12 06 D

Write your name here

Surname	Other names

Edexcel Certificate
Edexcel International GCSE

Centre Number | Candidate Number

Chemistry

Unit: KCH0/4CH0
Science (Double Award) KSC0/4SC0
Paper: 1C

Monday 21 May 2012 – Morning
Time: 2 hours

Paper Reference
KCH0/1C 4CH0/1C
KSC0/1C 4SC0/1C

You must have:
Calculator

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.

Information

- The total mark for this paper is 120.
- 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.
- Keep an eye on the time.
- 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 ▶

P40134A

1/1/1/1/

P 4 0 1 3 4 A 0 1 2 8

PEARSON

THE PERIODIC TABLE

Period	1	2					Group						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 A student was asked to find the mass of salt dissolved in 100 cm^3 of sea water.

She was given the following instructions.

Step **A** Weigh an empty evaporating basin

Step **B** Transfer 50 cm^3 of sea water into the basin

Step **C** Heat the sea water in the basin until all the water has evaporated

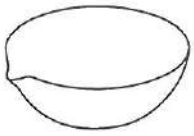
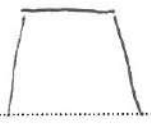
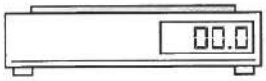
Step **D** Allow the basin and residue to cool

Step **E** Weigh the basin and residue of salt

(a) During the experiment, the student used several pieces of apparatus.
Some of them are shown in the table.

Complete the table.

(6)

Image of apparatus	Name of apparatus	One step in which the apparatus was used
	evaporating basin	C
	measuring cylinder	B
	tripod	C
	balance	A or E

Many errors

(b) State, with a reason, **one** safety precaution that the student should take when doing this experiment.

(2)

Precaution

wear goggles

Reason

water may spit out

(c) The student obtained the following results.

mass of basin and salt (step **E**) = 81.50 g

mass of empty basin (step **A**) = 78.60 g

Calculate the mass of salt dissolved **in 100 cm³** of sea water.

(1)

