

Write your name here

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**Pearson Edexcel  
International GCSE**

Centre Number

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Candidate Number

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# 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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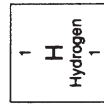
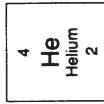
**PEARSON**

# THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0

Group

Period



7 Li Lithium 3	9 Be Beryllium 4	11 Na Sodium 11	12 Mg Magnesium 12	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18								
19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36
37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54
55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86
87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89															

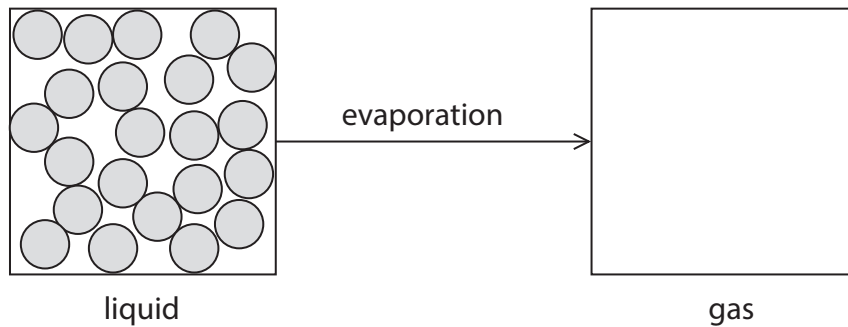
Key

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)

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- (c) Explain why heating a liquid causes it to evaporate more quickly. (2)

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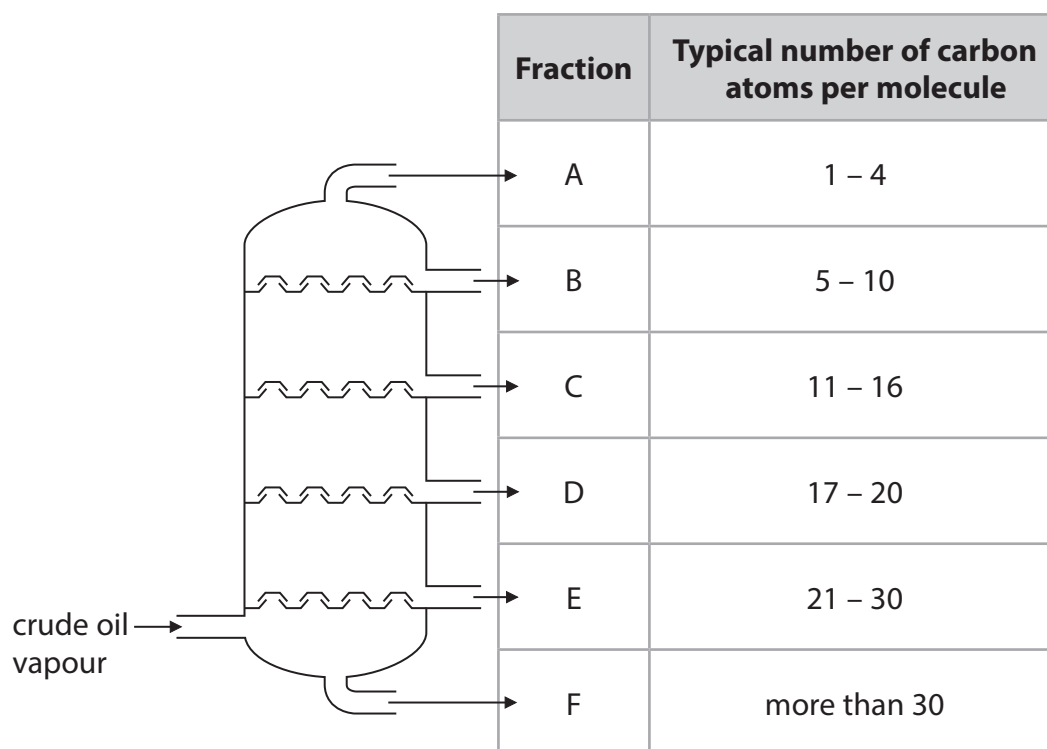
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**(Total for Question 1 = 4 marks)**



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



(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)

