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 ▶

P 5 3 2 7 4 A 0 1 3 2

Pearson

THE PERIODIC TABLE

Group

Period	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 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	
a noble gas	
a mixture	
a liquid at room temperature	
used in fire extinguishers	
used as a fuel	

(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.

water
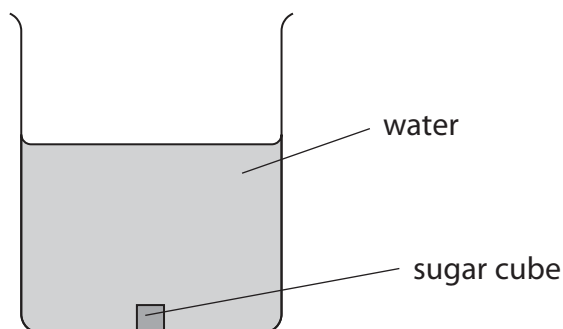
sugar cube

(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.
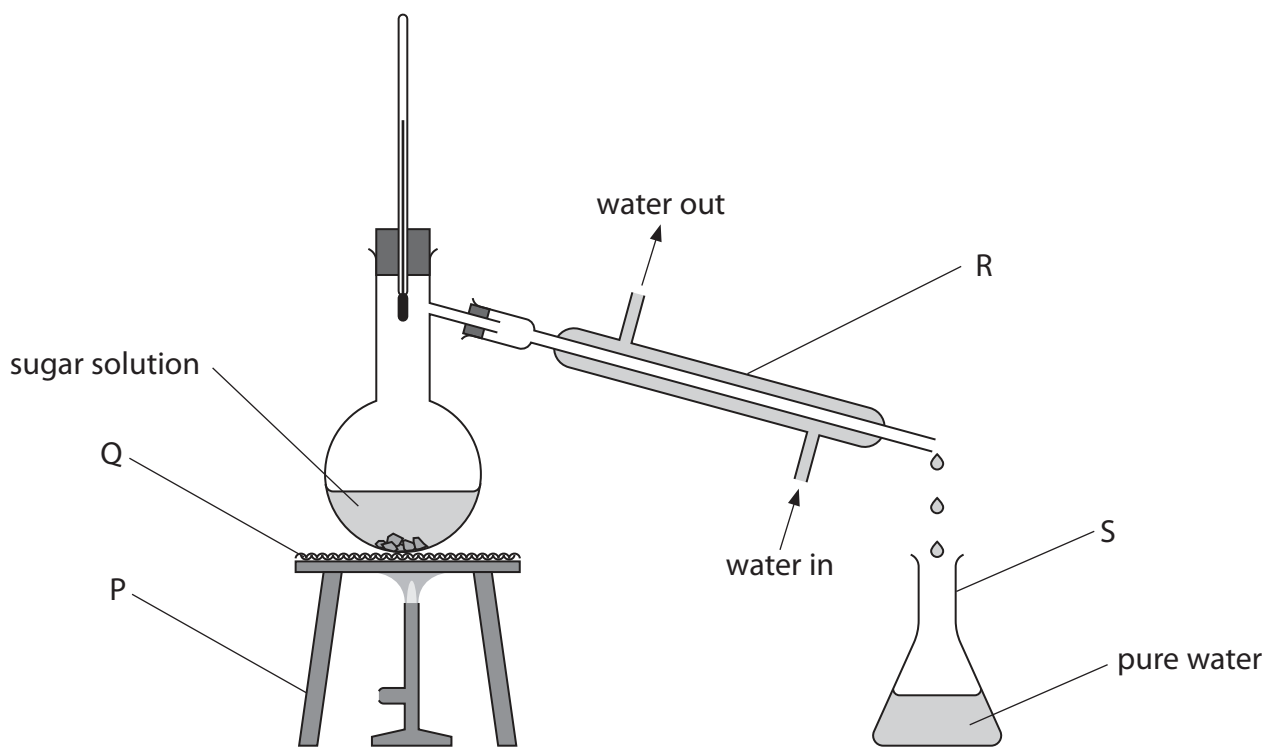
(3)

....

....

....

....

....

....

P 5 3 2 7 4 A 0 4 3 2

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

water out

R

sugar solution

Q

P

water in

S

pure water

(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 ....

Q ....

R ....

