Write your name here

Surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Chemistry

Unit: 4CH0
Science (Double Award) 4SC0
Paper: 1CR

Thursday 17 May 2018 – Morning
Time: 2 hours

Paper Reference
4CH0/1CR
4SC0/1CR

You must have:
Ruler
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.
- 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 ▶

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

Answer ALL questions.

1 The table gives information about some substances.

Complete the table by choosing substances from the box that match the information.

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

(6)

air	bromine	carbon dioxide	copper
helium	iodine	methane	nitrogen

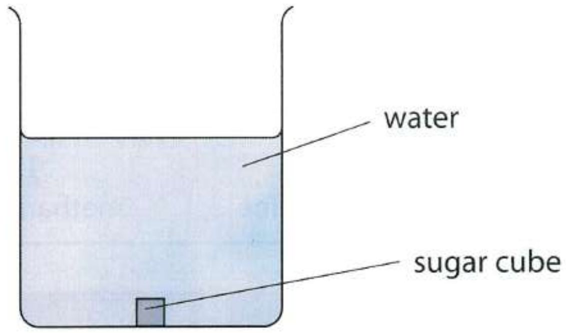
Information	Substance
a good conductor of electricity	Copper
a noble gas	Helium
a mixture	Air
a liquid at room temperature	Bromine
used in fire extinguishers	Carbon Dioxide
used as a fuel	Methane

(Total for Question 1 = 6 marks)

2 A sugar cube is placed in a beaker containing water.

The beaker is left until the sugar cube disappears and a sugar solution forms.

The concentration of the solution is the same at the bottom and top of the beaker.

