Index number: _____ SEC06/1.13m

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2013 SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	I
DATE:	21st May 2013
TIME:	9:00 a.m. to 11:00 a.m.

Useful data
Relative atomic masses: H = 1; C = 12; N = 14; O = 16; Na = 23; S = 32; Cl = 35.5
The molar volume for gases at s.t.p. = 22.4 dm^3

Directions to Candidates

- *Write your index number in the space at the top left-hand corner of this page.*
- ***Answer ALL questions.*** *Write 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 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	7	4	5	9	6	6	6	6	5	20	20	100

DO NOT WRITE ABOVE THIS LINE

Section 1: Answer ALL questions in this Section. Write your answers in the spaces provided.

1. (a) A sample of air is analysed by using a series of reagents.
State **one** observation that may be made when a **small** amount of air:
(i) is bubbled through concentrated calcium hydroxide solution;

(ii) is passed over powdered anhydrous copper(II) sulphate.

(2 marks)

(b) Give balanced equations for the reactions occurring in (a)(i) and (a)(ii).
Reaction in (i)

Reaction in (ii)

(4 marks)
[Total: 6 marks]

6

2. The table below shows some data about three elements **P, Q** and **R**. These letters are **NOT** their chemical symbols.

(a) Complete the missing data.

	Mass Number	**Number of protons**	**Number of neutrons**
P	7	3	
Q	12		6
R		17	18

(3 marks)

(b) Using the letters **Q** and **R**, give the formula of a compound that contains the elements **Q** and **R**. _____. (2 marks)

(c) What type of bonding do you expect for the compound between:

(i) **Q** and **R** _____

(ii) **P** and **R** _____

(2 marks)
[Total: 7 marks]

7

DO NOT WRITE ABOVE THIS LINE

3. Consider the following compounds:

$HC \equiv CH$	$CH_3CH_2CH_2CH_2CH_3$	$CH_3CH=CH_2$
A	**B**	**C**

(a) Give the names of the compounds **A** and **B**.

A: _____

B: _____

(2 marks)

(b) Write the compounds **A**, **B** and **C** in order of their boiling points, putting the one with the lowest boiling point first.

_____

(1 mark)

(c) A student has a beaker on the laboratory bench with a liquid in it. The teacher has told the class that it contains one of **A**, **B** or **C.** Which of **A**, **B** or **C** is it likely to be?

_____

(1 mark)
[Total: 4 marks]

4

4. (a) Several elements have *isotopes*. What does the term in italics mean?

_____

_____

(2 marks)

(b) A textbook gives the following data about the element with symbol X:

	Relative abundance
^{6}X	7.42%
^{7}X	92.58%

Use the given data to calculate the relative atomic mass of element X.

_____

_____

_____

(3 marks)
[Total: 5 marks]

5

DO NOT WRITE ABOVE THIS LINE

5. Propane, C_3H_8, can burn in oxygen.
   (a) Give **two** terms to describe the flame that may be observed when propane burns in a plentiful supply of air.

_____

(2 marks)

   (b) Give a balanced equation for the complete combustion of propane.

_____

(2 marks)

   (c) A mixture contains 10.0 cm^3 of propane and 60.0 cm^3 of oxygen at room temperature and pressure. The mixture is ignited and after the reaction takes place, the products are cooled back to room temperature. All gaseous volumes, before and after reaction, are measured at the same temperature and pressure.
   Using the equation in the answer to (b), calculate:
   (i) the volume of carbon dioxide produced;

_____

_____

(1 mark)

   (ii) the volume of the final gaseous mixture at room temperature and pressure.

_____

_____

_____

(4 marks)
[Total: 9 marks]

9

6. The following are oxides of some elements: MgO, Al_2O_3, H_2O, Na_2O, NO_2 .
   (a) From the list choose:

   (i) a basic oxide which is soluble in water: _____

   (ii) a neutral oxide: _____

   (iii) an acidic oxide: _____

   (iv) an amphoteric oxide: _____

(4 marks)

   (b) For the oxide in (a)(iii), give a balanced equation to show how this oxide reacts with water.

_____

(2 marks)
[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

7. Some dilute hydrochloric acid is added dropwise to a small flask containing zinc turnings. The hydrogen given off is collected in a gas syringe.
   (a) Write a balanced equation for the reaction.

(2 marks)

   (b) Sketch a labelled diagram to show how the apparatus can be set up.

(3 marks)

   (c) How can it be checked that some hydrogen gas has collected in the syringe?

(1 mark)
[Total: 6 marks]

6

8. (a) Using the terms **less than 7, 7** and **greater than 7,** complete the table below to indicate the pH value of the following substances.

	pH
lemon juice	
lime water	
cooking oil	
vinegar	

(4 marks)

   (b) (i) Mention an indicator, besides litmus and universal indicator, that can be used to check your answer for lemon juice.

   (ii) What can be observed if your indicator in (b)(i) is used?

(2 marks)
[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

9. (a) Fill in the blanks in the following passage:

A number of elements have different bonding arrangements between atoms, and so have different structures. Carbon exists in two forms, as either diamond or _____. These different physical forms of the same element are called _____. Likewise sulfur also exists in two physical forms, that is _____ and _____ sulfur. (4 marks)

(b) Although sulfur exists in different physical forms, these forms are chemically the same substance. Suggest a simple test to prove this.

_____

_____

(2 marks)

[Total: 6 marks]

6

10. Complete the statements given below using the following words. They may be used once, more than once or not at all.

silver chalk sugar sodium aluminium iron

Powdered _____ reacts with dilute sulfuric acid liberating hydrogen. However, if _____ metal is used the reaction is quite dangerous.

_____ is a very unreactive metal and is not easily attacked by air, water, acid or alkali. After some time in air, an oxide layer is formed on _____ which protects the substance from further attack.

Calcium reacts readily with cold water but _____ will only react if placed in steam.

[Total: 5 marks]

5

DO NOT WRITE ABOVE THIS LINE

Section 2: Answer BOTH questions. Write your answers on the lined pages provided.

