Write your name here

| Surname | Other names |
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| | |

**Pearson Edexcel International GCSE**

Centre Number | | | | | |

Candidate Number | | | | |

# Chemistry

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

Thursday 14 May 2015 – 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.
- 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* ▶

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P 4 4 2 6 8 A 0 1 3 6

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

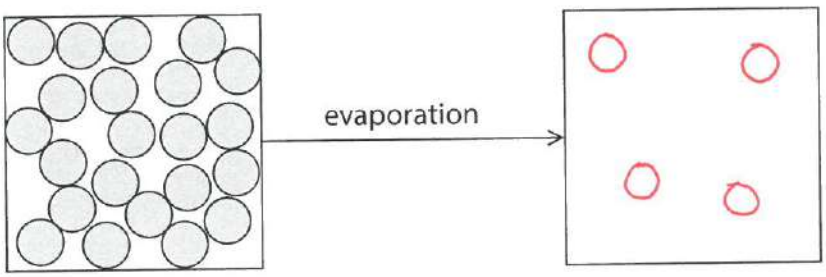
Atomic number

P 4 4 2 6 8 A 0 2 3 6

**Answer ALL questions.**

**1** When a liquid evaporates at room temperature, it changes into a gas.

The diagram shows the arrangement of the particles in a liquid.




(a) Complete the diagram to show the arrangement of four particles in a gas.

(1)

(b) Describe the movement of particles in a gas.

(1)

freely / random / fast

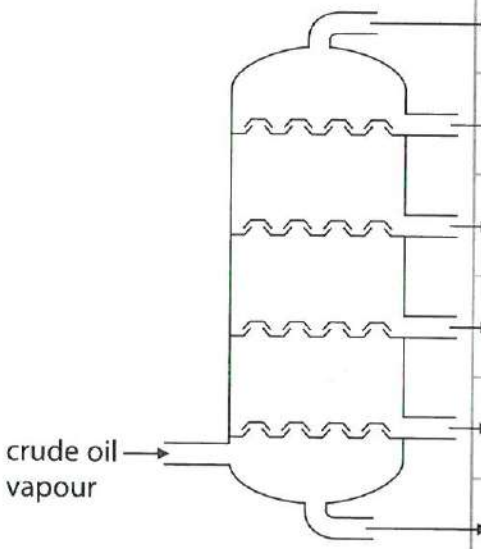
(c) Explain why heating a liquid causes it to evaporate more quickly.

(2)

- kinetic energy of particles increase
- more particles have enough energy to ~~evaporate~~ escape

**(Total for Question 1 = 4 marks)**

**2** The diagram shows the separation of crude oil into fractions.




| Fraction | Typical number of carbon atoms per molecule |
|---|---|
| A | 1 – 4 |
| B | 5 – 10 |
| C | 11 – 16 |
| D | 17 – 20 |
| E | 21 – 30 |
| F | more than 30 |

(a) What is the name of this method of separation?

(1)

fractional Distillation

(b) Complete the table by giving the correct fraction, A, B, C, D, E or F, for each description.

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

(3)

| Fraction | Description |
|---|---|
| A | contains only gases |
| F | is the most viscous |
| F | contains bitumen |

(c) State the relationship between the number of carbon atoms per molecule and the boiling point of the fraction.

(1)

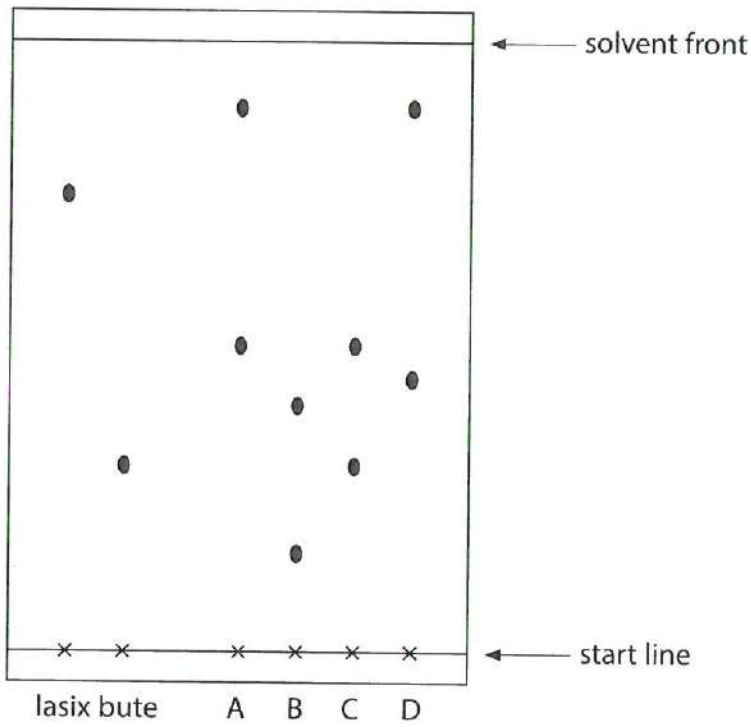
As the number of carbon atoms increases. the $T_b$ increases.

