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 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	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															

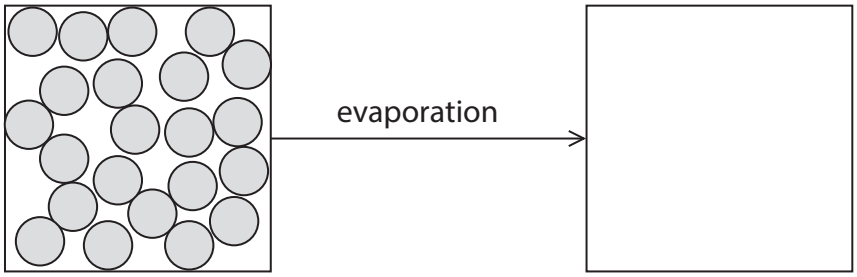
Key

Relative atomic mass
Symbol
Name
Atomic number

Answer ALL questions.

1 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)

.....

.....

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

(2)

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.....

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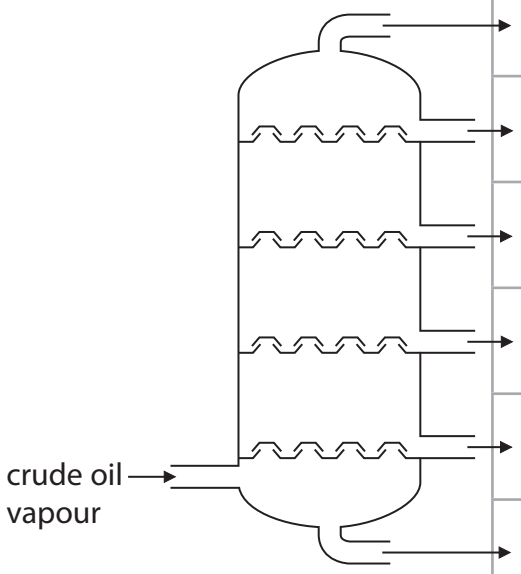
.....

(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)

.....

(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
	contains only gases
	is the most viscous
	contains bitumen

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

(1)

.....

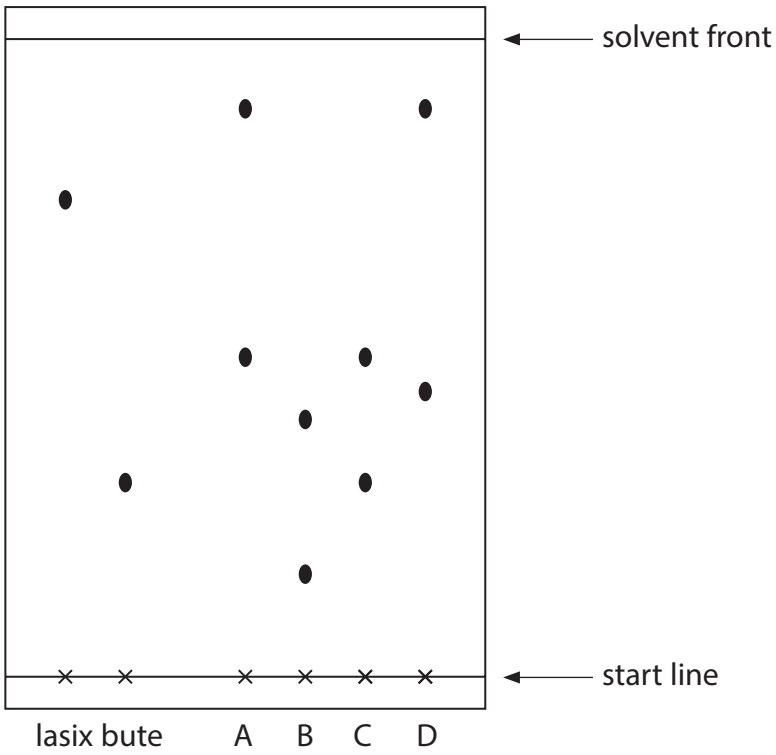
.....

