Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Wednesday 16 January 2019

Afternoon (Time: 1 hour) | Paper Reference **4CH0/2C**

Chemistry

Unit: 4CH0

Paper: 2C

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 5 5 9 3 9 A 0 1 2 0

Pearson

THE PERIODIC TABLE

Period	Group 1	2										3	4	5	6	7	0
1	1 H Hydrogen 1																4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass
Symbol
Name
Atomic number

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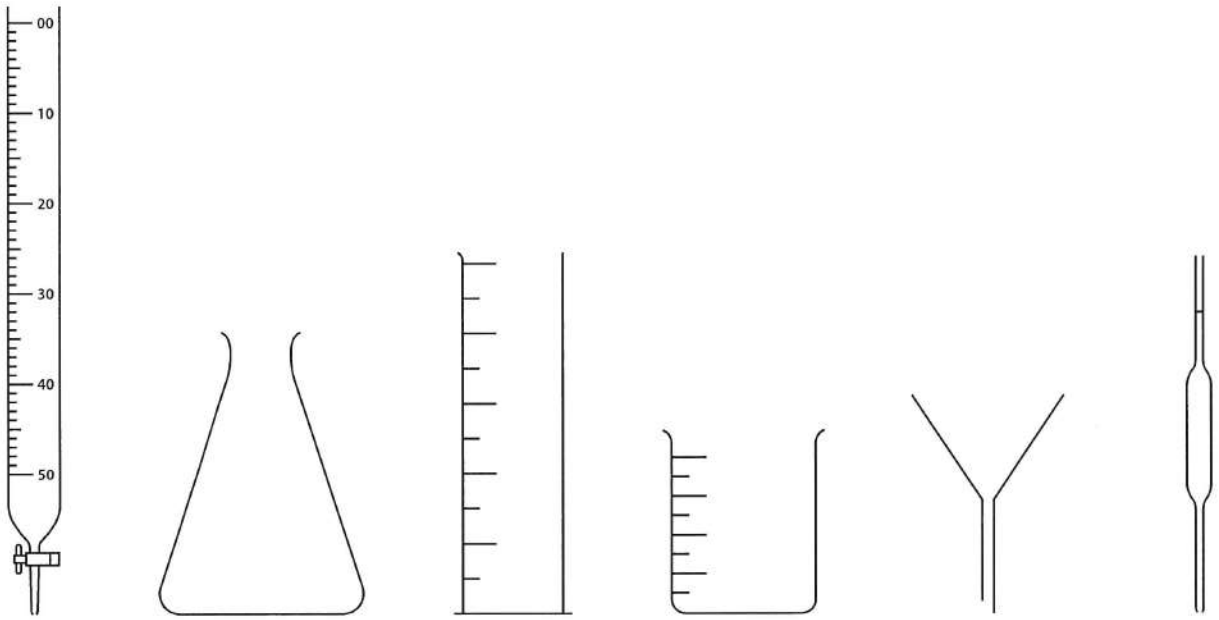
Answer ALL questions.

1 The diagram shows six pieces of apparatus that are used in the laboratory.



The table lists the names of four pieces of apparatus.

Complete the table by giving a letter, A, B, C, D, E or F, to identify each piece of apparatus listed.

(4)

Name of apparatus	Letter
beaker	D
burette	A
measuring cylinder	C
pipette	F

(Total for Question 1 = 4 marks)

2 Rubidium is an element in Group 1 of the Periodic Table.

A sample of rubidium contains two isotopes, $^{85}_{37}Rb$ and $^{87}_{37}Rb$

(a) (i) State how the nuclei of the two isotopes are similar.

(1)

They contain the same number of protons.

(ii) State how the nuclei of the two isotopes are different.

(1)

They contain a different number of neutrons.

(iii) How many electrons are in the outer shell of a rubidium atom?