**(Total for Question 2 = 5 marks)**

**3** Illegal drugs are sometimes used to affect the performance of racehorses.
These drugs can be detected in horse urine using chromatography.

- a concentrated sample of urine from each horse is spotted onto the start line of a sheet of chromatography paper
- known illegal drugs are also spotted onto the same paper
- ethanol is used as the solvent

The chromatogram shows urine samples, A, B, C and D, and the two illegal drugs lasix and bute.




(a) Explain which urine sample contains an illegal drug.

**(2)**

C - has a spot in line with the drug

(b) What is the meaning of the term **solvent**?

(1)

A substance that dissolves a solute

(c) The results for known drugs are given as $R_f$ values.

$$R_f \text{ value} = \frac{\text{distance travelled by the drug}}{\text{distance travelled by the solvent}}$$

Calculate the $R_f$ value for lasix.

(2)

$$\frac{6.0 - 6.2}{8.0 - 8.2}$$

$R_f$ value for lasix = 0.73 - 78

(d) Suggest how the solubility of the drug in the solvent affects the distance travelled by the substance.

(1)

The more soluble the substance the further it will travel

**(Total for Question 3 = 6 marks)**

**4** Lithium, potassium and caesium are three metals in Group 1 of the Periodic Table.

(a) A small piece of each metal is placed on water in separate large troughs.

Complete the table by giving the correct metal, lithium, potassium or caesium, for each description.

(2)

| Description of reaction | Metal |
|---|---|
| explodes on contact with water | Cs |
| fizzes gently | Li |
| reacts violently and forms a lilac flame | K |

(b) (i) Give the name and formula of the gas formed when potassium reacts with water.

(2)

name hydrogen

formula $H_2$

(ii) Give the name and formula of the compound formed when lithium reacts with water.

(2)

name Lithium hydroxide

formula LiOH

↑ Not chemical equation

$2Li + 2H_2O \longrightarrow 2LiOH + H_2$

(iii) Describe how you could show that an alkaline solution is formed when caesium reacts with water.

