**2019 FORM 4**

**CHEMISRY**

**PAPER 233/2**

**THEORY**

**INSTRUCTIONS TO CANDIDATES**

* Write your name and index number in the spaces provided.
* Answer **ALL** the questions in the spaces provided.
* Electronic calculators and Mathematical tables **may** be used.
* All workings **must** be clearly shown where necessary.

**For Examiner’s Use Only**

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| **Questions** | **Maximum Score** | **Candidates Score** |
| **1** | **16** |  |
| **2** | **13** |  |
| **3** | **13** |  |
| **4** | **11** |  |
| **5** | **13** |  |
| **6** | **14** |  |
| **80** |  |

1. The diagram below shows part of the Frasch process used for extraction of sulphur. Use it to answer the questions that follow.
2. Identify (1mark) X………………………………………………………………………………….................
3. Why is it necessary to use superheated water and hot compressed air in this process (2mark)

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1. State two physical properties of sulphur that makes it possible for it to be extracted by this method (2marks)

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b) The diagram below shows part of the process in the manufacture of sulphuric (VI) acid. Study it and answer questions that follow



i) Give two reasons why air is referred to as a mixture (2 marks)

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ii) What is the role of concentrated sulphuric (VI) acid in chamber A (1mark)

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iii) Name two catalysts that can be used in the catalytic chamber B (2marks)

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iv) State two roles of the heat exchanger (2marks) ……………………………………………………………………………………………………............................................................................................................................................................................................

v) Describe the test for a Sulphite anion SO32- (2 mark)

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vi) Explain the observation made when a few drops of concentrated sulphuric (VI) acid are added to crystal of hydrated copper II sulphate? Explain your answer (2mks)

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2. Use the standard electrode potential for elements G,H,J, K and L given below to answer the questions that follow

Half reactions Electrode potential (volts)

 G2+(aq) + 2e– G(s) -2.90

 H2+(aq) + 2e– H(s) -2.38

 J+(aq) + e– ½J2(g) 0.00

 K2+(aq) + 2e– K(s) +0.34

 ½L2(g) + e– L–(aq) +2.87

i) Which element could be hydrogen. Explain (1mark)

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ii) Which two half cell would produce the highest potential difference (e.m.f) when combined (1mark)

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iii) In the space provided below construct a well labelled electrochemical cell obtained when G2+/G and K2+/K half cells are combined (3marks)

iv) Calculate the EƟ value of the electrochemical cell constructed in (iii) above (2marks)

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v) It is advisable to store a nitrate solution of K in a container made f H. Explain. (2marks)

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 b) During electrolysis of aqueous copper (II) sulphate using copper electrodes a current of 0.4 ampheres was passed through the cell for 5 hours

i) Write an ionic equation of the reaction that occurred at the cathode (1mark)

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ii) Determine the change in mass of the anode which occurred as a result of the electrolysis process ( Cu= 63.5 1 Faraday= 96500 coulombs) (3marks)

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3. Study the reactive scheme below and answer the questions that follow.

i) What is the distinguished physical property of substance P (1mark)

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ii) Identify a suitable reagent that can be used in step I . (1mark)

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iii) Describe how C3H7COOH can be distinguished from C4H9OH (2marks)

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iv) Write an equation for the reaction that takes place in step III. (1 mark)

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v) Name the type of reaction that occurs in steps II and VII. (2 marks)

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vi) If 7.4g of butanol completely underwent step III, determine the volume of gas Z produced at STP (MGV = 22.4L , C= 12.0, H=1.0 O=16.0) (3 marks)

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 vii) Write an equation for the reaction between R and one mole of fluorine. (1 mark)

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 viii) Describe a chemical test for liquid X. (2 marks)

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4. Aluminium is extracted using the electrolytic cell represented by the diagram below

i) Why is aluminium extracted by electrolytic method? (1 mark)

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ii) Name the electrodes labelled X and Y (2marks)

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iii)The chief ore from which aluminium is extracted is bauxite.

a)Name **two** main impurities present in bauxite. (2 marks)

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b) Aluminium oxide is the main component in bauxite with a melting point of 2015°C but electrolysis of
 molten aluminium oxide is carried out at 800°C. Explain how this is achieved. (2mks)

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iv) Write the equations for the reaction taking place at the anode. (1 mark)

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vi) Duralumin (an alloy of copper, aluminium and magnesium) is preferred to pure aluminium in the construction of aeroplane bodies. Give **one** property of duralumin that is considered. (1 mark)

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5. The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements

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|   |   |   |   |   |   |   |   |   |
| C |   |   |   | F | G |   | I |   |
|   |   |   |   |   |   | H |   | K |
| D | E |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   | J |   |

i) Identify the most reactive non-metal. Explain. (2 marks)

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ii) What is the name given to the family of elements of which I and J belong? (1 mark)

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iii) Using dots (•) and crosses (×) to represent electrons, show bonding in the compound formed between C and H. (2 marks)

iv) How does the atomic radius of F compare with that of I. Explain. (2 marks)

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 b) Study the table below and answer the questions that follow.

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| --- | --- | --- | --- | --- | --- | --- |
| Substance  | M | N | O | P | Q | R |
| M.P. °C | 801 | 1356 | -101 | 26 | -39 | 113 |
| B.P °C | 1410 | 2850 | -36 | 154 | 457 | 445 |
| Electrical conductivity in solid state | Poor | Poor | Poor | Poor | Good | Poor |
| Electrical conductivity in molten state | Good | Poor  | Poor | Poor | Good | Poor |

i) Explain why substance M is a good conductor in molten state and not in solid state. (2marks)

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ii) What is the most likely structure of substance N. Explain. (2 marks)

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iii) Identify, with reasons, a substance that exists as a liquid at room temperature. (2 marks)

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6. A piece of marble chip (calcium carbonate) is put in a beaker containing excess of dilute hydrochloric acid which is placed on a reading balance. The mass of the beaker and its contents is recorded every two minutes as shown in the table.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Time (min) | 0 | 2 | 4 | 6 | 8 | 10 | 12 |
| Mass (g) | 126.4 | 126.3 | 126.2 | 126.1 | 126.0 | 126.0 | 126.0 |

i) Why is there a continuous loss of mass of the reaction mixture. (1 mark)

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ii)Write an equation for the reaction taking place. (1 mark)

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iii)State two different ways by which the reaction could have been made more rapid. (2 marks)

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iv) Why does the mass remain constant after 8 minutes (1 mark)

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v)State the observations that would be made if a few drops of lead II nitrate solution was added to 1cm3 of the resulting solution followed by excess ammonia solution. (2 marks)

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vi) State one environmental effect that excess carbon (IV) oxide in the air causes. (1 mark)

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vii)The energy profile for the forward direction of a reversible reaction is shown.



 Sketch on the diagram the path for a catalysed reaction. (2 mark)

viii)What do you observe when you introduce the following substances in this equation



2CrO2-4(aq) + 2H+(aq) Cr2O2-7(aq) + H2O(l) ΔH= -477Kj/Mol

Yellow Orange

 i) Dilute hydrochloric acid solution (2 mark)

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 ii) Increase heat (2 mark)