

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD  
UNIVERSITY OF MALTA, MSIDA

**SECONDARY EDUCATION CERTIFICATE LEVEL**

**SEPTEMBER 2016 SESSION**

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SUBJECT:	<b>Chemistry</b>
PAPER NUMBER:	I
DATE:	29 <sup>th</sup> August 2016
TIME:	9:00 a.m. to 11:05 a.m.

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**Useful data:**

**Relative atomic masses: O = 16; K = 39**

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**Directions to Candidates**

- Write your index number in the space at the top left-hand corner of this page.
  - **Answer ALL questions.** Write all your answers in the spaces provided in this booklet.
  - The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated in brackets.
  - You are reminded of the necessity for orderly presentation in your answers.
  - In calculations you are advised to show all the steps in your working, giving your answer at each stage.
  - The use of electronic calculators is permitted.
  - A **Periodic Table** is printed on the back of this booklet.
- 

**For examiners' use only:**

Question	1	2	3	4	5	6	7	8	9	10	11	12	Total
Score													
Maximum	6	6	6	6	6	6	6	7	6	5	20	20	100

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**Section A: Answer ALL questions in this Section. Write your answers in the spaces provided.**

1. Use the appropriate term from those listed below so as to complete the blank spaces in the paragraph. Each term may be used once, more than once or not at all.

less	more	solvent	saturation	solute	decreasing	increasing	solution
------	------	---------	------------	--------	------------	------------	----------

In an experiment, some sugar is placed in a small beaker. Distilled water is added and the contents well-stirred so that all the sugar dissolves. A \_\_\_\_\_ forms. The sugar is called the \_\_\_\_\_ and the water is called the \_\_\_\_\_. If not enough water is added, \_\_\_\_\_ is reached and some sugar remains undissolved at the bottom of the beaker. The remaining sugar may be made to dissolve by \_\_\_\_\_ the temperature of the mixture. If the beaker with its contents is placed in the refrigerator \_\_\_\_\_ sugar will be observed at the bottom.

**Total: 6 marks**

6

2. The table below shows two commonly available laboratory chemicals.

(a) Complete the table so as to show some of the properties of the **two** substances:

	pH (less than 7, 7, or greater than 7)	Effect on red litmus
sulfuric acid		
sodium hydroxide solution		

(4)

(b) Sulfuric acid can form **two** types of salts on reacting with sodium hydroxide; a normal salt and an acid salt. Give the formulae or names of these two salts:

(i) Normal salt: \_\_\_\_\_;

(ii) Acid salt: \_\_\_\_\_.

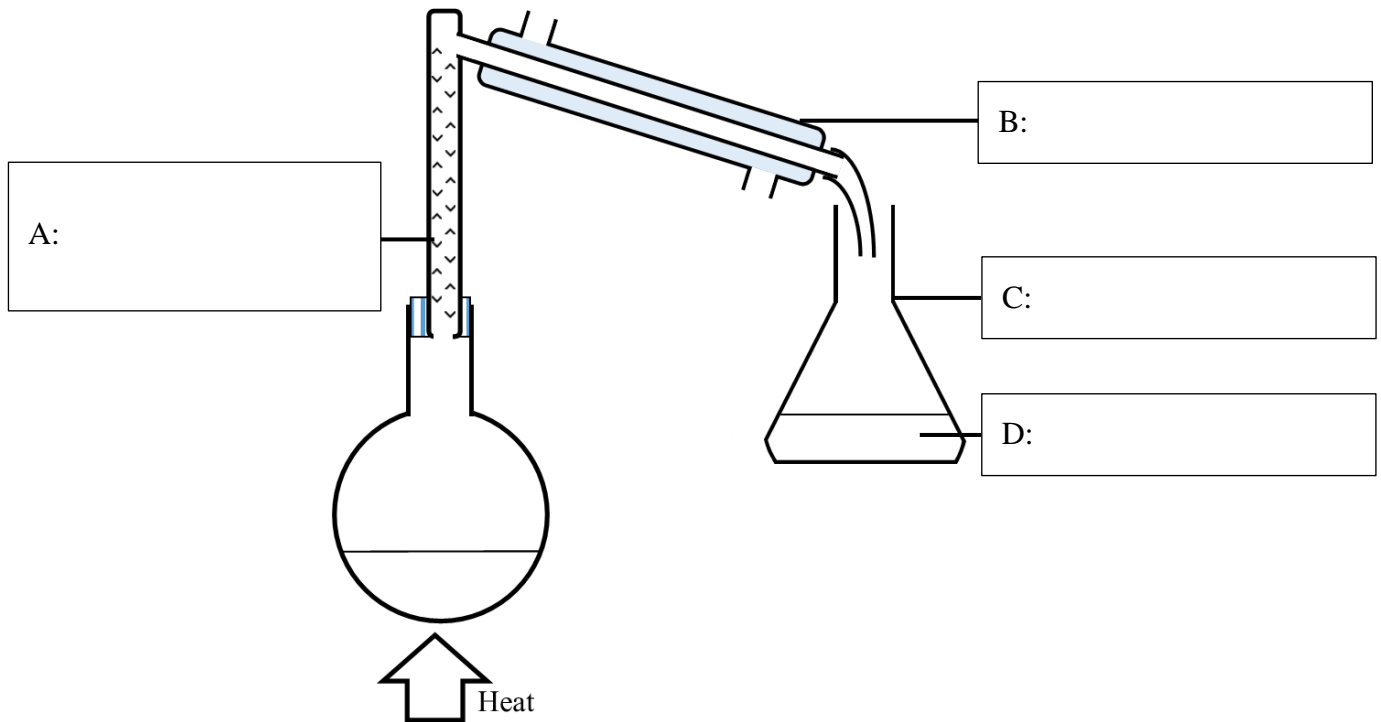
(2)