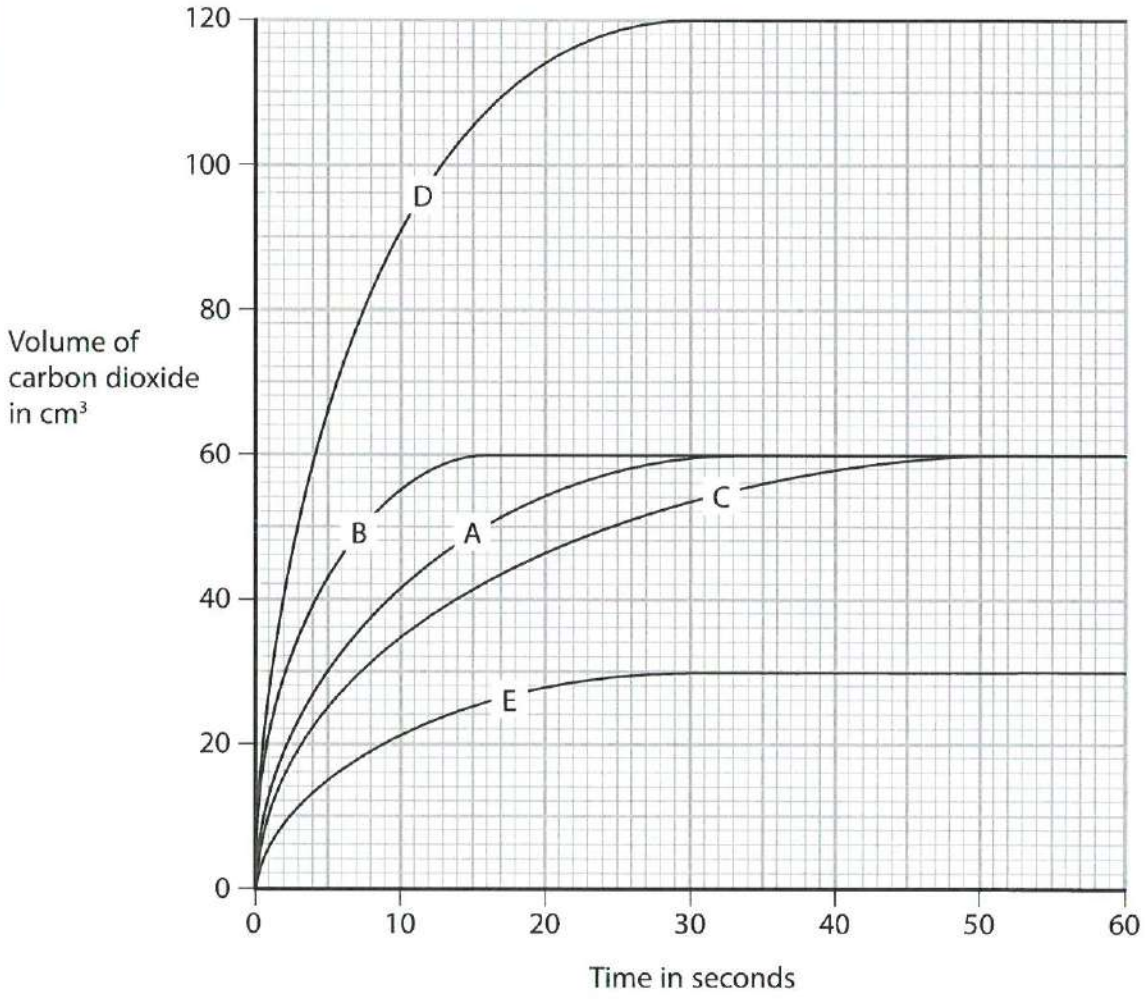
**(2)**

+ red litmus

→ blue

**(Total for Question 4 = 8 marks)**

**5** The graph shows the volumes of carbon dioxide given off when marble chips are reacted with hydrochloric acid in five different experiments.




(a) Curve A shows the volume of carbon dioxide given off when some marble chips are reacted with an excess of 1.0 mol/dm³ hydrochloric acid.

(i) Explain which curve, B, C, D or E, could represent the results obtained if half the mass of marble chips is used with excess of the acid.

**(2)**

E - vol of $CO_2$ is half

(ii) Explain which curve, B, C, D or E, could represent the results obtained if the reaction is performed at a lower temperature, with the same mass of marble chips and excess of the acid.

(2)

C - curve levels off later or reaction is slower

(iii) Explain which curve, B, C, D or E, could represent the results obtained if the marble chips are replaced by the same mass of powdered marble chips and excess of the acid.

(2)

B - curve levels off earlier or reaction is faster

(b) Suggest a suitable piece of apparatus for collecting the carbon dioxide in this experiment.

(1)

Gas syringe.

**(Total for Question 5 = 7 marks)**

**6** Solutions of lead(II) nitrate and sodium chloride react together to form a precipitate of lead(II) chloride.

The equation for the reaction is

$$Pb(NO_3)_2(aq) + 2NaCl(aq) \rightarrow PbCl_2(s) + 2NaNO_3(aq)$$

A student carries out a series of experiments to find how much precipitate is formed when different volumes of lead(II) nitrate are added.

She uses this method.

- place 15 $cm^3$ of sodium chloride solution into a boiling tube
- add 2.0 $cm^3$ of lead(II) nitrate solution
- allow the precipitate to settle
- measure the height of the precipitate
- repeat the experiment using different volumes of lead(II) nitrate solution

The table shows the student's results.

| Volume in $cm^3$ of lead(II) nitrate added | Height of precipitate in cm |
|---|---|
| 2.0 | 0.6 |
| 4.0 | 1.2 |
| 6.0 | 1.8 |
| 8.0 | 2.1 |
| 10.0 | 2.5 |
| 12.0 | 2.1 |
| 14.0 | 2.1 |

(a) Suggest why the height of the precipitate eventually stops increasing as more lead(II) nitrate solution is added.

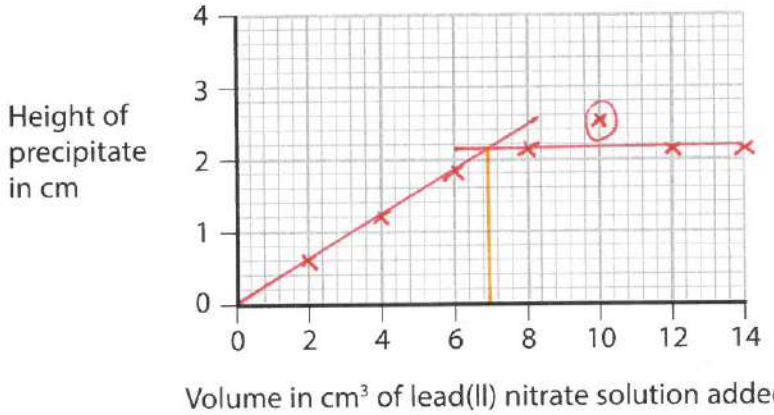
(1)

all NaCl has reacted

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

Draw a straight line of best fit through the origin and the first three points, and another straight line of best fit through the last four points.
Make sure that the two lines cross.