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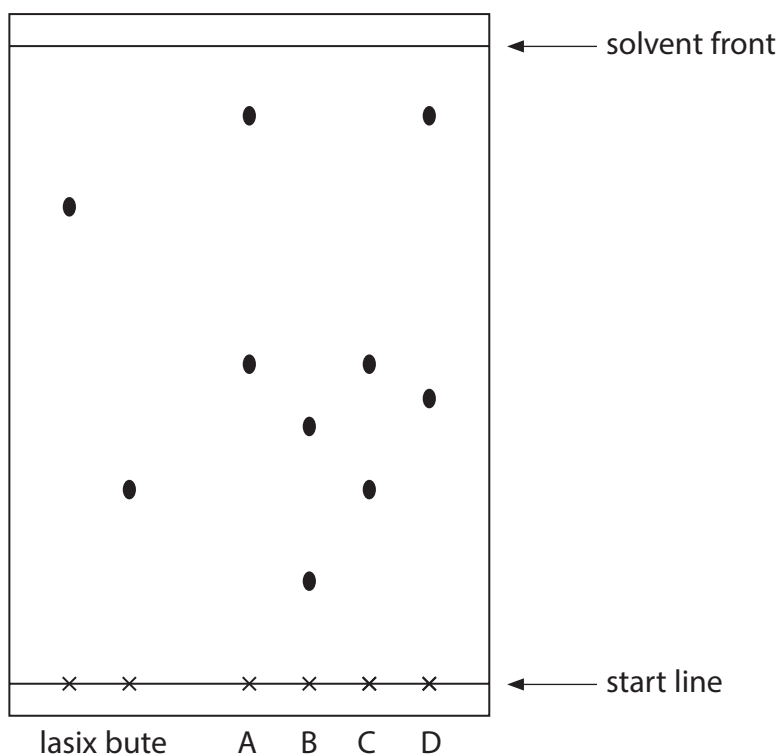
**(Total for Question 2 = 5 marks)**



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.

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

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)

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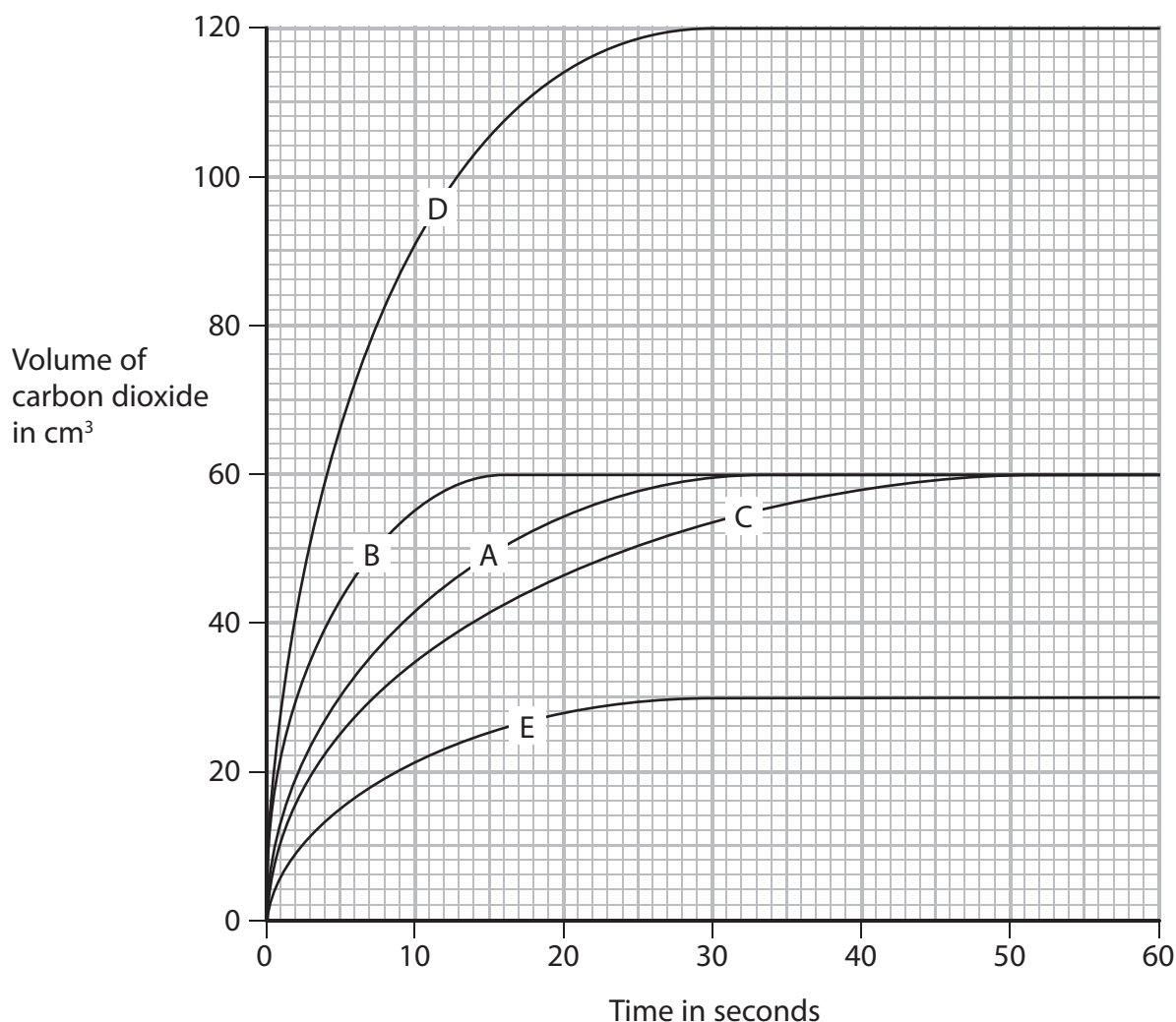
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**(Total for Question 4 = 8 marks)**