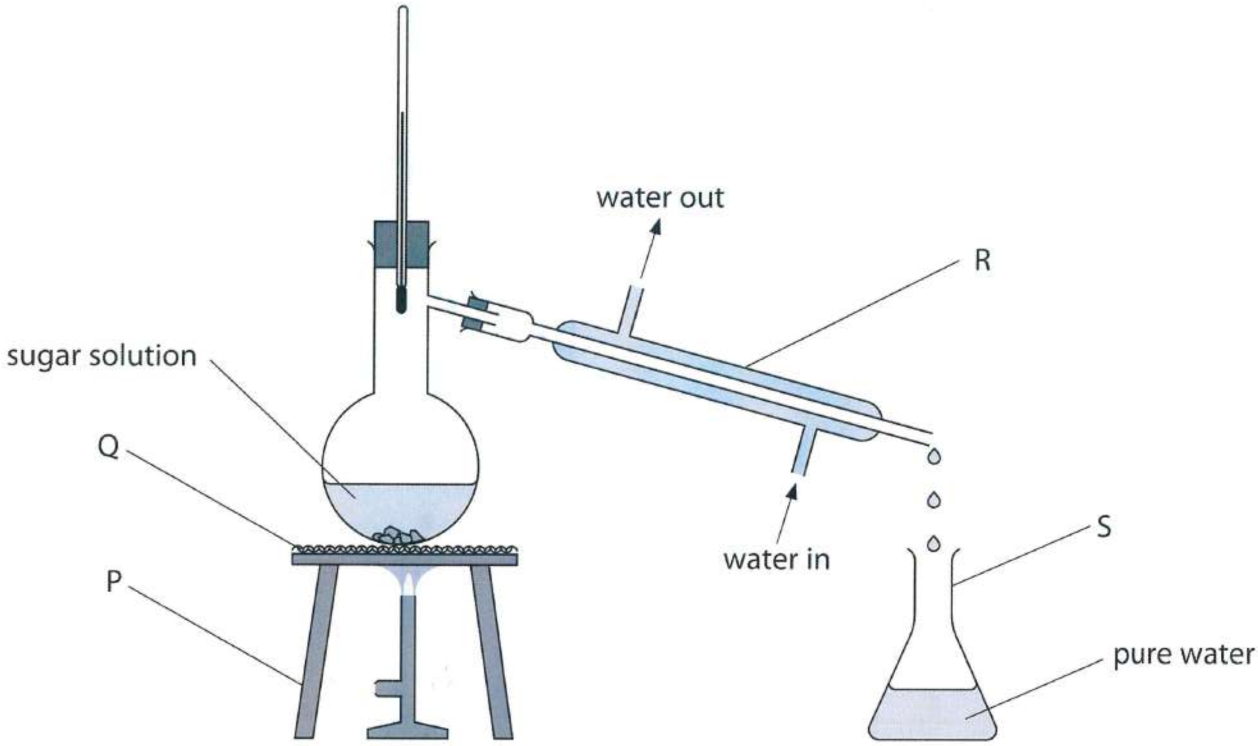


(a) Use the particle theory to explain what happens to the sugar cube to make the concentration of the solution the same at the bottom and top of the beaker.

(3)

Water particles collide with the sugar cube, causing sugar particles to dissolve. The sugar particles then spread out until they are evenly distributed in the water.

(b) This apparatus is used to obtain pure water from the sugar solution.



(i) What is the name of the process shown in the diagram?

(1)

☐ **A** crystallisation

☒ **B** distillation

☐ **C** filtration

☐ **D** sublimation

(ii) Give the name of each piece of apparatus.

(4)

P Tripod

Q Gauze

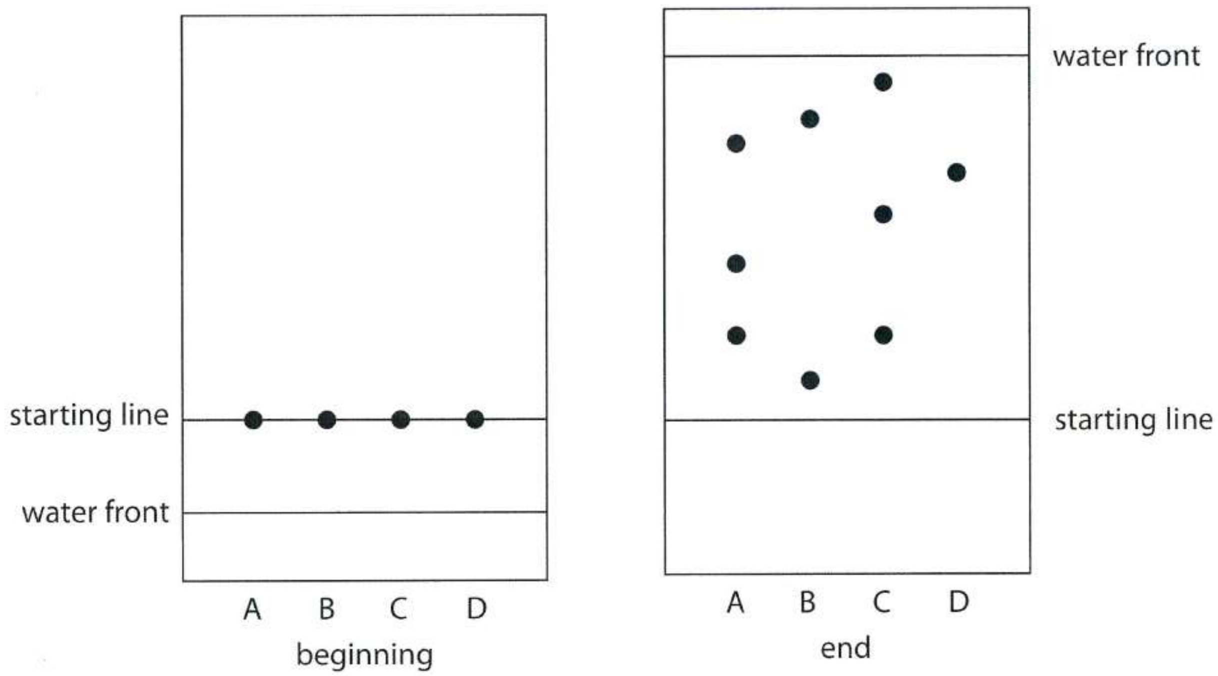
R Condenser

S Conical flask

(Total for Question 2 = 8 marks)

3 A student uses chromatography to investigate the colourings found in four different fruit drinks, A, B, C and D.

The diagram shows the chromatography paper at the beginning and at the end of the investigation.