S ....
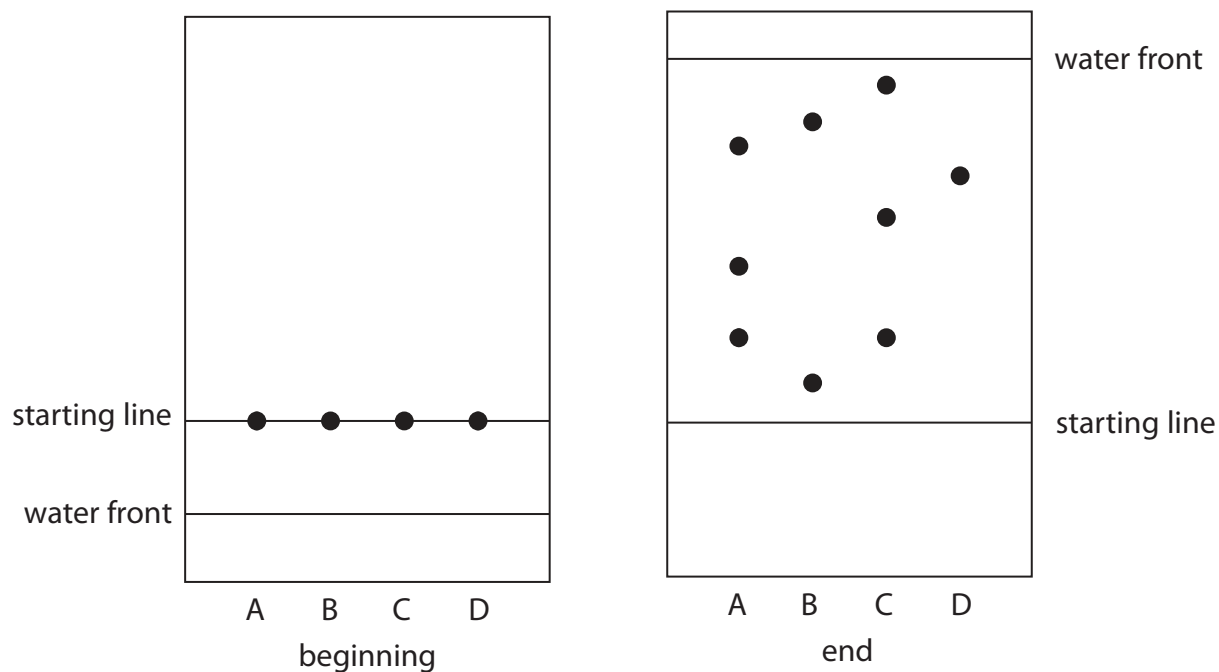
(Total for Question 2 = 8 marks)

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)

....

....

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

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

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

(2)

....

....

....

....

(iii) Explain which drinks contain the same colouring.

(2)

....

....

....

....

(Total for Question 3 = 6 marks)

P 5 3 2 7 4 A 0 7 3 2

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		
neutron		
electron		

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)

....

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

(1)

....

(iii) State which particle is a negative ion.

(1)

....

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

(1)

....

(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	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

(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)

....

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

(2)

1 ....

2 ....

(iv) Describe the environmental problem that occurs when acidic oxides dissolve in water in the atmosphere.
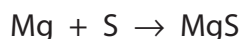
(2)

....

....

....

(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)

....

(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)

....

....

....

....

....

....

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

(3)

mass of MgS = ... g

(Total for Question 5 = 13 marks)

6 Carbon dioxide gas forms when dilute nitric acid is added to marble chips.
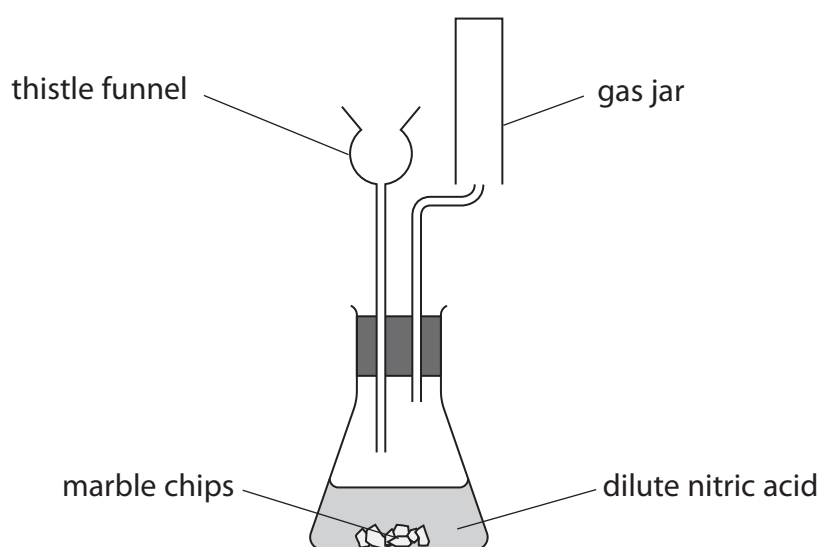
The word equation for the reaction is

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

(a) Write a chemical equation for the reaction.

