**NAME …………………………………………………………INDEX NO……………………**

**CANDIDATE’S SIGNATURE ………………………………….. DATE……………………**

**CHEMISTRY**

**PAPER 2**

**233/2**

**TIME:2 HOURS**

**FORM 4 END OF TERM 2 EXAMINATION 2021**

**INSTRUCTIONS**

* **Answer all the questions in the spaces provided.**
* **Mathematical tables and silent non-programmable electronic calculators may be used**
* **All working must be clearly shown where necessary.**
* **Candidates should answer the questions in English.**

**For examiners use only.**

|  |  |  |
| --- | --- | --- |
| **Question.** | **Maximum score** | **Candidates score** |
|  | **12** |  |
|  | **12** |  |
|  | **14** |  |
|  | **14** |  |
|  | **13** |  |
|  | **15** |  |
|  | **80** |  |

**FORM 4 – PAPER 2**

1. (a) The table below gives information about elements Q, R, S and T. The letters are not the actual symbols of the elements.

|  |  |  |  |
| --- | --- | --- | --- |
| Element | Atomic number | Atomic radius (nm) | Ionic radius (nm) |
| Q | 3 | 0.134 | 0.074 |
| R | 5 | 0.090 | 0.012 |
| S | 13 | 0.143 | 0.050 |
| T | 17 | 0.099 | 0.181 |

1. In which period of the periodic table is element R? Give a reason. (2 mks)
2. Explain why the atomic radius of R is smaller than that of Q. (2 mks)
3. Explain why the ionic radius of T is larger than its atomic radius. (2 mks)
4. Using dots (.) and crosses (x) to represent the outermost electrons, draw a diagram to show the bonding in the compound formed when Q reacts with T. (2 mks)

(b) The table below shows some properties of substances E, F and G. Study it and answer the questions that follow.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Substance** | **Melting point (oc)** | **Solubility in water** | **Electrical conductivity** | |
| **Solid state** | **Molten state** |
| E | -39 | Insoluble | Good | Good |
| F | 1610 | Insoluble | Poor | Poor |
| G | 801 | soluble | Poor | Poor |

1. Select a substance with:

Giant atomic structure \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1mk)

Giant ionic structure \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (1mk)

1. Which substance is likely to have metallic bonding? Give a reason (2 mks)
2. (a) Define the term molar heat of combustion. (1 mk)

(b) The following results were obtained when an experiment was carried out to determine the heat of combustion of ethanol. The experiment involved heating a known volume of water with a flame from ethanol burner. The burner was weighed initially and after the experiment.

Results

Volume of water in glass beaker = 200cm3

Mass of ethanol burner at the start = 86.66g

Mass of ethanol burner after experiment =86.20g

Initial temperature of water =24.0Oc

Density of water =1g/cm3

Specific heat capacity of water =4.2kj/kg/k

Calculate the:

1. Mass of ethanol burned (1 mk)
2. Amount of heat produced in this experiment (2)
3. Moles of ethanol burned ( C=12, H=1, 0=16) (2 mks)
4. Molar heat of combustion of ethanol (2 mks)

(c ) write a thermochemical equation for the combustion of ethanol (1 mk)

(d) Draw an energy level diagram for the combustion of ethanol. (3 mks)

1. Name the following compounds

O

OH

1. CH3CH2CH2C (1mk)

(1 mk)

1. CH3COOCH2CH2CH3 (1mk)

(b) Name any two components of crude oil found in laboratory gas (2 mks)

(c ) What is the difference between thermal cracking and catalytic cracking? (2 mks)

(d) Study the flow chart below:-

Sugar

Crude ethanol

Pure ethanol

Ethanoic acid

Substance C+ water

Process W

Process X

Sodium hydroxide

Polymer

Substance A

Substance B

Hydrogen gas

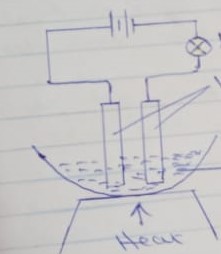
KMnO4

H+

Conc H2SO4

180oC

1. Identify process W and X (1 mk)
2. Name substances B and C (1 mk)
3. Write the equation for the reaction leading to production of substance A (1 mk)
4. Substance B was completely burned in air. Write the equation for the reaction (1 mk)
5. State and explain the observation made when bromine is added to a gas jar full of substance B in the presence of sunlight (2 mk)
6. The polymer D has a relative molecular mass of 112, 000. Calculate the number of monomers (C=12, H=1) (2 mks)
7. (a) The diagram below shows a set up used in the electrolysis of molten copper (II) chloride using inert electrodes



Bulb

Inert electrodes

Molten copper (II) chloride

heat

1. What happens to the brightness of the bulb as electrolysis proceeds? Explain (1 mk)
2. Label the cathode on the diagram above (1 mk)
3. Write the half equation for the reaction at the anode (1 mk)
4. Name a suitable pair of inert electrodes that can be used in this experiment

(b) Use the standard reduction electrode potentials given below to answer the questions that follows.

EØ (Volts)

Zn2+ (aq) + Ze- Zn (s) – 0.76

Pb2+ (aq) + 2e– Pb (s) -0.13

Cu2+ (aq) + Ze- Cu(s) + 0.34

Ag+(aq) + e- Ag(s) +0.80

(b) (i) identify the strongest reducing agent. Give a reason (2 mks)

(ii) Which two half cells would give the highest emf when combined? (1 mk)

1. Calculate the end of the two half cells identified in (ii) above. (1 mk)
2. Explain whether or not the following reaction can take place: (2 mks)
3. Draw a well labelled diagram of the electrochemical cell obtained when the half cells of lead and silver are combined. (3 mks)
4. (a) The diagram below shows spot of pure A, B and C on chromatography paper. Spot D is that of a mixture.

A

B

C

D

After development A,B and C were found to have moved 8cm, 3cm and 6cm respectively. D was separated into two sports which had moved 6cm and 8 cm.

On the diagram

1. Label the baseline (1mks)
2. Show the position of all the spots after development (3mks)
3. Identify the substances present in the mixture D (2mk)

(b) Describe how ammonium chloride can be separated from a solid mixture of ammonium chloride and anhydrous calcium chloride (3mk)

(c) The table below shows liquids that are miscible and those that are immiscible

Liquid L3 L4

L1 Miscible Miscible

L2  Miscible Immiscible

Use the information given to answer the questions that follow.

1. Name the method that can be used to separated L1 and L3 from the mixture of the two (1 mk)
2. Describe how a mixture of L2 and L4 can be separated (3 mk)
3. (a) The extraction of aluminum from its one takes place in two stages, purification stage and electrolysis stage.
4. Name the ore from which aluminum is extracted. (1 mk)
5. Name one impurity which is removed at the purification stage (1 mk)
6. Name the substance added to the electrolyte to lower in order to its melting point. (1 mk)
7. Write the equation for the reaction that takes place at:

Cathode (1 mk)

Anode (1 mk)

(b) Iron is extracted from its ore by the blast furnace process.

(i) Name the method used to concentrate the ore (1 mk)

(ii) Name one ore from which iron is extracted (1 mk)

1. One of the components of the waste gases from furnace is nitrogen (iv) oxide. Describe the adverse effects it has on the environment. (2 mks
2. Give two uses of wrought iron (2 mks)

(c) During the extraction of zinc, the ore is first roasted in air before feeding it into a furnace.

1. Name the main ore from which zinc is extracted. (1 mk)
2. Write an equation for the reaction that takes place when the ore is roasted in air (1 mk)
3. Give two uses of zinc metal (2 mks)