(a) State why the student should draw the starting line in pencil.

(1)

Pencil won't dissolve in water.

(b) (i) Which drink contains only one colouring?

(1)

☐ **A**

☐ **B**

☐ **C**

☒ **D**

(ii) Explain which drink contains the most soluble colouring.

(2)

C, as it produced the spot which moved the furthest.

(iii) Explain which drinks contain the same colouring.

(2)

A and C, as they both have a spot at the same level.

(Total for Question 3 = 6 marks)

4 (a) Table 1 lists three subatomic particles.

Complete table 1 by giving the relative mass and relative charge of each subatomic particle.

(3)

Subatomic particle	Relative mass	Relative charge
proton	1	+1
neutron	1	0
electron	$\frac{1}{1836}$	−1

Table 1

(b) Table 2 shows the number of protons, neutrons and electrons in particles P, Q, R, S and T.

Particle	Number of protons	Number of neutrons	Number of electrons
P	11	12	10
Q	8	8	10
R	10	10	10
S	9	10	9
T	12	12	12

Table 2

Use table 2 to answer these questions.

Each particle, P, Q, R, S and T, may be used once, more than once or not at all.

(i) State which particle has the highest mass number.

(1)

T

(ii) State which particle contains two electrons in its outer shell.

(1)

T

(iii) State which particle is a negative ion.

(1)

Q

(iv) State which particle is an atom of an element in Group 7 of the Periodic Table.

(1)

S

(c) Which of these statements is correct for isotopes of the same element?

(1)

☐ **A** they have a different atomic number

☐ **B** they have a different number of electrons

☐ **C** they have the same number of neutrons

☒ **D** they have the same number of protons

(Total for Question 4 = 8 marks)

5 The diagram shows a section of the Periodic Table.

Period	Group 1	Group 2		Group 3	Group 4	Group 5	Group 6	Group 7	Group 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

(a) (i) The elements in the Periodic Table are arranged in order of increasing

(1)

☒ **A** atomic number

☐ **B** mass number

☐ **C** neutron number

☐ **D** relative atomic mass

(ii) Identify the element that is in Period 3 and Group 5 of the Periodic Table.

(1)

Phosphorus

(iii) Name two elements in Period 2 that form acidic oxides.

(2)

1 Carbon

2 Nitrogen

(iv) Describe the environmental problem that occurs when acidic oxides dissolve in water in the atmosphere.

(2)

Acid rain which kills plants and trees.

(b) Magnesium and sulfur react to form an ionic compound.

The equation for this reaction is

$$Mg + S \rightarrow MgS$$

(i) Write a word equation for this reaction.

(1)

Magnesium + Sulfur → Magnesium Sulfide

(ii) Describe the changes in electronic configurations when magnesium reacts with sulfur to form the ionic compound MgS.

Show the charges on the ions.

(3)

Each Magnesium atom loses two electrons to form Mg^{2+}

Each Sulfur atom gains two electrons to form S^{2-}

(iii) Calculate the mass of MgS that forms when 0.30 g of magnesium reacts completely with sulfur.

(3)

	Mg + S	→	MgS
m	0.30		0.70
Mr	24		56
n	0.0125	⟶	0.0125

$n = \frac{m}{M_r}$ $m = nM_r$

mass of MgS = 0.70 g

(Total for Question 5 = 13 marks)

6 Carbon dioxide gas forms when dilute nitric acid is added to marble chips.

The word equation for the reaction is

calcium carbonate + nitric acid → calcium nitrate + carbon dioxide + water

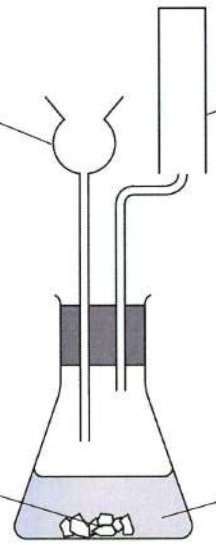
(a) Write a chemical equation for the reaction.