11. (a) Magnesium and calcium are in Group 2 of the Periodic Table. Use the copy of the Periodic Table to give:
    (i) the electronic configuration of a calcium atom; and
    (ii) the electronic configuration of a magnesium ion. (2 marks)

    (b) Give the names of **two** substances which cause water hardness. (2 marks)

    (c) Explain how ground water becomes hard water. Your answer must include balanced equations for any reactions mentioned. (4 marks)

    (d) Describe **one** simple chemical test that can be carried out to prove that a sample of distilled water has no hardness in it. (1 mark)

    (e) Potassium is in Group 1 of the Periodic Table. Give balanced equations for:
    (i) the reaction of potassium with oxygen to form substance **G**; and (2 marks)
    (ii) the reaction of substance **G** with water. (2 marks)

    (f) How does a solution of substance **G** from (e)(i) behave with red and blue litmus papers? (2 marks)

    (g) Sodium hydrogen carbonate decomposes on heating according to the equation:

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

    In an experiment, a sample of 100.0 g of sodium hydrogen carbonate was heated.
    (i) Calculate the maximum amount of sodium carbonate, in g, that can be produced. (4 marks)
    (ii) It is noted that the actual quantity of sodium carbonate produced during the experiment was 50.0 g. Express this actual quantity as a percentage of the maximum amount that can be produced. (1 mark)

[Total: 20 marks]

Please turn the page.

DO NOT WRITE ABOVE THIS LINE

12. A student carried out the following tests on substances **D**, **J** and **Y**. Read the information carefully and then answer the questions that follow.
The letters used do not represent the symbols of any element.

- Substance **D** is very soluble in water. A solution of **D** gives no precipitate with sodium hydroxide solution but gives off a pungent gas **E** with hydrochloric acid. Barium chloride solution gives a white precipitate, **F**, when added to a solution of **D**. **F** dissolves in dilute acid.

- A white solid **J** dissolves readily in water. When sodium hydroxide solution is added dropwise to a small amount of a solution of **J** in a test tube, a white precipitate, **L**, is obtained which is insoluble in excess sodium hydroxide solution.
J does not give a colour in a flame.
A few pieces of aluminium foil are added to a solution of **J** in a test tube, followed by a few drops of sodium hydroxide solution. An alkaline gas, **N**, is given off.

- When the white substance **Y** is warmed with sodium hydroxide solution a gas **V** having a pungent smell is produced. **V** gives white fumes, **W,** with hydrogen chloride.
On adding a few drops of calcium(II) nitrate solution to a solution of **Y**, a white suspension, **Z** , is observed.

(a) Give the name or formula of the substances **D, E, F, J, L, N, Y, V, W, Z**. (10 marks)

(b) Give balanced equations for the following:
(i) the reaction of **J** with sodium hydroxide to form **L**;
(ii) the reaction of **Y** with sodium hydroxide solution;
(iii) the reaction of **Y** with calcium nitrate. (6 marks)

(c) Give the name of a reagent that can be used to check the identity of **E** and state any observations expected. (2 marks)

(d) Give the ionic equation, including state symbols, for the reaction of barium chloride with substance **D**. (2 marks)

[Total: 20 marks]

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

PERIODIC TABLE

I	II											III	IV	V	VI	VII	VIII
																	4 He 2
7 Li 3	9 Be 4											11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
23 Na 11	24 Mg 12											27 Al 13	28 Si 14	31 P 15	32 S 16	35.5 Cl 17	40 Ar 18
39 K 19	40 Ca 20	45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27	59 Ni 28	63.5 Cu 29	65 Zn 30	70 Ga 31	73 Ge 32	75 As 33	79 Se 34	80 Br 35	84 Kr 36
85 Rb 37	88 Sr 38	89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178.5 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

Key

Relative atomic mass — A; X; Z — *Atomic Number*

						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

Index Number:_____ SEC06/2A.13m

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2013 SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	IIA
DATE:	22nd May 2013
TIME:	9:00 a.m. to 11:00 a.m.

Useful data

Relative atomic masses: H = 1; C = 12; N = 14; O = 16; Al = 27; Cl = 35.5; Cu = 63.5; Zn = 65
The molar volume for gases at s.t.p. = 22.4 dm^3
Standard temperature and pressure (s.t.p.): 0 ^oC and 1 atm
Faraday constant: 96,500 C
Q = It

Directions to Candidates

- *Write your index number in the space at the top left-hand corner of this page.*
- *Answer ALL questions in Section 1 and any TWO questions from Section 2. Write 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 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	13	14	Total
Score															
Maximum	5	8	6	8	6	6	6	6	5	4	20	20	20	20	100

DO NOT WRITE ABOVE THIS LINE

Section 1: Answer ALL questions in this Section. Write your answers in the spaces provided.

1. (a) Following a heavy snow-storm that hit the British Isles this winter, Skynews reported: *"... **for London** ... more than 100,000 tonnes of salt were used to keep roads clear (from ice and snow) . . . "*

(i) Explain briefly what happens to the melting of ice when salt is added to it.

_____

_____

_____

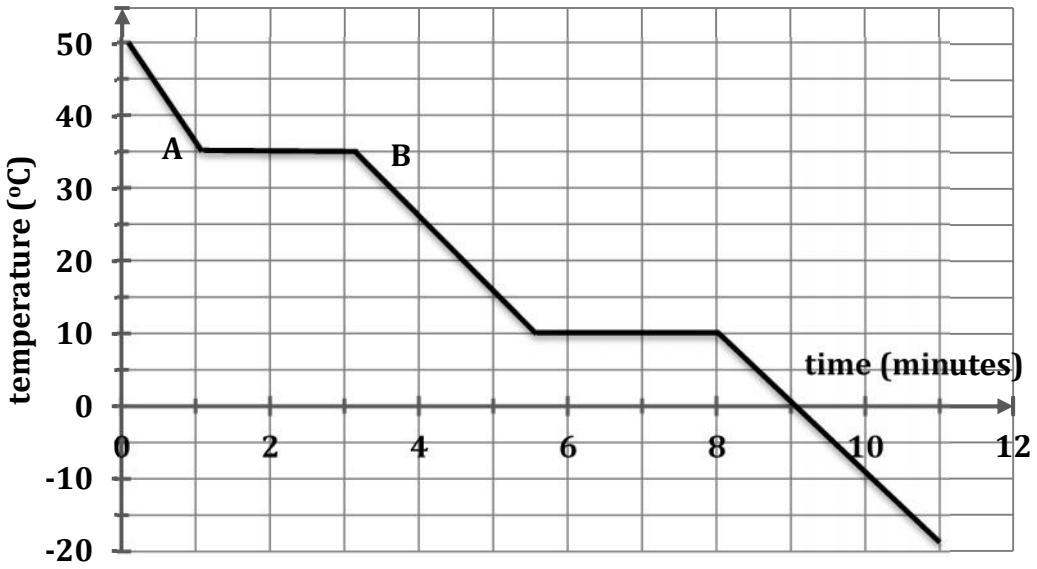
(2 marks)

(ii) State what happens to the boiling point of a liquid if it contains impurities.

