………**

***(Do not write your School/Centre Name or Number anywhere on this booklet)***

**P525/1**

**CHEMISTRY**

**Paper 1**

2 ¾ hours

**Uganda Advanced Certificate of Education**

**CHEMISTRY**

**Paper 1**

**2 hours 45 minutes**

**INSTRUCTIONS TO CANDIDATES**:

*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 JK-1 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*

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

**Turn Over**

**SECTION A (46 MARKS)**

1. A mixture of sodium hydrogen carbonate and anhydrous sodium carbonate was heated until no further loss in mass occurred. During the heating, 0.55g of gas was evolved and when the residue was cooled, it was found to weigh 4.225g.

(a) Write an equation for the reaction that took place. *(1½ marks)*

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(b) Determine the composition by mass of the original mixture. *(5 marks)*

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1. (a) A proton, a neutron and an electron all travelling at the same velocity enter a magnetic field. State which particle is deflected most and explain your answer. *(1½ marks)*

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(b) State two reasons why particles must be ionized before being analysed in a mass spectrometer. *(1 mark)*

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(c) A sample of Boron with relative atomic mass of 10.8 gave a mass spectrum with two peaks, one at mass to charge=10 and the other at mass to charge =11. Calculate the ratio of heights of the two peaks. *(2marks)*

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1. Complete the following equations and in each case name the main organic product. *(1½ marks)*

Name:

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 *(1½ marks)*

Name ................................................................................................................................



 *(1½ marks)*

Name:.............................................................................................................................

Conc. HNO3

(d) ………………………………….. *(1½ marks)*

heat

Name: ....................................................................................................................

1. 12.5 g of concentrated sulphuric acid was weighed in a stoppered bottle and diluted with water to make 250 cm3 of solution. 25 cm3 of the resultant solution required 26.35 cm3 of a solution containing 0.95 M hydroxyl ions for complete reaction.

Calculate the percentage of water in the original acid, assuming that it is the only impurity. *(4 marks)*

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1. Excess concentrated ammonia solution was added to an aqueous solution of cobalt(II) chloride hexahydrate followed by excess concentrated hydrochloric acid.

(a) State what was observed. *(1½ marks)*

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(b) Write equations for the reactions that took place. *(2½ marks)*

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1. Write equations for the dissolution of each of the following substances in water. State whether the resultant solution is neutral, basic or acidic.

(a) Sodium sulphide *(2 marks)*

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(b) Ammonium methanoate *(1½ marks)*

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(c) Phenylammonium chloride *(2 marks)*

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1. Name a reagent that can be used to distinguish between each of the following pairs of substances. In each case state what would be observed when the reagent is treated with each member of the pair.

(a) HCOONa(aq) and Na2C2O4(aq)

Reagent: *(½ mark)*

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Observation: *(1 mark)*

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Reagent: *(1 mark)*

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Observation: *(1½ marks)*)

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Reagent: *(1 mark)*

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Observation: *(1½ marks)*)

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1. A 0.05 M aqueous solution of hydrogen sulphide had a pH of 4 at 25o C. Calculate

(a) the percentage of ionization of hydrogen sulphide. *(2 marks)*

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(b) The first ionization constant of hydrogen sulphide. State any assumptions made *(2 marks)*

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1. (a) Propan-2-ol reacts with aqueous iodine and sodium hydroxide solution on warming to form a pale yellow precipitate. In an experiment, a student obtained 39 g of pale yellow precipitate from 10 g of propan-2-ol. Calculate the percentage yield. *(3½ marks)*

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(b) (i) Explain what is meant by the term **electropositivity** *(1 mark)*

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(ii) Arrange the following substances in order of increasing ionic character: *(1 mark)*

CO2, LiC*l*, MgF2, NaC*l*, NH3, S2C*l*2

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**SECTION B (54 MARKS**)

1. (a) (i) Explain what is meant by the term **distribution coefficient.** *(1½ marks)*

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(ii) State the conditions under which the distribution law is valid. *(1 mark)*

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(b) When iodine was shaken with a mixture of benzene and 0.125 M aqueous solution potassium iodide, the concentration of benzene was found to be 0.2 M at 25o C. 25 cm3 of the aqueous layer required 25 cm3 of 0.093 M sodium thiosulphate solution for complete reaction.

