Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Wednesday 9 January 2019

Morning (Time: 2 hours)

Paper Reference **4CH0/1C 4SC0/1C**

Chemistry

Unit: 4CH0

Science (Double Award) 4SC0

Paper: 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.
- 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 ▶

P55714A

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

P 5 5 7 1 4 A 0 1 2 8

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

Answer ALL questions.

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

(a) Substances can be changed from one state to another.

The box lists some words relating to changes of state.

condensing	cooling	evaporation
heating	melting	sublimation

Complete the table by giving the correct word from the box for each change of state.

Each word may be used once, more than once, or not at all.

(3)

Change of state	Name of change
from solid to liquid	Melting
from liquid to gas	Evaporation
from solid to gas	Sublimation

(b) The particles in a solid are closely packed, arranged in a regular pattern and vibrate about a fixed position.

Describe the arrangement and movement of the particles in a gas.

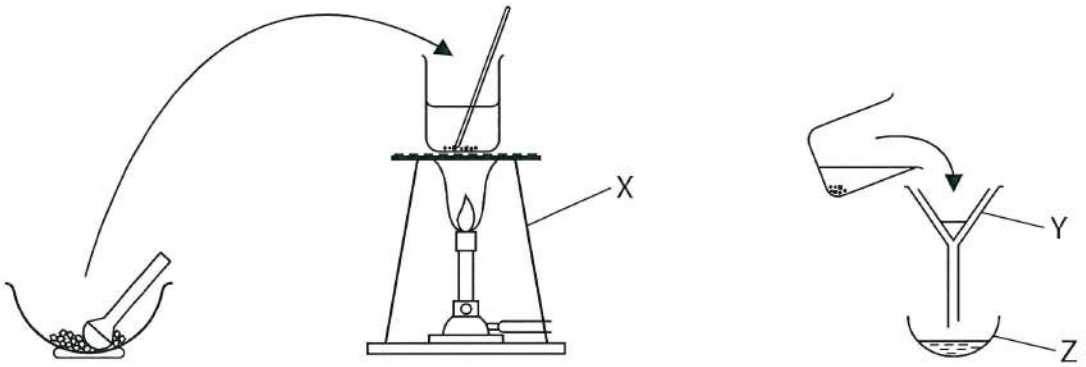
(3)

Gas particles have an irregular arrangement with large gaps between them. They move freely and quickly.

(Total for Question 1 = 6 marks)

2 Rock salt is a mixture of the soluble salt, sodium chloride, and some insoluble impurities.

The diagram shows the first three stages of a method used to obtain pure sodium chloride from rock salt.



Stage 1
rock salt crushed

Stage 2
crushed rock salt added to water

Stage 3

(a) Name the pieces of apparatus labelled X, Y and Z

(3)

X Tripod

Y Funnel

Z Evaporating basin

(b) (i) State why the mixture of rock salt and water is warmed and stirred in stage 2.

(2)

So the sodium chloride dissolves more quickly.

(ii) What is water in stage 2?

(1)

- ☐ **A** a residue
- ☐ **B** a solute
- ☐ **C** a solution
- ☒ **D** a solvent

(c) (i) Explain what happens to the impurities in stage 3.

(2)

Impurities remain in the filter paper as they are insoluble.

(ii) What is the liquid collected at the end of stage 3?

(1)

