Index Number: _____ SEC06/1.13s

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

SECONDARY EDUCATION CERTIFICATE LEVEL

SEPTEMBER 2013 SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	I
DATE:	5th September 2013
TIME:	9:00 a.m. to 11:00 a.m.

Useful data

Relative atomic masses: O = 16; Mg = 24

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	**5**	**4**	**6**	**6**	**9**	**6**	**6**	**6**	**6**	**6**	**20**	**20**	**100**

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

1. Use the following terms to complete the paragraph below. Each term may be used once, more than once or not at all.

molecules boiling energy purity melting sublimation condensation

When ice is heated, its particles gain _____ and it turns into a liquid. The temperature at which this change in state occurs is called the _____ point of the solid. On further heating the _____ point of liquid water is reached and steam is obtained. These two temperatures can be used to check the _____ of the water.

When solid iodine crystals are heated they undergo _____.

5

[Total: 5 marks]

2. (a) Petroleum (crude oil) is a mixture of hydrocarbons including natural gas, which can be separated into various parts. Name the process that can be used for this separation.

_____

(1 mark)

(b) Mention **two** products, apart from petrol (or gasoline), that are produced by the separation of petroleum.

_____

(2 marks)

(c) Long chain alkanes can be made to undergo a process to form shorter chain alkanes and ethane: petrol can be obtained by this process. Name the process.

_____

(1 mark)

[Total: 4 marks]

4

3. The table below shows experimental results that Andrea obtained during a practical at school. In this experiment, a piece of magnesium ribbon was heated in a crucible, first at low heat for 5 to 10 minutes and then at full heat with the lid half open for another 5 to 10 minutes. The crucible was then left to cool and weighed. The crucible was heated again for 5 to 10 minutes at high heat, then cooled and reweighed.

   The following experimental data was obtained:

Items	Mass (g)
Crucible and lid	17.606
Crucible, lid and magnesium	17.654
Crucible, lid and oxide of magnesium produced (first heating)	17.686
Crucible, lid and oxide of magnesium produced (second heating)	17.686

   (a) Calculate the mass of magnesium used.

_____

(1 mark)

   (b) Calculate the mass of oxide of magnesium produced.

_____

(1 mark)

   (c) Calculate the mass of oxygen in the oxide of magnesium produced.

_____

(1 mark)

   (d) Calculate the empirical formula of the compound between magnesium and oxygen.

_____

_____

_____

_____

(3 marks)
[Total: 6 marks]

6

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4. Carbon monoxide is a very toxic (poisonous) gas.

   (a) Give a balanced equation to show how methane, CH_4, can burn in air to give **carbon monoxide and water only**.

   _____

   (2 marks)

   (b) How can it be checked that a gas is carbon monoxide?

   _____

   (1 mark)

   (c) What is the effect of carbon monoxide on the body?

   _____

   (1 mark)

   (d) How can the reaction in (a) be improved so that carbon dioxide and not carbon monoxide is formed?

   _____

   (1 mark)

   (e) How can it be checked that a gas jar contains carbon dioxide?

   _____

   (1 mark)

[Total: 6 marks]

6

5. (a) Complete the following equations which represent some properties of sulfuric acid.

   $H_2SO_4 + Zn \rightarrow$ _____ + _____

   $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4$ (aq) + _____

   H_2SO_4 (conc) + NaCl (s) $\rightarrow NaHSO_4$ + _____

   (4 marks)

   (b) (i) Balance the following equation:

   Cu(s) + ____ H_2SO_4 (conc) $\rightarrow$ $CuSO_4$ (aq) + ____ H_2O (l) + ____ SO_2 (g)

   (3 marks)

   (ii) What property of sulfuric acid is being shown in this reaction?

   _____

   (1 mark)

   (iii) State **one** observation that can be made in this reaction.

   _____

   (1 mark)

[Total: 9 marks]

9

6. (a) Give ionic equations for the following reactions:

(i) iron(II) sulphate ($FeSO_4$) solution reacting with sodium hydroxide (NaOH) solution;

_____

_____

(2 marks)

(ii) copper(II) chloride ($CuCl_2$) solution reacting with silver nitrate ($AgNO_3$) solution.