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- 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  $1.0 \text{ mol/dm}^3$  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)

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

(1)

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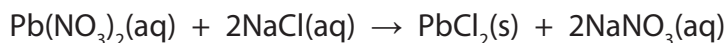
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**(Total for Question 5 = 7 marks)**



- 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



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<sup>3</sup> of sodium chloride solution into a boiling tube
- add 2.0 cm<sup>3</sup> 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 <sup>3</sup> 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)

.....

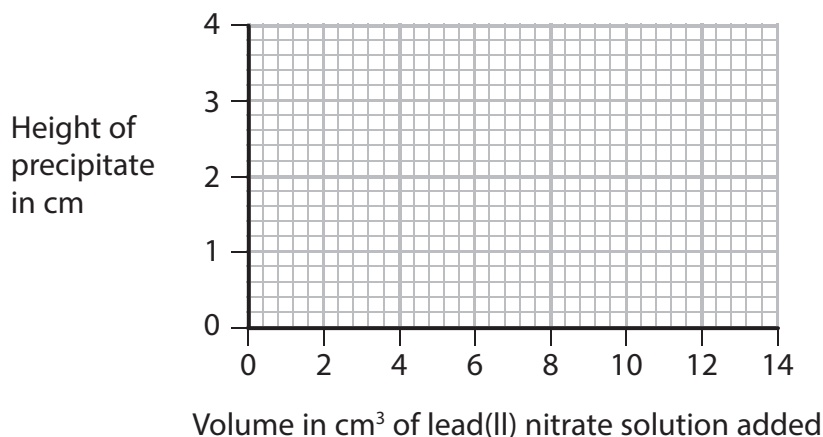
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(b) (i) Plot the student's results on the grid.

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<sup>3</sup> of sodium chloride solution was added instead of 2 cm<sup>3</sup>
- C** 20 cm<sup>3</sup> 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<sup>3</sup> of the sodium chloride solution.

(1)

volume = .....cm<sup>3</sup>

**(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  $C_n H_{2n+2}$

(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<sub>8</sub>H<sub>18</sub>) 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<sub>12</sub>H<sub>26</sub>) 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.