(2)

....

(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 ....

....

2 ....

....

P 5 3 2 7 4 A 0 1 2 3 2

(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)

....

....

....

....

....

....

(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

P 5 3 2 7 4 A 0 1 3 3 2

(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)

....

....

....

....

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

(2)

....

....

....

....

(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)

O   C   O
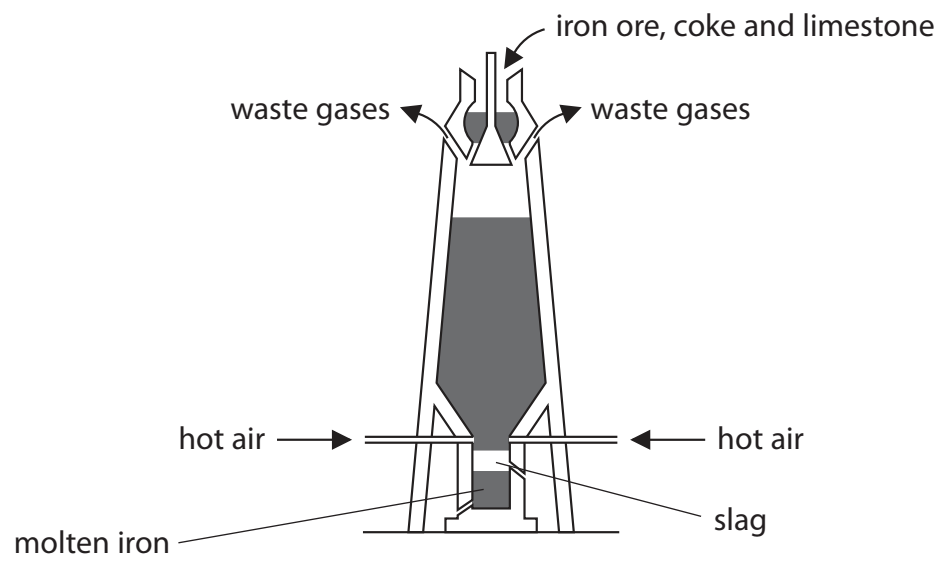
(Total for Question 6 = 13 marks)

7 Iron is produced in a blast furnace.

iron ore, coke and limestone

waste gases ← → waste gases

hot air → ← hot air

slag

molten iron

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

(1)

....

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

(1)

....

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

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

(2)

....

....

....

....

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

(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.

mineral wool
soaked in crude oil

heat
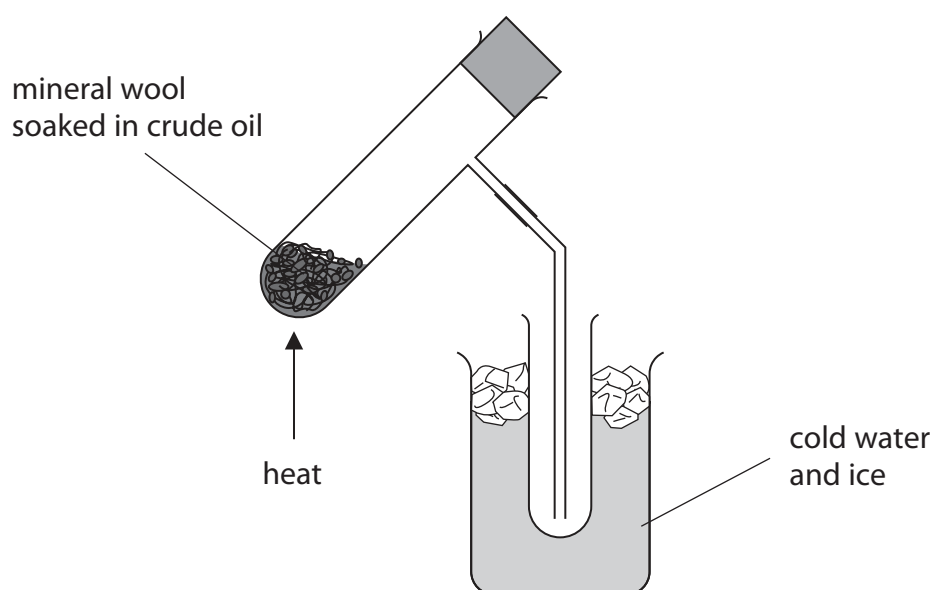
cold water
and ice

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

(1)

....