_____

(1 mark)

(b) A substance is cooled from 50°C to –20°C. The graph shows the cooling curve for the substance, that is the change in temperature (in °C) with time (in minutes).



From the graph, one can conclude the boiling and the melting points of the substance.

(i) The melting point of the substance is: _____

(1 mark)

(ii) In a different experiment, the line **AB** is at a different distance from the x-axis. What can one conclude from this?

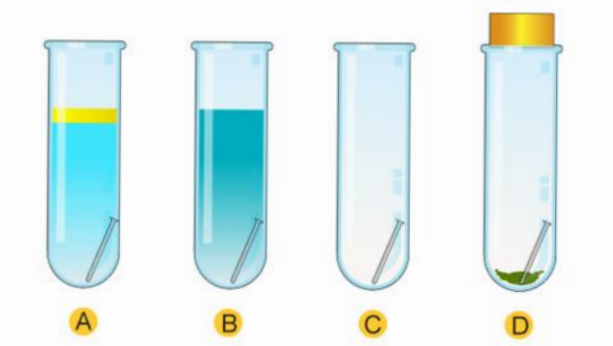
_____

(1 mark)
[Total: 5 marks]

5

DO NOT WRITE ABOVE THIS LINE

2. (a) The following experiment was conducted to investigate the conditions under which rusting of iron occurs. An iron nail is placed in each of four test tubes, under the conditions as indicated below.



http://www.bbc.co.uk/bitesize/standard/chemistry/metals/corrosion/revision/1/

(i) Indicate whether rusting will take place or not in each of the four cases by writing yes or no in the table below.

Test tube	Conditions	Does the nail rust? – yes / no
A	Boiled water + oil layer	
B	Salt water	
C	Air	
D	Air + calcium chloride + stoppered test tube	

(2 marks)

(ii) State the conditions needed for rusting to occur that can be concluded from these experiments.

(3 marks)

(b) A piece of magnesium is sometimes attached to parts of boats to prevent them from corroding. Suggest another method that prevents corrosion. Use the indications in part (a) to explain this method of protection.

(3 marks)
[Total: 8 marks]

8

DO NOT WRITE ABOVE THIS LINE

3. (a) Propane and propene are burnt, and undergo complete combustion, in a plentiful supply of air.
   (i) Write the chemical equation for the complete combustion of propene.

_____

(1 mark)

   (ii) If the combustion of these hydrocarbons is carried out in a limited supply of oxygen, they undergo incomplete combustion. Mention **two** other products that are obtained if the reactions are carried out in a limited supply of air.

_____

(2 marks)

   (b) Explain briefly how propane and propene can be distinguished by a simple chemical test. No equations are required.

_____

_____

_____

_____

(3 marks)
[Total: 6 marks] 6

4. (a) Sulfuric acid is produced industrially through the Contact Process. The process can be summarised into four chemical reactions. The first step of the process is usually the burning of sulfur in an excess of air. Complete the following chemical equations as necessary:

   (i) Step 1 – the burning of sulfur: $S\ (s) + O_2\ (g) \rightarrow SO_2\ (g)$

   (ii) Step 2: $2SO_2\ (g) + O_2\ (g) \rightleftharpoons$ _____ $\Delta H = -196$ kJ/mol

   (iii) Step 3: _____ $+ H_2SO_4\ (l) \rightarrow$ _____

   (iv) Step 4: _____ $+ H_2O\ (l) \rightarrow 2H_2SO_4\ (l)$

(4 marks)

   (b) Step 2 in the Contact Process is a reversible reaction. It is carried out using a catalyst and the conditions are: a pressure of 1 to 2 atmospheres and a temperature of 400 – 450 ^oC.
   (i) Give the chemical formula of the catalyst used.

_____

(1 mark)

DO NOT WRITE ABOVE THIS LINE

(ii) How does the catalyst affect the reversible reaction?

(1 mark)

(iii) The higher the temperature, the faster a reaction proceeds. If the reaction occurs at 1000 ^{o}C, it should be faster. Explain briefly why the temperature that is actually used is 400 – 450 ^{o}C.

(2 marks)

[Total: 8 marks]

8

5. (a) Iron can be obtained from iron(III) oxide in more than one way. It can be obtained by reaction with hydrogen or by reaction with carbon monoxide.

(i) Write the chemical equation for the reaction of iron(III) oxide with hydrogen.

(2 marks)

(ii) Write the chemical equation for the reaction of iron(III) oxide with carbon monoxide.

(2 marks)

(b) "***Making iron – In the blast furnace***

Iron is extracted from iron ore in a huge container called a blast furnace. Iron ores . . . contain iron oxide. The oxygen must be removed from the iron oxide to leave the iron behind. . . ."

http://www.bbc.co.uk/schools/gcsebitesize/science/aqa_pre_2011/rocks/metalsrev2.shtml

(i) Name the iron ore that is used in the blast furnace for the production of iron.

(1 mark)

(ii) Apart from the iron ore, there are another two raw materials that are used in the blast furnace. List these two materials.

(1 mark)

[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

6. (a) Petroleum (crude oil) is a mixture of hydrocarbons including natural gas. Various products are extracted from petroleum. Ethene is one of the gases produced during the refining of petroleum. It can also be obtained by **cracking**.
(i) Name the process by which the various products are extracted from petroleum.

(1 mark)

(ii) Explain the term **cracking**.

(1 mark)

(b) Ethene undergoes a number of reactions.
(i) Write the chemical equation that indicates the hydration of ethene. Indicate the catalyst used.

(2 marks)

(ii) The product in (b)(i) can also be obtained by fermentation of glucose. Write the chemical equation for fermentation, indicating the catalyst used.