_____

_____

(2 marks)

(b) Give **one** observation that can be made in (a)(i) and **one** observation in (a)(ii).

Observation in (a)(i): _____

_____

Observation in (a)(ii): _____

_____

(2 marks)

[Total: 6 marks]

6

7. Consider the following reaction and the corresponding ΔH value:

$$2NO_2(g) \rightleftharpoons N_2O_4(l) \qquad \Delta H = -57.2kJ$$

Write **True** or **False** next to each of the following statements that refer to the reaction.

(a)	The symbol $\rightleftharpoons$ means that N_2O_4 is formed very fast.	
(b)	It is best to carry out the reaction in a fume cupboard.	
(c)	Heat is necessary to change NO_2 into N_2O_4.	
(d)	A catalyst will produce more of the gas.	
(e)	An increase in pressure will produce more N_2O_4.	
(f)	The intensity of the brown colour increases as the temperature decreases.	

[Total: 6 marks]

6

8. In a laboratory experiment John reacted together dilute hydrochloric acid and dilute sodium hydroxide solution, according to the equation:

$$HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l) \qquad \Delta H = -57.3kJ$$

(a) What does the symbol ΔH represent?

_____

(2 marks)

(b) Use 'energy' as y-axis and 'progress of reaction' as x-axis to draw a well-labelled energy level diagram for the reaction which is represented by the equation given above.

(3 marks)

(c) During the same laboratory session, Maria carried out the same reaction as John using smaller volumes of the same solutions.
State **one** way in which Maria's experiment will be different from John's.

_____

_____

(1 marks)
[Total: 6 marks]

6

9. (a) What is the oxidation state of the underlined element:

FeCl_3: _____

ZnO: _____

(2 marks)

(b) Consider the reaction below and name the substance that is oxidised and the substance that is reduced:

$$2Na + Cl_2 \rightarrow 2NaCl$$

(i) Substance oxidised: _____

(ii) Substance reduced: _____

(2 marks)

(c) Explain briefly your conclusions.

_____

_____

(2 marks)

[Total: 6 marks]

6

10. (a) Give the name or formula of a substance that can be obtained on a large scale from each of the following:

Air: _____

Sulfur: _____

Sea-water: _____

(3 marks)

(b) (i) Limestone mainly contains calcium carbonate. The exterior walls of buildings may get corroded as years pass. Suggest a reason why this may happen.

_____

(1 mark)

(ii) Limestone can be converted to lime and subsequently to slaked lime. Write the chemical equation that represents the conversion of lime to slaked lime.

_____

(2 marks)

[Total: 6 marks]

6

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

11. (a) (i) Iron is obtained by the reduction of Fe_2O_3 using carbon monoxide, CO.
Give balanced equations for each of the following reactions that occur in the Blast Furnace:
- the thermal decomposition of calcium carbonate to form carbon dioxide;
- the reaction of carbon dioxide with carbon; and
- the reaction of Fe_2O_3 with carbon monoxide to produce iron. (6 marks)

(ii) In what physical state is the iron obtained in the Blast Furnace? (1mark)

(b) Aluminium is obtained on a large scale from bauxite by electrolysis.
(i) Give the formula of bauxite. (1 mark)
(ii) Name the substance that is added to bauxite during the process. (1 mark)
(iii) Give the equations occurring at each electrode. (4 marks)
(iv) What material is the anode made of? (1 mark)
(v) Why must the anode be replaced after some time in use? (2 marks)
(vi) Mention **two** uses for aluminium and explain why aluminium is suitable for these uses. (4 marks)

[Total: 20 marks]

12. (a) Give the meaning of the following terms:
(i) a solution; and
(ii) a saturated solution. (4 marks)

(b) Copper(II) sulfate crystals are placed in a boiling-tube, that is then gently heated.
(i) Write a balanced equation for the reaction. (2 marks)
(ii) State **two** observations that can be made during the experiment. (2 marks)

(c) A group of students are given a mixture that contains sand, ammonium chloride and some kitchen salt.
Describe in detail how the students can obtain separate samples of each substance present in the mixture.
Diagrams of the apparatus used must be included. (12 marks)

[Total: 20 marks]

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PERIODIC TABLE

I	II											III	IV	V	VI	VII	VIII
							Key										4 **He** 2
							Relative atomic mass — A; X; Z — Atomic Number										
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															

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.13s

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

SECONDARY EDUCATION CERTIFICATE LEVEL

SEPTEMBER 2013 SESSION

SUBJECT:	**Chemistry**
PAPER NUMBER:	IIB
DATE:	5th September 2013
TIME:	4:00 p.m. to 6:00 p.m.

