CSEC Type Chemistry Questions
Paper 02
SECTION A

Answer ALL questions in this section.

1. The molar and mass concentrations of sodium hydroxide solution were determine by observing the temperature change in a neutralization reaction.

    A pipette was used to transfer 35 cm^3 of sodium hydroxide to a polystyrene cup. A measuring cylinder was used to transfer 40 cm^3 of 0.25 mol dm^{-3} of sulphuric acid at 5 cm^3 intervals to the polystyrene cup. The highest temperature reached after each addition was recorded.

    Table 1 shows the volumes of sulphuric acid used to react with 35 cm^3 sodium hydroxide and the highest temperature changes that occurred.

    TABLE 1: EXPERIMENTAL RESULTS

Volume of H_2SO_4 added (cm^3)	Temperature (^0C)
0	26.0
5	30.0
10	34.5
15	37.5
20	39.5
25	39.5
30	36.5
35	34.0
40	30.0

a) (i)   Plot a graph for temperature against volume of acid added using 2 cm $\rightarrow$ 5^0C on the y-axis and 2cm $\rightarrow$5cm^3

            on the x-axis.   **[3 marks]**

    (ii)   From the graph, determine the temperature at which neutralization occurs.   **[1 mark]**
            _____

    (iii)   Determine the volume of H_2SO_4 used at the end point of the reaction.   **[1 mark]**
            _____

    (iv)   Calculate the number of moles of H_2SO_4 in the value determined from the graph.   **[2 marks]**
            _____
            _____
            _____

    (v)   Write a balanced chemical equation for the reaction.   **[2 marks]**
            _____

    (vi)   Determine the number of moles of sodium hydroxide in the pipette volume.   **[2 marks]**
            _____
            _____

(vii)   Calculate the number of moles of sodium hydroxide in 1000 cm^3 of solution.   **[2 marks]**

_____
_____

(viii)   Calculate the mass of sodium hydroxide present in 1000 cm^3 of solution.   **[2 marks]**

_____
_____

b)   The reaction between sodium hydroxide and sulphuric acid causes an increase in temperature. However when sodium carbonate reacts with ethanoic acid the temperature decreases. These are examples of two different types of reaction:

     i.   Based on the information given, what type of reaction is
- NaOH and H_2SO_4 - _____
- Na_2CO_3 and CH_3COOH - _____

[2 marks]

     ii.   Distinguish between the two types of reactions identified in b) i) above.

NaOH and H_2SO_4

_____
_____

Na_2CO_3 and CH_3COOH

_____
_____

[2 marks]

     iii. Derive the ionic equation for the reaction between sodium carbonate and ethanoic acid. (Be sure to show the removal of the spectator ions.)

_____
_____
_____
_____

[2 marks]

c)   On heating a sample of solid **T**, with a valency of 2, a yellow solid, **U**, was observed when hot that became white on cooling with the liberation of gas **V.** The gas **V** liberated was bubbled through limewater to form a cloudy white precipitate. Two separate mixtures of **T** were made, by adding distilled water to some of the solid. When dilute aqueous ammonia solution was added one of the mixture a white precipitate formed which dissolves forming a colourless solution in excess. Adding potassium hexacyanoferrate solution to the second mixture gave white precipitate.

     i.   Identify gas solids **T** and **U** and gas **V.**   **[3 marks]**

_____
_____
_____

     ii.   Write the equation, in terms of **T**, for the decomposition of solid **T**.   **[1 mark]**

_____

Total 25 marks

2. Potassium has two isotopic forms with mass numbers 39 and 41 respectively. Potassium has an atomic number of 19.

    a) Draw a labelled diagram to illustrate the number of protons, neutrons and electrons present in an atom of potassium 41.

    [3 marks]

    b) To which group of the periodic table does element potassium 41 belong? Give a reason for your answer.

    Element potassium 41 belongs to Group

    _____

    Reason:

    _____

    _____

    [2 marks]

    c) What differences, if any, are expected between the chemical reactions of potassium 39 and potassium 41? Explain your answer.

    _____

    _____

    _____

    [2 marks]

    d) What type of chemical bonding will be formed when potassium 39 combines with $^{16}_{8}O$? Give a reason for your answer.

    Type of chemical bonding:

    _____

    Reason:

    _____

    _____

    [3 marks]

e) Write the chemical formula of the compounds expected to be formed when potassium 39 combine with those of oxygen 16.
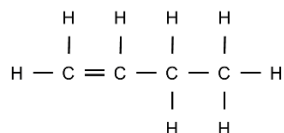
Chemical formula: _____

[1 mark]

f) Potassium oxide and calcium oxide have melting points 740^0C and 2572^0C, respectively. Account for the difference in their melting points.
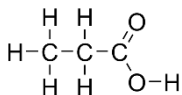
_____

_____

_____
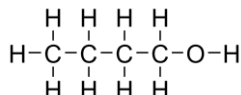
_____

_____

[4 marks]

Total 15 marks

3. Below are five organic compounds, A, B, C, D and E.
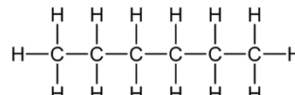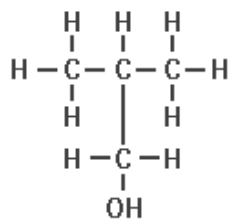

Compound A   Compound B   Compound C   Compound D

Compound E

a) i) Which compounds belong to the same homologous series?