(2 marks)
[Total: 6 marks]

6

7. **By using oxidation numbers**, deduce whether the element or ion indicated in bold print is being oxidised or reduced. Show your reasoning clearly.
(a) **Cu** $\rightarrow Cu^{2+} + 2e$

(2 marks)

(b) **Zn** + $H_2SO_4 \rightarrow ZnSO_4 + H_2$

(2 marks)

DO NOT WRITE ABOVE THIS LINE

(c) $Zn + \mathbf{Cu}SO_4 \rightarrow ZnSO_4 + Cu$

_____

_____

(2 marks)

6

[Total: 6 marks]

8.(a)Diagrams **A** and **B** are the energy level diagrams for two different reactions.

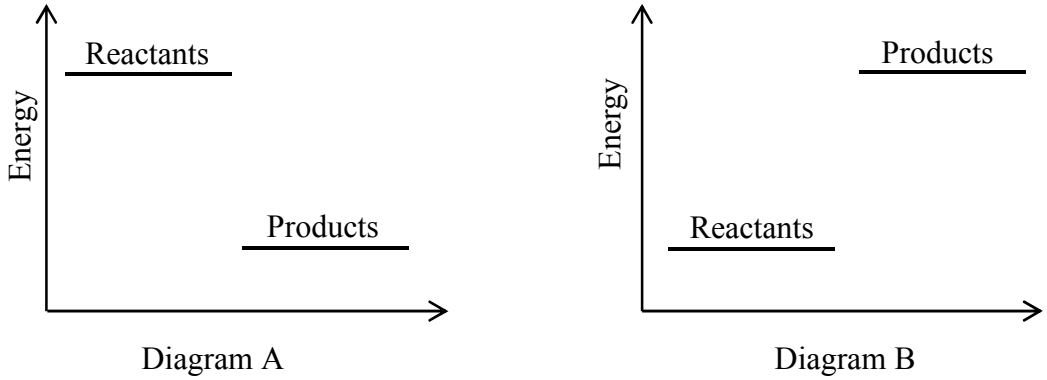


Diagram A Diagram B

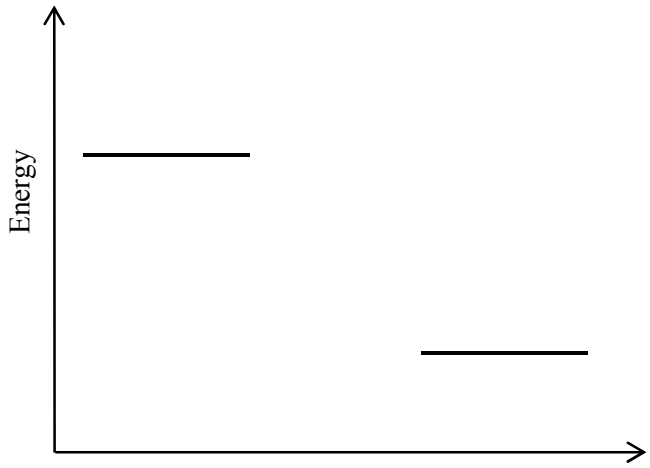
(i) An endothermic reaction is represented by diagram _____

(ii) An exothermic reaction is represented by diagram _____

(iii) The reaction of carbon with oxygen is represented by diagram _____

(3 marks)

(b) Complete the diagram below to give an energy profile of a reaction, and indicate the ΔH and the activation energy of the reaction on the graph.



(3 marks)

6

[Total: 6 marks]

DO NOT WRITE ABOVE THIS LINE

9. The conversion of dinitrogen tetroxide to nitrogen dioxide is a reversible reaction that can be represented by the following equation:

$$N_2O_4\ (g) \rightleftharpoons 2NO_2\ (g) \qquad \Delta H = +58 kJ\ mol^{-1}$$

(a) Indicate the colour change that will be observed as this reaction proceeds.

_____

(1 mark)

(b) Explain briefly **two changes** that can be carried out to shift the equilibrium towards a higher concentration of nitrogen dioxide.

_____

_____

_____

(2 marks)

(c) Explain why the rate of a chemical reaction increases with temperature.

_____

_____

_____

(2 marks)

[Total: 5 marks]

5

10. Describe what happens when each of the following substances is placed in a beaker of water:

(a) Rock salt (NaCl): _____

(1 mark)

(b) Limestone ($CaCO_3$): _____

(1 mark)

(c) Gypsum ($CaSO_4.2H_2O$): _____

(1 mark)

(d) Slaked lime ($Ca(OH)_2$): _____

(1 mark)

[Total: 4 marks]

4

DO NOT WRITE ABOVE THIS LINE

Section 2: Answer TWO questions from this Section. Write your answers in the lined pages provided.

11. (a) When sodium nitrate, zinc nitrate and sodium hydrogencarbonate are heated, they all undergo decomposition reactions. Write an equation, including state symbols, and describe the expected observations when **each** is heated to constant mass. (9 marks)

(b) When a sample of zinc nitrate was heated until there was no further change in mass, a solid residue was left. Calculate the mass of solid residue that is produced when 3.78 g of zinc nitrate is heated. (4 marks)

(c) Copper(II) chloride can be prepared in the laboratory by the action of hydrochloric acid on copper(II) carbonate.

(i) Write an equation representing the reaction that takes place between copper(II) carbonate and the acid. (2 marks)

(ii) Calculate the mass of copper(II) carbonate and the volume of 2 $moldm^{-3}$ hydrochloric acid required to produce 2.71 g of copper(II) chloride, assuming complete reaction. (5 marks)

[Total: 20 marks]

12. (a) As is the case in other metals, aluminium is extracted from an ore present in the earth's crust.

(i) While iron is extracted by using a gaseous reducing agent, aluminium is extracted by the electrolysis of the molten ore. Explain briefly why this difference is necessary. (2 marks)

(ii) Outline the main steps in the process of the extraction of aluminium, starting from the purified ore. No technical details are required, but the main focus should be the processes taking place at the electrodes, including chemical equations whenever necessary. (5 marks)

(iii) If a current of 100,000 A passes through the electrolytic cell, calculate the quantity of charge that passes in one hour. (2 marks)

(iv) Assuming that the plant works for 24 hours every day, calculate the maximum mass of aluminium (to the nearest kg) that can be produced daily. (4 marks)

(v) Suggest what factor can be changed in order to have a production of 1000 kg of aluminium **a day**. Indicate any assumption/s that are being taken into consideration in these calculations. (2 marks)

(b) *"Copper is a good conductor of electricity . . . The extraction of copper from copper ore is done by reduction with carbon. However, the copper produced is not pure enough for use as a conductor, so it is purified using electrolysis."*

