Write your name here

Surname	Other names

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International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

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

Tuesday 14 January 2014 – Morning
Time: 2 hours

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

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 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 ▶

P42863A

1/1/1/1/1/1/

P 4 2 8 6 3 A 0 1 3 2

PEARSON

THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
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

Answer ALL questions.

1 Rock salt is a mixture of salt and sand. Crystals of pure salt can be obtained from rock salt by using the method below.

Use words from the box to complete the sentences.

You may use each word once, more than once or not at all.

(5)

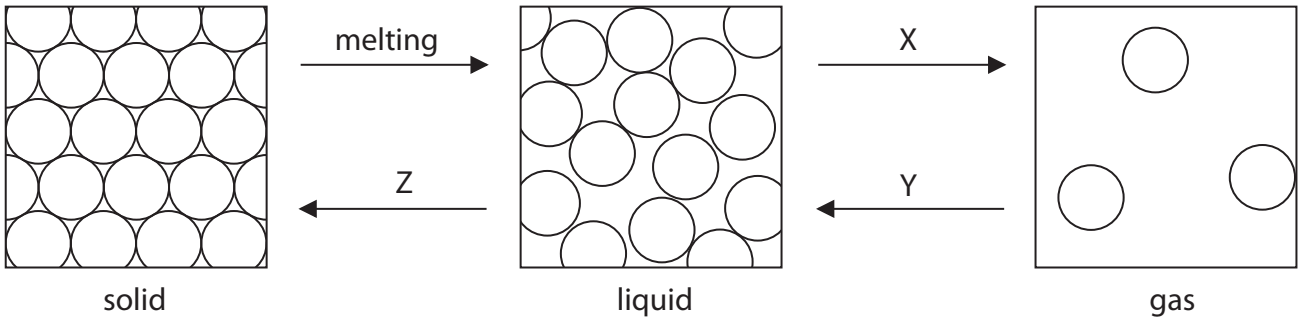
crystals	dissolve	evaporate	filter	solution	solvent

- Grind the rock salt into a fine powder.
- Add the powder to hot water and stir to ..... the salt.
- Filter the mixture. The salt ..... passes through the filter paper leaving behind the sand.
- Boil the filtrate to ..... some of the water.
- Leave the saturated solution to cool so that ..... of salt form.
- Finally, ... the cold mixture to separate the crystals from the remaining solution.

(Total for Question 1 = 5 marks)

2 The three states of matter are solid, liquid and gas.

The diagram shows how the particles are arranged in each of these states.



(a) Use words from the box to show the changes of state labelled X, Y and Z.

You may use each word once, more than once or not at all.

(3)

boiling	condensing	crystallisation	diffusion	freezing

X .....

Y .....

Z .....

(b) Which statement best describes the movement of the particles in a gas?

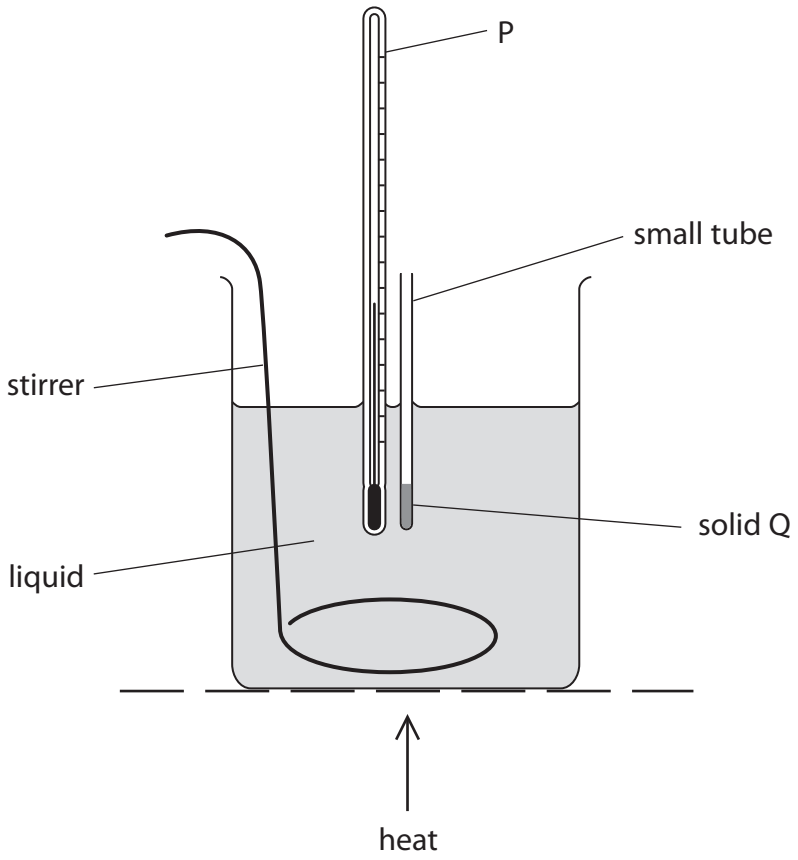
(1)