(2)

$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$

(b) A student needs to prepare and collect some carbon dioxide gas, using the reaction between marble chips and dilute nitric acid.

The diagram shows how he sets up his apparatus.



(i) State two reasons why the student's set-up is not suitable for collecting carbon dioxide.

(2)

1 CO_2 would escape through the thistle funnel.

2 Gas jar is the wrong way up.

(ii) The student then sets up his apparatus correctly, but uses excess dilute sulfuric acid instead of dilute nitric acid.

The reaction produces calcium sulfate.

Explain why the reaction stops, even though there are still marble chips and unreacted sulfuric acid in the flask.

(2)

Calcium sulfate is insoluble and forms a coating on the marble chips which prevent them from reacting.

(c) Some carbon dioxide is bubbled into distilled water containing universal indicator.

A solution of pH 6 is produced.

This shows that the solution is

(1)

☐ **A** weakly alkaline

☐ **B** strongly alkaline

☒ **C** weakly acidic

☐ **D** strongly acidic

(d) Carbon dioxide contains simple molecules.

The atoms in the molecules are joined by covalent bonds.

(i) State what is meant by the term **covalent bond**.

(2)

Electrostatic Attraction between a shared pair of electrons and the nuclei of both atoms.

(ii) Explain why carbon dioxide has a low boiling point.

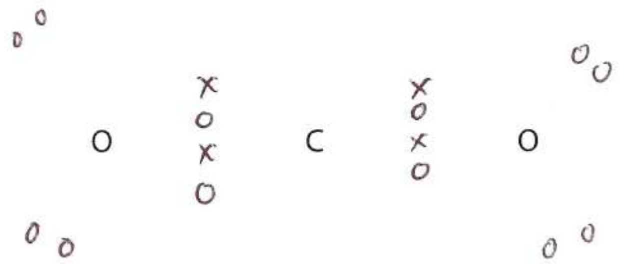
(2)

Weak intermolecular forces require little thermal energy to overcome.

(iii) Complete the diagram, using dots and crosses, to show the arrangement of the electrons in a molecule of carbon dioxide.

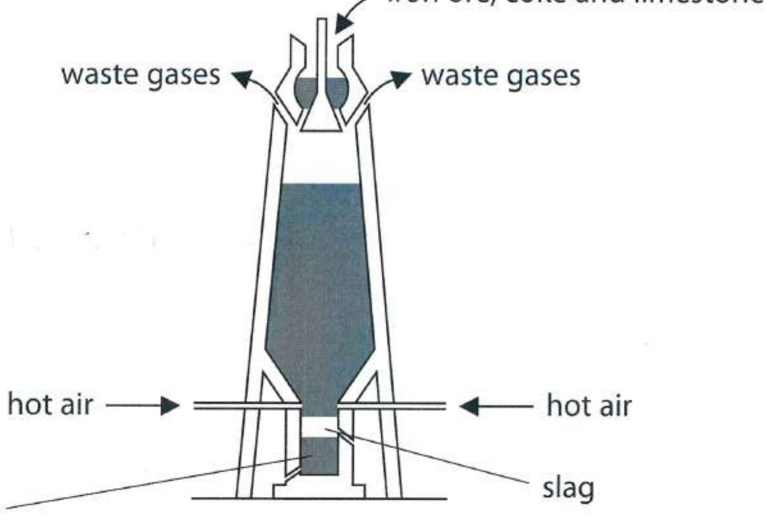
Show only the outer shell electrons.