Useful data

Relative atomic masses: H = 1; C = 12
The molar volume for gases at s.t.p. = 22.4 dm^3
Standard temperature and pressure (s.t.p.): 0 ^{O}C and 1 atm

Directions to Candidates

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

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

1. (a) Air is a mixture of gases. Complete the following table with the appropriate names and approximate amounts of gases that make up air.

Gas	Percentage Amount
	0.03%
Oxygen	
	78%

(3 marks)

(b) In the laboratory, oxygen can be prepared from hydrogen peroxide.

(i) Write the chemical equation that shows the reaction of hydrogen peroxide to give oxygen.

_____

(2 marks)

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

_____

(1 mark)
[Total: 6 marks]

6

2. Silicon has three isotopes, indicated here by **A**, **B** and **C**: $A = {}^{28}_{14}Si, B = {}^{29}_{14}Si, C = {}^{30}_{14}Si$.

(a) How many electrons are present in an atom of isotope **A**?

_____

(1 mark)

(b) How many protons would be present in the nucleus of an atom of isotope **B**?

_____

(1 mark)

(c) Give the number of neutrons in the nucleus of: (i) Isotope **A**: _____

(ii) Isotope **B**: _____ (iii) Isotope **C**: _____

(3 marks)

(d) The relative atomic mass of silicon is 28.08. Which one of the three isotopes **A**, **B** and **C** is the most abundant in nature?

_____

(1 mark)
[Total: 6 marks]

6

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3. (a) Give the structural formulae, showing **ALL** the bonds, of each of the organic compounds in the table below.

Name	Structural formula
ethene	
propene	
propane	

(3 marks)

(b) Propane and propene belong to two different homologous series.

(i) Give the names of the two homologous series.

_____

(1 mark)

(ii) Give a simple chemical test that can distinguish between propane and propene.

_____

_____

(1 mark)

(c) Ethene and propene belong to the same homologous series. How does the boiling point vary as the chain gets longer within the series?

_____

(1 mark)

[Total: 6 marks]

6

DO NOT WRITE ABOVE THIS LINE

4. (a) Use the Periodic Table and give the electronic configuration of the following elements:

carbon: _____

chlorine: _____

sodium: _____

(3 marks)

(b) By drawing only the outer shell of electrons, show how atoms of carbon combine with those of chlorine to form a stable compound.

(2 marks)

(c) Give **one** difference between the compound of carbon and chlorine and that of sodium and chlorine.

_____

(1 mark)

[Total: 6 marks]

6

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5. (a) Propane, C_3H_8, is an alkane. Write a balanced equation to show what happens when propane is burnt in an abundant supply of air.

_____

(2 marks)

(b) A sample of propane, of mass 8.8 g, is at standard temperature and pressure (STP).

(i) Calculate the number of moles of propane.

_____

_____

_____

(2 marks)

(ii) What volume at standard temperature and pressure is occupied by 8.8 g of propane?

_____

_____

_____

(2 marks)
[Total: 6 marks]

6

6. (a) Fill in the blanks in the table below:

Name or formula of oxide	Type of oxide	State in nature
Calcium oxide – CaO		
	Amphoteric oxide	Solid
	Neutral oxide	
Sulfur dioxide – SO_2		Gas

(3 marks)

(b) (i) What is an amphoteric oxide?

_____

(1 mark)

(ii) Write the equation for the reaction of sulfur dioxide with sodium hydroxide solution.