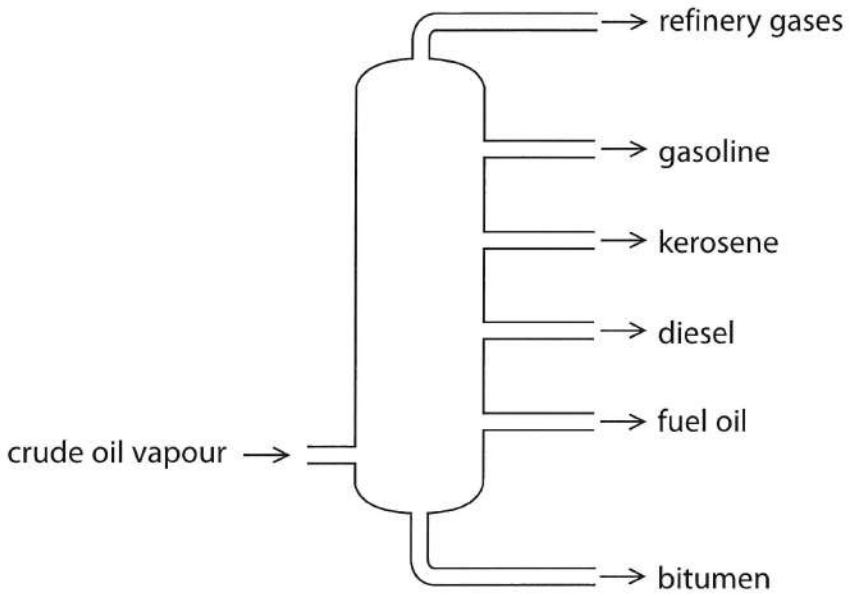
- ☐ **A** a residue
- ☐ **B** a solute
- ☒ **C** a solution
- ☐ **D** a solvent

(Total for Question 2 = 9 marks)

BLANK PAGE

3 Crude oil is a mixture of hydrocarbons.

(a) The diagram shows a column used in the industrial process to separate crude oil.



(i) Name the industrial process used to separate crude oil.

(1)

Fractional distillation.

(ii) State a use for kerosene and a use for bitumen.

(2)

kerosene Fuel for aircraft

bitumen Roads

(b) A molecule of the hydrocarbon eicosane has the formula $C_{20}H_{42}$

(i) Explain which homologous series eicosane belongs to.

(2)

Alkanes because $C_{20}H_{42}$ fits the general formula of alkanes, C_nH_{2n+2}.

(ii) Name a catalyst used in the industrial cracking of eicosane.

(1)

Silica

(iii) In a possible reaction for the cracking of eicosane, the products are three molecules of C_4H_8 and one molecule of another hydrocarbon.

Complete the equation for this reaction.

(1)

$$C_{20}H_{42} \rightarrow 3C_4H_8 + C_8H_{18}$$

(c) Hydrocarbons can be saturated or unsaturated.

(i) Explain what is meant by the term **hydrocarbon**.

(2)

Contains only carbon and Hydrogen.

(ii) State what is meant by a hydrocarbon being saturated.

(1)

Contains only single carbon-carbon bonds.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(iii) Describe a chemical test used to distinguish between unsaturated and saturated hydrocarbons.

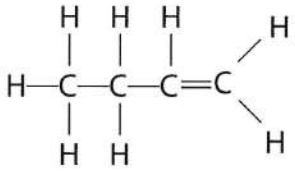
(3)

test Bromine water.

results Saturated hydrocarbons cause bromine water to turn colourless from orange.
Unsaturated hydrocarbons produce no change.

(d) The unsaturated hydrocarbon C_4H_8 has several isomers.

The displayed formula for one of these isomers is



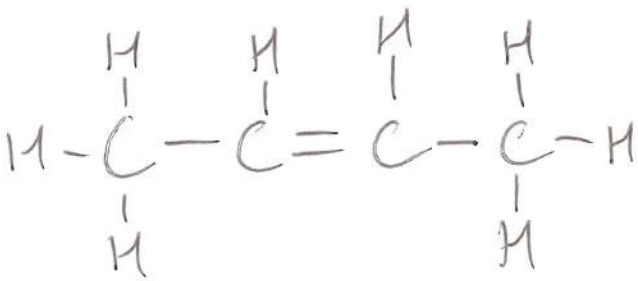
(i) Name this isomer.