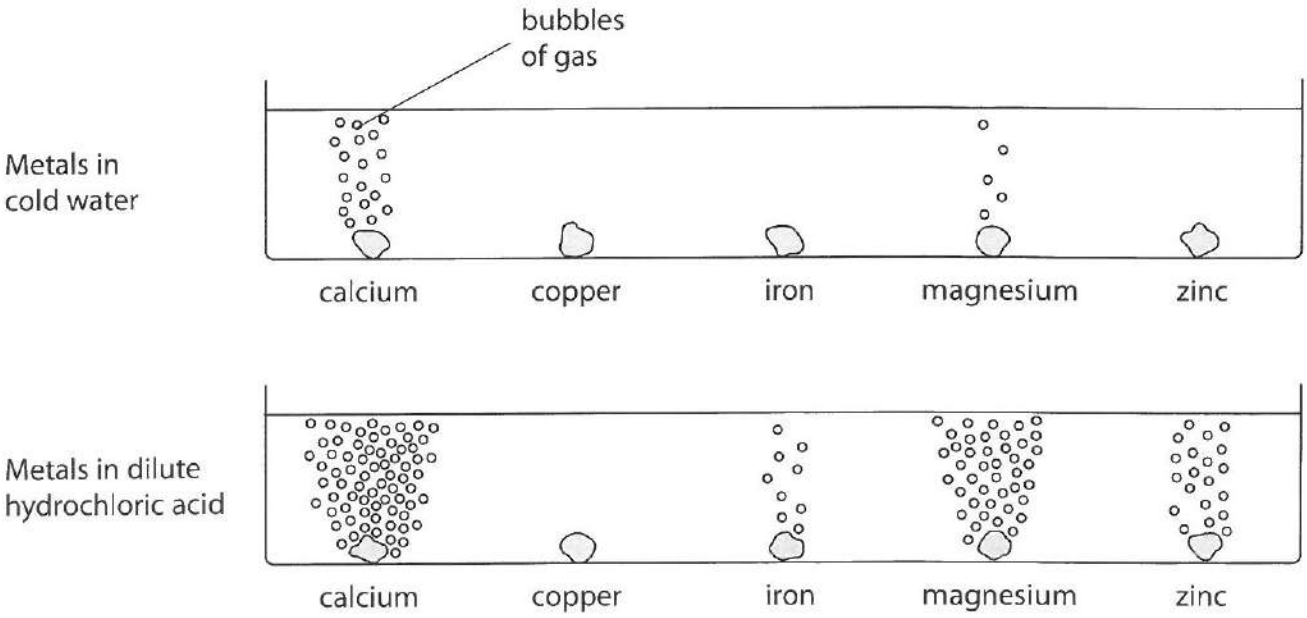
81.5 − 78.60 bold

= 2.9 (x2)

Mass of salt = 5.8 g

(Total for Question 1 = 9 marks)

2 The diagrams show the reactions of some metals with cold water and with dilute hydrochloric acid.



(a) Answer the following questions, using only the metals that appear in the diagrams.

(i) Name **two** metals that react with cold water.

(2)

Ca and Mg

(ii) Name **one** metal that reacts with dilute hydrochloric acid but **not** with cold water.

(1)

Zn or Fe

(iii) Arrange the five metals in order of reactivity.

(3)

Most reactive metal Ca

Mg

Zn

Fe

Least reactive metal Cu

2 (b) Some magnesium powder is added to dilute sulfuric acid in a test tube.
A colourless solution is formed and a gas is given off.

When more magnesium is added, the reaction continues for a while and then stops, leaving some magnesium powder in the test tube.

excess →

When a flame is placed at the mouth of the test tube, the gas burns with a squeaky pop.

(i) Identify the gas produced.

(1)

H_2

(ii) Suggest why the reaction stops.

(1)

all the H_2SO_4 has reacted

some state both reactants

(iii) State the name of the colourless solution.

(1)

Magnesium sulfate not sulfide

(iv) How could you separate the magnesium powder from the colourless solution?

(1)

filter

(c) In some fireworks, magnesium powder reacts quickly with oxygen in the air.
During this reaction heat energy is produced.

(i) What name is given to reactions in which heat energy is produced?

(1)

exothermic

(ii) Name the compound formed when magnesium reacts with oxygen.

(1)

Magnesium oxide

(Total for Question 2 = 12 marks)

3 When solutions are mixed together, precipitates sometimes form.

(a) Barium carbonate is an insoluble compound. It is formed as a precipitate when solutions of the soluble compounds barium chloride and sodium carbonate are mixed.

When solutions of the soluble compounds potassium chloride and sodium sulfate are mixed, no precipitate is formed.

Complete the table to show the results of mixing solutions of some compounds.

(3)

Solubility rules not learnt.

	sodium carbonate solution	**sodium sulfate solution**
barium chloride solution	precipitate of barium carbonate	precipitate of barium sulfate
potassium chloride solution	No precipitate.	no precipitate
calcium chloride solution	precipitate of calcium carbonate	precipitate of calcium sulfate

(b) When solutions of lead(II) nitrate and potassium bromide are mixed, a precipitate of lead(II) bromide and a solution of potassium nitrate are produced.

The equation for the reaction is

$$Pb(NO_3)_2(aq) + 2KBr(aq) \rightarrow PbBr_2(s) + 2KNO_3(aq)$$

not (l)

Complete the equation by inserting the state symbols.

(1)

3 (c) In order to prepare a **pure**, **dry** sample of lead(II) bromide, a student took the mixture produced in part (b).

He then

- filtered the mixture
- washed the solid residue with distilled water
- left the solid in a warm place for several hours

(i) Why did the student filter the mixture?