(4)




(ii) Draw a circle on the grid around the point that represents the anomalous result.

(1)

(iii) Which statement is a possible explanation for this anomalous result?

(1)

☒ **A** the precipitate was not allowed to settle before its height was measured

☐ **B** only 1 $cm^3$ of sodium chloride solution was added instead of 2 $cm^3$

☐ **C** 20 $cm^3$ of lead(II) nitrate solution was used

☐ **D** the reaction was carried out at a higher temperature

(iv) Why should the graph line pass through the origin?

(1)

No precipitate is produced when no lead (II) nitrate is added

(v) Use your graph to estimate the volume of lead(II) nitrate solution that would be required to react completely with 15 $cm^3$ of the sodium chloride solution.

(1)

volume = 7 $cm^3$

**(Total for Question 6 = 9 marks)**

**7** Alkanes are saturated hydrocarbons that can be obtained from crude oil.

The general formula of the homologous series of alkanes is $C_nH_{2n+2}$

(a) (i) What is the meaning of the term **saturated**?

(1)

No (c=c) double bonds

(ii) What is the meaning of the term **hydrocarbons**?

(2)

Molecule containing hydrogen and carbon only

(iii) Pentane is an alkane with five carbon atoms in its molecule.

What is the molecular formula of pentane?

(1)

- ☐ **A** $C_5H_8$
- ☐ **B** $C_5H_{10}$
- ☒ **C** $C_5H_{12}$
- ☐ **D** $C_5H_{14}$

(b) (i) Octane ($C_8H_{18}$) is an alkane that is present in petrol.

When octane burns completely in oxygen it forms carbon dioxide and water.

Write a chemical equation for the complete combustion of octane.

(2)

$C_8H_{18} + 12\frac{1}{2}O_2 \longrightarrow 8CO_2 + 9H_2O$

(ii) Give the name of a toxic gas that may be produced by the incomplete combustion of octane.

(1)

Carbon monoxide

(c) Dodecane ($C_{12}H_{26}$) is another alkane. When heated and passed over a suitable catalyst, it decomposes to form octane and one other hydrocarbon.

(i) State how a catalyst increases the rate of this decomposition.

(1)

Provides an alternative pathway with a lower activation energy

(ii) Give the name of a suitable catalyst for this process.

(1)

Aluminium oxide

(iii) Complete the equation that represents the reaction

(1)

$C_{12}H_{26} \rightarrow C_8H_{18} + 2\ C_2H_2$

(iv) Name the other hydrocarbon produced in this reaction.

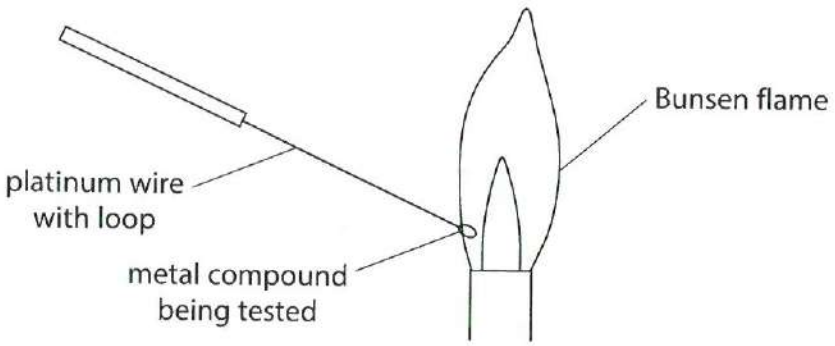
(1)

ethene

**(Total for Question 7 = 11 marks)**

**8** A flame test is carried out on three metal compounds, X, Y and Z.

The diagram shows the apparatus used.




(a) (i) Suggest two reasons why platinum is a suitable metal to use as the wire in this test.

(2)

1 high melting point

2 Inert or does not colour flame

(ii) Why should the platinum wire be cleaned between each test?

(1)

Remove substances that may affect the colour

(iii) Why is a luminous Bunsen flame not suitable for carrying out a flame test?

(1)

Difficult to see colour or not hot enough

(b) The three metal compounds are also tested separately with three reagents.