(1)

but-1-ene

(ii) Draw the displayed formula of another isomer of C_4H_8

(1)



(Total for Question 3 = 15 marks)

4 (a) (i) Explain what is meant by the term **covalent bonding**.

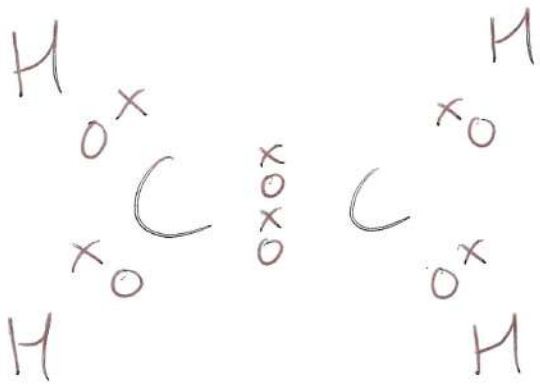
(2)

Electrostatic attraction between a shared pair of electrons and both nuclei.

(ii) Draw a dot and cross diagram to show the bonding in a molecule of ethene, C_2H_4

Show only the outer electrons.

(2)



(b) Substances A and B are covalently bonded and have simple molecular structures.

The table gives the boiling points for substances A and B.

Substance	Boiling point in °C
A	−42
B	−0.5

(i) Explain why substances with simple molecular structures have low boiling points.

(2)

Intermolecular forces are weak and require little energy to overcome.

(ii) Suggest why the boiling point of B is higher than the boiling point of A.

(1)

B has stronger intermolecular forces than A.

(iii) Substance B has the empirical formula C_2H_5 and an M_r value of 58.

Determine the molecular formula of substance B.

(2)

$2(12) + 5 = 29$

$\frac{58}{29} = 2$

$\therefore C_4H_{10}$

(c) Substance X is also covalently bonded, but its structure is different from that of A and B. It has a boiling point of 2230 °C.

Explain, in terms of its structure, why X has such a high boiling point.

(2)

X has a giant covalent structure with many strong covalent bonds which require large amounts of energy to overcome.

(Total for Question 4 = 11 marks)

5 Hot, molten sulfur reacts with oxygen to form sulfur dioxide gas.

(a) Describe what is seen when a sample of hot, molten sulfur is lowered into a gas jar containing oxygen.

(1)

Blue flame

(b) Sulfur dioxide gas is formed during the reaction between dilute hydrochloric acid and sodium sulfite, Na_2SO_3

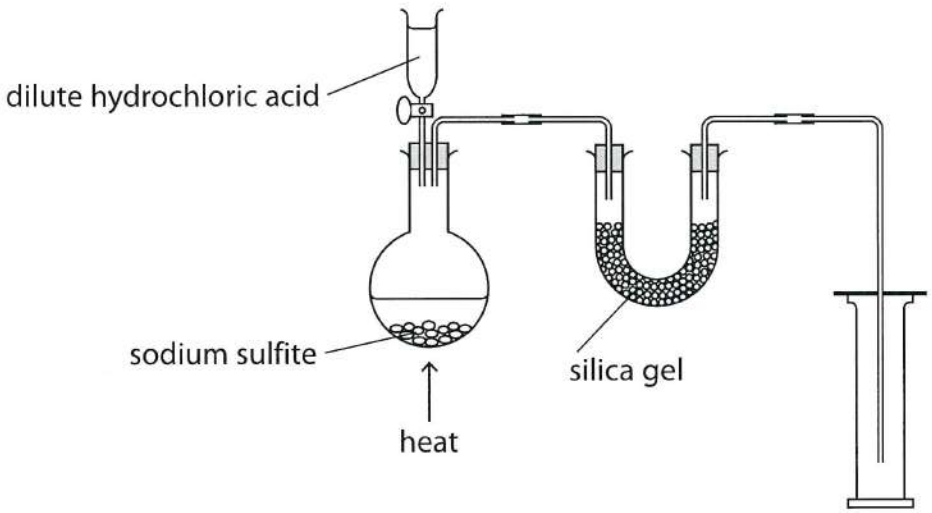
A salt and water are also formed.