(1)

Remove solution wrong way around.

or obtain $PbBr_2$

(ii) Why did he wash the solid residue?

(1)

wash away solution - must not specific

(iii) Why is it better to use distilled water rather than tap water to wash the solid residue?

(1)

It is pure

(iv) Why did he leave the solid in a warm place?

(1)

evaporate water not crystalise.

or avoid decomposition

(Total for Question 3 = 8 marks)

12 08 07

4 The diagram shows the positions of some elements in the Periodic Table.

1	2											3	4	5	6	7	0
																H	
																	He
																F	
Na																Cl	
K																Br	

(a) Complete the following sentence.

(1)

The elements in the Periodic Table are arranged in order of .....

atomic number some mass

(b) Name an element shown in the diagram that is:

(2)

(i) a metal Na or K

(ii) a halogen F / Cl / Br

(c) (i) Name **two** elements in the diagram that react together to form an ionic compound.

not ions

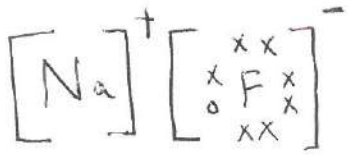
(1)

Na or K and F / Cl / Br

(ii) Draw a dot and cross diagram for the ions in the compound formed in (c)(i).
Show only the outer electrons. Include the charge on each ion.

(3)

Read carefully



not covalent

4 (d) Chlorine reacts quickly with hot iron to form iron(III) chloride.
Bromine reacts less quickly with hot iron to form iron(III) bromide.

Suggest how fluorine reacts with hot iron and name the compound formed.

(2)

F reacts very quickly to form iron (III) fluoride

(e) When chlorine gas is bubbled through an aqueous solution of sodium bromide, a displacement reaction takes place.

The ionic equation for the reaction is:

$$Cl_2(g) + 2Br^-(aq) \rightarrow 2Cl^-(aq) + Br_2(aq)$$

State the colour change that you would observe in the solution during this reaction.

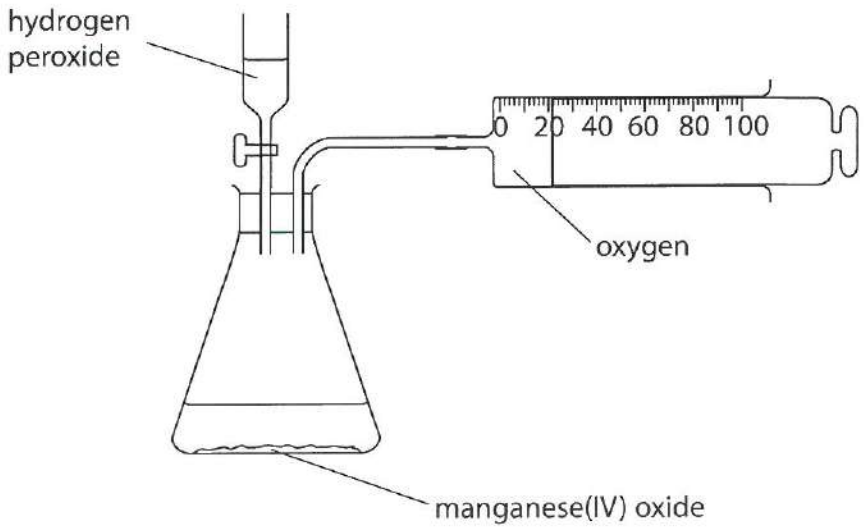
(2)

Colour at start colourless

Colour at end orange / yellow / brown } challenging

(Total for Question 4 = 11 marks)

5 The apparatus in the diagram is used to collect the oxygen produced by the decomposition of hydrogen peroxide, H_2O_2



(a) Write a chemical equation for the decomposition of hydrogen peroxide.

(2)

not correct

$2H_2O_2 \longrightarrow 2H_2O + O_2$

(b) Describe a test to show that the gas collected in the syringe is oxygen.