_____

[1 mark]

ii) State the homologous series to which the compounds you named in a) i) belong, and give a reason for placing them in the same homologous series.

_____

_____

_____

_____

[2 marks]

iii) State the relationship that exist between compound C and compound E.

_____

[1 mark]

b) Compound A can be converted to compound C via hydration. State the reagent(s) and condition(s) necessary for the reaction.

Reagent(s):   _____

Reaction condition(s):   _____

[2 marks]

c) Describe one test that may be used to distinguish Compound A from Compound D.

_____

_____

_____

_____

[3 marks]

d) Compound B and Compound C react in the presence of conc. H_2SO_4 to form an organic product with a sweet smell.

i. State two reasons for using conc. H_2SO_4.

_____

_____

[2 marks]

ii. Draw the full structural formula of the organic product that is formed when Compound B reacts with Compound C.

Structure:

[2 marks]

e) Members belonging to the homologous series of Compound C may be detected on a driver's breath via the breathalyser test.

i. Identify the oxidizing agent that is used in the breathalyser test.

_____

[1 mark]

ii. State the colour change that takes place when the oxidizing agent has been reduced.

_____

[1 mark]

Total 15 marks

SECTION B

Answer ALL questions in this section.

4. Zinc carbonate ($ZnCO_3$) and copper metal (Cu) are both treated with an excess of concentrated and dilute nitric acid, respectively, in separate experiments.

    a) Write two balanced chemical equations, including state symbols, for the reactions above.　　　　**[4 marks]**

    b) Write the ionic equation for the $ZnCO_3$ and dilute nitric acid reaction.　　　　**[2 marks]**
      i.   Write the oxidation half equation.　　　　**[1 mark]**
     ii.   Write the reduction half equation.　　　　**[1 mark]**

    c) State the expected observations for the above reactions.　　　　**[3 marks]**

    d) With the aid of a labelled diagram, describe one way in which ammonia may be prepared in the laboratory. Be sure to include the
      - Reagents needed
      - Drying agent
      - Chemical equation　　　　**[4 marks]**

Total 15 marks

5. Aluminium is extracted from alumina by electrolysis. The electrolyte is a molten mixture of aluminium oxide and cryolite. Figure 1 below shows the extraction of aluminium via electrolysis.
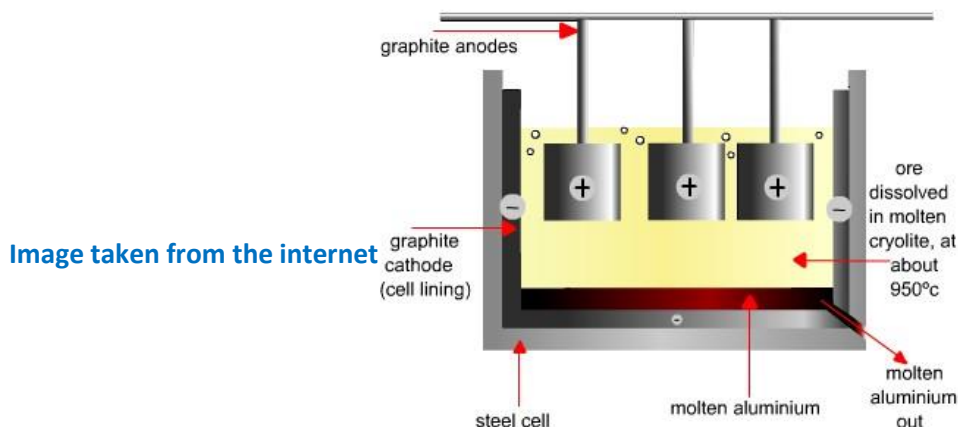

Image taken from the internet

Figure 1: The extraction of aluminium via electrolysis.

a) Define the term 'electrolysis'. **[1 mark]**
b) Write the anodic and cathodic half equation. **[4 marks]**
c) Outline the role and importance of cryolite. **[2 marks]**
d) Calculate the mass of the aluminium will be extracted after 5 minutes and 30 seconds at 5 amperes. **[3 marks]**
e) In the electrolysis of copper (II) sulphate using copper electrodes the copper electrode decreases in mass.
   i. Give an account for this observation. **[2 marks]**
   ii. Draw a detailed labelled diagram showing the electrolysis of copper (II) sulphate using copper electrodes. **[3 marks]**

Total 15 marks

6. The international community has developed innovative technological ways of reducing the effect of pollution in the environment. Green chemistry was developed so as to minimize this effect.

a) Define the term pollution. **[2 marks]**

b) Identify TWO sources of water pollution. **[2 marks]**

c) Define the term Green Chemistry. **[2 marks]**

d) State THREE principles of green chemistry. **[3 marks]**

e) Carbon monoxide is used to reduce haematite (Fe_2O_3) to produced iron in the blast furnace liberating carbon dioxide.

   i. Write the balanced chemical equation, including appropriate state symbols, for the reaction above. **[2 marks]**

   ii. Calculate the mass of iron produced if 0.12 dm^3 of carbon dioxide produced at room temperature and pressure (rtp).
[4 marks]

[Relative atomic mass of Fe = 56; One mole of gas occupies 24 dm^3 at rtp]

Total 15 marks