(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)

.....

.....

.....

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

(1)

.....

.....

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

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

Calculate the R_f value for lasix.

(2)

R_f value for lasix =.....

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

(1)

.....

.....

(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	
fizzes gently	
reacts violently and forms a lilac flame	

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

(2)

name .....

formula .....

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

(2)

name .....

formula .....

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

(2)

.....

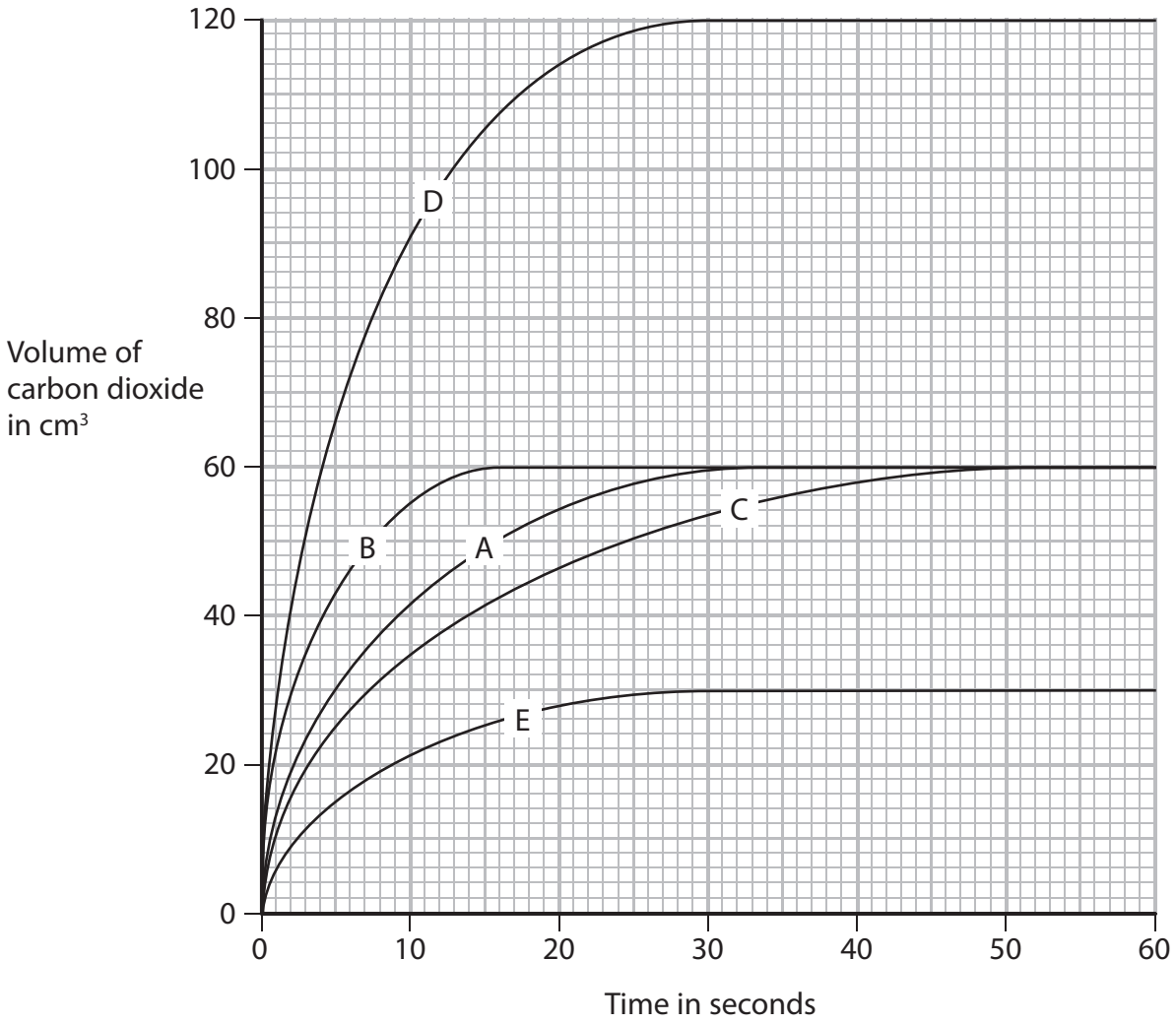
.....