**Total: 6 marks**

6

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3. Look at the following diagram for the apparatus used for fractional distillation and answer the questions that follow.



- (a) Label parts **A**, **B**, **C** and **D**. (4)
- (b) Mark clearly on the diagram:
- (i) the direction of water flowing through apparatus **B**;
  - (ii) an appropriate position for a thermometer to be used. (2)

**Total: 6 marks**

6

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4. This question is about Reaction A and Reaction B shown below:

Reaction A: Calcium carbonate + hydrochloric acid  $\rightarrow$  E + water + F

Reaction B: G + carbon dioxide  $\rightarrow$  calcium carbonate + H

(a) Complete the word equations by identifying the chemical names or formulae of the missing substances:

Reaction A: E \_\_\_\_\_ F \_\_\_\_\_

Reaction B: G \_\_\_\_\_ H \_\_\_\_\_

(4)

(b) State **one** observation that can be made during **each** of the reactions **A** and **B**.

Observation in Reaction **A**: \_\_\_\_\_

Observation in Reaction **B**: \_\_\_\_\_

(2)

**Total: 6 marks**

6

5. An analysis of a sample of an oxide of potassium showed that it contained 70.91% of potassium and 29.09% of oxygen.

(a) Using the information given above, calculate the empirical formula of this oxide.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (4)

(b) If the relative formula mass of this oxide is 110, determine the formula of the ionic compound in part (a).

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (2)

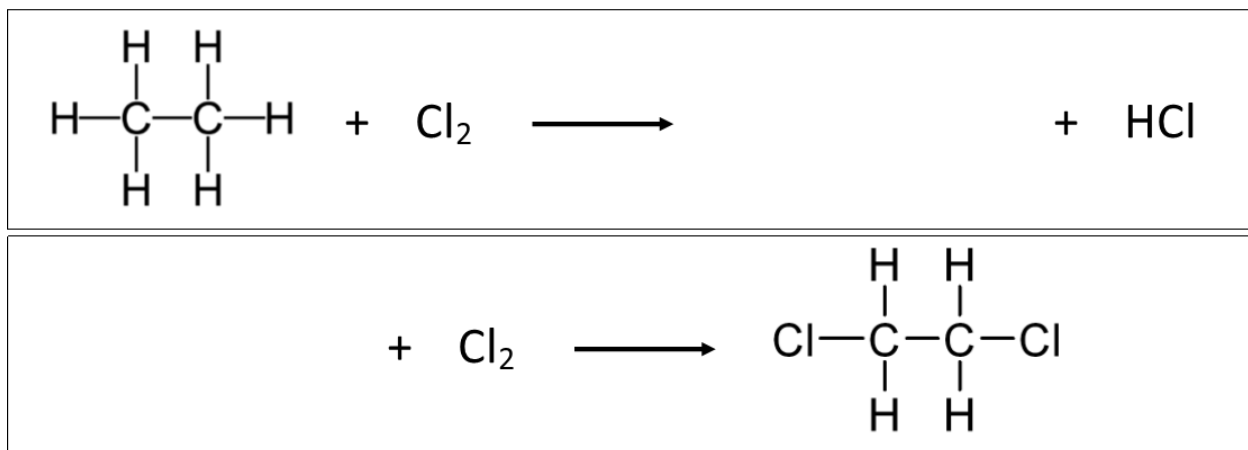
**Total: 6 marks**

6

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6. Chlorine can undergo chemical reactions with both ethane and ethene.

(a) Complete the diagram below to show the structures of the missing compounds.



(2)

(b) State the condition required for chlorine to react with ethane.

\_\_\_\_\_ (1)

(c) Name the type of reaction taking place when chlorine reacts with:

(i) ethane; \_\_\_\_\_

(ii) ethene. \_\_\_\_\_ (2)

(d) Give **one** reason why the reaction of chlorine with ethane is different from the reaction of chlorine with ethene.

\_\_\_\_\_ (1)

**Total: 6 marks**

6

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7.