(1)

relights a glowing splint

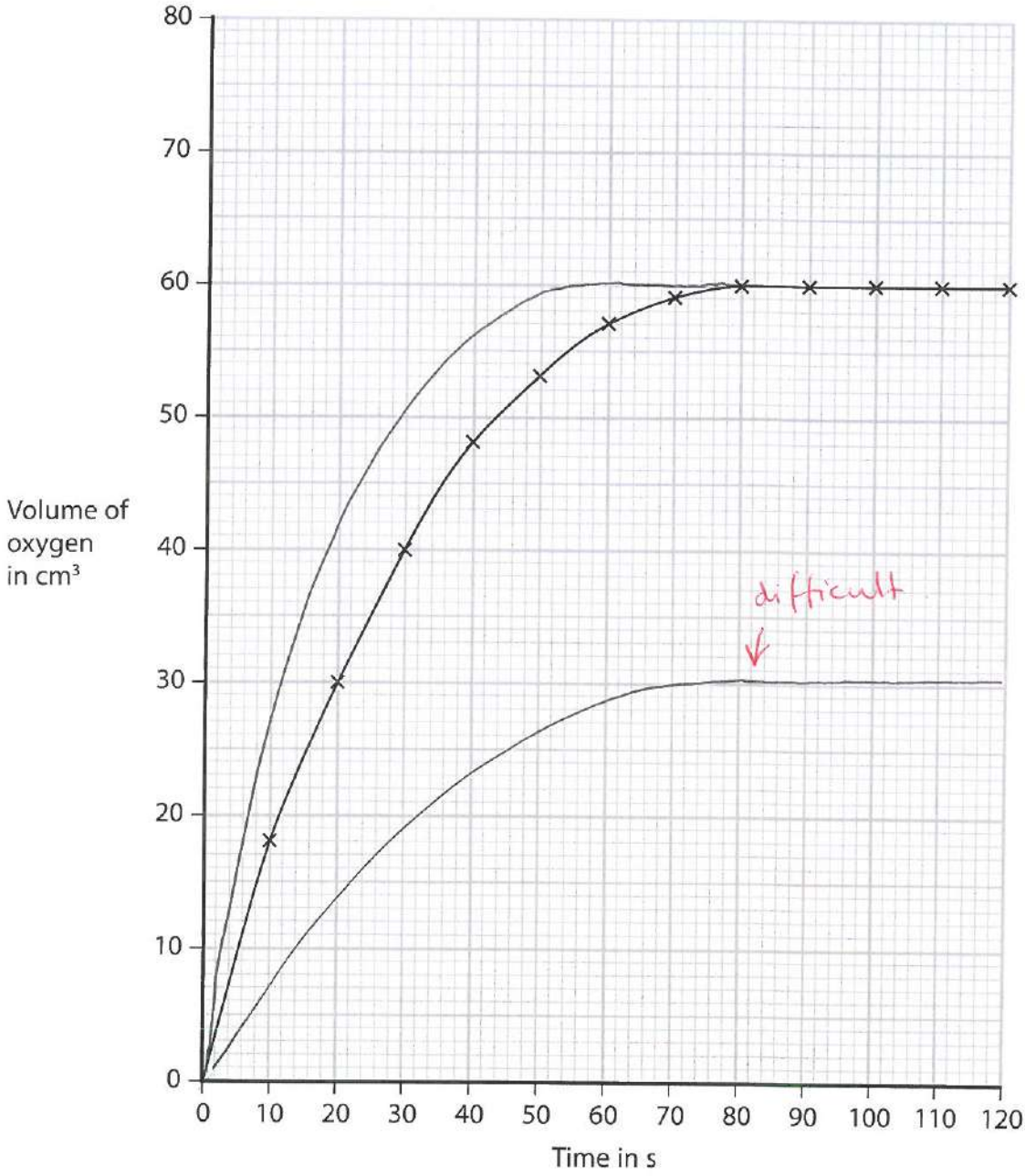
(c) Manganese(IV) oxide is a catalyst for this reaction.