.....

.....

(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)

.....

.....

.....

.....

(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)

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

(1)

(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)

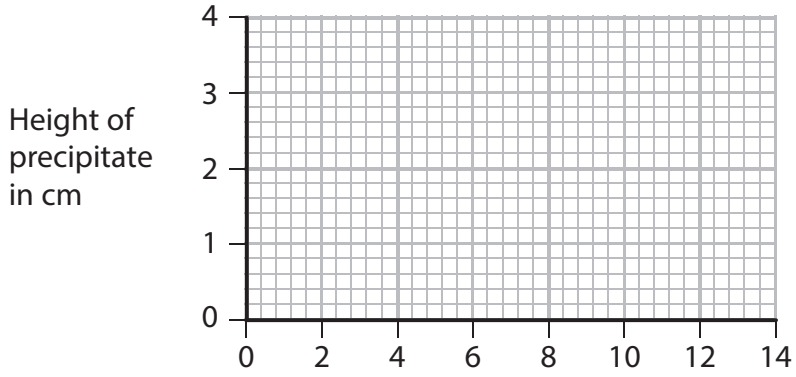
.....

.....

(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)

.....

.....

(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 = ... 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)

.....

.....

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

(2)

.....

.....

.....

.....

(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)

.....

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

(1)

.....

(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)

.....

.....

.....

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

(1)

.....

(iii) Complete the equation that represents the reaction

(1)

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

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

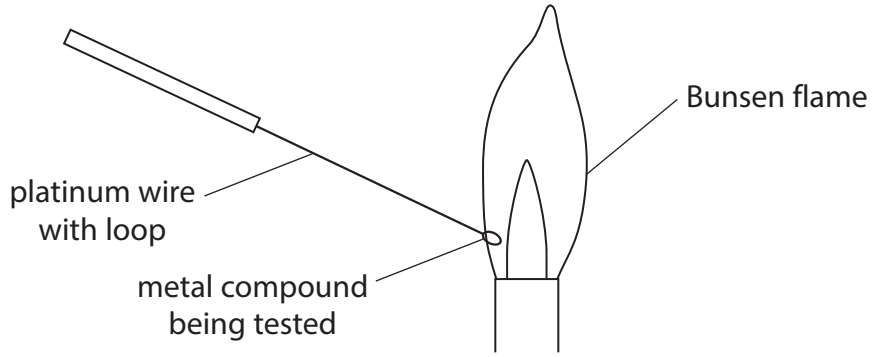
(1)

.....

(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 .....

.....

2 .....

.....

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

(1)

.....

.....

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

(1)

.....

.....

(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 .....

compound Y .....

(ii) Identify the cation present in compound Z.

(1)

.....

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

(3)

test .....

.....

result .....