(1)

- ☒ **A** 1
- ☐ **B** 3
- ☐ **C** 9
- ☐ **D** 37

(b) The relative abundances of the two isotopes in the sample of rubidium are

$^{85}_{37}Rb$ 72.2 % $^{87}_{37}Rb$ 27.8 %

Calculate the relative atomic mass of rubidium.

Give your answer to one decimal place.

(2)

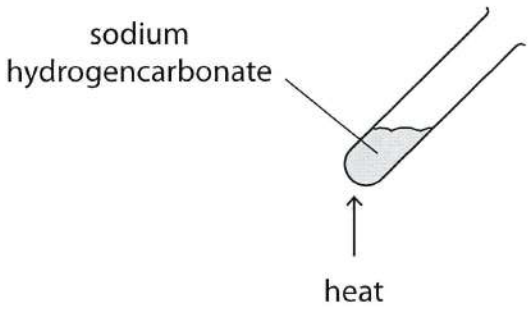
$(0.722 \times 85) + (0.278 \times 87) = 85.556$

≈ 85.6

relative atomic mass = 85.6

(Total for Question 2 = 5 marks)

3 A student uses this apparatus to investigate the action of heat on sodium hydrogencarbonate ($NaHCO_3$).



The equation for the reaction is

$$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

(a) (i) State the type of reaction taking place.

(1)

Thermal decomposition

(ii) Describe a test to show that the gas given off is carbon dioxide.

(2)

test Bubble through limewater

result Turns milky

(b) The student heats a 1.00 g sample of sodium hydrogencarbonate for one minute.

He then measures the mass of solid left in the test tube.

He repeats the experiment four times, heating separate samples of mass 1.00 g for a different number of minutes each time.

The table shows the student's results.

Time in minutes	1	2	3	4	5
Mass of solid left in test tube in g	0.89	0.78	0.69	0.63	0.63

(i) State why the mass of solid in each test tube decreases.

(1)

Gases are given off.

(ii) Suggest why the mass of solid stops decreasing after four minutes.

(1)

All of the $NaHCO_3$ has decomposed.

(Total for Question 3 = 5 marks)

4 Sodium reacts with fluorine to form sodium fluoride.

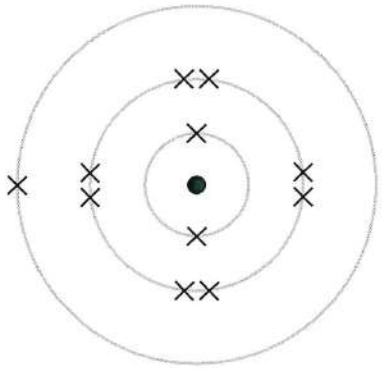
The reaction is very exothermic.

(a) State what is meant by the term **exothermic**.

(1)

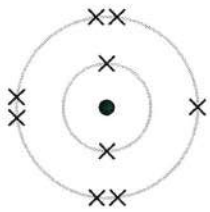
The reaction gives out heat.

(b) The diagram shows the electronic configuration of a sodium atom.

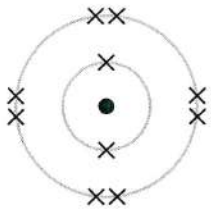


Which of these diagrams shows the electronic configuration of a fluorine atom?

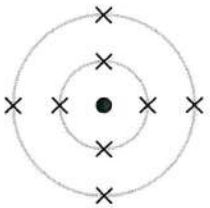
(1)



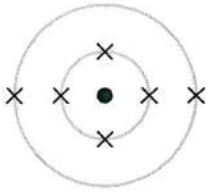
A ☒



B ☐



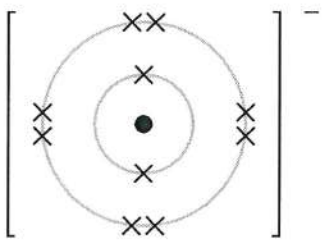
C ☐



D ☐

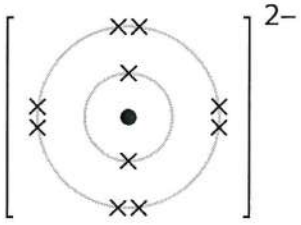
(c) Sodium ions and fluoride ions are formed when sodium reacts with fluorine.