- (a) Effervescence due to a colourless gas **I** can be observed if some hydrogen peroxide is placed in a test tube in the presence of a suitable catalyst. Give the name or formula of gas **I** and state how the identity of the gas can be confirmed by a simple test.

Name or formula of **I** \_\_\_\_\_Test for **I** \_\_\_\_\_ (2)

- (b) When sodium hydroxide solution is added dropwise to a solution of an unknown substance and the mixture is warmed gently, a pungent smelling gas **J** is given off. This gas gives dense white fumes with hydrochloric acid. Give the name of the gas **J** and give another test to confirm the presence of **J**.

Name of gas **J** \_\_\_\_\_Test for **J** \_\_\_\_\_ (2)

- (c) A drop of silver nitrate solution is added to some tap water. Immediately a white precipitate, **K**, forms. Precipitate **K** darkens on exposure to sunlight. Give the symbol of the ion present in tap water which causes the formation of precipitate **K** and the name or formula of precipitate **K**.

Symbol of ion \_\_\_\_\_

Name or formula of **K** \_\_\_\_\_ (2)

Total: 6 marks

6

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8. The composition of air at sea level is as follows:

- 21% **L**
- 78% **M**
- 1% other gases, such as water vapour and **N**.

(a) Identify gas:

(i) **L**; \_\_\_\_\_

(ii) **M**; \_\_\_\_\_

(iii) **N**. \_\_\_\_\_ (3)

(b) Explain, in terms of chemical bonding, why gas **M** is used as an inert atmosphere in some experiments.

\_\_\_\_\_ (1)

(c) Under what conditions of temperature can a sample of air be liquefied? (Actual values are not required)

\_\_\_\_\_ (1)

(d) The amount of water vapour present in the air varies depending on the atmospheric conditions. Briefly describe a simple test which may be used to prove the presence of water vapour in a sample of air.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

**Total: 7 marks**

7

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9. The burning of fossil fuels is a major source of air pollution. Not only do they produce greenhouse gases such as carbon dioxide and water vapour but also gases that are harmful to humans and the environment.

(a) Give the name or formula of **three** such gases:

(i) Gas 1: \_\_\_\_\_

(ii) Gas 2: \_\_\_\_\_

(iii) Gas 3: \_\_\_\_\_ (3)

(b) Explain how each of these gases comes to be present in the air when diesel is burnt in a car engine.

(i) Gas 1: \_\_\_\_\_  
\_\_\_\_\_

(ii) Gas 2: \_\_\_\_\_  
\_\_\_\_\_

(iii) Gas 3: \_\_\_\_\_  
\_\_\_\_\_ (3)

**Total: 6 marks**

6



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10. Being a transition metal, copper has the following properties:

- (i) Forms compounds with the same anion where copper has a different valency;
- (ii) Forms coloured salts.

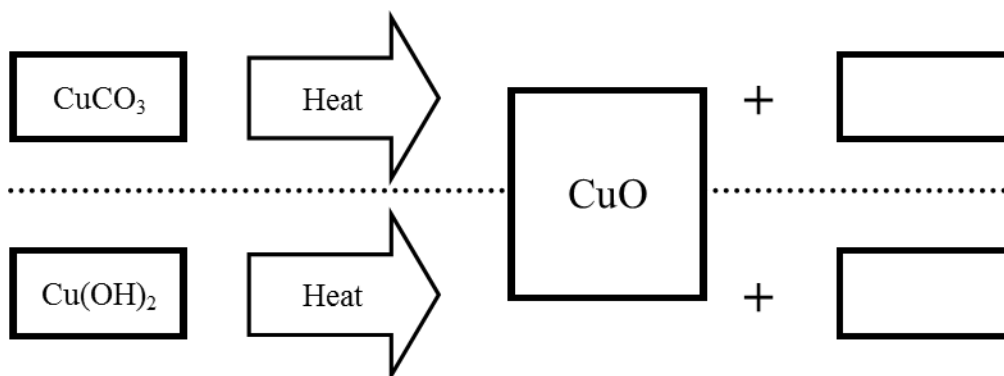
(a) Give examples of compounds to show that copper exhibits the properties listed above.

Property	Example of Compound	Valency
(i) Forms compounds with the same anion where copper has a different valency.		I
		II

Property	Example of Compound	Colour
(ii) Forms coloured salts		

(3)

(b) Copper(II) oxide may be obtained in the laboratory by the action of heat on either copper(II) carbonate or copper(II) hydroxide. Complete the blanks in the figure below by giving the **formulae** of the other products formed during these **two** reactions.