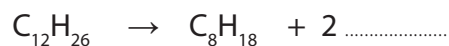
(1)

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

(1)

(iii) Complete the equation that represents the reaction

(1)



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

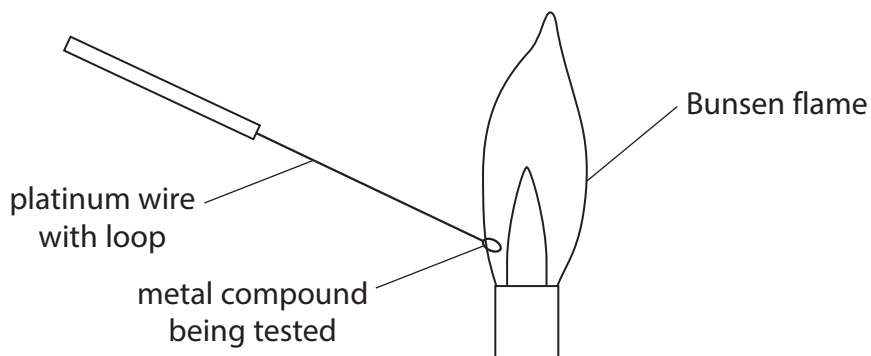
(1)

**(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 .....

.....

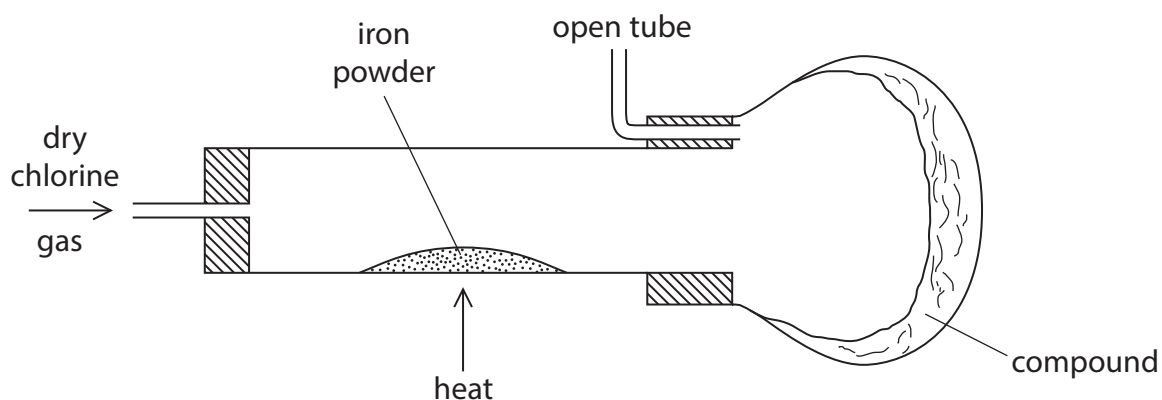
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(Total for Question 8 = 12 marks)



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)