The diagram shows the electronic configuration and charge of a fluoride ion.

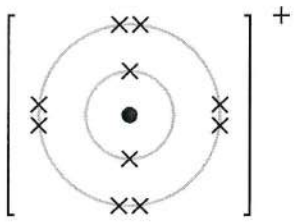


Which of these diagrams shows the electronic configuration and charge of a sodium ion?

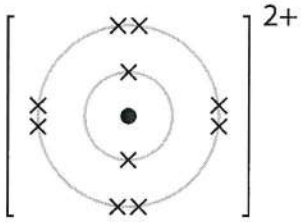
(1)



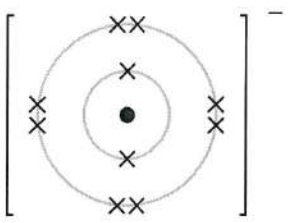
A ☐



B ☒



C ☐



D ☐

(d) Explain, in terms of its structure and bonding, why sodium fluoride has a high melting point.

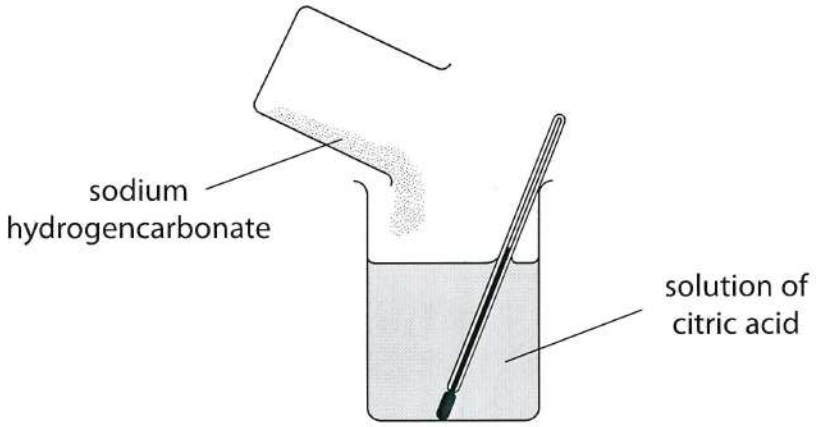
(4)

NaF forms a giant ionic lattice, which has many strong electrostatic forces between oppositely charged ions, which require lots of energy to overcome.

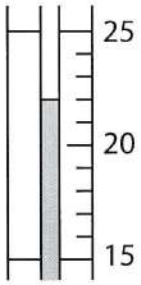
(Total for Question 4 = 7 marks)

5 A student finds the temperature change when a mass of 0.5 g of sodium hydrogencarbonate is added to 50 cm^3 of a solution of citric acid.

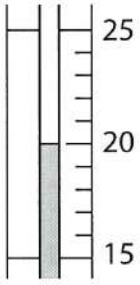
She repeats the experiment using masses of 1.0 g, 1.5 g and 2.0 g of sodium hydrogencarbonate.



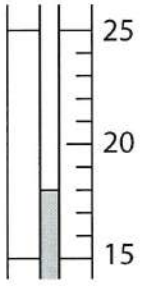
(a) The diagrams of the thermometer show the lowest temperature reached, in °C, for each experiment.



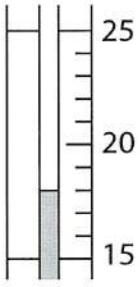
0.5 g of sodium hydrocarbonate



1.0 g of sodium hydrocarbonate



1.5 g of sodium hydrocarbonate



2.0 g of sodium hydrocarbonate

Use the diagrams to complete the table of results.

(2)

Mass of sodium hydrogencarbonate in g	Initial temperature in °C	Lowest temperature reached in °C	Decrease in temperature in °C
0.5	25	22	3
1.0	24	20	4
1.5	23	18	5
2.0	23	18	5

(b) Another student does the experiment.