(2)

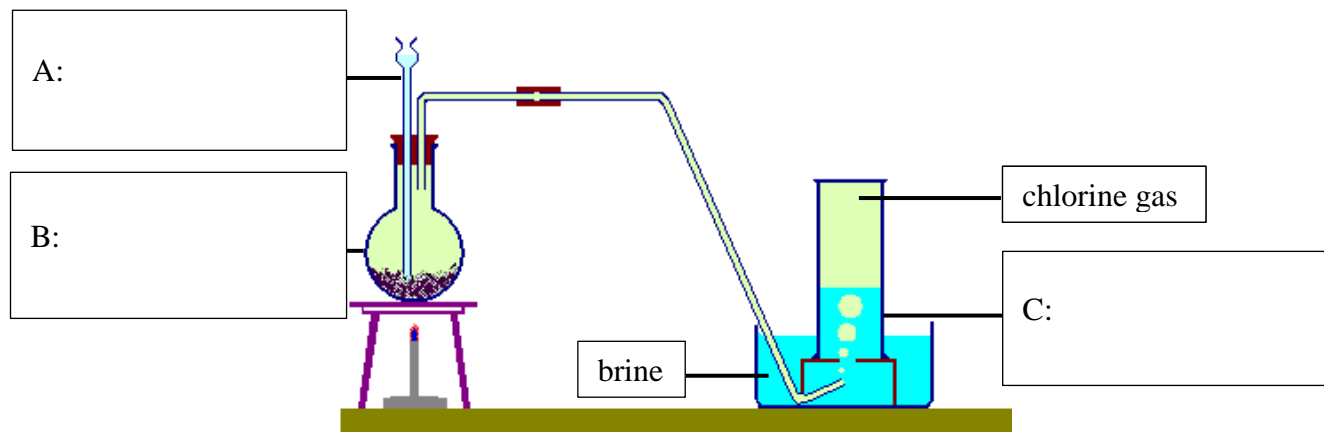
Total: 5 marks

5

**Section B: Answer ALL questions in this Section. Write your answers in the spaces provided.**

11.

- (a) The following diagram shows the apparatus for a suitable method to produce chlorine gas in the laboratory.



(<http://www.chem.canterbury.ac.nz/>)

- (i) Name the pieces of apparatus labelled **A**, **B** and **C** in the diagram. (3)
- (ii) Name a better apparatus than **A** to be used in this experiment. (1)
- \_\_\_\_\_
- (iii) Name the **two** reagents used, the one placed in **A** and the one placed in **B**, to produce chlorine gas.
- Reagent in A: \_\_\_\_\_
- Reagent in B: \_\_\_\_\_ (2)
- (iv) Write a balanced chemical equation for the reaction taking place between the reagents in (a)(iii). (2)
- \_\_\_\_\_

*Question 11 continues on the next page*

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- (b) Consider the reactions of chlorine, bromine and iodine with potassium chloride solution, potassium bromide solution and potassium iodide solution. Fill in the blanks in the table below by writing the products of the reaction or 'no reaction' as may be the case. Some answers have been given as examples.

	KCl solution	KBr solution	KI solution
Chlorine +	No reaction	$\text{Cl}^- + \text{Br}_2$	
Bromine +			
Iodine +			No reaction

(6)

- (c) There is no reaction between chlorine and potassium chloride solution, but chlorine water reacts with potassium bromide solution.

- (i) Give the name of this type of reactions.

\_\_\_\_\_ (1)

- (ii) Write a balanced ionic equation, including state symbols, for the reaction between chlorine and potassium bromide.

\_\_\_\_\_  
 \_\_\_\_\_ (3)

- (iii) Explain briefly, by referring to your answer to (c)(ii), why this reaction takes place.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

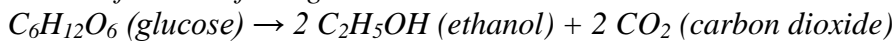
Total: 20 marks

20

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12.

- (a) "Yeast and certain bacteria perform ethanol fermentation . . . The net chemical equation for the production of ethanol from glucose is:



Ethanol fermentation is used for the production of beer, wine and bread."

(<http://chemistry.about.com/>)

- (i) Draw the structural formula of ethanol.

(1)

- (ii) There is functional group isomerism for the formula  $C_2H_6O$ ; one of the isomers is ethanol. Explain the term functional group isomerism and draw the structural formula of the other functional group isomer with the formula  $C_2H_6O$ .

Functional group isomerism: \_\_\_\_\_

\_\_\_\_\_

Structural formula:

(2)

- (iii) Ethanol can be oxidized by acidified potassium dichromate. Give the name and structural formula of the product.

Name: \_\_\_\_\_

Structural Formula:

(2)

- (b) Ethanol and the product in part (a)(iii) react together.

- (i) Give the name of this type of reaction.

\_\_\_\_\_ (1)

- (ii) Write a balanced chemical equation to represent this reaction.

\_\_\_\_\_ (2)

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- (iii) This reaction is very slow unless some concentrated sulfuric acid is added to the reacting mixture. Explain briefly the role of concentrated sulfuric acid on:

The rate of reaction: \_\_\_\_\_ (1)

The equilibrium position: \_\_\_\_\_

\_\_\_\_\_ (2)

- (c) Vinegar is an aqueous solution of a carboxylic acid. Its concentration can be calculated by means of a titration with sodium hydroxide using phenolphthalein indicator.