State and explain the effect of a catalyst on the rate of this reaction.

(3)

- speeds up rate of reaction
- provides an alternative pathway
- with a lower activation energy

5 (d) The graph shows the results from an experiment using a 0.50 mol/dm^3 solution of hydrogen peroxide at 25 °C.



(i) On the same axes, sketch the curve you would expect with the same volume of a 0.25 mol/dm^3 solution of hydrogen peroxide at 25 °C. Label this curve **A**.

(2)

(ii) On the same axes, sketch the curve you would expect with the same volume of a 0.50 mol/dm^3 solution of hydrogen peroxide at 35 °C. Label this curve **B**.

(2)

(Total for Question 5 = 10 marks)

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6 The element carbon has three common isotopes.
These are carbon-12, carbon-13 and carbon-14.

(a) Complete the table to show the number of protons and neutrons in each isotope of carbon.

(2)

Isotope	Mass number	Number of protons	Number of neutrons
carbon-12	12	6	6
carbon-13	13	6	7
carbon-14	14	6	8

(b) Explain, in terms of electrons, why the three isotopes have the same chemical properties.

(1)

same number of electrons

(c) (i) State what is meant by the term **relative atomic mass, A_r**

(2)

- The average (mean) mass of an atom
- compared to the mass of C-12

poorly answered.

(ii) A sample of carbon contained 98.90% carbon-12 and 1.10% carbon-13.

Use this information to calculate the relative atomic mass of carbon in the sample.
Give your answer to **two** decimal places.

(3)

$$\frac{(98.9 \times 12) + (1.10 \times 13)}{100}$$

Relative atomic mass 12.01

(Total for Question 6 = 8 marks)

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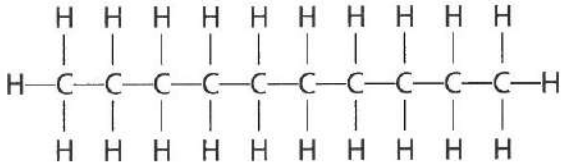
7 Decane is a hydrocarbon found in crude oil.

The diagram shows the structure of a decane molecule.



(a) (i) Explain why decane is described as a hydrocarbon.

(2)

Contains only carbon and hydrogen

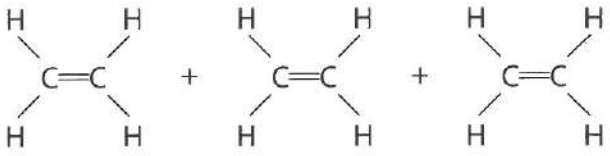
(ii) Give the molecular formula for decane.

(1)

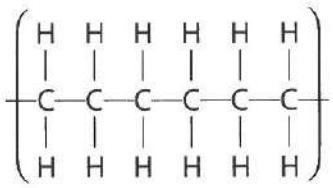
$C_{10}H_{22}$

(b) Decane and ethene, C_2H_4, are produced during the cracking of eicosane, $C_{20}H_{42}$

Ethene is used to make poly(ethene).



ethene



poly(ethene)

7 (i) What is the name given to this type of polymerisation?

(1)

addition

(ii) Use the diagram to state **two** changes that occur during the formation of poly(ethene).

(2)

- one of the bonds in the double bond breaks
- monomers (ethenes) (molecules) join together

(c) Explain why cracking is an important process in the oil industry.