(2)



(Total for Question 6 = 13 marks)

7 Iron is produced in a blast furnace.



(a) Give the common name of the iron ore that contains Fe_2O_3

(1)

Haematite

(b) Name the gas that makes up the highest percentage of the waste gases.

(1)

Nitrogen

(c) Carbon monoxide is the main reducing agent in the blast furnace.

Explain how the carbon monoxide is formed in the blast furnace.

(2)

Carbon reacts with oxygen to form carbon dioxide. Carbon dioxide reacts with carbon to form carbon monoxide.

(d) Write the chemical equation for the reduction of Fe_2O_3 by carbon monoxide.

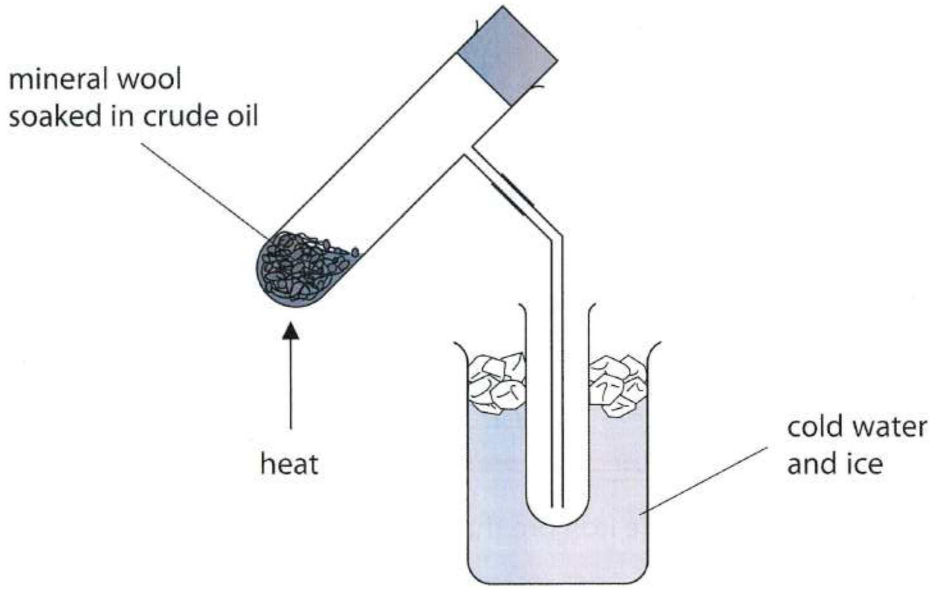
(2)

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

(Total for Question 7 = 6 marks)

8 Crude oil is a mixture of organic compounds.

A teacher uses this apparatus to separate a sample of crude oil into some fractions. She uses a clamp and stand to support the test tube being heated.



(a) (i) State what other piece of apparatus the teacher would need.

(1)

Thermometer

(ii) Explain why the test tube is placed in a beaker containing cold water and ice.

(2)

To cool the vapours and cause them to condense.

(b) The table shows the range of boiling points for the fractions collected by the teacher.

Fraction	Range of boiling point in °C
A	30–60
B	60–100
C	100–140
D	140–180

(i) Identify the fraction that is the least viscous at room temperature.

(1)

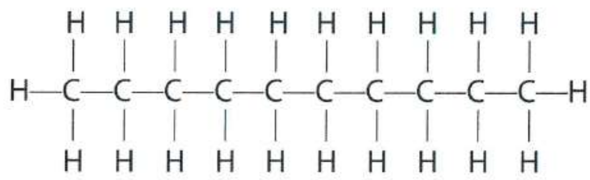
A

(ii) Identify the fraction that contains compounds with the smallest molecules.

(1)

A

(c) Fraction D contains decane that has this displayed formula.



(i) Determine the molecular formula of decane.

(1)

$C_{10}H_{22}$

(ii) Give the general formula of the homologous series that includes decane.

