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Write your name here

| Surname | Other names |
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| | |

**Pearson Edexcel Certificate**
**Pearson Edexcel International GCSE**

Centre Number | | | | | |

Candidate Number | | | | |

# Chemistry

## Unit: KCH0/4CH0
## Science (Double Award) KSC0/4SC0
## Paper: 1C

Thursday 14 May 2015 – Morning
**Time: 2 hours**

Paper Reference
**KCH0/1C 4CH0/1C**
**KSC0/1C 4SC0/1C**

**You must have:**
Calculator, ruler

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* ▶

P44267A



1/1/1/1/1/1/

P 4 4 2 6 7 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 |

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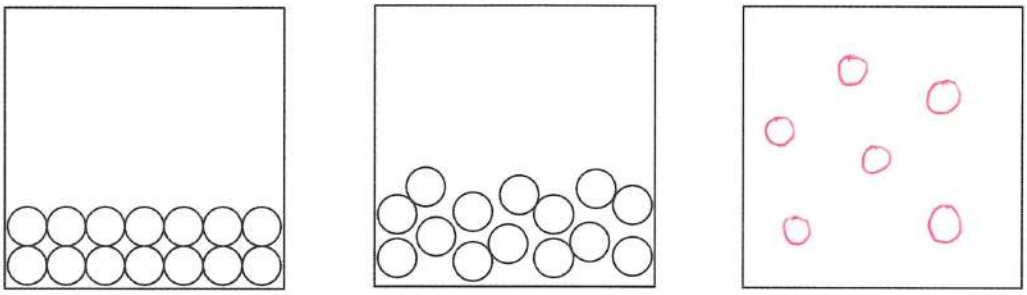
**Answer ALL questions.**

**1** This question is about the states of matter.

(a) The diagram shows the three states of matter for a substance.



solid liquid gas

Each circle represents a molecule of the substance.

1.01

(i) Complete the diagram by drawing six circles to represent molecules in the gas state.

**(1)**

(ii) Which statement is correct about the movement or arrangement of the molecules of this substance?

**(1)**

1.01

- ☐ **A** They move randomly in the solid state.
- ☒ **B** They move randomly in the liquid state.
- ☐ **C** They are arranged in fixed positions in the liquid state.
- ☐ **D** They are arranged in fixed positions in the gas state.

(iii) Which term is used for a solid changing to a liquid?

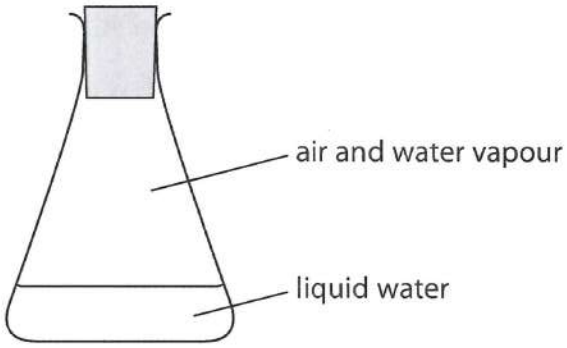
**(1)**

1.02

- ☐ **A** boiling
- ☐ **B** condensing
- ☐ **C** freezing
- ☒ **D** melting

(b) Some cold water is poured into a conical flask and a bung inserted.

The diagram shows the flask after a few minutes.




(i) What is occurring in the flask?

(1)

1.02

☐ **A** boiling and condensing

☒ **B** condensing and evaporating

☐ **C** evaporating and freezing

☐ **D** freezing and melting

(ii) Which formula represents a substance that is **not** present in the flask?

(1)

☐ **A** $H_2O(g)$

1.02

☐ **B** $H_2O(l)$

☐ **C** $N_2(g)$

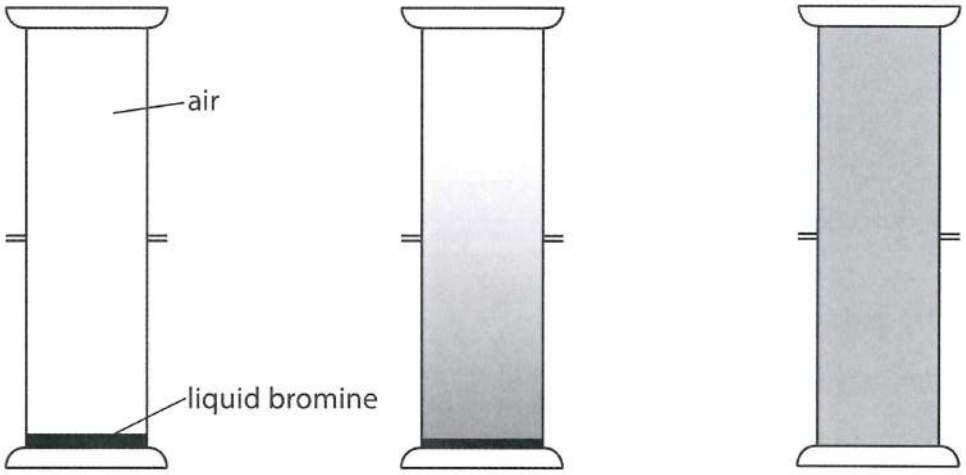
☒ **D** $N_2(l)$

**(Total for Question 1 = 5 marks)**

**2** A teacher demonstrates, in a fume cupboard, two experiments to show the movement of particles.

(a) In the first experiment she places some liquid bromine at the bottom of a gas jar. She then places another gas jar containing air on top of it, as shown in the diagram.