The reagents used are

- aqueous acidified silver nitrate
- aqueous acidified barium chloride
- aqueous sodium hydroxide

The table shows the results of all the tests.

| Metal compound | Flame test | Aqueous acidified silver nitrate | Aqueous acidified barium chloride | Aqueous sodium hydroxide |
|---|---|---|---|---|
| X | yellow | white precipitate | no precipitate | no precipitate |
| Y | red | no precipitate | white precipitate | no precipitate |
| Z | no colour | no precipitate | no precipitate | green precipitate |

(i) Give the name of compound X and of compound Y.

(4)

compound X Na Cl

compound Y $Li_2SO_4$

(ii) Identify the cation present in compound Z.

(1)

$Fe^{2+}$

(c) Describe a chemical test, other than heating, that could be used to show that compound Z contains carbonate ions.

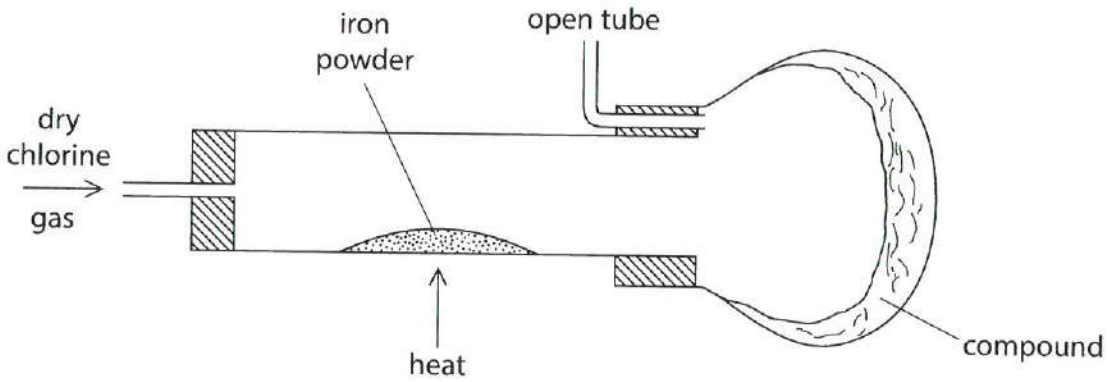
(3)

test • add acid
• test gas with limewater

result • limewater turns cloudy.

**(Total for Question 8 = 12 marks)**

**9** The diagram shows the apparatus used to form a compound containing iron and chlorine.




(a) (i) State the colour of chlorine gas.

(1)

Green

(ii) Suggest why it is necessary to have an open tube fitted to the apparatus.

(1)

allow gas to escape

(iii) For safety reasons, this reaction should be carried out in a fume cupboard.

Explain why this is necessary.

(1)

$Cl_2$ is toxic

(b) A mass of 2.800 g of iron reacts with 5.325 g of chlorine.

(i) Calculate the empirical formula of the compound formed.

(3)

| Fe | Cl |
|---|---|
| 2.8 | 5.325 |
| 56 | 35.5 |
| 0.05 | 0.15 |
| 0.05 | 0.05 |
| 1 | : 3 |

empirical formula = $FeCl_3$

(ii) Suggest a name for this compound.

(1)

Iron (III) chloride

(c) When chlorine gas is bubbled into aqueous sodium hydroxide, a mixture of bleach (NaClO), sodium chloride and water is formed.

Write a chemical equation for this reaction.

(2)

$Cl_2 + 2NaOH \longrightarrow NaCl + NaClO + H_2O$

**(Total for Question 9 = 9 marks)**

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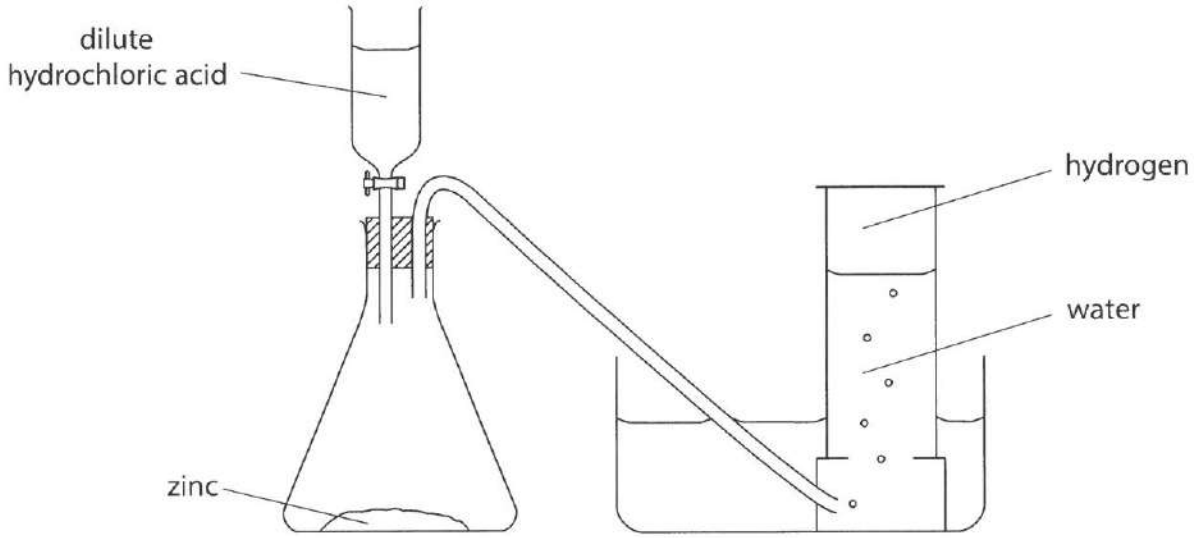
**10** This apparatus can be used to prepare a sample of hydrogen.