- ☒ **A** The particles vibrate about fixed positions.
- ☒ **B** The particles slide past one another.
- ☒ **C** The particles move freely.
- ☒ **D** The particles do not move at all.

(c) The diagram shows apparatus that can be used to measure the melting point of a solid.

The solid is placed in a small tube. The small tube is then put into a liquid contained in a beaker.

The liquid is gently heated and the temperature at which solid Q melts is recorded.



(i) Give the name of the apparatus labelled P.

(1)

.....

(ii) Solid Q melts at 140 °C.

Explain why water is not a suitable liquid to use in this experiment.

(1)

.....

.....

(iii) Suggest why the liquid in the beaker needs to be stirred constantly.

(1)

.....

.....

(Total for Question 2 = 7 marks)

3 Air is a mixture of gases.

The table gives the formulae of three gases and their approximate percentage by volume in a sample of dry, unpolluted air.

Gas	Percentage by volume
CO_2	0.04
N_2	78
O_2	21

(a) (i) Give the names of the two main gases in the sample of air.

(1)

..... and .....

(ii) Give the name of the gas that makes up most of the remaining 0.96% of the air.

(1)

.....

(b) State a use for N_2

(1)

.....

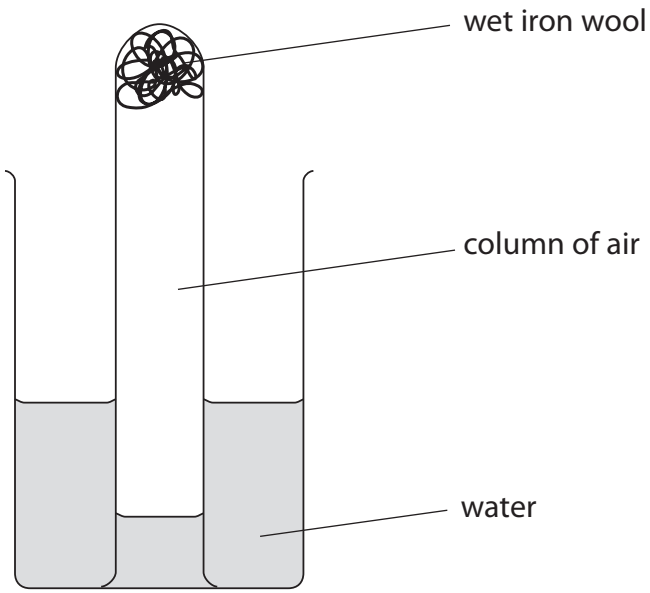
.....

(c) Give the name of a gas present in **polluted** air that causes acid rain.

(1)

.....

(d) A student used this apparatus to find the percentage by volume of oxygen in a sample of air.



She used this method.

- place some wet iron wool in the bottom of a test tube
- invert the test tube in a beaker containing water
- measure the height of the column of air in the test tube
- leave the test tube for one week
- measure the new height of the column of air

The table shows her results.

Initial height of column of air in mm	80
Final height of column of air in mm	63

(i) Some of the iron turned into rust.

Write a word equation for this reaction.

(2)

.....

(ii) Use the student's results to calculate the percentage of oxygen in this sample of air.

(2)

Percentage of oxygen .....

(e) The student left the apparatus for another week and measured the height of the column of air again.

From this measurement, how could she tell whether all of the oxygen in the test tube had been used up in the first week?

(1)

.....

.....