The table shows his results.

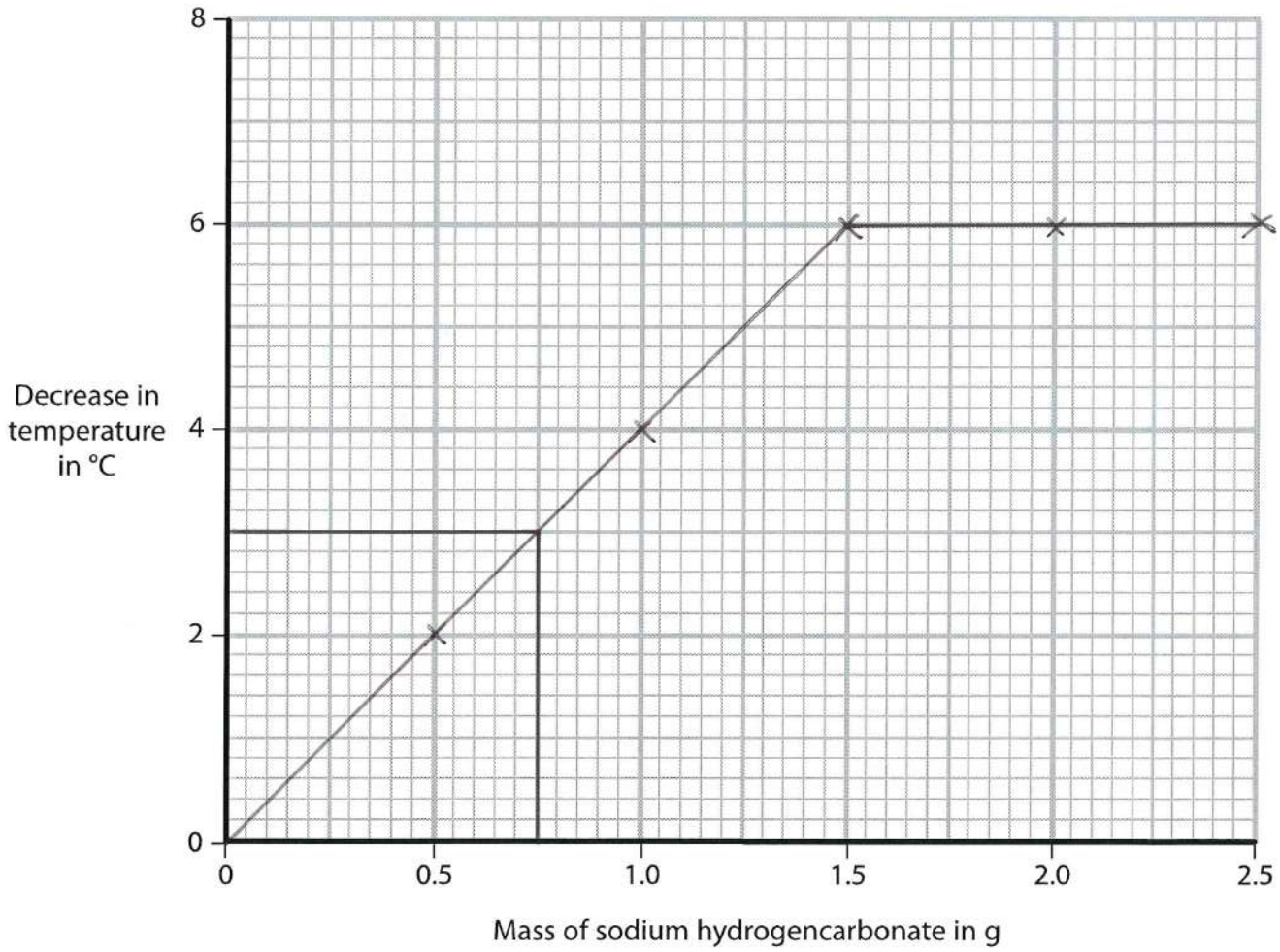
Mass of sodium hydrogencarbonate in g	0.5	1.0	1.5	2.0	2.5
Decrease in temperature in °C	2	4	6	6	6

(i) Plot this student's results on the grid.