- (i) Explain the role of phenolphthalein in this experiment.

\_\_\_\_\_ (1)

- (ii) Draw a simple diagram to indicate how the apparatus is set up for an acid-base titration.

(3)

- (d) In an experiment to find the acid concentration of a sample of vinegar, 25.00 cm<sup>3</sup> of vinegar required 20.75 cm<sup>3</sup> of 1.00 mol dm<sup>-3</sup> sodium hydroxide for complete neutralisation.

- (i) What apparatus is used to transfer exactly 25.00 cm<sup>3</sup> of vinegar?

\_\_\_\_\_ (1)

- (ii) Calculate the amount of sodium hydroxide (in moles) present in 20.75 cm<sup>3</sup>.

\_\_\_\_\_

\_\_\_\_\_ (2)

- (iii) Calculate the concentration of the acid in vinegar, given that this acid and sodium hydroxide react at a ratio of 1:1.

\_\_\_\_\_

\_\_\_\_\_ (2)

**Total: 20 marks**

20

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UNIVERSITY OF MALTA, MSIDA

**SECONDARY EDUCATION CERTIFICATE LEVEL**

**SEPTEMBER 2016 SESSION**

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SUBJECT: **Chemistry**  
 PAPER NUMBER: **IIB**  
 DATE: **29<sup>th</sup> August 2016**  
 TIME: **4:00 p.m. to 6:05 p.m.**

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**Useful data:**

**Relative atomic masses: H = 1; N = 14; O = 16; Na = 23; Mg = 24; S = 32; Al = 27; Pb = 207**

**Avogadro constant, L:  $6 \times 10^{23}$**

**$Q = It$**

**1 Faraday = 96500 C**

**Standard temperature and pressure (STP): 0 °C and 1 atm**

**The molar volume for gases at STP: 22.4 dm<sup>3</sup>**

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**Directions to Candidates**

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- 

**For examiners' use only:**

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Score															
Maximum	6	6	7	5	6	5	9	3	7	7	20	20	20	20	100

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**Section A: Answer ALL questions in this Section. Write your answers in the spaces provided.**

1. Materials can be distinguished as conductors and non-conductors.  
 (a) Indicate whether each of the following substances is a conductor (by writing C) or non-conductor (by writing NC) in the table below.

Material	Conductor / Non-conductor
Graphite	
Sodium chloride crystals	
Potassium iodide solution	

(3)

- (b) Briefly explain the difference between conductors and non-conductors.

\_\_\_\_\_ (1)

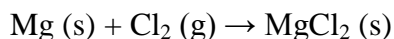
- (c) An aqueous solution of copper(II) sulfate is an electrolyte while an aqueous solution of sugar is not. Explain this difference.

\_\_\_\_\_ (2)

**Total: 6 marks**

6

2. Consider the following redox reaction:



- (a) Continue the following statements:

\_\_\_\_\_ is reduced because it \_\_\_\_\_ electrons.

\_\_\_\_\_ is oxidized because it \_\_\_\_\_ electrons.

(4)

- (b) Consider again the reaction in part (a). Explain what is reduced and what is oxidized in terms of oxidation numbers.

\_\_\_\_\_ (2)

**Total: 6 marks**

6

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3. The percentage composition of water of crystallization in a sample of hydrated magnesium sulfate can be calculated in the laboratory through the procedure outlined below.

(a) Fill in the missing steps in this procedure.

(i)	A sample of hydrated magnesium sulfate crystals is placed in a crucible and weighed.
(ii)	The crucible and contents are then placed over a Bunsen burner and heated for 5 minutes.
(iii)	The crucible is removed and allowed to cool.
(iv)	
(v)	The crucible is returned to the Bunsen burner and heated for a further 5 minutes.
(vi)	
(vii)	
(viii)	If the result of steps (iv) and (vii) are the same the experiment is stopped but if they differ steps (iii) and (iv) are repeated until two identical readings are obtained.

(3)

(b) Explain why step (viii) is required.

\_\_\_\_\_  
\_\_\_\_\_ (1)

(c) Given that the formula of hydrated magnesium sulfate is  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ , calculate the percentage composition by mass of water of crystallization in hydrated magnesium sulfate.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (3)

**Total: 7 marks**

7

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4. Sodium sulfate decahydrate is an efflorescent substance. Other substances can be hygroscopic or deliquescent. Complete the table below to identify the meaning of these terms and provide an example of each.

Term	Example	Definition
<i>Efflorescent</i>	$Na_2SO_4 \cdot 10H_2O$	
		<i>Absorbs water from the atmosphere to form a hydrated salt.</i>
		<i>Absorbs water from the atmosphere to form a solution.</i>

Total: 5 marks

5

5. The main fractions that are produced during the fractional distillation of crude oil are given in Column A. Column B gives the boiling point range of these fractions but they are **not** in the same order as the fractions in Column A. Write the corresponding boiling point range next to the fraction listed in Column A.