(Total for Question 3 = 9 marks)

4 This is a description of how the orange colouring can be extracted from rose petals.

- crush the petals using a pestle and mortar
- add the crushed petals to some ethanol in a beaker
- heat to about 60 °C and stir to produce an orange solution
- separate the orange solution from the petals

(a) (i) Suggest why ethanol is used instead of water.

(1)

.....

.....

(ii) Ethanol is a flammable liquid.

Suggest how it could be heated safely.

(1)

.....

.....

(iii) How could the orange solution be separated from the petals?

(1)

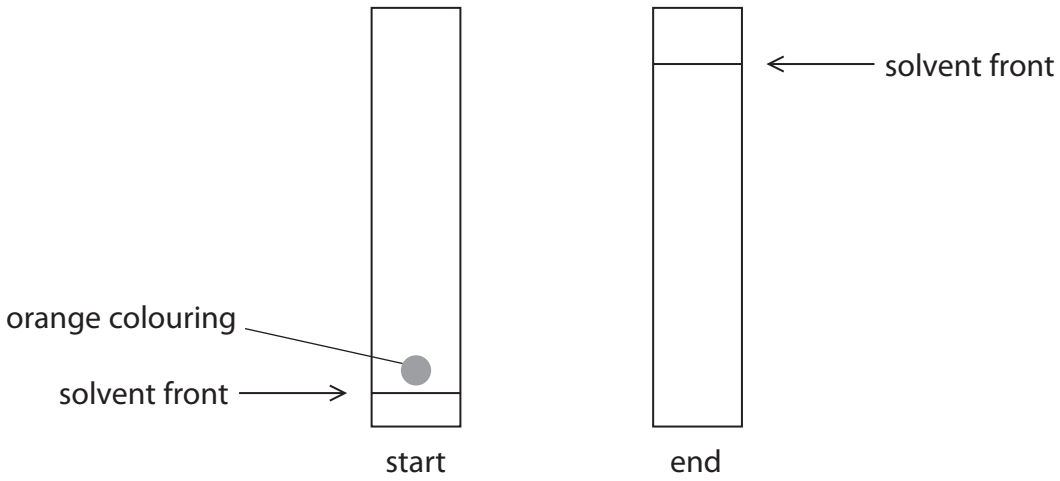
.....

(b) The orange colouring is analysed using chromatography and is found to consist of two different colours, red and yellow.

The diagram shows the chromatography paper at the start of the experiment.

Complete the diagram to show a possible result at the end of the experiment.

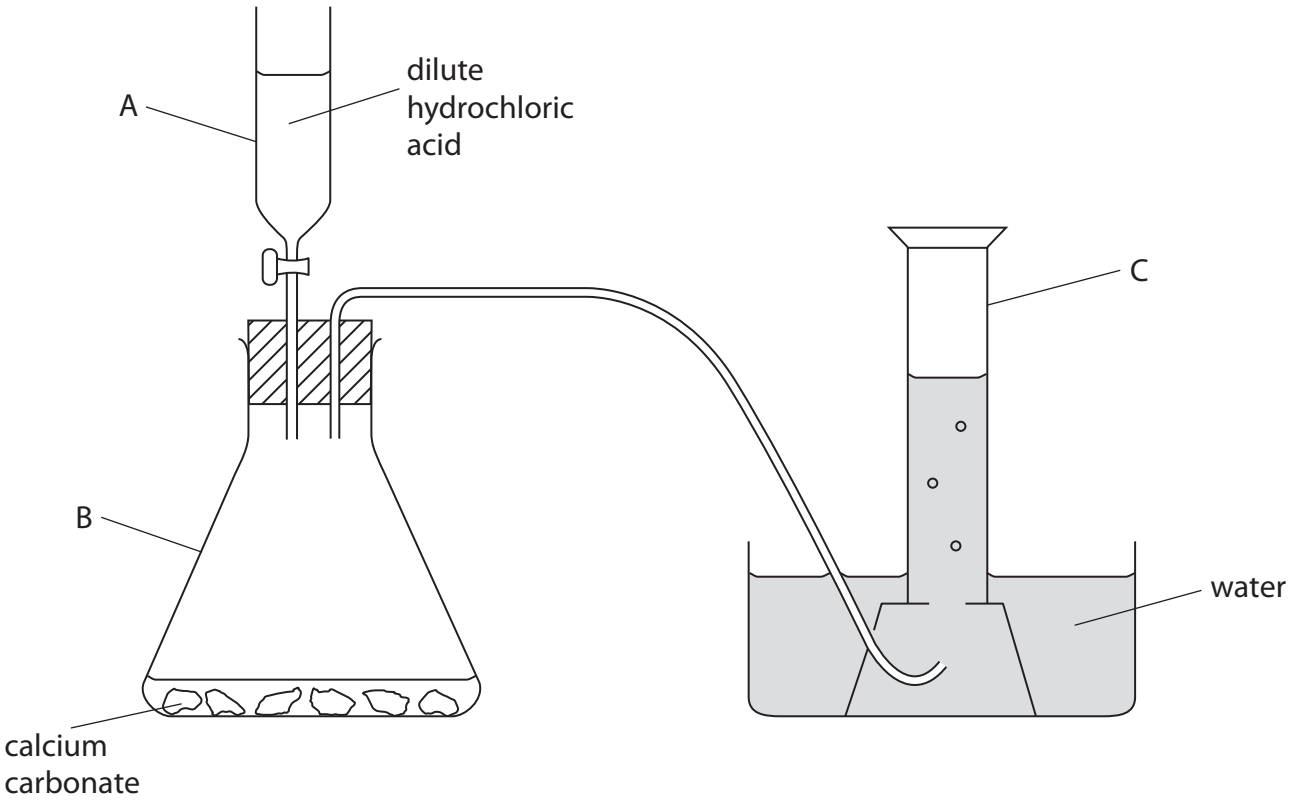
(2)