_____

(2 marks)
[Total: 6 marks]

6

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7. (a) Chlorine gas can be prepared by the oxidation of concentrated hydrochloric acid by manganese(IV) oxide. How can the presence of chlorine gas be tested? Indicate what would be observed.

_____

_____

_____

(3 marks)

(b) When hydrogen is heated with lead(II) oxide the following reaction takes place:

$$H_2 + PbO \rightarrow Pb + H_2O$$

(i) What property of hydrogen is displayed by the reaction shown above?

_____

(1 mark)

(ii) Indicate an observation that can be observed when this reaction is carried out.

_____

(1 mark)

(iii) What safety precaution should be taken in the laboratory to prevent the hydrogen from exploding during this experiment?

_____

_____

(1 mark)
[Total: 6 marks]

6

8. (a) Indicate whether each of the following substances is acidic, alkaline or neutral:

		acidic / alkaline / neutral
(i)	Vinegar	
(ii)	Household bleach	
(iii)	Pure water	
(iv)	Caustic soda	

(4 marks)

(b) Suggest a possible pH value for:

(i) pure water: _____

(ii) a fizzy soft drink: _____

(2 marks)
[Total: 6 marks]

6

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9. A Form 5 student carried out an investigation. He placed a piece of magnesium into each of three beakers containing magnesium sulfate solution, iron(II) sulfate solution and copper(II) sulfate solution respectively. Similar experiments were done with pieces of copper and iron.
He drew up the following observations:

	Magnesium sulfate (aq)	**Copper(II) sulfate (aq)**	**Iron(II) sulfate (aq)**
Magnesium		Copper precipitated	Iron precipitated
Copper	No reaction		No reaction
Iron	No reaction	Copper precipitated	

(a) List the three metals in order of their reactivity, with the most reactive first and the least reactive last.

_____

(3 marks)

(b) If each of the three metals (magnesium, copper and iron) is added to a solution of sodium sulfate, no reaction takes place. What can be concluded about the reactivity of sodium compared to that of these three metals?

_____

(1 mark)

(c) Silver powder was added to each of the three aqueous solutions mentioned above, and no reaction was observed. What can be concluded about the reactivity of silver compared to that of the three metals?

_____

(1 mark)

(d) Predict what would happen if a piece of magnesium is placed in a beaker containing silver nitrate solution.

_____

(1 mark)

[Total: 6 marks]

6

10. Complete the following paragraph using the following words. Each word can be used once, more than once or not all.

no, one , two, three, four, five, allotropes, isotopes, electricity

Diamond and graphite are two _____ of carbon. Diamond acquires its hardness because each carbon atom is held strongly by _____ covalent bonds, leaving _____ free electrons. In graphite every carbon atom is held by _____ covalent bonds, with the number of free electrons per atom being _____. Thus graphite conducts _____ while diamond does not.

[Total: 6 marks]

6

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

11. When hydrochloric acid was poured over a piece of iron in a test tube**,** a solution **A** was formed and a colourless gas **Z** was released**.** The colourless gas **Z** burned with a pop. When a few drops of sodium hydroxide solution were added to **A**, a green precipitate **B** was obtained. When a few drops of silver nitrate solution were added to some hydrochloric acid, a white precipitate **C** was obtained.
A white solid **D** gave a bright yellow flame when placed on a piece of nichrome wire in the non-luminous part of a Bunsen flame. A solution of **D** gave no visible reaction with sodium hydroxide solution but gave a white precipitate **E** with barium chloride solution. On adding hydrochloric acid to precipitate **E**, there was no reaction.

    (a) Give the name or formula of **A**, **B**, **C**, **D**, **E**, and **Z**. (10 marks)

    (b) (i) Give the ionic equation for the reaction of **A** with sodium hydroxide. (3 marks)
    (ii) Give the equation for the reaction of hydrochloric acid with silver nitrate solution. Your equation should include state symbols. (2 marks)
    (iii) State what would be observed when a glass rod dipped into a concentrated ammonia solution is brought close to the mouth of a test tube containing a concentrated solution of hydrochloric acid. (1 mark)
    (iv) Write the equation of the reaction that takes place in part (iii). (2 marks)
    (v) When hydrochloric acid is added to calcium carbonate, a gas is evolved. Give the equation for this reaction. (2 marks)