(4)

- produces smaller molecules
- which are more useful
- e.g. use to make petrol
- also produces alkenes
- which are used to make polymers.
- Crude oil has a surplus of long chain molecules

(Total for Question 7 = 10 marks)

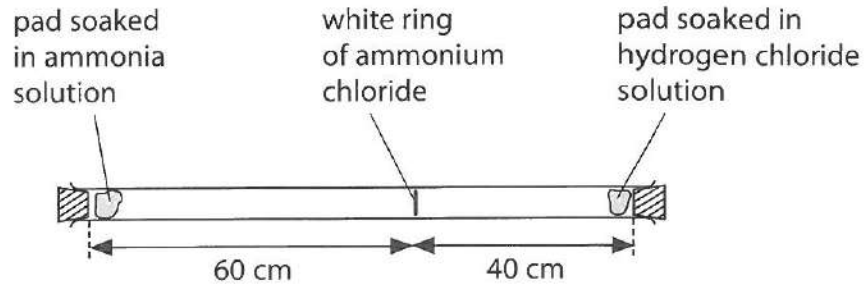
8 When ammonia gas and hydrogen chloride gas mix, they react together to form a white solid called ammonium chloride.

The equation for the reaction is:

$$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$$

A cotton wool pad was soaked in ammonia solution and another was soaked in hydrogen chloride solution. The two pads were then put into opposite ends of a dry glass tube at the same time.

After five minutes, a white ring of solid ammonium chloride formed.



(a) (i) What name is given to the movement of the two gases?

(1)

Diffusion

(ii) Identify which gas is moving faster and give a reason for your choice.

(1)

NH_3 because it moves further

(b) The experiment was repeated at a higher temperature.

State and explain how this change would affect the time taken for the white ring to form.

(3)

- Ring forms more quickly
- Particles have more energy
- therefore diffuse faster

8 (c) Gas particles move at a speed of several hundred metres per second at room temperature.

Suggest **one** reason why it took five minutes for the white ring to form.

(1)

- Particles collide with air

or - Partides collide with one another } poorly answered.

or - Partides move in random direction **(Total for Question 8 = 6 marks)**

9 When water is added to a mixture of sand and cement, a reaction takes place between silicon dioxide in the sand and calcium oxide in the cement. The reaction produces a salt called calcium silicate.

The equation for the reaction is:

$$SiO_2 + CaO \rightarrow CaSiO_3$$

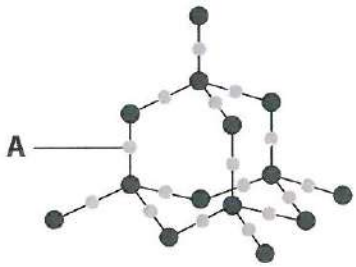
(a) Explain why silicon dioxide reacts with calcium oxide.

(2)

SiO_2 is an acid and CaO is a base

Difficult

(b) Part of the structure of silicon dioxide is shown in the diagram.



(i) What does particle **A** represent? Give a reason for your answer.

(2)

oxygen - it forms two bonds

Difficult

(ii) Explain, in terms of its bonding and structure, why silicon dioxide has a very high melting point.

not ionic

(4)

- SiO_2 is a giant covalent structure.
- SiO_2 has many strong covalent bonds which require a lot energy to break
- the bonds

(Total for Question 9 = 8 marks)

10 When sodium is burned in air, one of the products is a pale yellow solid, **X**.

(a) A sample of solid **X** was found to contain 1.15 g of sodium and 0.80 g of oxygen.

(i) Show, by calculation, that the empirical formula of **X** is NaO.

(2)

Na	O
1.15	0.8
23	16
0.05	0.05
1 : 1	= NaO

(ii) The relative formula mass of **X** is 78.

Deduce the formula of **X**.

(2)

NaO = 39

$\frac{78}{39}$ = 2 × NaO =

many 2NaO

Formula of **X** Na_2O_2

(b) Solid **X** reacts with water to form sodium hydroxide, NaOH, and hydrogen peroxide, H_2O_2

(i) Write a chemical equation to represent the reaction between **X** and water.

(2)

$Na_2O_2 + 2H_2O \longrightarrow 2NaOH + H_2O_2$

(ii) The solution formed in the reaction between **X** and water turns red litmus blue.