(Total for Question 4 = 5 marks)

5 This apparatus can be used to make and collect carbon dioxide.

This is done by adding dilute hydrochloric acid to calcium carbonate.



(a) Give the names of the pieces of apparatus labelled A, B and C.

(3)

A .....

B .....

C .....

(b) When an excess of carbon dioxide is bubbled through limewater, reaction 1 occurs, followed by reaction 2.

The equations for these reactions are

reaction 1 $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

reaction 2 $CaCO_3(s) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$

Suggest two observations that would be made when excess carbon dioxide is bubbled through limewater.

(2)

1 .....

.....

2 .....

.....

(c) Carbon dioxide is used in some fire extinguishers because it does not support combustion.

State another property of carbon dioxide that makes it suitable for use in fire extinguishers.

(1)

.....

.....

(d) Carbon dioxide is slightly soluble in water. The solution formed has a pH of 5.6

Which is the best description of a solution of carbon dioxide in water?

(1)

- ☒ **A** strongly acidic
- ☒ **B** strongly alkaline
- ☒ **C** weakly acidic
- ☒ **D** weakly alkaline

(Total for Question 5 = 7 marks)

6 The table gives some data about the first six members of a homologous series of compounds called the alkanes.

Alkane	Molecular formula	Relative formula mass	Boiling point in °C
methane	CH_4	16	–164
ethane	C_2H_6	30	–87
propane	C_3H_8	44	–42
butane	C_4H_{10}		0
pentane	C_5H_{12}	72	
hexane		86	69

(a) Complete the table by

- giving the molecular formula of hexane
- giving the relative formula mass of butane
- suggesting the boiling point of pentane

(3)

(b) What does the data show about the relationship between boiling point and relative formula mass?

(1)

.....

.....

.....

(c) The molecular formula of ethene is C_2H_4

Ethene and ethane are in different homologous series.

Explain how the formulae of these compounds show that they are in different series.

(1)

.....

.....

(d) (i) In the table, draw displayed formulae for the two alkanes with the molecular formula C_4H_{10}

(2)

Displayed formula 1	Displayed formula 2

(ii) What is the name given to compounds that have the same molecular formula but different displayed formulae?

(1)

.....

(e) The reaction between ethane and bromine (Br_2) is similar to the reaction between methane and bromine.

(i) Write a chemical equation for the reaction between ethane and bromine.

(2)

.....

(ii) What is the name given to the type of reaction that occurs when ethane reacts with bromine?

(1)

.....

(iii) Suggest the condition necessary for this reaction to occur.

(1)

.....