Column A	Answer
Fuel oil	
Kerosene	
LPG	
Bitumen	
Petrol	
Diesel	

Column B
< 40 °C
40 °C - 170 °C
170 °C - 250 °C
250 °C - 350 °C
350 °C - 400 °C
> 400 °C

Total: 6 marks

6

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6. The Cassar family bought a new washing machine and wanted to check if the water in their area was hard or soft.
- (a) Describe a simple **chemical** test that may be carried out at home by the Cassar family to determine this. Write the observation one would expect for hard and soft water.

Test	Observation	
	For hard water	For soft water

(3)

- (b) The experiment that the Cassar family carried out indicated that the water in their town was very hard.
- (i) Explain why this could be detrimental to their new washing machine.

\_\_\_\_\_

\_\_\_\_\_ (1)

- (ii) How can the Cassar family solve this problem?

\_\_\_\_\_

\_\_\_\_\_ (1)

**Total: 5 marks**

5

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7. Calcium carbonate and sodium nitrate undergo *thermal decomposition*.

(a) Explain the term *thermal decomposition*.

\_\_\_\_\_ (2)

(b) In both cases a gas is given off. Identify the gas for each reaction.

(i) Gas given off from decomposition of calcium carbonate: \_\_\_\_\_

(ii) Gas given off from decomposition of sodium nitrate: \_\_\_\_\_ (2)

(c) Calcium oxide is the solid produced when calcium carbonate decomposes. Draw the bonding present in calcium oxide, CaO. Show outer electrons only.

(2)

(d) Nitrogen dioxide can be prepared in the laboratory by the thermal decomposition of lead(II) nitrate.

(i) Write a balanced chemical equation for this reaction.

\_\_\_\_\_ (2)

(ii) State **one** observation that will be visible during this reaction.

\_\_\_\_\_ (1)

**Total: 9 marks**

9

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8. When allowed to stand, nitrogen dioxide reaches dynamic equilibrium with dinitrogen tetroxide, according to the equation:



What is the effect on the equilibrium position when:

- (a) the pressure is increased? \_\_\_\_\_
- (b) the temperature is increased? \_\_\_\_\_
- (c) a catalyst is added? \_\_\_\_\_

(3)

**Total: 3 marks**

3

9. A sample of lead(II) nitrate,  $\text{Pb}(\text{NO}_3)_2$ , was found to weigh 3.31 g. Calculate, showing all working:

- (a) the relative mass of lead(II) nitrate;

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (2)

- (b) the number of moles of lead(II) nitrate present in 3.31 g of lead nitrate;

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (1)

- (c) the number of nitrate ions in 3.31 g of lead(II) nitrate.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (3)

**Total: 6 marks**

6

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10. *Some covalent compounds exist as simple molecules while others are found as giant molecules (macromolecules).*

(a) Classify the following substances as simple molecular or giant molecular:

(i) Carbon dioxide: \_\_\_\_\_

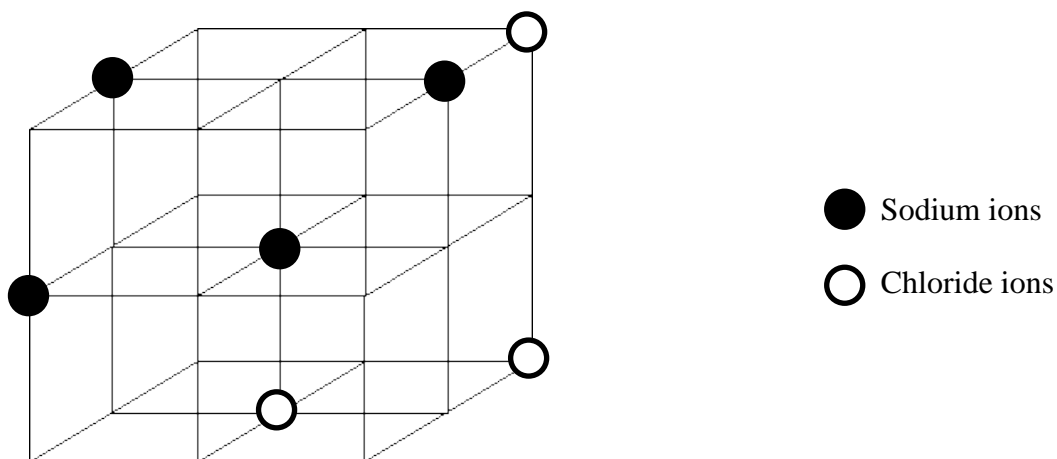
(ii) Graphite: \_\_\_\_\_

(iii) Diamond: \_\_\_\_\_

(iv) Carbon monoxide: \_\_\_\_\_

(2)

(b) Sodium chloride is an ionic compound and exists as an ionic lattice. Complete the diagram below by drawing the remaining sodium and chloride ions.