Draw a straight line of best fit through the first three points and another straight line of best fit through the last two points.

Make sure the two lines cross.

(3)



(ii) Use your graph to find the mass of sodium hydrogencarbonate required to produce a decrease in temperature of 3 °C.

(1)

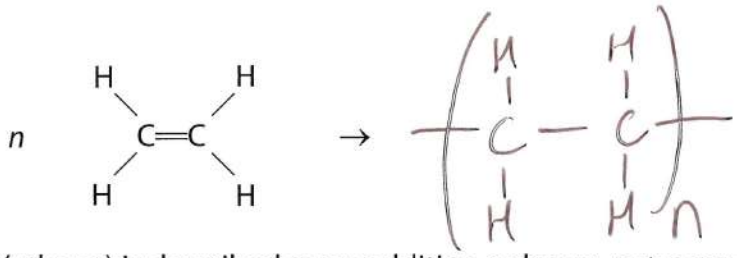
mass = 0.75 g

(Total for Question 5 = 6 marks)

6 Poly(ethene) is an addition polymer made from ethene, C_2H_4

(a) Complete the equation to show the formation of poly(ethene) from ethene.

(2)



(b) State why poly(ethene) is described as an addition polymer, not a condensation polymer.

(1)

The polymer is the only product of the reaction.

(c) Many shopping bags are made of poly(ethene).

(i) One useful property of poly(ethene) is that it is inert so it does not react with food.

Explain two other properties of poly(ethene) that make it useful for shopping bags.

(2)

1 Strong so doesn't break.

2 Low density so not heavy.

(ii) Another property of poly(ethene) is that it is non-biodegradable.

Two methods of disposing of poly(ethene) are landfill and burning.

Give one problem caused by each method of disposal.

(2)

landfill Land gets filled up

burning Greenhouse gases produced.

(Total for Question 6 = 7 marks)

7 Magnesium can be obtained by the electrolysis of magnesium chloride.

Solid magnesium chloride is obtained from seawater.

The magnesium chloride is melted and then electrolysed. The positive electrode is made of graphite and the negative electrode is made of steel.

Magnesium forms at the negative electrode. Chlorine forms at the positive electrode.

(a) Explain why the magnesium chloride has to be melted before it can be electrolysed.

(2)

Ions cannot flow when solid.
Ions can flow when molten

(b) Write an ionic half-equation to represent the formation of magnesium at the negative electrode.

(1)

$Mg^{2+} + 2e^- \rightarrow Mg$

(c) Suggest why steel is **not** used for the positive electrode.

(1)

Steel reacts with chlorine.

(Total for Question 7 = 4 marks)

8 Submarines that spend a long time underwater use sodium peroxide (Na_2O_2) to absorb carbon dioxide (CO_2) from the air in the submarine.

The equation for the reaction is

$$2Na_2O_2 + 2CO_2 \rightarrow 2Na_2CO_3 + O_2$$

(a) There are 140 people on the submarine.

Each person produces 480 dm^3 of carbon dioxide per day.

(i) Calculate the total amount, in moles, of carbon dioxide produced on the submarine in one day.
[assume 1 mol of CO_2 occupies 24.0 dm^3]

(2)

$140 \times 480 = 67200\ dm^3\ CO_2$

$\frac{67200}{24} = 2800\ mol$

amount of CO_2 = 2800 mol

(ii) Calculate the mass, in kilograms, of sodium peroxide required to absorb all of the carbon dioxide produced in the submarine in one day.
[M_r of Na_2O_2 = 78.0]

(2)

$2Na_2O_2 + 2CO_2 \longrightarrow 2Na_2CO_3 + O_2$

m 218400

Mr 78

n 2800 2800

$m = nMr$

mass of Na_2O_2 = 218.4 kg

(b) Spaceships use either lithium hydroxide (LiOH) or lithium peroxide (Li_2O_2) to absorb carbon dioxide.