(i) Write an expression for the partition coefficient of iodine between benzene and water. *(½ mark)*

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(ii) Calculate the concentration of tri iodide ions in the aqueous layer. *(The partition coefficient of iodine between benzene and water at 25o C is 400).* *(4½ marks)*

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(iii) Calculate the equilibrium constant for the reaction leading to formation of tri iodide ions in the aqueous layer. *(1½ marks)*

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1. Complete the following equations and in each case write the accepted mechanism for the reaction.

1. MnO4-(aq)/ŌH(aq)

(a) ……………………….. *(3 marks)*

2. H2O, warm

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 *(3½ marks)*

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dilute NaOH(aq)

(c) ……..……………………….. *(2½ marks)*

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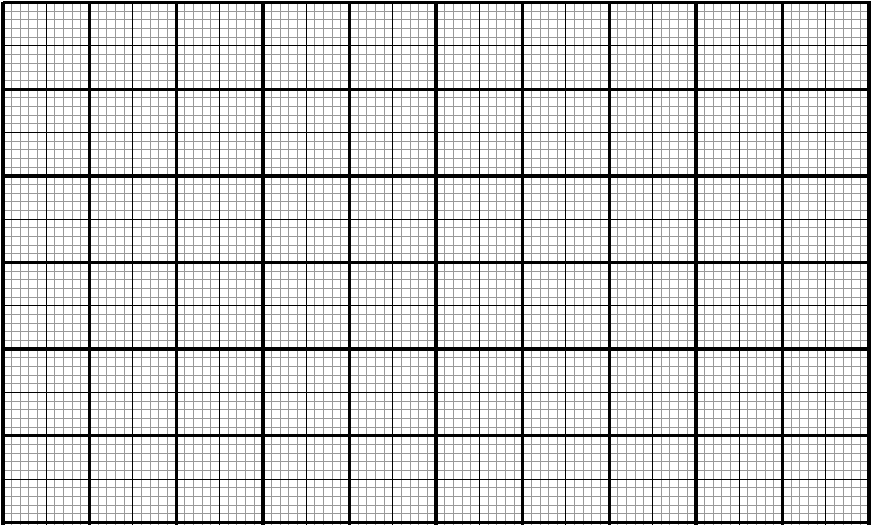
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1. The first electron affinities of group (VII) are given in the table below.

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| --- | --- | --- |
| **Element** | **Atomic number** | **First electron affinity/kJmol-1** |
| Fluorine | 9 | -328 |
| Chlorine | 17 | -349 |
| Bromine | 35 | -325 |
| Iodine | 53 | -295 |

(a) (i) Plot a graph of electron affinity against atomic number *(2½ marks)*



(ii) Explain the shape of the graph *(3 marks)*

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(b) (i) Write the general outermost electronic structure of group (VII) elements. *(½ mark)*

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(ii) Write equations to show how fluorine reacts with aqueous sodium hydroxide solution *(3 marks)*

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1. Write equations to show how the following conversions can be carried out. Indicate the reagents and conditions for the reactions

(a) Iodoethane to Aminomethane *(3 marks)*

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(b) Benzene to Ethyl phenylamine *(3 marks)*

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(c) Phenylmethanol to cyclohexanone (3 marks)

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1. Laminaria sea weed concentrates iodide ion derived from sea water. The sea weed is burnt in a limited supply of air and the ash obtained is boiled with water, filtered and the filtrate treated with an excess of hydrogen peroxide solution. The liberated iodine is extracted in trichloromethane, the appropriate layer is the separated and titrated with a standard solution of sodium thiosulphate