Write a chemical equation for this reaction.

(2)

$2HCl + Na_2SO_3 \rightarrow 2NaCl + SO_2 + H_2O$

(c) This apparatus can be used to collect a pure, dry sample of sulfur dioxide gas.



(i) Suggest the purpose of the silica gel.

(1)

To dry the gas.

(ii) Name the method used in the diagram to collect the sulfur dioxide gas.

(1)

Downward delivery

(iii) State the physical property of sulfur dioxide gas that allows it to be collected in this way.

(1)

Denser than air

(d) A sample of sulfur dioxide reacts with water to form an acidic solution.

(i) Identify the acid formed.

(1)

Sulfurous acid, H_2SO_3

(ii) A few drops of methyl orange indicator are added to this solution.

State the colour of the indicator in this solution.

(1)

Red/pink

(iii) Give the formula of the ion responsible for this colour.

(1)

H^+

(iv) An alkali is then added to neutralise the acid.

State the final colour of the indicator.

(1)

Orange

(Total for Question 5 = 10 marks)

6 A student investigates the rate of the reaction between magnesium ribbon and dilute hydrochloric acid. The products are magnesium chloride and hydrogen.

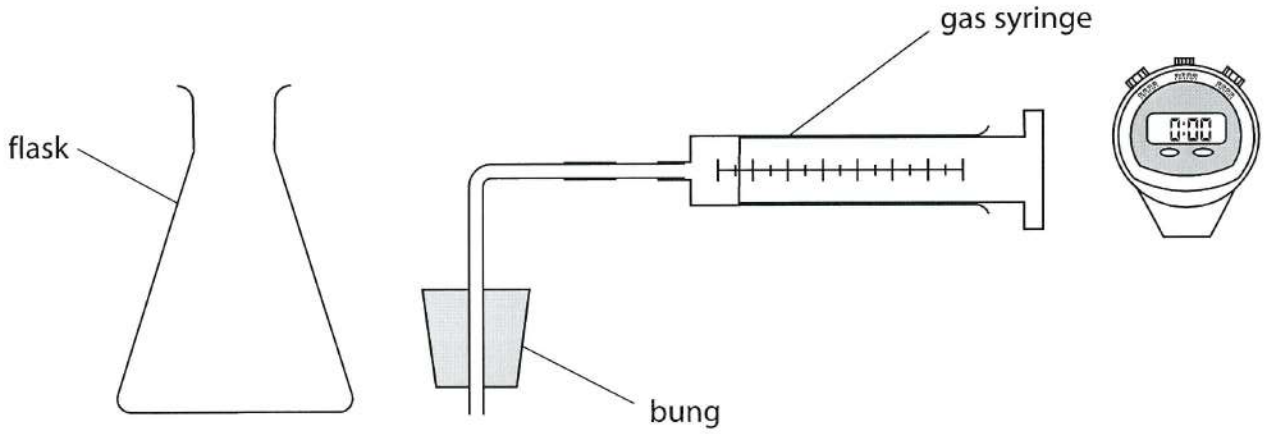
(a) The equation for the reaction is

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

Complete the equation by adding the state symbols.

(1)

(b) The student uses these pieces of apparatus in his experiment.



This is his method.

- clean a strip of magnesium ribbon to remove the oxide layer
- pour 50 cm^3 of 0.5 mol/dm^3 hydrochloric acid into the flask
- put the clean magnesium ribbon into the flask
- quickly put the bung into the flask to connect the gas syringe
- record the volume of gas in the syringe every minute for eight minutes

(i) Suggest why the student cleans the magnesium ribbon to remove the oxide layer.

(1)

To increase the rate of reaction.

(ii) Suggest why the student needs to put the bung into the flask quickly.