(a) Write a chemical equation for the reaction between zinc and hydrochloric acid.

Include state symbols.

(2)

$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$

(b) State two observations you would make when hydrochloric acid reacts with zinc in the conical flask.

(2)

1 fizzing

2 zinc dissolves.

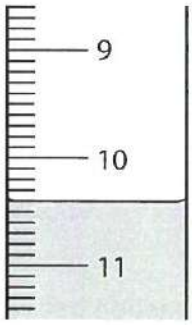
(c) A student carries out two experiments to find the volume of dilute hydrochloric acid required to completely react with 0.5 g of zinc powder.

**Experiment 1**

She fills a burette to the 0.00 $cm^3$ mark with dilute hydrochloric acid.

She places 0.5 g of zinc powder into a conical flask and then slowly adds the acid to the zinc until the reaction is complete.

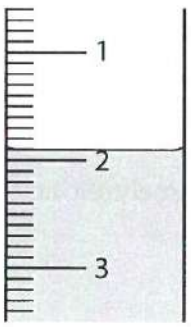
The diagram shows the final reading on the burette.



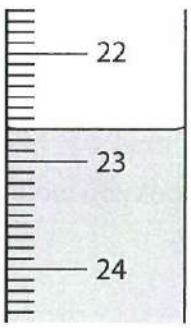

**Experiment 2**

She then repeats the experiment with 0.5 g of zinc powder from the same source, but with a different sample of dilute hydrochloric acid.

The diagram shows the initial and final burette readings for this experiment.




initial reading




final reading

(i) Use the burette readings to complete the table, recording the volumes to the nearest 0.05 $cm^3$.

(3)

| | Experiment 1 | Experiment 2 |
|---|---|---|
| final burette reading in $cm^3$ | 10·40 | 22·70 |
| initial burette reading in $cm^3$ | 0·00 | 1·90 |
| volume in $cm^3$ of acid added | 10·40 | 20·80 |

(ii) The concentration of the acid in experiment 1 was 0.74 $mol/dm^3$.

Explain how the concentration of the acid in experiment 2 can be calculated.

(2)

- Vol of acid has doubled
- Conc is halved

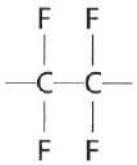
**(Total for Question 10 = 9 marks)**

**11** Tetrafluoroethene ($C_2F_4$) is a gas that is stored in cylinders.

A chemist opened the valve on a new cylinder of tetrafluoroethene. He was surprised when no gas came out.

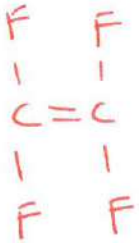
He decided to check the contents of the cylinder. He found it contained a white powder. The tetrafluoroethene had formed a polymer.

(a) The displayed formula for the repeat unit of the addition polymer formed is



(i) Draw the displayed formula of the monomer.

(1)



(ii) What is the meaning of the term **polymer**?

(2)

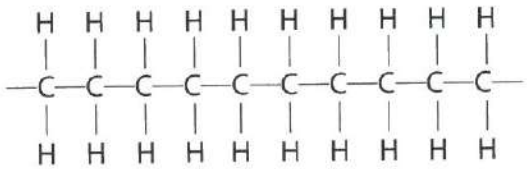
A long chained molecule formed when many small monomers join

(iii) Suggest the name of this polymer.

(1)

polytetrafluoroethene

(b) The displayed formula for a section of another addition polymer is



Give the name and molecular formula of the monomer used to form this polymer.

(2)

name ethene

molecular formula $C_2H_4$

(c) Explain why addition polymers that are buried in landfill sites remain chemically unchanged for many years.

(2)

Do not biodegrade because they are inert

**(Total for Question 11 = 8 marks)**

**12** A student carries out an investigation to compare the reactivities of four metals, aluminium, copper, zinc and M.

He adds strips of zinc to the aqueous solutions of the nitrates of each metal.