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

(2)

....

....

....

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

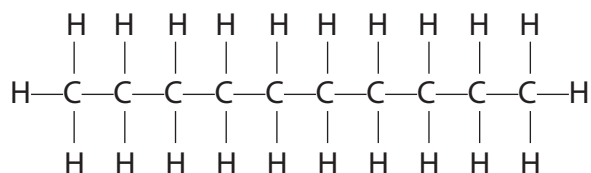| Fraction	Range of boiling point in °C
A	30–60
B	60–100
C	100–140
D	140–180

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

(1)

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

(1)

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

$$\begin{array}{c} \quad H \quad H \quad H \quad H \quad H \quad H \quad H \quad H \quad H \quad H \\ \quad | \quad | \quad | \quad | \quad | \quad | \quad | \quad | \quad | \quad | \\ H-C-C-C-C-C-C-C-C-C-C-H \\ \quad | \quad | \quad | \quad | \quad | \quad | \quad | \quad | \quad | \quad | \\ \quad H \quad H \quad H \quad H \quad H \quad H \quad H \quad H \quad H \quad H \end{array}$$

(i) Determine the molecular formula of decane.

(1)

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

(1)

(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)

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

(2)

1 ....

2 ....

(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)

....

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

(1)

most reactive ....

....

....

least reactive ....

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

(1)

....

....

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

(1)

....

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

(1)

....

....

....

(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.

copper(II) sulfate solution

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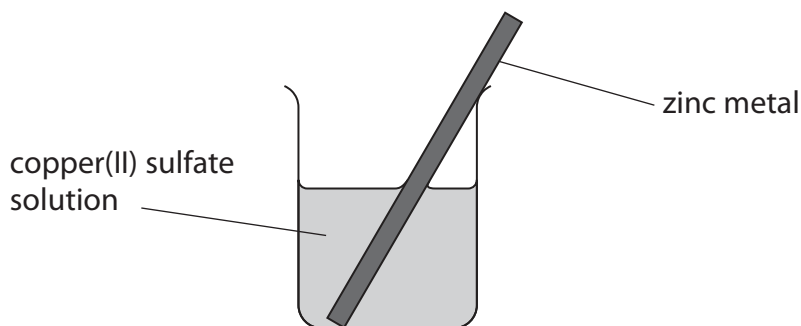
(i) The reaction that occurs shows zinc is more reactive than copper.

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

(2)

1 ....

2 ....

(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.
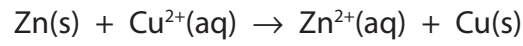
(2)

....

....

....

....

(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)

....

....

....

....

....

....
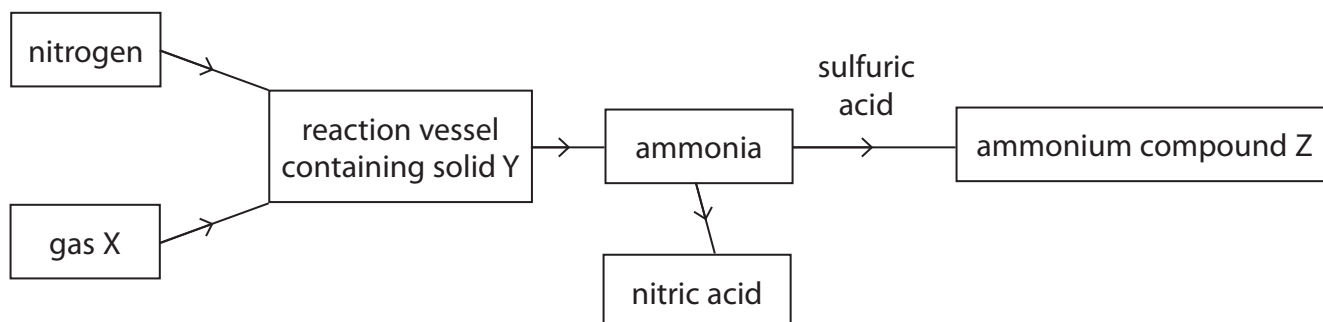
(Total for Question 9 = 12 marks)

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

```
nitrogen ─┐
          ├─→ reaction vessel ──→ ammonia ──sulfuric──→ ammonium compound Z
          │    containing solid Y      │      acid
gas X ────┘                            │
                                       ↓ nitric acid
```

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

(2)

....

....

....

....

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

(2)

gas X ....

raw material ....

(iii) The reaction vessel contains solid Y.

Identify solid Y.

(1)

....

(iv) State the purpose of solid Y.

(1)

....

....

....

P 5 3 2 7 4 A 0 2 2 3 2

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

(1)

....