(1)

C_nH_{2n+2}

(d) $C_{14}H_{30}$ is a long chain molecule. It can undergo cracking to give octane, C_8H_{18}, and two molecules of the same alkene.

(i) Write an equation for this cracking process.

(2)

$C_{14}H_{30} \rightarrow C_8H_{18} + 2C_3H_6$

(ii) State two conditions used in industry for catalytic cracking.

(2)

1 Silica

2 600-700°c

(Total for Question 8 = 11 marks)

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9 The order of reactivity of metals can be found using different methods.

(a) One method is to add the metals to cold water and to dilute hydrochloric acid.

The table shows the observations made when samples of four metals are added separately to cold water and to dilute hydrochloric acid.

Metal	Observation when added to cold water	Observation when added to dilute hydrochloric acid
magnesium	bubbles produced very slowly	bubbles produced very quickly
platinum		no change
sodium	bubbles produced very quickly	not done
zinc	no change	bubbles produced slowly

(i) State the observation that is made when platinum is added to cold water.

(1)

No reaction

(ii) Place the four metals in order of reactivity.

(1)

most reactive Sodium

Magnesium

Zinc

least reactive Platinum

(iii) Describe a test to show that the bubbles contain hydrogen gas.

(1)

Burns with a pop.

(iv) Write a word equation for the reaction between magnesium and dilute hydrochloric acid.

(1)

Magnesium + Hydrochloric acid → Magnesium chloride + Hydrogen

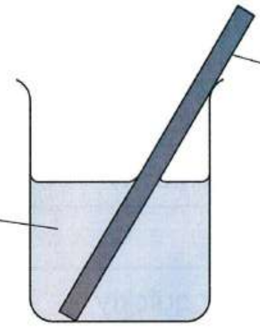
(v) Suggest why the reaction between sodium and dilute hydrochloric acid is not done.

(1)

It is a violent reaction.

(b) Displacement reactions are another method used to find the order of reactivity of metals.

In an experiment, a piece of zinc metal is placed in a beaker containing copper(II) sulfate solution.



(i) The reaction that occurs shows zinc is more reactive than copper.

State two observations that would be made as the reaction occurs.

(2)

1 Pink-brown solid formed

2 Blue solution is decolourised.

(ii) In a second experiment, a piece of copper metal is placed in a beaker containing nickel sulfate solution.

No reaction occurs.

Explain why it is not possible to determine the complete order of reactivity for copper, nickel and zinc from these two experiments.

(2)

We don't know whether zinc or nickel is more reactive as no experiment was done between a zinc salt and nickel.

(c) The ionic equation for the reaction between zinc and copper(II) sulfate is

$$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$$

Explain why this is described as a redox reaction.

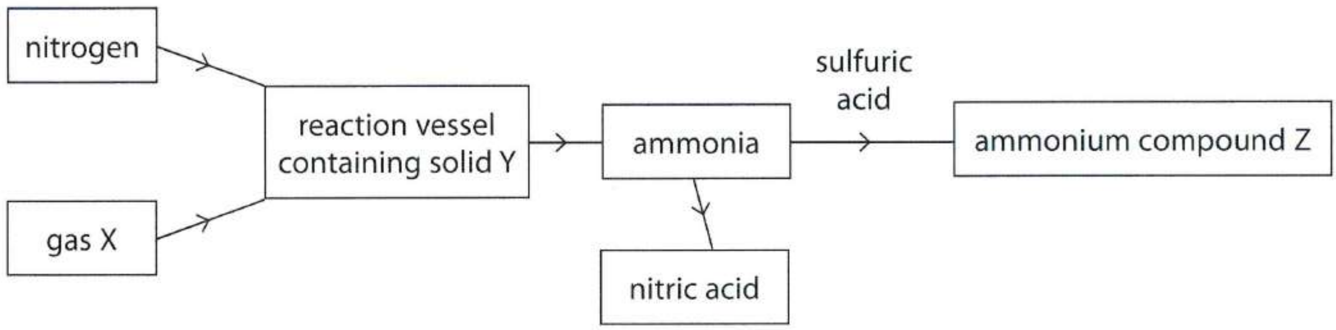
(3)

Zinc loses electrons, Copper ion gains electrons

Zinc is oxidised and the copper ion is reduced.

