SECTION A

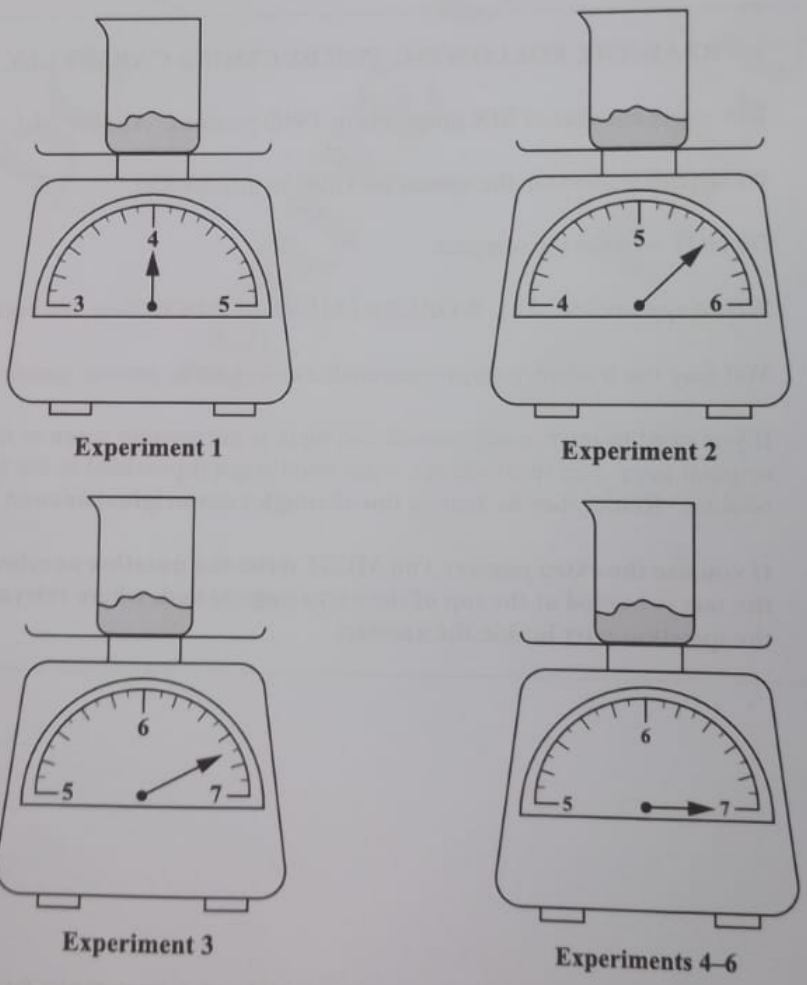
Answer ALL questions.

DO NOT spend more than 30 minutes on Question 1.

1. A student conducted a series of experiments to investigate how different volumes of sulfuric acid, H_2SO_4, added to 50 cm^3 of 0.50 mol dm^{-3} silver nitrate, $AgNO_3$, affects the mass of the precipitate produced.

The student conducted Experiments 1–6 by changing the volume of sulfuric acid in each experiment as shown in Table 1 **on page 6**. In each experiment, the precipitate formed was filtered, washed, dried and weighed in a beaker.

Figure 1 shows the mass of the beaker and the precipitate produced for Experiments 1–6.



Experiment 1 **Experiment 2**

Experiment 3 **Experiments 4–6**

Figure 1. Mass of beaker and precipitate produced (in grams) for Experiments 1–6

(a) Define EACH of the following terms.