(1)

To prevent Hydrogen gas from escaping.

(iii) Suggest when the student should start the stop watch.

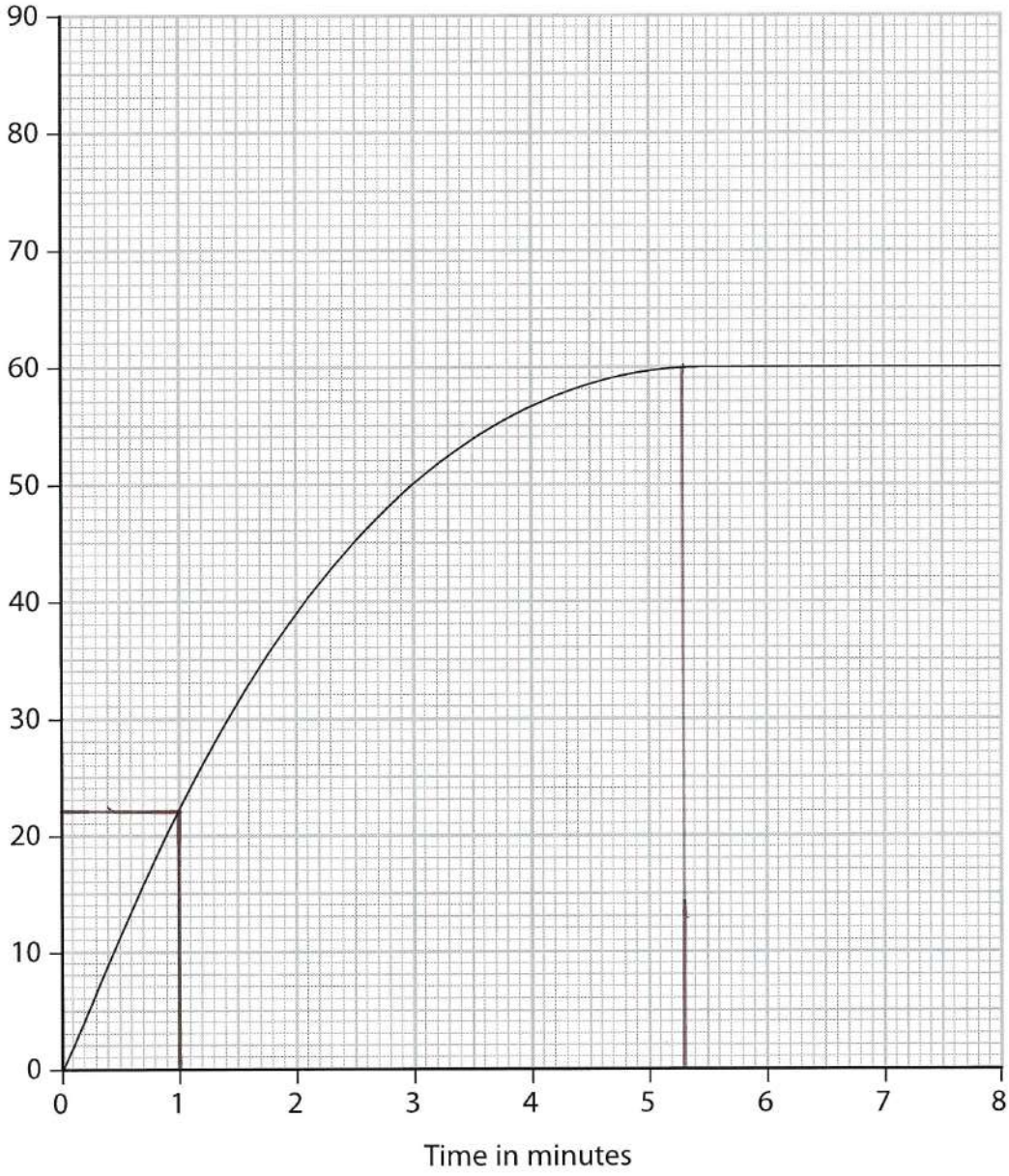
(1)

As soon as they put the bung into the flask.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) The graph shows the results of the student's experiment.