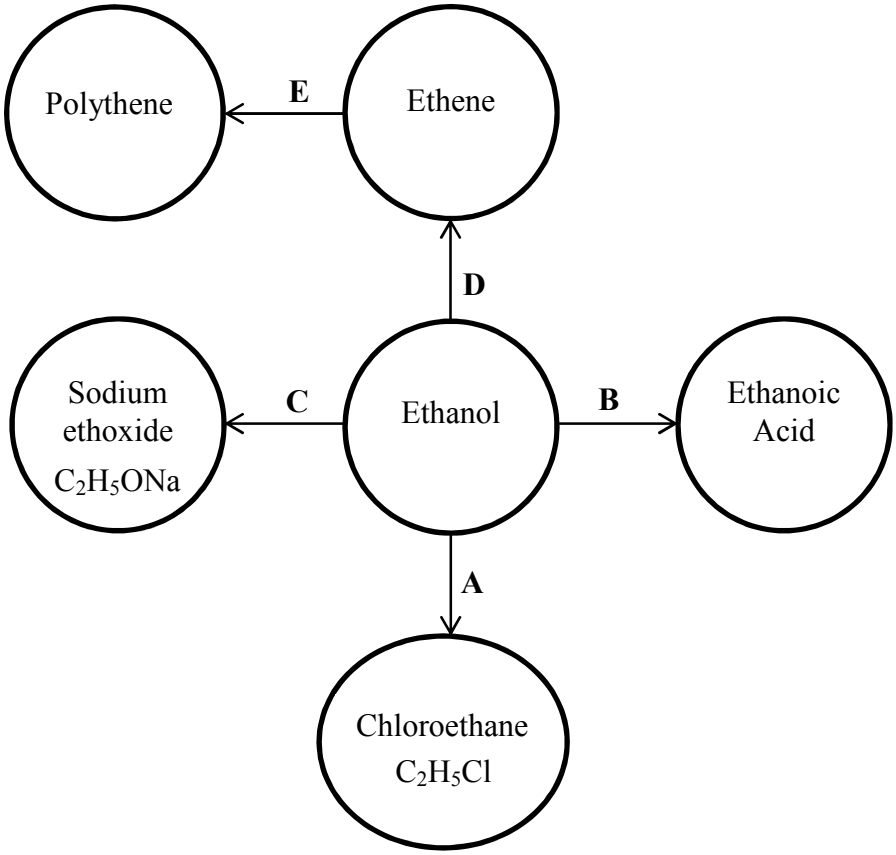
http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/ions/electrolysisrev3.shtml

Outline the process by which copper *"is purified using electrolysis."* (5 marks)

[Total: 20 marks]

DO NOT WRITE ABOVE THIS LINE

13. Consider the following reaction scheme and answer the questions below. The letters **A**, **B**, **C**, **D** and **E** are not chemical symbols.



(a) Explain briefly each of the chemical changes indicated by letters **A** to **E**. Include chemical equations and conditions wherever necessary. (15 marks)

(b) (i) Describe a simple chemical test to show that ethanoic acid has acidic properties. Write the equation for the reaction that takes place. (3 marks)

(ii) How can ethanoic acid be used to distinguish between two unlabelled containers containing ethanol and ethanoic acid respectively? Any other additional reagent can be used. (2 marks)

[Total: 20 marks]

14. (a) (i) Carbon dioxide, carbon monoxide, sulfur dioxide and nitrogen dioxide are the world's major polluting gases. For **each** gas state: **one** likely source, and **one** harmful effect on the environment. (8 marks)

(ii) Name a greenhouse gas, without considering any of the four gases indicated in (a)(i). (1 mark)

(iii) Explain briefly what is meant by the term 'greenhouse effect'. Include a diagram in your explanation. (2 marks)

DO NOT WRITE ABOVE THIS LINE

(b) (i) Considering one of the gases in (a)(i), explain briefly its role in the production of acid rain. Include chemical equations wherever necessary. (2 marks)

(ii) *"Acid rain triggers a number of inorganic and biochemical reactions with deleterious* (harmful) *environmental effects . . ."*

http://www.chemistry.wustl.edu/~edudev/LabTutorials/Water/FreshWater/acidrain.html

Outline **one** harmful effect of acid rain. Include chemical equations wherever necessary. (2 marks)

(c) The build-up of CFCs in the earth's atmosphere is undesirable.

(i) What does CFC stand for? (1 mark)

(ii) State **two** sources of CFCs. (2 marks)

(iii) Explain briefly the harmful effects that the accumulation of CFCs in the atmosphere can have. (2 marks)

[Total: 20 marks]

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

PERIODIC TABLE

I	II										III	IV	V	VI	VII	VIII
																4 **He** 2
7 **Li** 3	9 **Be** 4										11 **B** 5	12 **C** 6	14 **N** 7	16 **O** 8	19 **F** 9	20 **Ne** 10
23 **Na** 11	24 **Mg** 12										27 **Al** 13	28 **Si** 14	31 **P** 15	32 **S** 16	35.5 **Cl** 17	40 **Ar** 18
39 **K** 19	40 **Ca** 20	45 **Sc** 21	48 **Ti** 22	51 **V** 23	52 **Cr** 24	55 **Mn** 25	56 **Fe** 26	59 **Co** 27	59 **Ni** 28	63.5 **Cu** 29	65 **Zn** 30	70 **Ga** 31	73 **Ge** 32	75 **As** 33	79 **Se** 34	80 **Br** 35	84 **Kr** 36
85 **Rb** 37	88 **Sr** 38	89 **Y** 39	91 **Zr** 40	93 **Nb** 41	96 **Mo** 42	99 **Tc** 43	101 **Ru** 44	103 **Rh** 45	106 **Pd** 46	108 **Ag** 47	112 **Cd** 48	115 **In** 49	119 **Sn** 50	122 **Sb** 51	128 **Te** 52	127 **I** 53	131 **Xe** 54
133 **Cs** 55	137 **Ba** 56	139 **La** 57	178.5 **Hf** 72	181 **Ta** 73	184 **W** 74	186 **Re** 75	190 **Os** 76	192 **Ir** 77	195 **Pt** 78	197 **Au** 79	201 **Hg** 80	204 **Tl** 81	207 **Pb** 82	209 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
223 **Fr** 87	226 **Ra** 88	227 **Ac** 89															

Key

Relative atomic mass — A
X
Z — *Atomic Number*

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

Index Number:_____ SEC06/2B.13m

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2013 SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	IIB
DATE:	22nd May 2013
TIME:	9:00 a.m. to 11:00 a.m.