(Total for Question 6 = 12 marks)

7 Distress flares are used to attract attention in an emergency. The flares contain magnesium, which burns with a bright, white flame to form magnesium oxide.

(a) The reaction between magnesium and oxygen is exothermic.

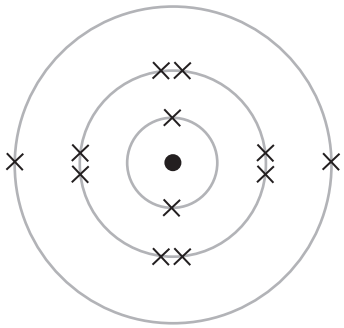
What is meant by the term **exothermic**?

(1)

.....

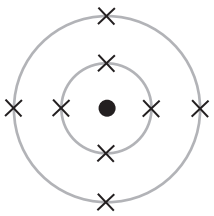
.....

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

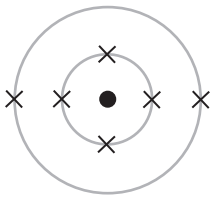


Put a cross in a box to indicate the diagram that shows the electronic configuration of an oxygen atom.

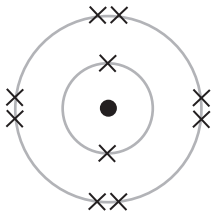
(1)



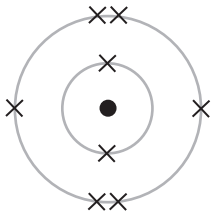
A ☒



B ☒



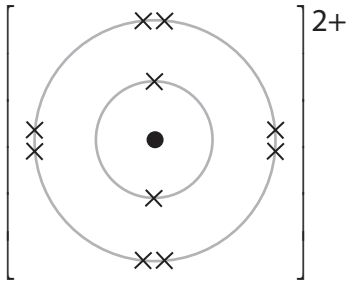
C ☒



D ☒

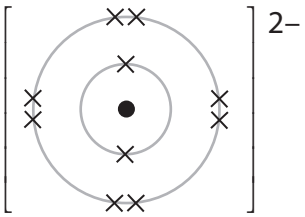
(c) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen.

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

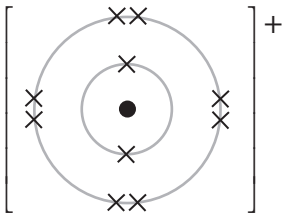


Put a cross in a box to indicate the diagram that shows the electronic configuration and charge of an oxide ion.

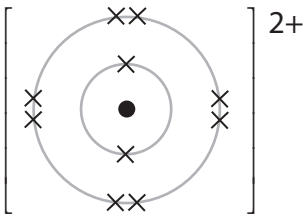
(1)



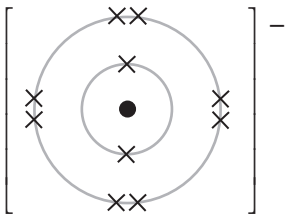
A ☒



B ☒



C ☒



D ☒

(d) A major use of magnesium oxide is as a refractory material, which is a material that can withstand very high temperatures.

Explain, in terms of its structure and bonding, why magnesium oxide has a very high melting point.

(4)

(e) Magnesium oxide is also used as an antacid. It helps relieve indigestion by neutralising hydrochloric acid in the stomach.

Give the name and formula of the salt produced when magnesium oxide reacts with hydrochloric acid.

(2)

Name .....

Formula .....

(Total for Question 7 = 9 marks)

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8 The table gives information about the first three elements in Group 1 of the Periodic Table.

Element	Atomic number	Relative atomic mass	Electronic configuration	Density in g / cm³	Melting point in °C
lithium	3	7	2.1	0.53	180
sodium	11	23	2.8.1	0.97	98
potassium	19	39	2.8.8.1	0.86	64

(a) Which information shows that the elements have similar chemical properties?

Give a reason for your choice.

(2)

Information .....

Reason .....

.....

(b) The elements in Group 1 show a clear trend (regular pattern) in some of their **physical** properties.

Identify the physical property that shows a clear trend.

(1)

.....

.....

(c) The elements also show a clear trend in their **chemical** properties, such as their reaction with water.

When a small piece of lithium is added to water it fizzes gently and eventually disappears to form a solution.

(i) Describe a test to show that the gas given off is hydrogen.