(i) Use the graph to find the volume of gas in the syringe at one minute.

Show on the graph how you obtained your answer.

(2)

volume = 22 cm³

(ii) Use the graph to find the time when the reaction stops.

(1)

time = 5.3 minutes

(iii) Suggest two possible reasons why the reaction stops.

(2)

1 All the magnesium has reacted.

2 All hydrochloric acid has reacted.

(iv) Explain when the rate of reaction is greatest.

(2)

At the start of the reaction, as the curve is steepest.

(d) Explain how increasing the concentration of the hydrochloric acid affects the rate of the reaction with magnesium.

Refer to the particle collision theory in your answer.

(4)

More particles in the same volume so more successful collisions per unit time. This means the rate of reaction increases.

(Total for Question 6 = 15 marks)

7 In the Periodic Table, the vertical columns of elements are called groups.

(a) The table gives some information about the first four elements in Group 0.

Element	Relative atomic mass (A_r)	Boiling point in °C
helium	4	−269
neon	20	−246
argon	40	−186
krypton	84	−153

(i) State the relationship between the relative atomic mass and the boiling point of these elements.

(1)

The greater the relative atomic mass the higher the boiling point.

(ii) State why the elements in Group 0 are unreactive.

(1)

They do not easily gain or lose electrons.

(b) The elements in Group 7 of the Periodic Table are called halogens.

State why the halogens have similar chemical properties.

Refer to electronic configurations in your answer.

(1)

They all have seven electrons in their outer shell.

(c) The order of reactivity of the halogens can be shown by using displacement reactions.

(i) When chlorine is added to sodium bromide solution, chlorine displaces bromine.

Write a chemical equation for this reaction.

(1)

$Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$

(ii) State the colour of the solution formed in this reaction.

(1)

Orange

(iii) Explain whether or not a reaction takes place when bromine water is added to sodium chloride solution.

(2)

No reaction, as bromine is less reactive than chlorine so it cannot displace the chlorine.

(iv) The displacement reaction between potassium iodide and chlorine can be represented by the ionic equation

$$2I^- + Cl_2 \rightarrow I_2 + 2Cl^-$$

Explain why this is described as a redox reaction.

(2)

I^- ions lose electrons so are oxidised.
Cl_2 molecules gain electrons so are reduced.

(d) Chlorine reacts with hydrogen to form hydrogen chloride gas.

(i) Write the chemical equation for this reaction.

(1)

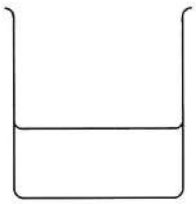
$H_2 + Cl_2 \rightarrow 2HCl$

(ii) Some methylbenzene is poured into beaker A.

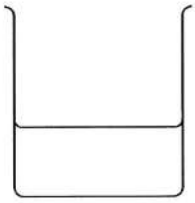
Some water is poured into beaker B.

Hydrogen chloride gas is dissolved in each liquid.

A separate piece of dry blue litmus paper is dipped into each solution.



A
hydrogen chloride dissolved in methylbenzene



B
hydrogen chloride dissolved in water

Explain what happens to
- the piece of litmus paper dipped into beaker A
- the piece of litmus paper dipped into beaker B.

(4)

beaker A No change to litmus paper as HCl doesn't form H^+ ions in methyl benzene.

beaker B Litmus turns red as H^+ ions are formed.

(Total for Question 7 = 14 marks)

8 The table shows information about the effect of adding sodium hydroxide solution to solutions containing zinc ions, calcium ions or aluminium ions.