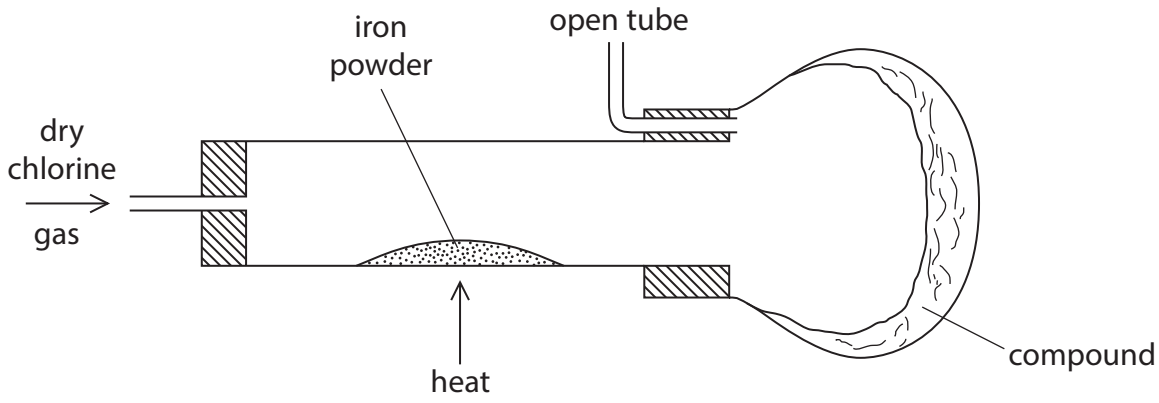
.....

.....

.....

(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)

.....

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

(1)

.....

.....

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

Explain why this is necessary.

(1)

.....

.....

(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)

empirical formula = ...

(ii) Suggest a name for this compound.

(1)

.....

(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)

.....

(Total for Question 9 = 9 marks)

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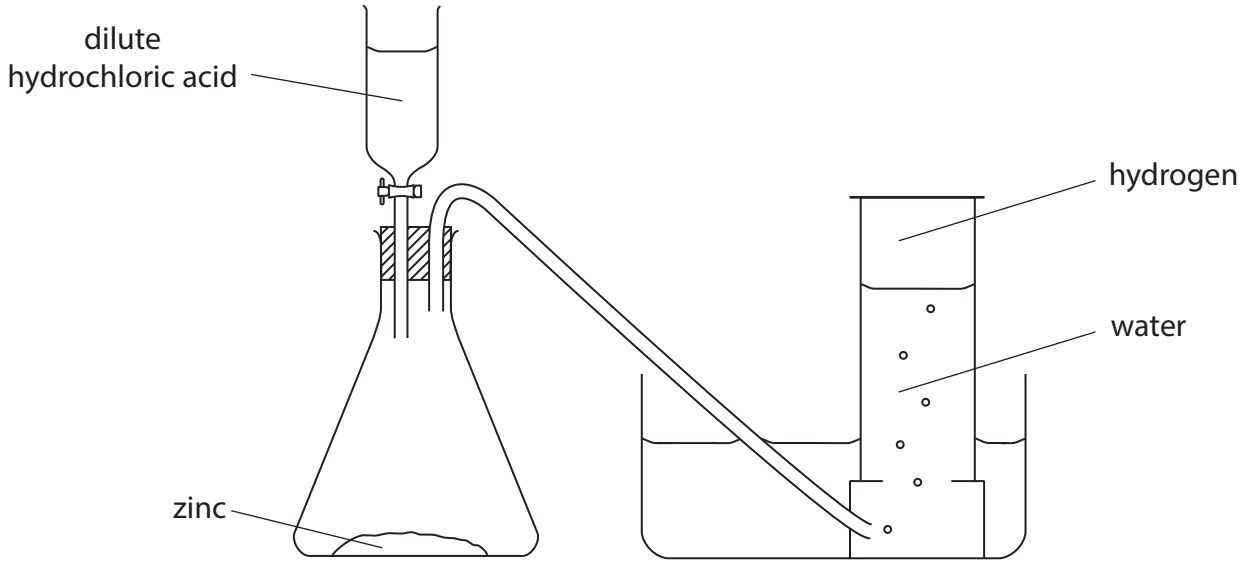
10 This apparatus can be used to prepare a sample of hydrogen.



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

Include state symbols.

(2)

.....

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

(2)

1 .....

.....

2 .....

.....

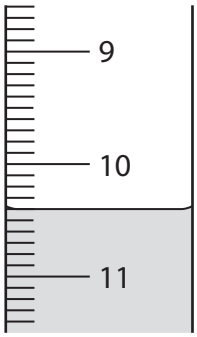
(c) A student carries out two experiments to find the volume of dilute hydrochloric acid required to completely react with 0.5 g of zinc powder.