Useful data

Relative atomic masses: H = 1; C = 12; N = 14; O = 16; Na = 23; Al = 27; S = 32; Cu = 63.5; Zn = 65
The molar volume for gases at s.t.p. = 22.4 dm^3
Standard temperature and pressure (s.t.p.): 0 ^oC and 1 atm
Faraday constant: 96,500 C
Q = It

Directions to Candidates

- *Write your index number in the space at the top leftt-hand corner of this page.*
- *Answer ALL questions in Section 1 and any TWO questions from Section 2. Write 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 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.*

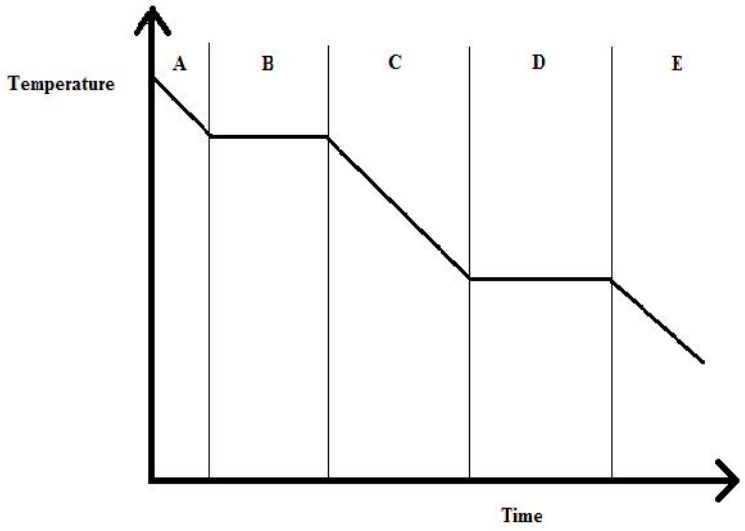
For examiners' use only:

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

DO NOT WRITE ABOVE THIS LINE

Section 1: Answer all questions in this section: Write your answers in the spaces provided.

1. The following graph shows the temperature of a substance as it cools down.



(a) (i) In what physical state would the substance in region **A** of the graph be present in?

(1 mark)

(ii) Give the name of the process that is taking place in region **B** of the graph.

(1 mark)

(iii) Explain, in terms of particles, why there is no change in the temperature of the substance in part **D.**

(2 marks)

(b) In a snow storm that hit the British Isles this winter Skynews reported that *"… **for London** … more than 100,000 tonnes of salt were used to keep roads clear (from ice and snow) … "*. How does salt help in keeping roads clear from ice and snow?

(2 marks)
[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

2. (a) List the **two** conditions which must be present for rusting to take place.

(i) _____

(ii) _____

(2 marks)

(b) Suggest another substance which will make a piece of iron rust faster.

The presence of _____

(1 mark)

(c) A piece of magnesium or zinc is sometimes attached to parts of boats to prevent them from corroding. Mention another **two** ways of protection from corrosion.

(i) _____

(ii) _____

(2 marks)

(iii) State another way of preventing moving parts of a machine from rusting.

_____

(1 mark)

[Total: 6 marks]

6

3. (a) Butane (C_4H_{10}) is the gas which is used as fuel in some gas cookers. Give the equation for the reaction that takes place when this gas is burnt completely in a plentiful supply of air.

_____

(2 marks)

(b) Give the formula of the gas that is produced if butane is burnt in a limited supply of air.

_____

(1 mark)

(c) The gas that is produced in **(b)** is poisonous. Explain what happens if this gas is inhaled.

_____

_____

(1 mark)

(d) Give the equation to show how the gas in **(b)** is formed in the blast furnace.

_____

(2 marks)

[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

4. The following reaction scheme shows how sulfur may be used in the industrial preparation of sulfuric acid. However some formulae have been replaced by the letters **A**, **B, C** and **D**. (The letters **A**, **B**, **C** and **D** are not the symbols of any particular element.)

$S + O_2 \longrightarrow$ **A** $\xrightarrow{+ O_2}$ **B** $\xrightarrow{+ C}$ $H_2S_2O_7$ $\xrightarrow{+ D}$ H_2SO_4

(a) Give the correct formulae for the substances **A, B, C** and **D.**

Formula for **A:** _____ Formula for **B:** _____

Formula for **C:** _____ Formula for **D:** _____

(4 marks)

(b) Give the name of the catalyst used in the reaction to produce substance **B.**

_____

(1 mark)

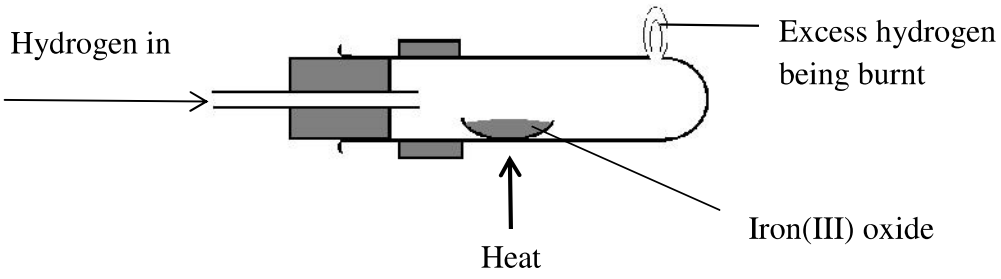
(c) Sulfuric acid is used in the preparation of hydrogen chloride. Give the equation for this reaction.

_____

(1 mark)
[Total: 6 marks]

6

5. The following diagram shows a simple laboratory setting for the reduction of iron(III) oxide **(Fe_2O_3).**



(a) (i) Write down the equation for the reaction that takes place during the experiment.

_____

(2 marks)

(ii) What change in colour is expected?

_____

(1 mark)

DO NOT WRITE ABOVE THIS LINE

(b) (i) If this reaction were to be carried out on a large scale, would hydrogen gas be used?

_____

(1 mark)

(ii) Give a reason for the answer to (b) (i).

_____

(1 mark)

(c) Why is the excess hydrogen coming out of the tube burnt?