Ion in solution	Effect of adding a few drops of sodium hydroxide solution	Effect of adding excess sodium hydroxide solution
zinc, Zn^{2+}	white precipitate forms	white precipitate disappears
calcium, Ca^{2+}	white precipitate forms	white precipitate remains
aluminium, Al^{3+}	white precipitate forms	white precipitate disappears

(a) A student is provided with a sample of a white solid.

(i) The student dissolves some of the white solid in water and then adds a few drops of sodium hydroxide solution. A white precipitate forms.

She concludes that the sample contains calcium ions.

Explain whether the student's conclusion is valid.

(2)

It is not valid because it could also be zinc or aluminium as we haven't seen the effect of adding excess sodium hydroxide

(ii) Give a different test to show that the white solid contains calcium ions.

(2)

test Flame test

result Brick red

(b) A hydrated salt has the formula $AB_2.xH_2O$

A is a positive ion and B is a negative ion.

When the hydrated salt is heated, this reaction occurs.

$$AB_2.xH_2O \rightarrow AB_2 + xH_2O$$

A scientist heats a sample of the hydrated salt until all the water has been lost.

She records the mass of the salt before and after heating.

The table shows her results.

Mass of hydrated salt	Mass of salt after heating
6.1 g	5.2 g

(i) Describe how the scientist could make sure that all the water has been lost.

(2)

Reheat until constant mass.

(ii) Use the scientist's results to find the value of x in $AB_2.xH_2O$

[M_r of AB_2 = 208 M_r of H_2O = 18]

(4)

$m(H_2O) = 6.1 - 5.2$

$= 0.9\,g$

$n = \frac{m}{M_r}$ $n(AB_2) = \frac{5.2}{208}$ $n(H_2O) = \frac{0.9}{18}$

$= 0.025\,mol$ $= 0.05\,mol$

$1 : 2$

x = 2

(c) Describe how the scientist could use a solution of the salt to find out if the negative ions are chloride ions.

(3)

Add HNO_3

Add $AgNO_3$

White precipitate forms.

(d) The test shows that the negative ions are chloride ions.

(i) Calculate the relative atomic mass of metal A using the formula and M_r value of the anhydrous salt, AB_2

(1)

$208 - 2(35.5) = 137$

relative atomic mass of A = 137

(ii) Identify metal A.

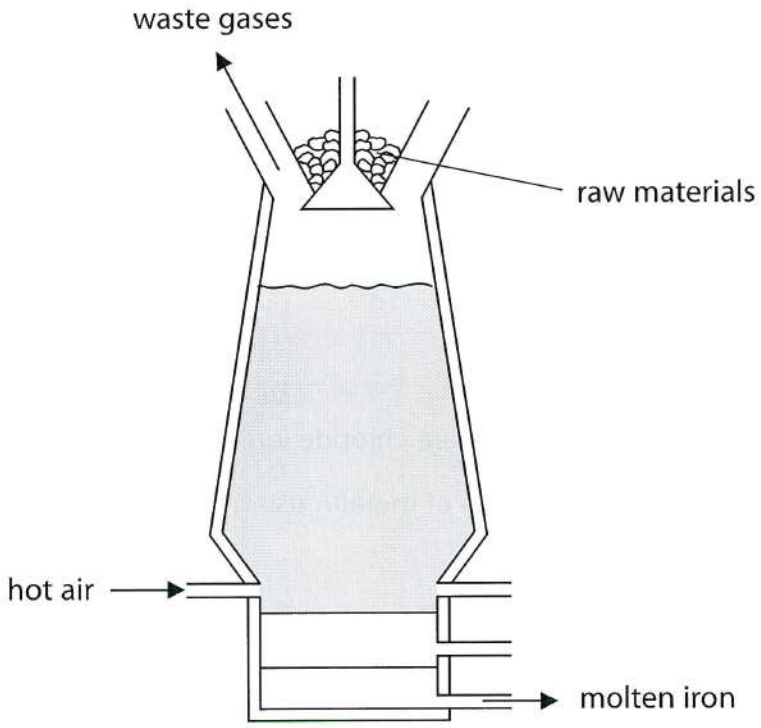
(1)

Barium

(Total for Question 8 = 15 marks)

9 Some metals can be obtained by heating their oxides with carbon.

(a) The diagram shows a blast furnace used to produce iron from iron ore.