After a few minutes he removes the strips of zinc and examines them.

The table shows his results.

| Solution | Result |
|---|---|
| aluminium nitrate | no change |
| copper(II) nitrate | brown coating on zinc |
| zinc nitrate | no change |
| nitrate of metal M | grey coating on zinc |

(a) Name the substance that causes the brown coating on the zinc.

(1)

Copper

(b) State why there is no change in the experiment with zinc nitrate solution.

(1)

Zinc X cannot displace itself

(c) The student repeats the experiment with strips of metal M instead of strips of zinc. The table shows his results.

| Solution | Result |
|---|---|
| aluminium nitrate | no change |
| copper(II) nitrate | brown coating on M |
| zinc nitrate | no change |
| nitrate of metal M | no change |

Using information from both tables of results, place the metals aluminium, copper, zinc and M in order of decreasing reactivity.

(2)

most reactive ..... Al .....

..... Zn .....

..... M .....

least reactive ..... Cu .....

(d) Magnesium reacts with an aqueous solution of silver nitrate.

The reaction can be represented by the ionic equation

$$Mg(s) + 2Ag^{+}(aq) \rightarrow Mg^{2+}(aq) + 2Ag(s)$$

(i) State why this reaction is described as a redox reaction.

(1)

oxidation + reduction occur

(ii) Explain, in terms of electrons, which species is behaving as an oxidising agent in this reaction.

(2)

Silver ion as it gains electrons.

**(Total for Question 12 = 7 marks)**

**13** A student uses the following method to prepare a sample of hydrated zinc nitrate crystals.

step 1 put 25 $cm^3$ of dilute nitric acid into a beaker

step 2 add zinc carbonate until it is in excess

step 3 separate the dilute solution of zinc nitrate from the mixture

The student then obtains crystals from the dilute solution of zinc nitrate.

(a) Name the piece of apparatus used to measure the nitric acid in step 1.

(1)

measuring cylinder

(b) How would the student know when she has added an excess of zinc carbonate?

(1)

No fizzing or solid seen

(c) Name the separation method used in step 3.

(1)

filtration

(d) The student wants to obtain a pure, dry sample of hydrated zinc nitrate crystals from the dilute solution.

One method is to leave the solution so that all the water evaporates.

Describe another method, involving crystallisation, that the student could use.

(4)

- heat to partially evaporate (form a saturated solution)
- leave to cool (crystallise)
- filter
- leave to dry

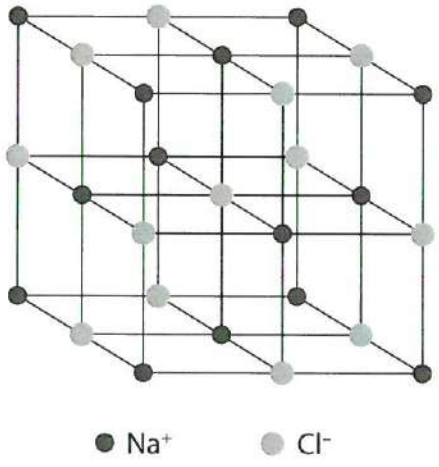
**(Total for Question 13 = 7 marks)**

**14** Sodium chloride (NaCl) and silicon dioxide ($SiO_2$) both have giant lattice structures.

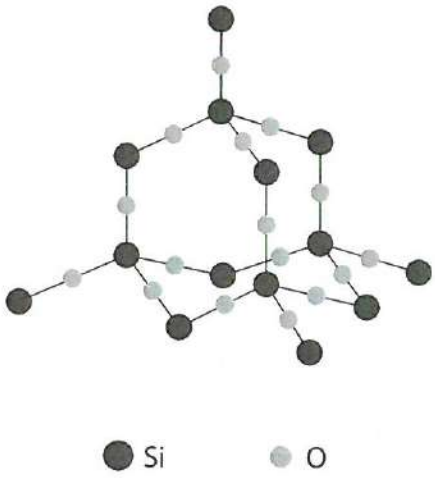
Sodium chloride is an ionic compound.

Silicon dioxide is a covalent compound.

Structure of sodium chloride




Structure of silicon dioxide




The table shows some properties of each compound.

| Sodium chloride | Silicon dioxide |
|---|---|
| melting point = 801 °C | melting point = 1610 °C |
| soluble in water | insoluble in water |
| conducts electricity when molten | does not conduct electricity when molten |

(a) (i) Explain why silicon dioxide has a high melting point.

(2)

· Giant covalvent structure
· Strong covalvent bonds
· Requires a lot of energy to break

(ii) Suggest why the melting point of silicon dioxide is higher than the melting point of sodium chloride.