(i) Acid

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(1 mark)

(ii) Normal salt

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(2 marks)

TABLE 1: MASS OF PRECIPITATE PRODUCED AT VARYING VOLUMES OF SULFURIC ACID

Experiment Number	Volume of Sulfuric Acid Added (cm^3)	Mass of Empty Beaker (g)	Mass of Beaker and Precipitate Produced (g)	Mass of Precipitate Produced (g)
1	4.0	2.5		
2	8.0	2.5		
3	11.0	2.5		
4	13.0	2.5		
5	15.0	2.5		
6	16.0	2.5		

(b) For EACH experiment shown in Figure 1 **on page 4**, record the corresponding mass of the beaker and the precipitate produced in Column 4 of Table 1. **(4 marks)**

(c) For EACH experiment in Table 1, calculate the mass of precipitate formed and record the value in Column 5. **(4 marks)**

(d) Using the axes provided in Figure 2 **on page 7**, plot a graph of the mass of precipitate produced against the volume of sulfuric acid added. Your graph should include two intersecting lines. **(5 marks)**

(e) On your graph, label the point that indicates the MINIMUM volume of the sulfuric acid required to precipitate ALL the silver ions from the silver nitrate solution and record this volume below.

Volume of the sulfuric acid .....

(2 marks)

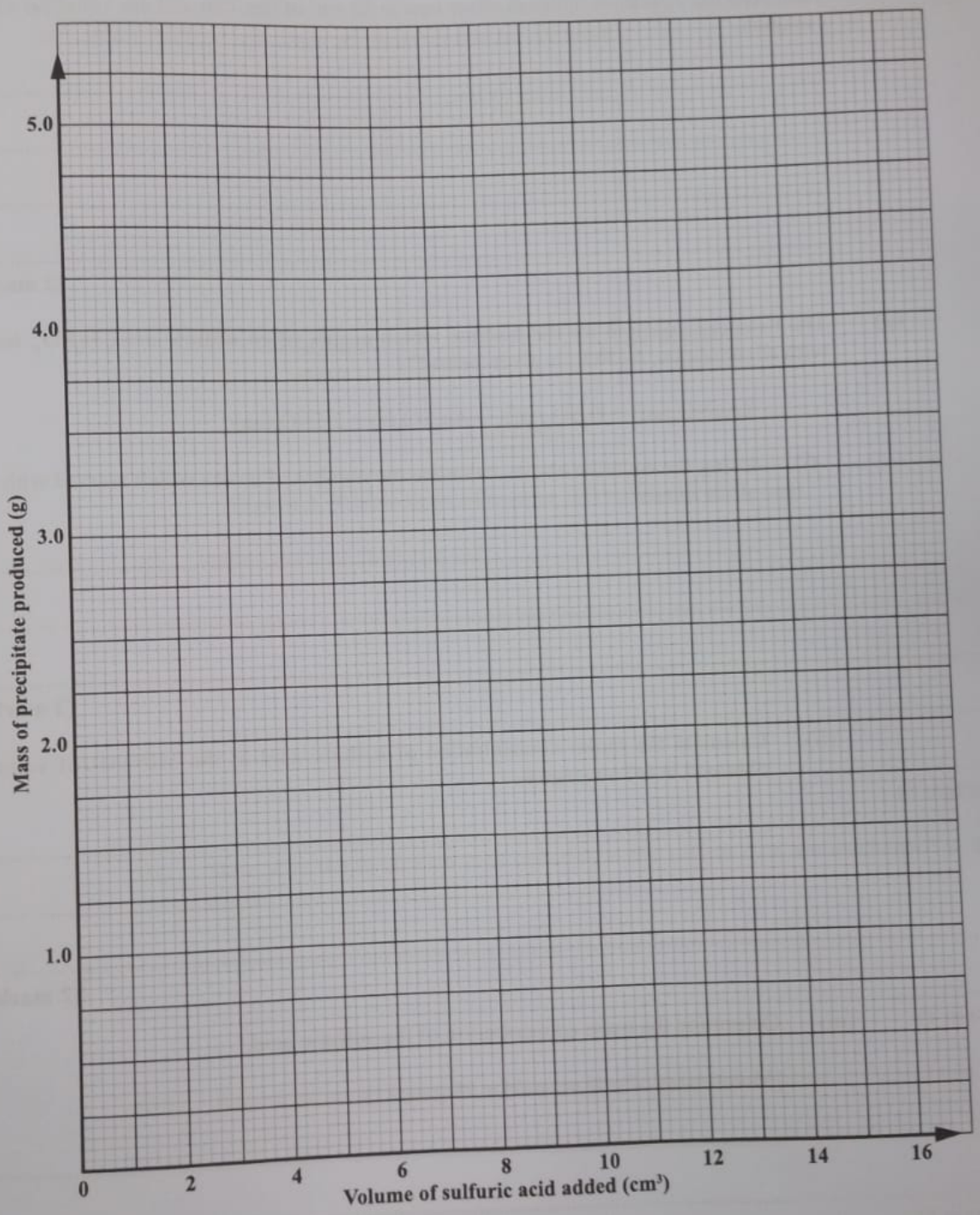


Figure 2. Graph of mass of precipitate produced (in grams) vs volume of sulfuric acid added (in cm^3)

(f) Calculate the number of moles of silver ions in 50 cm^3 of the 0.50 mol dm^{-3} of silver nitrate solution.

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(2 marks)

(g) The balanced equation for the reaction which occurs when sulfuric acid, H_2SO_4, reacts with silver nitrate, $AgNO_3$, is given below.

$$2AgNO_3(aq) + H_2SO_4(aq) \rightarrow Ag_2SO_4(s) + 2HNO_3(aq)$$

(i) Using the equation above, calculate the number of moles which reacted with the silver nitrate.

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(2 marks)

(ii) Calculate the molar concentration of sulfuric acid in the MINIMUM volume obtained in (e) **on page 6**.