(i) Give the name of an iron ore.

(1)

Haematite

(ii) Explain the role of the hot air in the furnace.

(2)

To provide oxygen to react with carbon.

(iii) Iron(III) oxide can be reduced by carbon.

Balance the equation for this reaction.

(1)

2 Fe_2O_3 + 3 C → 4 Fe + 3 CO_2

(iv) Limestone is one of the raw materials added to the blast furnace.

Explain how limestone removes the impurity, silica (SiO_2), from the furnace.

You may use equations to help your answer.

(3)

$CaCO_3$ decomposes to form CaO

CaO reacts with silica to form calcium silicate.

(b) (i) State why aluminium cannot be produced by heating its oxide with carbon.

(1)

Aluminium is more reactive than carbon.

(ii) Describe how aluminium is extracted from purified aluminium oxide.

(4)

Aluminium is extracted by electrolysis.
It is mixed with cryolite in a molten electrolyte.
Carbon and graphite electrodes are used.
Aluminium is formed at the cathode.

(Total for Question 9 = 12 marks)

10 A student does a titration to find the concentration of a solution of aqueous ammonia.

He uses this method.

- use a pipette to add 25.0 cm^3 samples of the solution into a conical flask
- add a few drops of indicator
- add sulfuric acid from a burette until the indicator changes colour permanently
- repeat the titration three more times

(a) (i) State what the student should do while adding the acid, to make sure that the indicator changes colour permanently.

(1)

Swirl flask

The table shows the student's titration results.

Volume of acid added in cm^3	23.40	23.15	22.95	23.10
Concordant results		✓	✓	✓

Concordant results are volumes within 0.20 cm^3 of each other.

(ii) Place ticks (✓) in the table to show which results are concordant.

(1)

(iii) Use the concordant results to calculate the average (mean) volume of acid added.

(2)

$$\frac{23.15 + 22.95 + 23.10}{3} = 23.07$$

average volume 23.07 cm^3

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) The table shows the titration results of another student.

Volume of aqueous ammonia used in cm^3	25.0
Concentration of sulfuric acid in mol/dm^3	0.0800
Average volume of sulfuric acid added from burette in cm^3	22.70

The equation for the reaction is

$$H_2SO_4 + 2NH_3 \rightarrow (NH_4)_2SO_4$$

(i) Calculate the amount, in moles, of H_2SO_4 in 22.70 cm^3 of the sulfuric acid.

(2)

$n = CV$

$n(H_2SO_4) = 0.0227 \times 0.08$

$= 0.001816 mol$

amount of H_2SO_4 = 1.816×10^{-3} mol

(ii) Calculate the amount, in moles, of NH_3 in the aqueous ammonia.

(1)

$1.816 \times 10^{-3} \times 2 = 0.003632 mol$

amount of NH_3 = 3.632×10^{-3} mol

(iii) Calculate the concentration, in mol/dm^3, of the aqueous ammonia.

(2)

$C = \frac{n}{V}$

$C(NH_3) = \frac{3.632 \times 10^{-3}}{0.025}$

$= 0.14528 mol dm^{-3}$

concentration of aqueous ammonia = 0.14528 mol/dm^3

(c) Describe how you could use the method of crystallisation to obtain a pure, dry sample of ammonium sulfate from a dilute solution of ammonium sulfate.

(4)

Heat the solution until crystals form in a cooled sample.
Leave the solution until crystals form.
Filter to obtain crystals.
Dry crystals using filter paper.

(Total for Question 10 = 13 marks)

TOTAL FOR PAPER = 120 MARKS