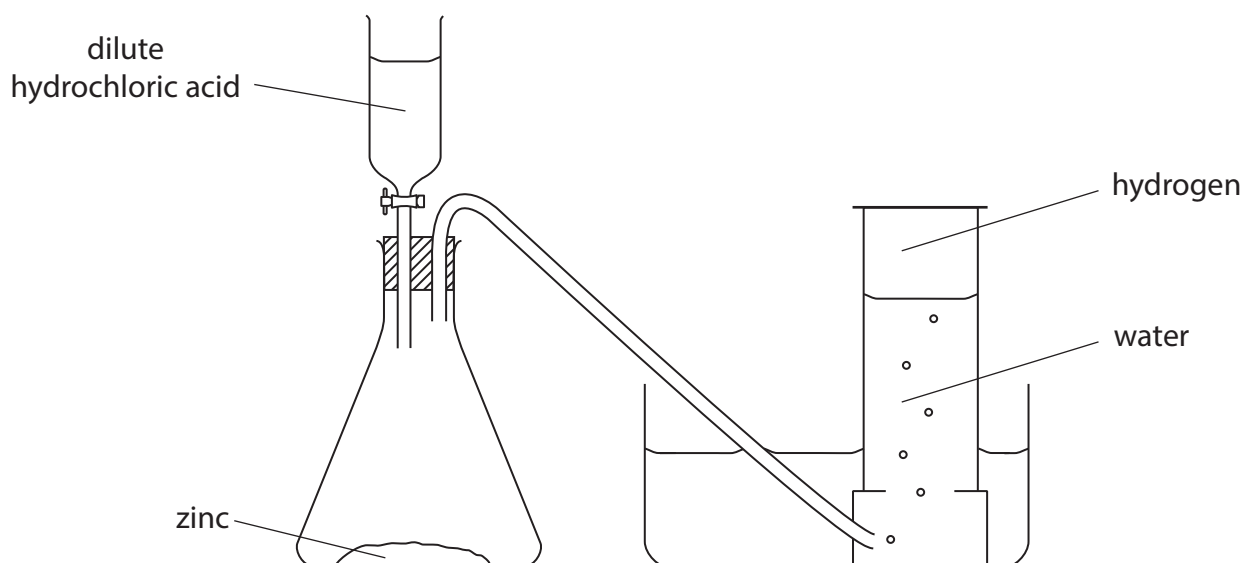
**(Total for Question 9 = 9 marks)**



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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 .....



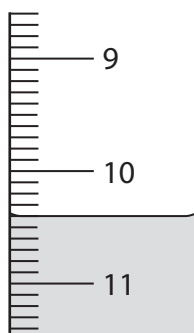
(c) A student carries out two experiments to find the volume of dilute hydrochloric acid required to completely react with 0.5 g of zinc powder.

### Experiment 1

She fills a burette to the 0.00 cm<sup>3</sup> 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.

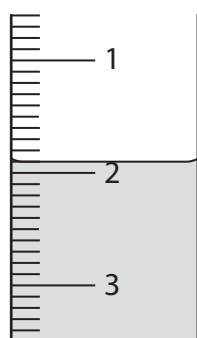
The diagram shows the final reading on the burette.



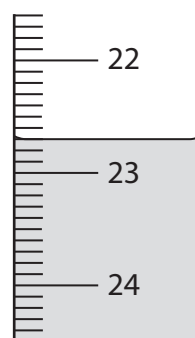
### Experiment 2

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  $0.05 \text{ cm}^3$ .

(3)

	Experiment 1	Experiment 2
final burette reading in $\text{cm}^3$		
initial burette reading in $\text{cm}^3$		
volume in $\text{cm}^3$ of acid added		

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

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

(2)

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

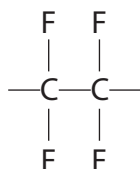


11 Tetrafluoroethene ( $C_2F_4$ ) is a gas that is stored in cylinders.

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)

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(iii) Suggest the name of this polymer.

(1)

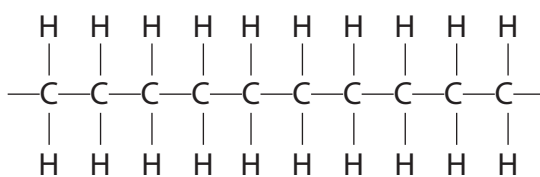
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(b) The displayed formula for a section of another addition polymer is



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 .....

.....

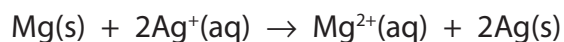
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least reactive .....



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

The reaction can be represented by the ionic equation



(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<sup>3</sup> 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)**

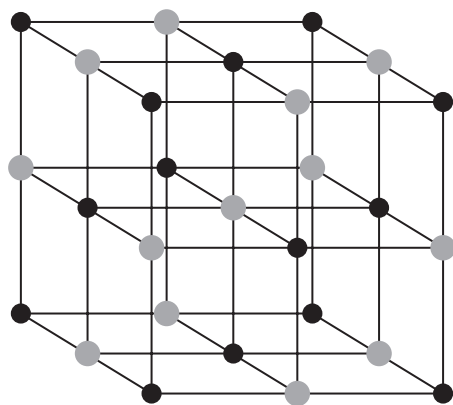


14 Sodium chloride (NaCl) and silicon dioxide (SiO<sub>2</sub>) both have giant lattice structures.

Sodium chloride is an ionic compound.