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(2 marks)

(iii) Determine the mass concentration of the sulfuric acid.

[Molar mass of sulfuric acid = 98 g mol^{-1}]

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(1 mark)

Total 25 marks

0 1 2 1 2 0 2 0 0 8

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2. Figure 3 shows a simplified diagram of the apparatus utilized for the electrolysis of aqueous copper (II) sulfate, $CuSO_4$ (aq), when platinum electrodes are used.

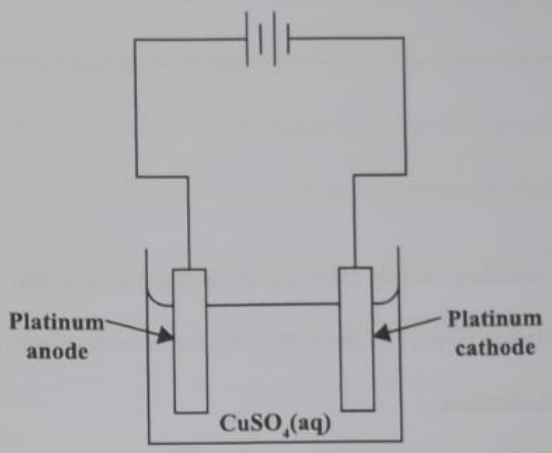


Figure 3. Electrolysis of copper (II) sulfate, $CuSO_4$ (aq)

(a) (i) Define the term 'electrolysis'.

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(2 marks)

(ii) State why the hydroxide ions rather than the sulfate ions are discharged at the anode.

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(1 mark)

(iii) Write a balanced equation, with state symbols, for the reaction at the cathode.

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(2 marks)

GO ON TO THE NEXT PAGE

0 1 2 1 2 0 2 0 0 9

(iv) State TWO changes that occur in the electrolyte.

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(2 marks)

(b) A redox reaction usually takes place during electrolysis.

(i) Define EACH of the following terms as it relates to redox reactions.

Reduction

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(1 mark)

Reducing agent

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(1 mark)

(ii) Deduce the oxidation state of sulfur in $CuSO_4$.

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(2 marks)

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(c) Calculate the mass of copper (in grams) which will be deposited at the cathode when 6A of current passes through the electrolytic cell for 45 minutes, as shown in Figure 3 **on page 9**.

[R.A.M. Cu = 64; 1 Faraday = 96 500 C]

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(4 marks)

Total 15 marks

3. (a) Cracking is a very important process in the petroleum industry.

(i) Define the term 'cracking'.