Identify the ion that causes this change.

(1)

OH^-

(iii) The displayed formula for hydrogen peroxide is H—O—O—H.

Complete the dot and cross diagram to show the arrangement of the outer shell (valence) electrons in a molecule of hydrogen peroxide.

(2)

(Total for Question 10 = 9 marks)

11 A student carried out a series of tests on a solid, **M**, in order to identify the ions that could be present.

The table shows her results.

Test	Method	Result
Test 1	Carry out a flame test on solid **M**	Lilac flame
Test 2	Dissolve solid **M** in water, and divide the solution into three portions, A, B and C	
	Portion A – add dilute sodium hydroxide solution	Green precipitate
	Portion B – add dilute hydrochloric acid, then barium chloride solution	No change
	Portion C – add dilute nitric acid, then silver nitrate solution	Yellow precipitate

(a) Identify the ion responsible for

(3)

(i) the lilac colour in the flame test

Potassium ion, K^+

(ii) the green precipitate when sodium hydroxide solution was added

Fe^{2+}

(iii) the yellow precipitate when silver nitrate solution was added

I^-

11 (b) Describe how the student should carry out a flame test on solid **M**.

(3)

- Use a wire
- to put solid in a blue flame

(c) (i) Why was dilute nitric acid added to the solution of solid **M** before using silver nitrate solution?

(1)

Removes carbonate ions Chemistry must be understood

(ii) Why should dilute hydrochloric acid **not** be used in place of dilute nitric acid in this test?

(2)

- Contains Cl^- OR - forms a precipitate
- Interferes with test - of $AgCl$

(d) The tests for negative ions that the student carried out involved precipitation.

Suggest **one** negative ion that cannot be identified by a precipitation reaction.

(1)

NO_3^- Really difficult.

(Total for Question 11 = 10 marks)

12 06 D 7

12 Lead can be extracted from lead(II) sulfide, PbS, in two stages.

Stage 1: Lead(II) sulfide is heated in air. It reacts with oxygen to produce lead(II) oxide and sulfur dioxide.

Stage 2: The lead(II) oxide is then heated in a blast furnace with coke.

(a) Write a chemical equation for the reaction in **Stage 1**.

(2)

Balanced.

$2PbS + 3O_2 \longrightarrow 2PbO + 2SO_2$

(b) The equation for the reaction that occurs when lead(II) oxide is heated with coke in a blast furnace is:

$$2PbO + C \rightarrow 2Pb + CO_2$$

(i) State, with a reason, whether PbO is oxidised or reduced in this reaction.

(1)

Reduced - loses oxygen

(ii) Calculate the minimum mass, in tonnes, of coke needed to react with 44.6 tonnes of lead(II) oxide.
[1 tonne = 10^6 g]

(3)

PbO : C
44.6 : ? 12
223 = 12
0.2 : 0.1 x

Mass of coke needed = 1.2 tonnes

12 (c) The molten lead obtained from the blast furnace contains 0.1% silver dissolved as an impurity.

The silver is removed by:

- adding zinc to the mixture of molten lead and silver at 530 °C and removing the mixture of molten zinc and silver that forms on top of the molten lead
- heating the mixture of molten zinc and silver until the zinc boils off as a gas, leaving almost pure, solid silver behind

Use the information above to answer the following questions.

Read carefully

(i) What can you deduce about the relative solubility of silver in zinc and in lead?

(1)

Silver is more soluble in zinc

(ii) What can you deduce about the melting point of the mixture of zinc and silver?

(1)

less than 530°C

(iii) What can you deduce about the boiling point of zinc compared to that of silver?

Explain your answer.

(2)

- lower
- zinc turns into a vapour while silver remains

(iv) Suggest why so much trouble is taken to remove such a small amount of silver from the lead.

(1)

Silver is valuable

(Total for Question 12 = 11 marks)

13 (a) Crystals of hydrated zinc sulfate, $ZnSO_4.xH_2O$, contain water of crystallisation.