The equations for the two reactions are

Equation 1 $2LiOH + CO_2 \rightarrow Li_2CO_3 + H_2O$

Equation 2 $2Li_2O_2 + 2CO_2 \rightarrow 2Li_2CO_3 + O_2$

Using information from the equations, give two reasons why lithium peroxide is more suitable than lithium hydroxide for use on spaceships.

(2)

1 Li_2O_2 absorbs more CO_2 per mol.

2 Li_2O_2 produces oxygen.

(Total for Question 8 = 6 marks)

9 Ethanol (C_2H_5OH) is made in industry by reacting ethene (C_2H_4) with steam at a temperature of 300 °C and a pressure of 70 atm. The percentage yield of ethanol is 43%.

The equation for the reaction is

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g) \qquad \Delta H = -45.3\,kJ/mol$$

(a) (i) State what the symbols $\rightleftharpoons$ and ΔH represent.

(2)

$\rightleftharpoons$ The reaction is reversible

ΔH Enthalpy change of reaction

(ii) Name the catalyst used in this industrial process.

(1)

Phosphoric acid.

(b) (i) Predict the effect on the yield of ethanol if the reaction is carried out at a temperature lower than 300 °C, but at the same pressure of 70 atm. [assume reaction reaches equilibrium]

Give a reason for your answer.

(2)

Yield of ethanol increases because the forward reaction is exothermic.

(ii) Predict the effect on the yield of ethanol if the reaction is carried out at a pressure lower than 70 atm, but at the same temperature of 300 °C. [assume reaction reaches equilibrium]

Give a reason for your answer.

(2)

Yield of ethanol decreases because there are more moles of gas on the left.

(c) One method of obtaining ethene is by cracking crude oil fractions.

Ethene can also be made by passing ethanol vapour over a hot aluminium oxide catalyst.

The equation for the reaction is

$$C_2H_5OH(g) \rightarrow C_2H_4(g) + H_2O(g)$$

(i) State the type of reaction taking place.

(1)

Dehydration

(ii) Suggest why it may be necessary, in the future, to make ethene using this reaction rather than by cracking crude oil fractions.

(1)

Crude oil is a finite resource.

(Total for Question 9 = 9 marks)

10 Samarium, Sm, is a metal used to make powerful magnets.

(a) Samarium can be obtained by heating its oxide with lanthanum, La.

$$Sm_2O_3 + 2La \rightarrow 2Sm + La_2O_3$$

The table shows the melting points of the substances involved in this reaction.

Substance	samarium	samarium oxide	lanthanum	lanthanum oxide
Melting point in °C	1072	2335	920	2315

(i) The operating temperature for this reaction is 1030 °C.

Explain which substance in the table could exist as a liquid at this temperature.

(2)

Lanthanum, melting point is below 1030°C

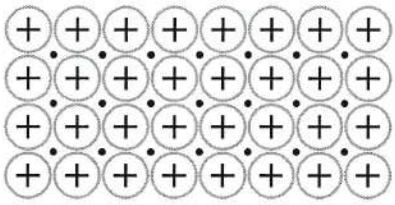
(ii) Samarium oxide neutralises hydrochloric acid to form samarium chloride, $SmCl_3$

Write a chemical equation for this reaction.

(1)

$Sm_2O_3 + 6HCl \rightarrow 2SmCl_3 + 3H_2O$

(b) The diagram shows the arrangement of the particles in samarium.



Key

⊕ samarium ion

• electron

Explain why samarium is malleable and is a good conductor of electricity.

(4)

Samarium is malleable as the ions are in layers which can easily slip over each other.

Samarium is a good conductor as it has a sea of delocalised electrons.

(Total for Question 10 = 7 marks)

TOTAL FOR PAPER = 60 MARKS

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