(a) (i) Explain why the sea weed is burnt to ash *(1 mark)*

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(ii) In what form is iodine liberated by boiling with water? *(½ mark)*

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(b) Explain the role of hydrogen peroxide. *(1½ marks)*

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(c) (i) Explain why it is necessary to use an organic extraction rather than titrate the liberated iodine directly. *(2 marks)*

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(ii) State the colour of iodine in the layer in which it concentrates. *(½ mark)*

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(d) 1 kg of sea weed produces sufficient iodine to react completely 100 cm3 of 0.1 M sodium thiosulphate solution. Calculate the mass of iodine extracted. *(3½ marks)*

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15. (a) Rubber in its raw form is of little use. Name and explain the process that is used to make rubber more useful. *(4 marks)*

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(b) The table below shows the boiling points of the hydrides of some elements of group V of the periodic table.

|  |  |
| --- | --- |
| **Hydride** | **Boiling point/oC** |
| NH3 | -33 |
| PH3 | -90 |
| AsH3 | -55 |
| SbH3 | -17 |

Explain the trend of the boiling points of the hydrides. *(5 marks)*

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16. In the extraction of copper from its ores, the ores are first concentrated and then roasted in air. The roasted material is then mixed with silica and heated with air in a blast furnace to form copper.

(a) (i) Define the term **ore** *(1 mark)*

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(ii) Write the name and formula of one ore from which copper can be extracted *(1 mark)*

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(b) Describe the process by which the ore named above can be concentrated.

*(3½ marks)*

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(c) Write equation for the process that took place when the ore is roasted in air *(1½ marks)*

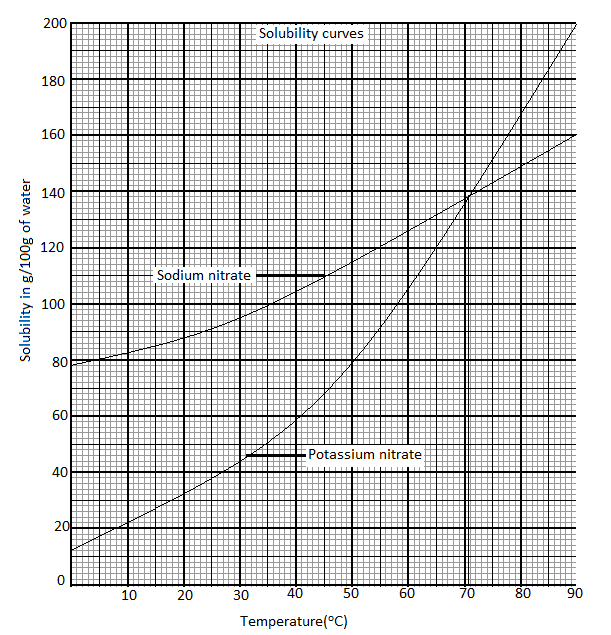
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(d) Write equations for the reactions that lead to the formation of copper in the blast furnace. (2 marks)

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17. The solubility curves of potassium nitrate and sodium nitrate are given in the graph below:

(a) Explain what is meant by the term **fractional crystallization**.*(1½ marks)*

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(b) At what temperature do the two salts have equal solubilities? *(1 mark)*

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(c) From the curves what do you deduce about the signs of heats of solution of two salts? Explain your answer. *(1½ marks)*

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(d) At 80oC, a saturated solution of potassium nitrate contains 40g of water. The solution was cooled to 20oC, what mass of potassium nitrate was deposited? *(2½ marks)*

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(e) How would you obtain at least 15g of pure potassium nitrate from a mixture of 60g of potassium nitrate and 80g of sodium nitrate? *(2 ½ marks)*

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**PERIODIC TABLE**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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  Ti  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**

**1. H – indicates Atomic number**

**2. H – indicates relative Atomic mass**

**1.0**

**END**