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(2 marks)

(ii) Several fractions are obtained from the fractional distillation of petroleum. State ONE use of bitumen.

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(1 mark)

(b) Compound A (C_4H_8) and Compound B (C_4H_{10}) were produced from cracking.

(i) State the names of Compound A and Compound B.

Compound A .....

Compound B .....

(2 marks)

(ii) Draw the FULLY displayed structure of Compound A.

(2 marks)

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(iii) State the homologous series to which Compound B belongs.

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(1 mark)

(iv) State ONE test that could be used to distinguish between Compound A and Compound B. Write the expected observations.

Test

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Observations

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(3 marks)

(c) Compound B (C_4H_{10}) can exist as structural isomers.

(i) Define the term 'structural isomers'.

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(2 marks)

(ii) In the space provided below, draw a FULLY displayed structure of ONE isomer of Compound B.

(2 marks)

Total 15 marks

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SECTION B

Answer ALL questions.

(a) Radioisotopes are very useful in everyday life. For example, Uranium-235 is used in energy generation because it produces large amounts of energy when the atoms split.

(i) Define the term 'isotopes'.

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(2 marks)

(ii) State TWO uses of radioisotopes, other than energy generation.

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(2 marks)

(b) The properties of elements can be explained based on their position in the Periodic Table.

The electronic configurations of four elements, W, X, Y and Z, are as follows

W: 2, 7 X: 2, 8, 2 Y: 2, 8, 6 Z: 2, 8, 8, 2

(i) State the TWO criteria which determine the position of elements in the Periodic Table.

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(2 marks)

(ii) State the appropriate group and period for Element Y.

Group .....

Period .....

(2 marks)

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(c) Elements W and X react together to form a compound.

(i) Deduce whether the compound formed is ionic or covalent.

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(1 mark)

(ii) Use dot and cross diagrams to show the bonding in the compound formed.

(3 marks)

(d) Element Z can react with dilute hydrochloric acid. Write a balanced equation, including state symbols, for this reaction.

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(3 marks)

Total 15 marks

598

A013

(a) Ethanol, (C_2H_5OH), is the second compound found in the alcohol homologous series. It is an important organic compound that can be produced via the fermentation of carbohydrates in the laboratory.

(i) State THREE characteristics of a homologous series.

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(3 marks)

(ii) Describe the fermentation process by which ethanol is produced from carbohydrates.

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(3 marks)

(iii) Write a balanced equation, with state symbols, showing all the products formed by the fermentation of carbohydrates.

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(3 marks)

) A sweet-smelling product is formed when ethanol reacts with ethanoic acid.

(i) State the name of the product formed.

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(1 mark)

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(ii) State the homologous series to which the product named in (b) (i) belongs.

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(1 mark)

(iii) The sweet-smelling product can also be hydrolysed in the laboratory. Draw the FULLY DISPLAYED structural formulae of the hydrolysis products.

Product 1

(2 marks)

Product 2

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

6. (a) List FOUR physical properties of metals.

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(4 marks)

(b) Chlorophyll and haemoglobin are two important organometallic compounds found in plants and animals respectively.

(i) Identify the metal that is present in EACH of the following organometallic compounds.

Chlorophyll .....

Haemoglobin .....

(2 marks)

(ii) State the importance of EACH of the following in plants and animals respectively.

Chlorophyll

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Haemoglobin

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(2 marks)

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(c) Several large fishes died and were seen floating close to a water source near the Easygoing Chemical Laboratory. Upon investigation it was noticed that several broken mercury thermometers had been dumped on the riverbank. An analysis of the dead fishes was conducted.

(i) Explain how the broken mercury thermometers caused the death of the large fishes.

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(3 marks)

(ii) Recommend TWO ways in which the personnel at the Easygoing Chemical Laboratory could correctly dispose of broken thermometers.

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(2 marks)

(iii) While working on an experiment in the chemistry laboratory at your school, the mercury thermometer you were using accidentally broke. State TWO actions you should take to avoid contamination.

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(2 marks)

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.