    [Total: 20 marks]

12. Human activity can unfortunately cause a lot of harm to the environment.

    (a) (i) Car engines produce oxides of nitrogen when there is no nitrogen in car fuels. Explain briefly. (2 marks)
    (ii) Mention another source, apart from cars, that produces oxides of nitrogen that are released into the atmosphere. (1 mark)
    (iii) How does a catalytic converter help to make the exhaust from cars less harmful? (2 marks)
    (iv) What health problems are associated with the presence of oxides of nitrogen in the atmosphere? (1 mark)

    (b) (i) 'Carbon dioxide is a greenhouse gas'. Explain briefly this statement. (3 marks)
    (ii) Mention **one** effect that is caused by greenhouse gases. (1 mark)

    (c) Both nitrogen dioxide and sulfur dioxide contribute to acid rain. Give balanced equations to show the reaction of nitrogen dioxide, NO_2, and sulfur dioxide, SO_2, with rainwater. (4 marks)

    (d) (i) In recent years much has been done to limit the use of certain substances in aerosols (sprays). What are such substances known as? (1 mark)
    (ii) What is the effect of such substances on the environment? (1 mark)

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(e) This question refers to the following reaction: $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$
Assuming that **all gaseous volumes are measured at the same temperature and pressure**, calculate:
(i) the volume of oxygen that is required to react with 20 cm^3 of carbon monoxide; (2 marks)
(ii) the volume of carbon dioxide that is produced in the reaction. (2 marks)

[Total: 20 marks]

13. (a) (i) Use the copy of the Periodic Table to give the electronic configuration of the first three elements in Group 2. (3 marks)
(ii) Use the electronic configuration of these elements to explain how the reactivity of the elements in this group varies as you go down from one element to the next. (4 marks)
(iii) Based on your reasoning in part (ii), list these three elements in order of their reactivity with the most reactive first. (3 marks)

(b) (i) Explain why one would expect the elements in Group 1 to react similarly to those of Group 2. (2 marks)
(ii) Place the elements sodium, potassium, magnesium and calcium in order of the chemical reactivity. (2 marks)

(c) (i) When salts of elements in Group 2 are dissolved in water they are said to cause temporary or permanent hardness. Explain how temporary hard water is different from water that has permanent hardness. (2 marks)
(ii) List **two** disadvantages of hard water. (2 marks)
(iii) List **two** things that one can do at home to soften water with permanent hardness. (2 marks)

[Total: 20 marks]

Question 14 is on the next page.

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14. Consider the following reactions:

Reaction 1: **compound A** is $CH_3CH=CH_2$
$CH_3CH=CH_2 + Cl_2 \rightarrow$ **compound B**

Reaction 2: **compound C** is CH_3CH_3
$CH_3CH_3 + Cl_2 \rightarrow$ **compound D**

Reaction 3: $C_2H_5OH +$ **compound E** $\rightarrow C_2H_5Cl + POCl_3 + HCl$

(a) (i) Name compounds **A, C,** and **E**. (3 marks)
(ii) Give the structures of compounds **B** and **D**. (2 marks)

(b) What conditions are necessary for Reaction 2 to occur? (1 mark)

(c) Ethanol, C_2H_5OH, can react with ethanoic acid, CH_3COOH, under appropriate conditions.
(i) What is this reaction called? (1 mark)
(ii) What conditions are necessary for this reaction to occur? (2 marks)
(iii) How would one know that the reaction took place? (2 marks)
(iv) Give a balanced equation for this reaction. (2 marks)
(v) What is the name of the organic product? (2 marks)

(d) Ethanol reacts with sodium liberating a gas. Give a balanced equation for this reaction. (2 marks)

(e) Ethanol can be changed into ethanoic acid using a test tube reaction.
(i) State the reagent that can be used for this reaction. (1 mark)
(ii) What is the colour change when this reaction occurs? (2 marks)

[Total: 20 marks]

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PERIODIC TABLE

I	II										III	IV	V	VI	VII	VIII
1 **H** 1																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