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

(2)

name ....

formula ....

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

(3)

....

....

....

....

....

....

(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)

....

....

....

....

(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)

....

(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)

....

....

(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)

....

....

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

Explain why ammonium nitrate is used in agriculture.

(2)

....

....

....

....

(Total for Question 10 = 19 marks)

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P 5 3 2 7 4 A 0 2 5 3 2

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)

$Pb(NO_3)_2$ (............................) + K_2CrO_4 (............................) → $PbCrO_4$ (............................) + $2KNO_3$ (............................)
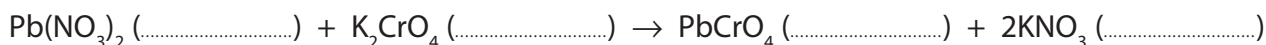
(ii) Use information from the equation to determine the charge on the chromate ion.

(1)

(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 cm³	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

P 5 3 2 7 4 A 0 2 6 3 2

(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)

Height of precipitate in cm

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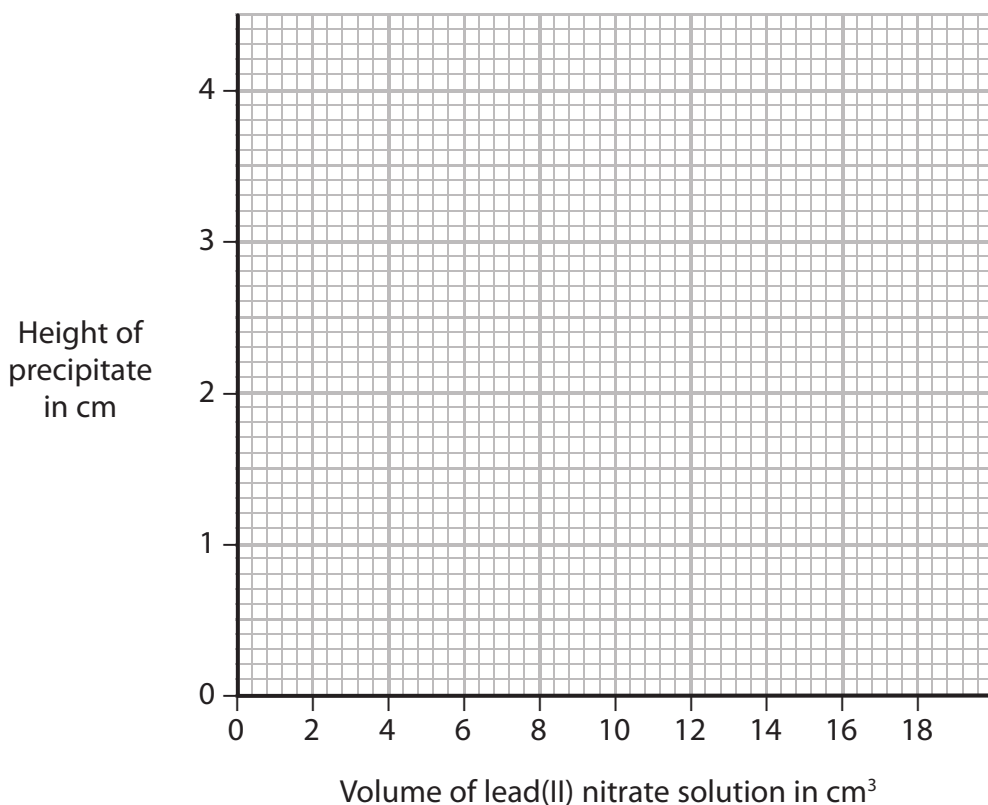
(iv) Use your graph to find the volume of lead(II) nitrate solution that reacts exactly with the 5.0 cm^3 of potassium chromate solution.

(1)

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

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

(2)

1 ....

....

2 ....

....

(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)

....

....

....

....

....

....

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

(2)

....

....

....

....

P 5 3 2 7 4 A 0 2 8 3 2

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

$$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$$
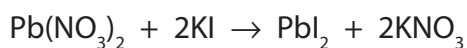
He finds that $5.0\,cm^3$ of $0.90\,mol/dm^3$ KI solution reacts with $8.0\,cm^3$ of $Pb(NO_3)_2$ solution.

Calculate the concentration, in mol/dm^3, of the $Pb(NO_3)_2$ solution.

(3)

concentration of $Pb(NO_3)_2$ solution = ... mol/dm^3

(Total for Question 11 = 18 marks)

TOTAL FOR PAPER = 120 MARKS

P 5 3 2 7 4 A 0 2 9 3 2

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