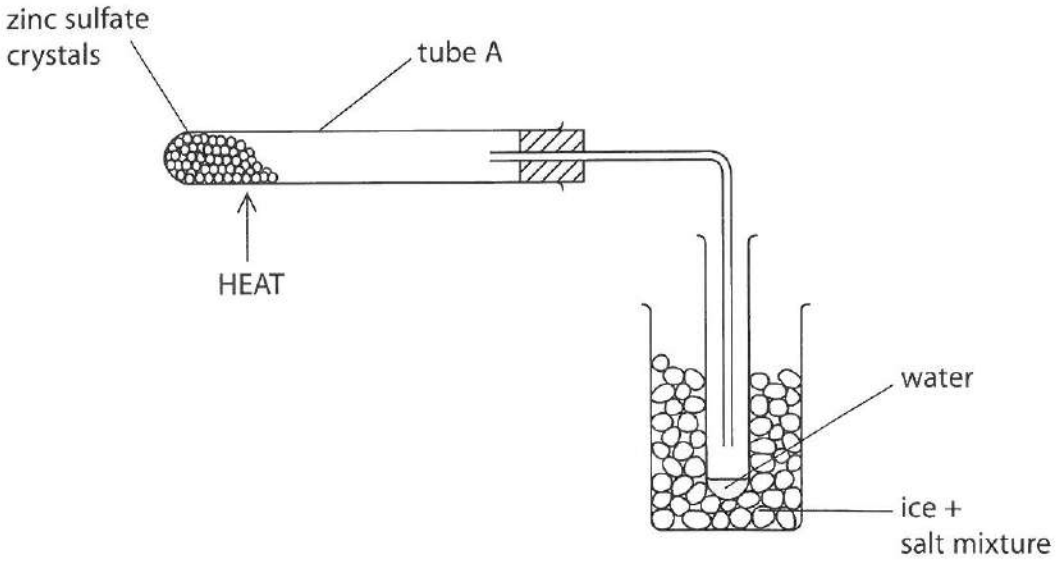
A student used the apparatus shown to remove and collect the water of crystallisation from the crystals in order to find the value of x.

He weighed the empty tube A.

He placed a sample of hydrated zinc sulfate crystals in tube A and reweighed it.

He heated the tube, allowed it to cool and weighed it again.

He repeated this process until two consecutive masses were the same. This is known as 'heating to constant mass'.



When hydrated zinc sulfate crystals are heated gently, they decompose according to the following equation:

$$ZnSO_4.xH_2O \rightarrow ZnSO_4 + xH_2O$$

The following masses were recorded:

Mass of tube A	= 10.12 g
Mass of tube A + $ZnSO_4.xH_2O$	= 18.73 g
Mass of tube A and $ZnSO_4$ after heating to constant mass	= 14.95 g

(i) Calculate the mass of $ZnSO_4$ formed after heating to constant mass.

(1)

14.95 − 10.12 = 4.83g

(ii) Calculate the mass of water collected after heating to constant mass.

(1)

18.73 − 14.95 = 3.78

13 (iii) The relative formula mass of $ZnSO_4$ is 161

The relative formula mass of water is 18

Use this information, and your answers to (a)(i) and (a)(ii), to calculate the value of x in the formula $ZnSO_4.xH_2O$

Show your working.

(3)

$ZnSO_4$ H_2O

$\frac{4.83}{161}$ $\frac{3.78}{18}$

$\frac{0.03}{0.03}$ $\frac{0.21}{0.03}$

1 : 7

x = 7

(b) Why is it necessary to heat the crystals to constant mass?

(1)

to remove all the water

(c) Describe how the student could use a chemical test to show that the liquid collected was water.

(2)

turns anhydrous (white) copper sulfate blue

(Total for Question 13 = 8 marks)

(TOTAL FOR PAPER = 120 MARKS)

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