(1)

.....

.....

(ii) Complete the equation for the reaction by inserting the state symbols.

(1)

$2Li(\ldots\ldots) + 2H_2O(\ldots\ldots) \rightarrow 2LiOH(\ldots\ldots) + H_2(\ldots\ldots)$

(iii) State and explain the effect that the solution formed has on red litmus paper.

(2)

.....

.....

.....

.....

(d) State two similarities and two differences between the reactions of lithium and potassium with water.

(4)

Similarities .....

.....

.....

Differences .....

.....

.....

(e) When lithium burns in oxygen it forms lithium oxide (Li_2O).

(i) Write a chemical equation for the reaction between lithium and oxygen.

(2)

.....

(ii) When sodium burns in oxygen, one of the products is sodium peroxide (Na_2O_2).

Balance the equation to show the formation of sodium peroxide.

(1)

..... Na + ... O_2 → .....Na_2O_2

(Total for Question 8 = 14 marks)

9 A student investigates how temperature affects the rate of reaction between two colourless solutions containing ions.

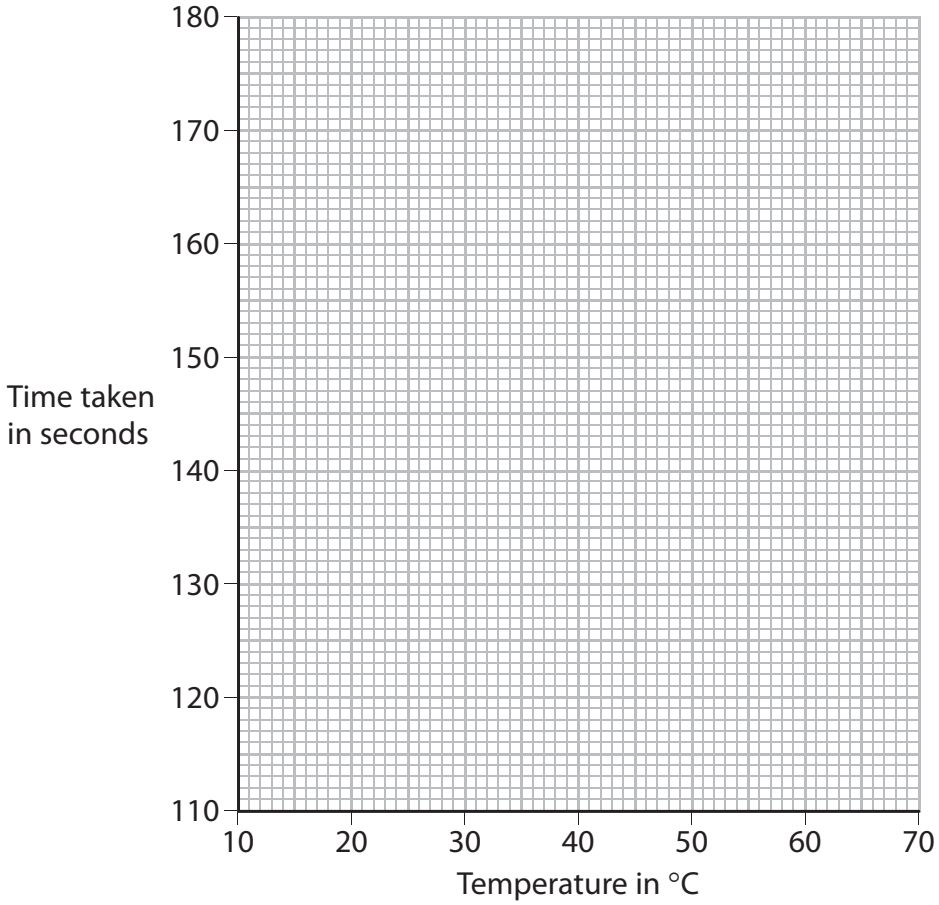
When he mixes the solutions, a reaction takes place between the ions and after a while the mixture suddenly turns blue. He performs the experiment at five different temperatures and on each occasion he measures the time taken for the mixture to turn blue.

The table shows his results.

Temperature in °C	15	19	26	38	60
Time taken in seconds	175	150	134	123	119

(a) (i) Plot the results on the grid and draw a curve of best fit.