(2)

(c) By referring to your answers in (a) and (b), explain why these substances have the following melting/sublimation temperatures.

Carbon (diamond)	> 4,000 °C (sublimes)
Carbon dioxide	- 78 °C (sublimes)
Sodium chloride	801 °C (melts)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(3)

**Total: 7 marks**

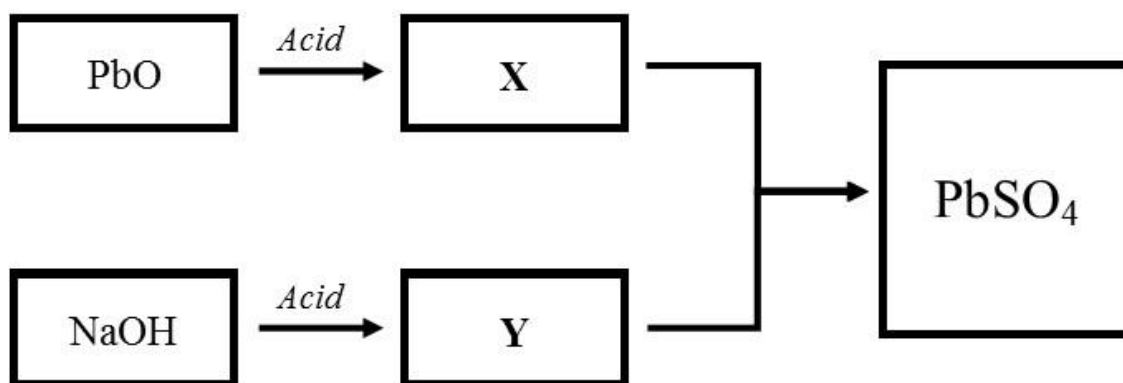
7



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**Section B: Answer TWO questions from this section. Write your answers in the lined pages provided. Clearly indicate the question numbers being answered.**

11. This question is about the preparation of lead(II) sulfate through a precipitation reaction between **X** and **Y**. **X** and **Y** are themselves prepared from lead(II) oxide and sodium hydroxide respectively. The procedure is illustrated in the diagram below:

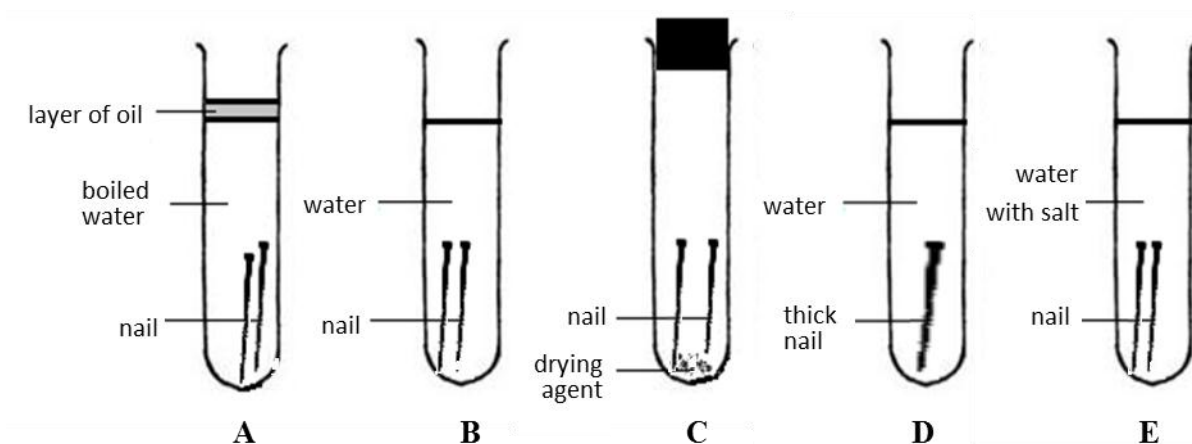


- (a) Explain how compound **X** can be prepared starting from lead(II) oxide and any acid of your choice. Your answer should include:
- the identity of **X**; (1)
  - the identity of the acid used along with lead(II) oxide to produce **X**; (1)
  - a balanced chemical equation for the reaction taking place; (2)
  - the method to produce **X**; and (1)
  - the separation technique/s and procedures required to collect a pure, dry sample of **X**. (3)
- (b) Explain how compound **Y** can be prepared starting from sodium hydroxide. Your answer should include:
- the identity of **Y**; (1)
  - the identity of the acid used along with sodium hydroxide; (1)
  - the method to produce **Y**; (4)
  - a balanced chemical equation for the reaction taking place; and (2)
  - the separation technique/s and procedures required to collect a pure, dry sample of **Y**. (2)
- (c) Solutions of **X** and **Y** are then prepared and mixed together to produce lead(II) sulfate.
- State **one** observation that will be visible during this reaction. (1)
  - If 0.8 moles of **X** are reacted with 0.5 moles of **Y**, what quantity (in moles) of lead(II) sulfate will be produced? (1)

**Total: 20 marks**

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12. The following laboratory setup was used by a student to investigate some of the causes of rusting and other factors that might affect its rate.