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.

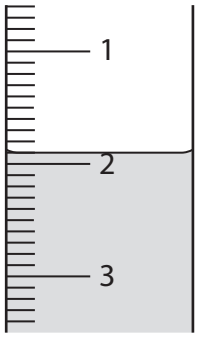
The diagram shows the final reading on the burette.



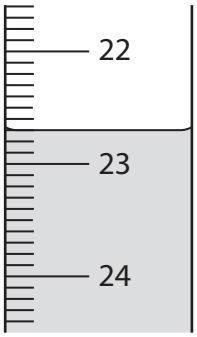
Experiment 2

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		
initial burette reading in cm^3		
volume in cm^3 of acid added		

(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)

.....

.....

.....

.....

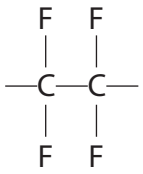
(Total for Question 10 = 9 marks)

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)

.....

.....

.....

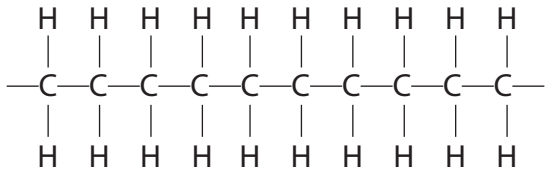
.....

(iii) Suggest the name of this polymer.

(1)

.....

(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 .....

molecular formula .....

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

(2)

.....

.....

.....

.....

(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)

.....

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

(1)

.....

.....

(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 .....

.....

.....

least reactive .....

(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)

.....

.....

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

(2)

.....

.....

.....

.....

(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)

.....

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

(1)

.....

.....

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

(1)

.....

(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)

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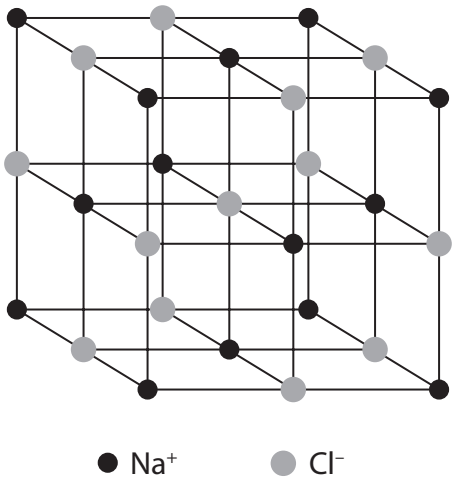
(Total for Question 13 = 7 marks)

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

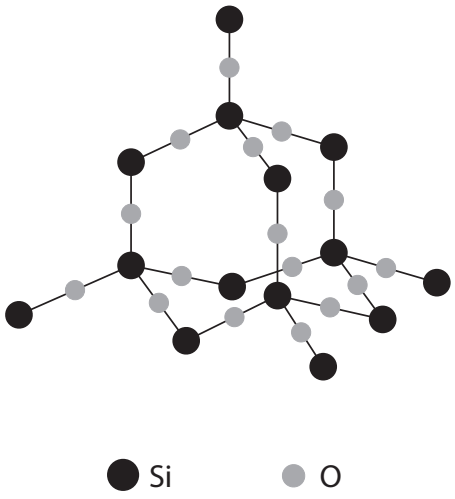
Sodium chloride is an ionic compound.

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)

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

(1)

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

(1)

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

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

(1)

(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)

average volume added = ... 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)

amount of $KMnO_4$ = ... 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)

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

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

(1)

amount of $FeSO_4$ in 250 cm^3 = ... 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)

mass of $FeSO_4$ = ...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)

mass of water = ... g

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

(1)

amount of H_2O = ... 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)

amount of $FeSO_4$ = ... mol

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

(1)

value of x = ...

(Total for Question 15 = 13 marks)

TOTAL FOR PAPER = 120 MARKS

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