(1)

Bonds in $SiO_2$ stronger than NaCl

(b) State why sodium chloride conducts electricity when molten.

(1)

ions are free to move

(c) Carbon dioxide is described as a simple molecular substance.

State why carbon dioxide ($CO_2$) is a gas at room temperature.

(1)

weak intermolecular forces.

**(Total for Question 14 = 5 marks)**

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**15** The formula for hydrated iron(II) sulfate is $FeSO_4.xH_2O$

The value of x is a whole number between 1 and 10. It can be determined by carrying out a titration with 0.0200 mol/dm$^3$ potassium manganate(VII) ($KMnO_4$) solution as follows:

- dissolve a sample of $FeSO_4.xH_2O$ in water to make 250 cm$^3$ of solution
- measure out 25.0 cm$^3$ of this solution into a conical flask
- add the $KMnO_4$ solution using a burette until the end point is reached
- record the volume of solution added
- repeat the titration three more times

The table shows the results.

| titration number | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| volume in cm$^3$ of $KMnO_4$ solution added | 22.80 | 22.10 | 22.50 | 22.20 |
| concordant titration results (✓) | | ✓ | | ✓ |

(a) Concordant results are those within 0.20 cm$^3$ of each other.

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

(1)

(b) Using the concordant results, calculate the average (mean) volume of $KMnO_4$ solution added. Give your answer to 2 decimal places.

(2)

$$\frac{22.1 + 22.2}{2}$$

average volume added = 22.15 cm$^3$

(c) Which is the most suitable piece of apparatus to measure out 25.0 cm$^3$ of $FeSO_4$ solution?

(1)

- ☐ **A** beaker
- ☐ **B** gas syringe
- ☐ **C** measuring cylinder
- ☒ **D** pipette

(d) These results were obtained in another titration.

| | |
|---|---|
| mass of $FeSO_4.xH_2O$ in 250 $cm^3$ of the $FeSO_4$ solution | 5.56 g |
| average volume of $KMnO_4$ solution added to 25.0 $cm^3$ of solution | 20.00 $cm^3$ |
| concentration of the $KMnO_4$ solution | 0.0200 $mol/dm^3$ |

(i) Calculate the amount, in moles, of $KMnO_4$ in 20.00 $cm^3$ of solution.

(2)

$n = c \times v$ $\quad dm^3 = \frac{20}{1000}$

$= 0.02 \times 0.02$ $\quad = 0.02$

$= 0.0004$

amount of $KMnO_4$ = 0.0004 mol

(ii) In this reaction one mole of $KMnO_4$ reacts with five moles of $FeSO_4$

Calculate the amount, in moles, of $FeSO_4$ in 25.0 $cm^3$ of the $FeSO_4$ solution.

(1)

Ratio = 1 : 5 $\quad 0.0004 \times 5$

amount of $FeSO_4$ in 25.0 $cm^3$ = 0.002 mol

(iii) Calculate the amount, in moles, of $FeSO_4$ in 250 $cm^3$ of this $FeSO_4$ solution.

(1)

$\frac{250}{25} = 10$ $\quad 0.002 \times 10$

amount of $FeSO_4$ in 250 $cm^3$ = 0.02 mol

(iv) Using your answer from (d)(iii), calculate the mass, in grams, of $FeSO_4$ in the 5.56 g of $FeSO_4.xH_2O$.

[$M_r$ of $FeSO_4$ = 152]

(1)

$m = n \times Mr = 0.02 \times 152$

mass of $FeSO_4$ = 3.04 g

(e) In another experiment it is found that 24.2 g of $FeSO_4.xH_2O$ contains 15.2 g of iron(II) sulfate ($FeSO_4$).

(i) Calculate the mass of water in 24.2 g of $FeSO_4.xH_2O$

(1)

24·2 − 15·2

mass of water = 9·0 g

(ii) Calculate the amount, in moles, of $H_2O$ in this mass of water.

(1)

$n = \frac{m}{Mr} = \frac{9}{18}$

amount of $H_2O$ = 0·5 mol

(iii) Calculate the amount, in moles, of $FeSO_4$ in 15.2 g of iron(II) sulfate.
[$M_r$ of $FeSO_4$ = 152]

(1)

$n = \frac{m}{Mr} = \frac{15·2}{152}$

amount of $FeSO_4$ = 0·1 mol

(iv) Using your answers to parts (ii) and (iii), calculate the value of x in $FeSO_4.xH_2O$.

(1)

Ratio $\frac{0·5}{0·1} : \frac{0·1}{0·1}$

5 : 1

value of x = 5

**(Total for Question 15 = 13 marks)**

**TOTAL FOR PAPER = 120 MARKS**



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