_____

(1 mark)

[Total: 6 marks]

6

6. Ethene is one of the gases produced during the refining of petroleum.

(a) Give the structural formula of this gas.

(1 mark)

(b) Ethene may be converted to ethanol.

(i) Give the name or formula of the substance that must be added to ethene to give ethanol.

_____

(1 mark)

(ii) Give the name or formula of the catalyst used during this reaction.

_____

(1 mark)

(iii) At what temperature would the best yield of ethanol be obtained?

_____

(1 mark)

(c) Ethanol may also be obtained by the process called fermentation.

(i) Give the name of the substance from which ethanol is produced by fermentation.

_____

(1 mark)

(ii) Give the name of the catalyst used in the final stage of this process.

_____

(1mark)

[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

7. For each of the following reactions work out the oxidation state of the element or ion which appears in bold print and state whether it has been oxidised or reduced.

(a) $\mathbf{Zn} + H_2SO_4 \rightarrow \mathbf{Zn}SO_4 + H_2$

Oxidation state? ☐ ☐

During this reaction zinc **(Zn)** has been _____

(2 marks)

(b) $\mathbf{Fe}_2O_3 + 2Al \rightarrow Al_2O_3 + 2\mathbf{Fe}$

Oxidation state? ☐ ☐

During this reaction iron **(Fe)** has been _____

(2 marks)

(c) $\mathbf{Cu} \rightarrow \mathbf{Cu}^{2+} + 2e$

Oxidation state? ☐ ☐

During this reaction copper **(Cu)** has been _____

(2 marks)

[Total: 6 marks]

6

8. (a) Diagrams **A** and **B** below show the energy changes that take place during two different reactions. Draw the activation energy on each of these diagrams.

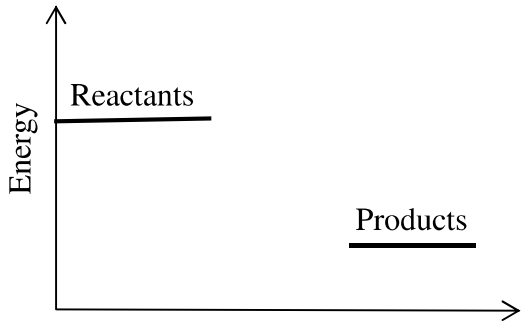


Diagram A

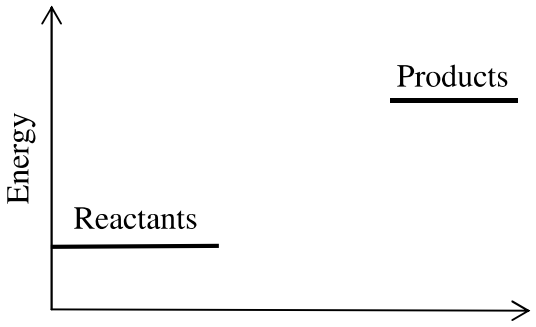


Diagram B

(2 marks)

(b) What type of reaction do diagrams **A** and **B** represent?

(i) An endothermic reaction is represented by diagram _____

(ii) An exothermic reaction is represented by diagram _____

(2 marks)

(c) Which of the above graphs would represent:

(i) combustion? _____

(ii) a neutralisation reaction? _____

(2 marks)

[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

9. Dinitrogen tetroxide may be converted to nitrogen dioxide according to the equation:

$$N_2O_4(g) \rightleftharpoons 2NO_2(g) \qquad \Delta H = +58kJ\ mol^{-1}$$

(a) What is the colour change that may be observed during this reaction?

_____

(1 mark)

(b) In a reaction that is in equilibrium, the rate of the forward reaction is equal to the rate of the reverse reaction. List **two** changes that may be used so that the reaction shown above, produces more nitrogen dioxide.

Change 1:_____

Change 2:_____

(2 marks)

(c) How would the presence of a catalyst affect the position of the equilibrium in a reversible reaction?

_____

(1 mark)

(d) Explain why the rate of a chemical reaction increases on increasing the temperature.

_____

_____

_____

(2 marks)
[Total: 6 marks]

6

10. Describe what happens when each of the following substances is placed in a beaker of water:

(a) Rock salt (NaCl) _____

(1 mark)

(b) Limestone ($CaCO_3$) _____

(1 mark)

(c) Gypsum ($CaSO_4.2H_2O$) _____

(1 mark)

(d) Natural gas (a mixture of hydrocarbons, mainly methane) _____

_____

(1 mark)

(e) Slaked lime ($Ca(OH)_2$) _____

(1 mark)

(f) Coke (mainly C) _____

(1 mark)
[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

Section 2: Answer TWO questions from this section. Write your answers in the lined pages provided.

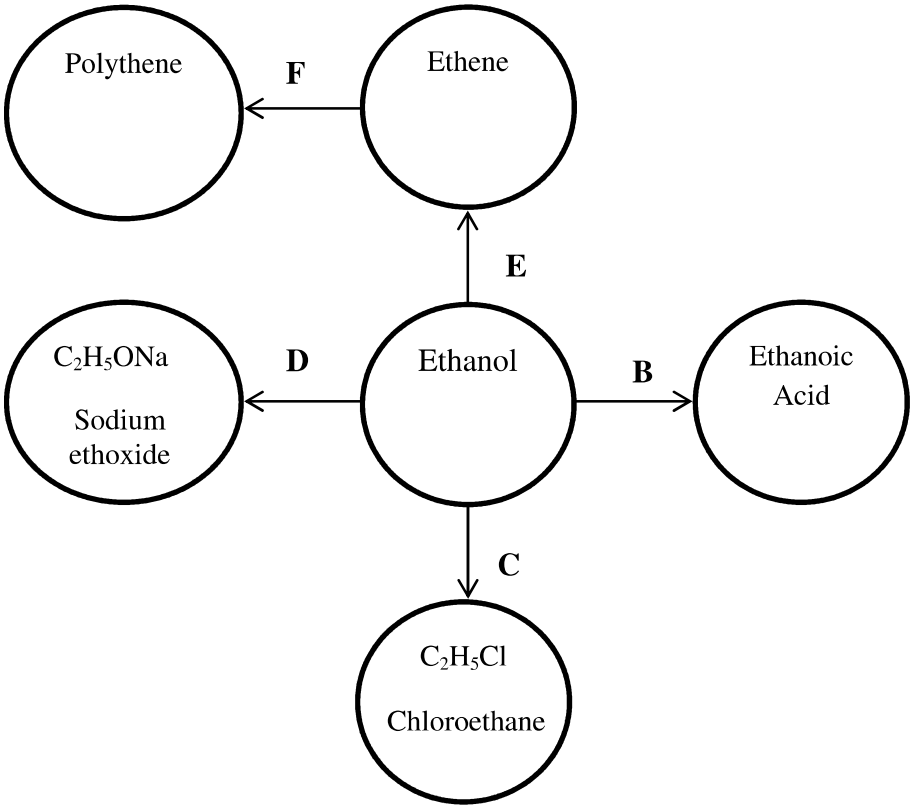
11. (a) Different products are obtained when different metal nitrates are heated. Write an equation and explain what one would expect to see when each of the following nitrates is heated to constant mass:
    (i) sodium nitrate; and
    (ii) zinc nitrate. (6 marks)