(3)



(ii) Use your graph to estimate the time taken for the mixture to turn blue at 50 °C.

(1)

.....

(iii) What does the graph show about the relationship between temperature and time taken?

(1)

.....

.....

(b) Explain, in terms of particles, why an increase in temperature increases the rate of this reaction.

(3)

(c) State a variable that must be kept constant for the experiment to be valid (a fair test).

(1)

(Total for Question 9 = 9 marks)

10 A student investigates the reaction between dilute hydrochloric acid and marble chips.

She uses this method.

- put 50 cm^3 of dilute hydrochloric acid into a polystyrene cup
- measure the initial temperature of the acid
- add 5.0 g of marble chips to the acid and stir the mixture
- measure the temperature of the mixture after 2 minutes

She carries out the experiment three times, using different sizes of marble chips each time.

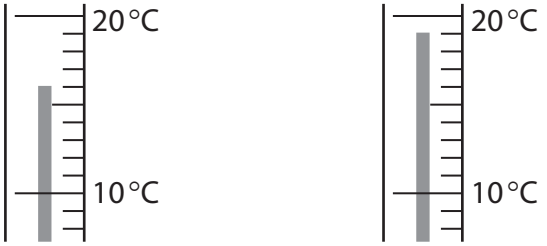
The diagram shows the temperatures for each experiment.

Experiment 1 – large marble chips

initial temperature

temperature after 2 minutes

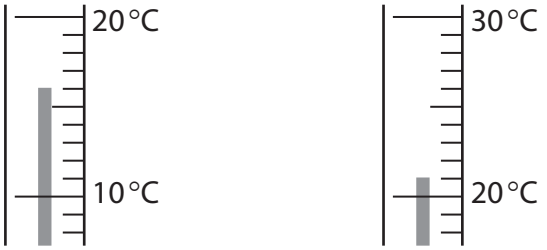
Experiment 2 – medium marble chips



initial temperature

temperature after 2 minutes

Experiment 3 – small marble chips



initial temperature

temperature after 2 minutes

(a) Record the temperature readings in the table and calculate the temperature changes.

(3)

	Initial temperature in °C	Temperature in °C after 2 minutes	Temperature change in °C
experiment 1			
experiment 2			
experiment 3			

(b) Explain why the temperature change in experiment 2 is greater than the temperature change in experiment 1.

(2)

.....

.....

.....

.....

.....

(c) Experiment 3 is repeated using 100 cm^3 of dilute hydrochloric acid in place of 50 cm^3. The acid is in excess in both reactions.

State and explain how the temperature change would be different for 100 cm^3 of dilute hydrochloric acid.

(2)

.....

.....

.....

.....

(Total for Question 10 = 7 marks)

11 Titanium is extracted from its main ore, rutile, in a three-stage process.

Stage 1 Rutile is heated with chlorine and coke (carbon) at a temperature of about 900 °C.

$$TiO_2 + 2Cl_2 + 2C \rightarrow TiCl_4 + 2CO$$

Stage 2 $TiCl_4$ is then added to liquid magnesium at a temperature of about 800 °C in an atmosphere of argon.

$$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$$

During the reaction the temperature rises to about 1100 °C.

Stage 3 The magnesium chloride is removed by distillation from the mixture formed in stage 2, leaving behind pure titanium.

(a) In stage 1, is the carbon oxidised or reduced?

Give a reason for your answer.

(1)

.....

.....

(b) What does the reaction in stage 2 indicate about the reactivity of magnesium compared to the reactivity of titanium?

Explain your answer.

(2)

.....

.....

.....

.....

(c) In stage 3, suggest why distillation can be used to remove magnesium chloride from titanium.

(1)

.....

.....

(d) Titanium has these properties.

- it is corrosion resistant
- it has a high melting point
- it has a very high strength-to-weight ratio
- it is non-toxic

Complete the table to suggest an important property of titanium for each use.

Choose from the four properties listed.

You must choose a different property for each use.

(3)

Use	Property
aircraft engines	
replacement hip joints	
propellers for boats	

(Total for Question 11 = 7 marks)

12 Magnesium reacts with dilute hydrochloric acid. The equation for the reaction is

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

(a) 0.0960 g of magnesium was added to 25.0 cm^3 of 0.400 mol/dm^3 hydrochloric acid.