(Total for Question 9 = 12 marks)

10 The Haber process is used to manufacture ammonia, NH_3, from the reaction between nitrogen and gas X.



(a) (i) Explain why nitrogen is described as an element but ammonia is described as a compound.

(2)

In Nitrogen all atoms have the same atomic number.

Ammonia contains two different elements bonded together.

(ii) Name gas X and the raw material it is obtained from.

(2)

gas X Hydrogen

raw material Natural gas

(iii) The reaction vessel contains solid Y.

Identify solid Y.

(1)

Iron

(iv) State the purpose of solid Y.

(1)

Catalyst

(b) (i) Name the type of reaction that occurs between ammonia and sulfuric acid.

(1)

Neutralisation

(ii) Give the name and formula of the ammonium compound Z.

(2)

name Ammonium Sulfate

formula $(NH_4)_2SO_4$

(iii) Describe a test to show that a solid sample of compound Z contains ammonium ions.

(3)

Add NaOH(aq), test gas produced with damp red Litmus paper. Litmus turns blue.

(c) Ammonia is an important material in the chemical industry and is often transported as a liquid in sealed containers.

Suggest why it is transported in the containers as a liquid rather than as a gas.

(2)

Liquid occupies smaller volume so they can transport more in the same volume.

(d) Ammonia is used to produce nitric acid.

The first stage of the process is shown in this equation.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -950\,kJ$$

(i) State what is meant by the symbol ΔH.

(1)

Enthalpy change

(ii) State why using a lower temperature would produce a greater yield of nitrogen monoxide, NO.
[assume the reaction reaches a position of equilibrium]

(1)

The forward reaction is exothermic.

(iii) State why using a lower pressure would produce a greater yield of nitrogen monoxide, NO.
[assume the reaction reaches a position of equilibrium]

(1)

More moles of gas on right hand side of the equation.

(e) Nitric acid and ammonia are used to produce ammonium nitrate.

Explain why ammonium nitrate is used in agriculture.

(2)

It is a fertiliser and therefore increases crop yield.

(Total for Question 10 = 19 marks)

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11 A student investigates the reaction between lead(II) nitrate solution and potassium chromate solution.

(a) Lead(II) nitrate solution and potassium chromate solution react to form a yellow precipitate of lead(II) chromate and potassium nitrate solution.

(i) Complete the equation by adding the state symbols.

(1)

$Pb(NO_3)_2$ (aq) + K_2CrO_4 (aq) → $PbCrO_4$ (s) + $2KNO_3$ (aq)

(ii) Use information from the equation to determine the charge on the chromate ion.

(1)

2 −

(b) The student uses this method for her investigation.

- place 5.0 cm^3 potassium chromate solution in a test tube standing in a test tube rack
- add 1.0 cm^3 lead(II) nitrate solution to the test tube
- allow the precipitate to settle and measure its height
- repeat the method using separate 5.0 cm^3 samples of potassium chromate and adding different volumes of lead(II) nitrate solution

These are the student's results.

Volume of lead(II) nitrate solution in cm^3	Height of precipitate in cm
1.0	0.3
2.0	0.6
4.0	1.2
6.0	1.8
8.0	2.4
9.0	2.7
11.0	3.0
12.0	3.0
14.0	2.1
16.0	3.0
18.0	3.0

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

(2)