- (a) Test-tubes A and C did not show any signs of rusting.
- Why was the water in test-tube A boiled? (1)
  - Why was a layer of oil used in test-tube A? (1)
  - Why was a drying agent used in test-tube C? (1)
  - What would the student performing the experiment conclude about the causes of rusting? (2)
  - What would be observed if the nail in test-tube B is wrapped in piece of magnesium ribbon? Give reasons for your answer. (3)
- (b) The nail in test-tube D had the **same mass** equivalent to two nails used in all the other test-tubes. On a daily basis, the student filters the contents of test-tubes B, D and E, allows them to dry, records their mass and returns them to their original test-tube conditions.
- Will the nails increase or decrease in mass? Explain your answer. (2)
  - Arrange test-tubes B, D and E in order of speed of rusting (slowest first) giving reasons for your answer. (4)
  - Sketch a graph of **mass (g)** against **time (days)** to illustrate your answer to (b)(ii). Indicate on the graph the plots for test-tubes B, D and E. (2)
- (c) The corrosion of iron is a huge cause of concern for many people around the world. List four different ways which may be used to prevent this from happening. (4)

**Total: 20 marks**

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13. Sulfur dioxide gas, SO<sub>2</sub>, is an environmental pollutant but it has useful properties in a laboratory.

(a) Give balanced equations to show how sulfur dioxide can be produced by:

- (i) the burning of sulfur in air or oxygen; (3)
- (ii) the reaction of copper and concentrated sulfuric acid. (4)

(b) Sulfur dioxide may be prepared in the laboratory by the reaction of hydrochloric acid and sodium sulfite according to the equation:



- (i) State **three** observations during this reaction. (3)
- (ii) Why is it better to collect the sulfur dioxide in a gas syringe rather than over water? (1)
- (iii) Excess hydrochloric acid is added carefully to 3.15 g sodium sulfite. Calculate:
  - the number of moles of sodium sulfite; (2)
  - the number of moles of sulfur dioxide gas produced; (2)
  - the volume that the sulfur dioxide produced will occupy if measured at standard temperature and pressure. (2)
- (c) If the same mass of sulfur, 3.15 g, is available, calculate the number of moles of sulfur dioxide that would be produced using the reaction in (a)(i). (4)
- (d) Describe a chemical test that can be used to confirm that the gas collected is in fact sulfur dioxide. (2)

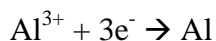
**Total: 20 marks**

DO NOT WRITE ABOVE THIS LINE

14. This question is about the large scale preparations of aluminium and copper – two very useful metals.

(a) Aluminium is extracted by an electrolytic process.

- (i) Name the raw materials which are used. (2)
- (ii) Why must the anode be replaced after a period of use? (2)
- (iii) Give a balanced half-equation to show the reaction occurring at the anode. (2)
- (iv) At the cathode the following reaction occurs:



A current of 3 amperes is allowed to pass for 2 hours through the apparatus. Calculate:

- the quantity of electricity, in faradays, used; (4)
- the number of moles of aluminium which are produced; (2)
- the mass of aluminium produced. (1)

(b) Copper is purified using an electrolytic process.

Write a brief explanation explaining how this purification can be carried out. Your answer must include:

- (i) the name of the electrolyte; (1)
- (ii) the name/s of the materials of the electrodes; (2)
- (iii) the name of the electrode at which copper is collected; (1)
- (iv) a balanced half equation showing the production of copper metal; (1)
- (v) **two** observations while the process is occurring. (2)

**Total: 20 marks**

















PERIODIC TABLE

I		II		III	IV	V	VI	VII	VIII
1 H 1	7 Li 3	9 Be 4	23 Na 11	11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
39 K 19	40 Ca 20	45 Sc 21	51 V 23	55 Mn 25	56 Fe 26	59 Ni 28	63.5 Cu 29	65 Zn 30	79 Se 34
85 Rb 37	88 Sr 38	89 Y 39	91 Zr 40	99 Tc 43	101 Ru 44	106 Pd 46	108 Ag 47	112 Cd 48	127 I 53
133 Cs 55	137 Ba 56	139 La 57	178.5 Hf 72	186 Re 75	190 Os 76	192 Ir 77	197 Au 79	201 Hg 80	210 At 85
223 Fr 87	226 Ra 88	227 Ac 89							222 Rn 86

Key

A	Atomic Number
X	Relative atomic mass
Z	

140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	252 Es 99	257 Fm 100	258 Md 101	259 No 102	260 Lr 103