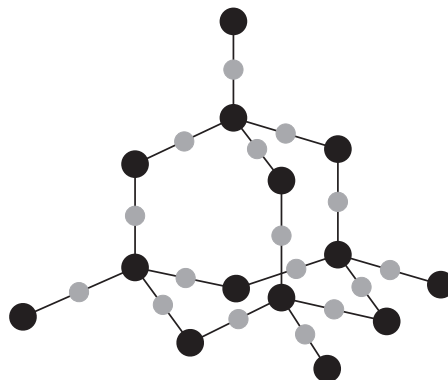
Silicon dioxide is a covalent compound.

Structure of sodium chloride



● Na<sup>+</sup>      ● Cl<sup>-</sup>

Structure of silicon dioxide



● Si      ● O

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<sub>2</sub>) 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  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$

The value of  $x$  is a whole number between 1 and 10. It can be determined by carrying out a titration with  $0.0200 \text{ mol/dm}^3$  potassium manganate(VII) ( $\text{KMnO}_4$ ) solution as follows:

- dissolve a sample of  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$  in water to make  $250 \text{ cm}^3$  of solution
- measure out  $25.0 \text{ cm}^3$  of this solution into a conical flask
- add the  $\text{KMnO}_4$  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 $\text{cm}^3$ of $\text{KMnO}_4$ solution added	22.80	22.10	22.50	22.20
concordant titration results (✓)				

(a) Concordant results are those within  $0.20 \text{ cm}^3$  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  $\text{KMnO}_4$  solution added. Give your answer to 2 decimal places.

(2)

average volume added = .....  $\text{cm}^3$

(c) Which is the most suitable piece of apparatus to measure out  $25.0 \text{ cm}^3$  of  $\text{FeSO}_4$  solution?

(1)

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



(d) These results were obtained in another titration.

mass of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ in $250 \text{ cm}^3$ of the $\text{FeSO}_4$ solution	5.56 g
average volume of $\text{KMnO}_4$ solution added to $25.0 \text{ cm}^3$ of solution	$20.00 \text{ cm}^3$
concentration of the $\text{KMnO}_4$ solution	$0.0200 \text{ mol/dm}^3$

(i) Calculate the amount, in moles, of  $\text{KMnO}_4$  in  $20.00 \text{ cm}^3$  of solution.

(2)

amount of  $\text{KMnO}_4 = \dots\dots\dots \text{ mol}$

(ii) In this reaction one mole of  $\text{KMnO}_4$  reacts with five moles of  $\text{FeSO}_4$

Calculate the amount, in moles, of  $\text{FeSO}_4$  in  $25.0 \text{ cm}^3$  of the  $\text{FeSO}_4$  solution.

(1)

amount of  $\text{FeSO}_4$  in  $25.0 \text{ cm}^3 = \dots\dots\dots \text{ mol}$

(iii) Calculate the amount, in moles, of  $\text{FeSO}_4$  in  $250 \text{ cm}^3$  of this  $\text{FeSO}_4$  solution.

(1)

amount of  $\text{FeSO}_4$  in  $250 \text{ cm}^3 = \dots\dots\dots \text{ mol}$

(iv) Using your answer from (d)(iii), calculate the mass, in grams, of  $\text{FeSO}_4$  in the  $5.56 \text{ g}$  of  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ .

$[M_r \text{ of } \text{FeSO}_4 = 152]$

(1)

mass of  $\text{FeSO}_4 = \dots\dots\dots \text{ g}$



(e) In another experiment it is found that 24.2 g of  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$  contains 15.2 g of iron(II) sulfate ( $\text{FeSO}_4$ ).

(i) Calculate the mass of water in 24.2 g of  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$  (1)

mass of water = ..... g

(ii) Calculate the amount, in moles, of  $\text{H}_2\text{O}$  in this mass of water. (1)

amount of  $\text{H}_2\text{O}$  = ..... mol

(iii) Calculate the amount, in moles, of  $\text{FeSO}_4$  in 15.2 g of iron(II) sulfate.  
[ $M_r$  of  $\text{FeSO}_4 = 152$ ] (1)

amount of  $\text{FeSO}_4$  = ..... mol

(iv) Using your answers to parts (ii) and (iii), calculate the value of x in  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ . (1)

value of x = .....

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

**TOTAL FOR PAPER = 120 MARKS**



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