    (b) (i) Write the equation for the reaction that occurs when sodium hydrogencarbonate is heated. (2 marks)
    (ii) What mass of solid residue is obtained when 3.78 g of zinc nitrate is heated until there is no further change in mass. (5 marks)

    (c) (i) Copper(II) sulfate may be prepared in the lab by the action of an acid on copper(II) carbonate. Write an equation for the reaction, including all state symbols. (2 marks)
    (ii) In the experiment in c(i), 4.0 g of copper(II) sulfate ($CuSO_4$) were produced. What volume of sulfuric acid of concentration 2 mol dm^{-3} was required? (3 marks)
    (iii) Find the volume of gas measured at s.t.p. that could be produced during this reaction. (2 marks)

[Total: 20 marks]

12. Consider the following reaction scheme and answer the questions below. (In this question the letters **B, C, D, E** and **F** do not represent the symbols of any element.)



(a) Describe a simple experiment to show how you would carry out change **B** in the laboratory. (3 marks)

DO NOT WRITE ABOVE THIS LINE

(b) (i) Draw the structural formula of ethanoic acid. (1 mark)
(ii) Describe a simple chemical test that can be carried out in the laboratory to show that ethanoic acid has the properties of an acid. Write the equation for the reaction that takes place. (4 marks)

(c) Reaction **C** may be brought about by the addition of phosphorus(V) chloride. Give the equation for the reaction that takes place. (2 marks)

(d) Give an equation for the reaction between ethanol and ethanoic acid. (2 marks)

(e) (i) When a piece of sodium is added to ethanol reaction **D** takes place. Give the equation for this reaction. (2 marks)
(ii) What volume of gas at s.t.p. will be produced during the reaction in e(i) if 0.575 g of sodium are added to excess of ethanol. (4 marks)

(f) (i) What type of reaction is taking place in change **E**? (1 mark)
(ii) Give one use of the compound polythene. (1 mark)

[Total: 20 marks]

13. (a) Both iron and aluminium are present in the earth's crust as their oxide ores. However while iron is extracted by using a gaseous reducing agent, aluminium is extracted by the electrolysis of the molten ore. Briefly explain why a different method is necessary. (2 marks)

(b) Outline the extraction of iron in the blast furnace by giving the equations for the chemical changes that take place and explaining why each reaction is important. (9 marks)

(c) (i) Give one large scale use of aluminium metal. (1 mark)
(ii) Give the equation for **each** reaction that takes place at the cathode and the anode during the extraction of aluminium from its ore. (4 marks)
(iii) Calculate the mass of aluminium produced when 100,000 amperes are passed through the cathode in 1 hour. (4 marks)

[Total: 20 marks]

14. (a) Carbon dioxide, carbon monoxide, sulfur dioxide and nitrogen dioxide are the world's main polluting gases. For **each** gas state **one** likely source and **one** harmful effect on the environment. (8 marks)

(b) Chlorofluorocarbons (CFCs) affect one of the gases that is naturally present in the upper atmosphere.
(i) Mention the name and the formula of this gas. (2 marks)
(ii) Explain the importance of the presence of this gas in the upper atmosphere. (1 mark)
(iii) Mention **one** harmful effect of its depletion. (1 mark)
(iv) Mention **two** harmful effects of the presence of this gas in the lower atmosphere. (2 marks)

(c) (i) Explain what is meant by the term "greenhouse effect". (3 marks)
(ii) State **one** disadvantage of the "greenhouse effect". (1 mark)
(iii) Mention **two** other greenhouse gases, apart from the one included in the list of gases in (a). (2 marks)

[Total: 20 marks]

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

DO NOT WRITE ABOVE THIS LINE

PERIODIC TABLE

I	II										III	IV	V	VI	VII	VIII
																4 **He** 2
7 **Li** 3	9 **Be** 4										11 **B** 5	12 **C** 6	14 **N** 7	16 **O** 8	19 **F** 9	20 **Ne** 10
23 **Na** 11	24 **Mg** 12										27 **Al** 13	28 **Si** 14	31 **P** 15	32 **S** 16	35.5 **Cl** 17	40 **Ar** 18
39 **K** 19	40 **Ca** 20	45 **Sc** 21	48 **Ti** 22	51 **V** 23	52 **Cr** 24	55 **Mn** 25	56 **Fe** 26	59 **Co** 27	59 **Ni** 28	63.5 **Cu** 29	65 **Zn** 30	70 **Ga** 31	73 **Ge** 32	75 **As** 33	79 **Se** 34	80 **Br** 35	84 **Kr** 36
85 **Rb** 37	88 **Sr** 38	89 **Y** 39	91 **Zr** 40	93 **Nb** 41	96 **Mo** 42	99 **Tc** 43	101 **Ru** 44	103 **Rh** 45	106 **Pd** 46	108 **Ag** 47	112 **Cd** 48	115 **In** 49	119 **Sn** 50	122 **Sb** 51	128 **Te** 52	127 **I** 53	131 **Xe** 54
133 **Cs** 55	137 **Ba** 56	139 **La** 57	178.5 **Hf** 72	181 **Ta** 73	184 **W** 74	186 **Re** 75	190 **Os** 76	192 **Ir** 77	195 **Pt** 78	197 **Au** 79	201 **Hg** 80	204 **Tl** 81	207 **Pb** 82	209 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
223 **Fr** 87	226 **Ra** 88	227 **Ac** 89															

Key

Relative atomic mass — A; X; Z — *Atomic Number*

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