(i) Calculate the amount, in moles, of magnesium used.

(2)

amount of magnesium = ... mol

(ii) Calculate the amount, in moles, of HCl in the 25.0 cm^3 of hydrochloric acid.

(2)

amount of HCl = ... mol

(b) Use your answers from (a) to determine which of the reactants is in excess.

Show your reasoning.

(2)

The reactant in excess is .....

(Total for Question 12 = 6 marks)

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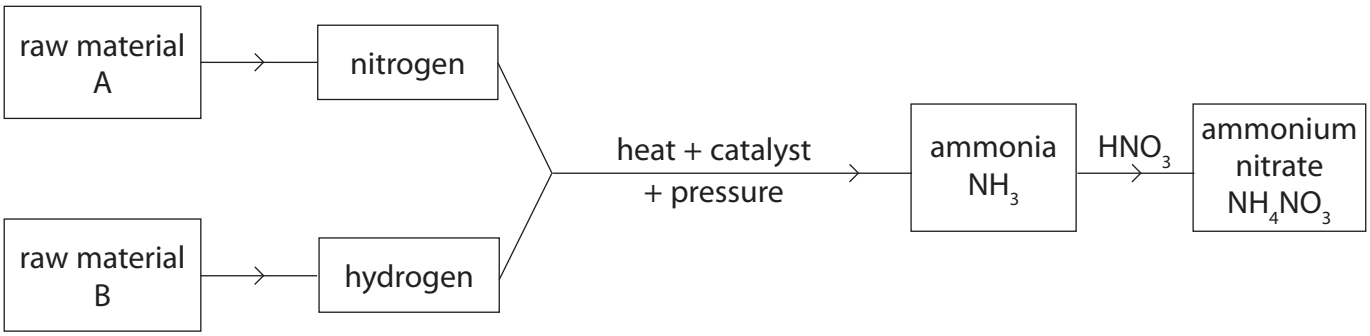
13 The diagram shows the manufacture of ammonia by the Haber process and its conversion into the fertiliser ammonium nitrate.



(a) Give the names of the raw materials A and B.

(2)

A .....

B .....

(b) State the temperature, pressure and catalyst used to convert the mixture of nitrogen and hydrogen into ammonia.

(3)

temperature .....

pressure .....

catalyst .....

(c) Give the name of the substance that has the formula HNO_3

(1)

.....

(d) The equation for the formation of ammonium nitrate from ammonia is

$$NH_3(aq) + HNO_3(aq) \rightarrow NH_4NO_3(aq)$$

25.0 cm^3 of a solution of ammonia of concentration 0.300 mol/dm^3 were reacted with a solution of HNO_3

15.0 cm^3 of HNO_3 were required to exactly neutralise the ammonia solution.

Calculate the concentration, in mol/dm^3, of the HNO_3 solution.

(3)

concentration of HNO_3 = ... mol/dm^3

(Total for Question 13 = 9 marks)

14 Carbon monoxide and hydrogen are used in the manufacture of methanol (CH_3OH).

The reaction is reversible and can reach a position of dynamic equilibrium.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \qquad \Delta H = -91 \text{ kJ/mol}$$

The reaction is carried out at a pressure of about 100 atmospheres and a temperature of 250 °C.

(a) State two features of a reaction that is in dynamic equilibrium.

(2)

1 .....

.....

2 .....

.....

(b) (i) How would a decrease in temperature at constant pressure affect the amount of methanol in the equilibrium mixture?

Explain your answer.

(2)

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(ii) How would an increase in pressure at constant temperature affect the amount of methanol in the equilibrium mixture?

Explain your answer.

(2)

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(c) Methanol (CH_3OH) can be converted into methanal (H_2CO).

A mixture of methanol and oxygen is passed over an iron oxide catalyst at 250 °C.

Methanal and water are the only two products.

(i) Write a chemical equation for the conversion of methanol into methanal.

(2)

(ii) What is meant by the term **catalyst**?

(2)

(iii) Explain how a catalyst works.

(2)

(d) Methanol can be used in racing cars as an alternative fuel to petrol.

Write the chemical equation for the complete combustion of methanol.

(2)

(Total for Question 14 = 14 marks)

(TOTAL FOR PAPER = 120 MARKS)

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