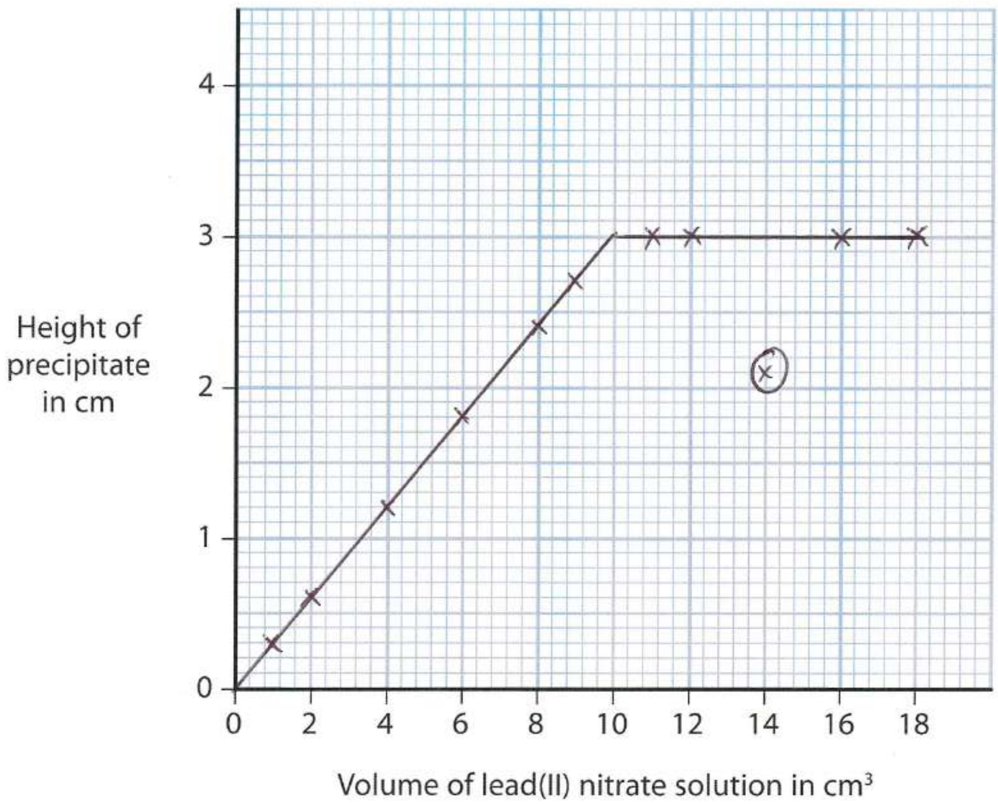
(ii) Circle the anomalous result on the grid.

(1)

(iii) Ignoring the anomalous result, draw a straight line of best fit through the first six points, and another straight line of best fit through the last five points.

Make sure that the two lines cross.

(2)



(iv) Use your graph to find the volume of lead(II) nitrate solution that reacts exactly with the 5.0 cm^3 of potassium chromate solution.

(1)

volume of lead(II) nitrate solution = 10 cm^3

(v) Suggest two possible reasons for the anomalous result.

(2)

1 Added too little lead (II) nitrate

2 Precipitate not left to settle for long enough

(c) (i) Describe how to obtain a pure, dry sample of solid lead(II) chromate from the test tube at the end of the investigation.

(3)

Filter off the precipitate
Wash the precipitate with distilled water.
Leave to dry.

(ii) Give a test to show that the potassium nitrate solution in the test tube contains potassium ions.

(2)

Flame test, produces a lilac flame.

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(d) The student does a similar experiment to produce a precipitate of lead iodide, PbI_2, using the following reaction.

$$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$$

He finds that 5.0 cm³ of 0.90 mol/dm³ KI solution reacts with 8.0 cm³ of $Pb(NO_3)_2$ solution.

Calculate the concentration, in mol/dm³, of the $Pb(NO_3)_2$ solution.

(3)

$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$

	$Pb(NO_3)_2$	$2KI$
V	8.0	5.0
C	0.28	0.90
n	2.25	4.5

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

concentration of $Pb(NO_3)_2$ solution = 0.28 mol/dm³

(Total for Question 11 = 18 marks)

TOTAL FOR PAPER = 120 MARKS

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