The diagram shows the apparatus at the start, after a few minutes and at the end of the experiment.




Place crosses (☒) in **two** boxes to show which statements are correct about this experiment.

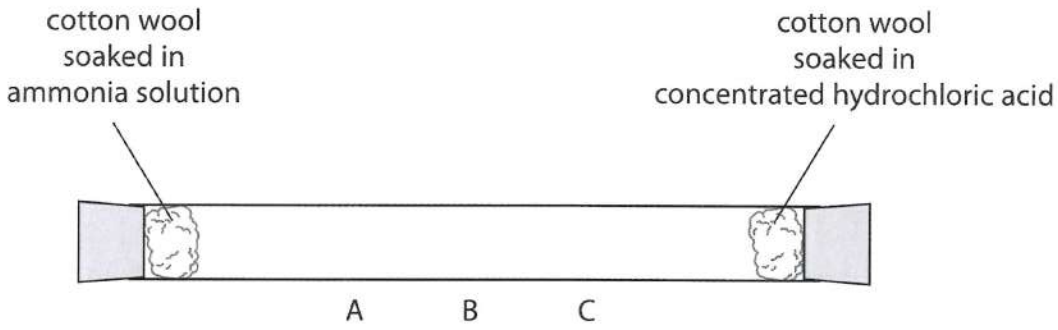
**(2)**

1.03

- ☐ **A** All the air particles in the upper gas jar stay there.
- ☐ **B** Bromine and air react to form bromine oxide.
- ☒ **C** Bromine has a darker colour than air.
- ☒ **D** Bromine vapour diffuses upwards.
- ☐ **E** Liquid bromine sublimes during the experiment.
- ☐ **F** The concentration of bromine in the lower gas jar does not change.

(b) In the second experiment, she soaks two pieces of cotton wool in different liquids and places them at opposite ends of a glass tube. She immediately seals the tube with bungs.

The diagram shows the apparatus at the start of the experiment.




During the experiment a white ring appears in the tube.

(i) State whether the white ring appears at A, B or C.

1.03

**(1)**

C

(ii) Explain your choice.

**(2)**

1.03

Ammonia diffuses faster because of lower Mr

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

**3** Magnesium is an element in Group 2 of the Periodic Table.

When magnesium burns in air it forms magnesium oxide.

(a) Describe two observations made when magnesium burns in air.

**(2)**

2.11

1 Bright / white light

2 white solid

(b) Magnesium oxide is

**(1)**

2.38

- ☐ **A** an acidic oxide formed from a metal
- ☐ **B** an acidic oxide formed from a non-metal
- ☒ **C** a basic oxide formed from a metal
- ☐ **D** a basic oxide formed from a non-metal

(c) Some magnesium oxide is tested with damp litmus paper.

(i) State the final colour of the litmus paper.

**(1)**

2.28

Blue

(ii) Identify the ion responsible for this colour.

**(1)**

2.28

$OH^-$

**(Total for Question 3 = 5 marks)**

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**4** A student adds dilute sulfuric acid to a beaker containing calcium chloride solution. He obtains a mixture containing a precipitate of calcium sulfate in a solution of hydrochloric acid.

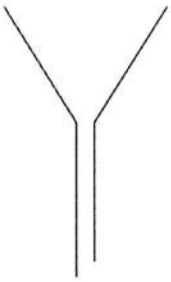
(a) Complete the equation for this reaction by inserting state symbols.

**(1)**

2.34

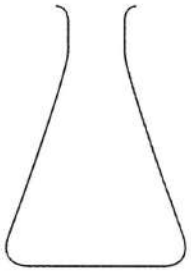
$CaCl_2$(aq) + $H_2SO_4$(aq) → $CaSO_4$(s) + 2HCl(aq)

(b) The student uses this apparatus to separate the mixture into a residue and a filtrate.



filter funnel

folded filter paper



conical flask

0.00

Draw a diagram to show how he should assemble the apparatus for the filtration.

**(2)**

(c) The student carries out a flame test on the filtrate he obtains and observes a brick-red colour.

(i) Identify the ion responsible for this colour.

(1)

2.46

$Ca^{2+}$

(ii) Suggest why this ion is present in the filtrate.

(1)

0.00

$CaSO_4$ is partially soluble OR Excess $CaCl_2$

(d) The student tests the filtrate for chloride ions by adding silver nitrate solution.

(i) State what he would observe in this test.

(1)

2.48

White ppt

(ii) State the name of the substance responsible for this observation.

(1)

2.48

Silver chloride

(iii) He reads in a textbook that dilute nitric acid should be added before the silver nitrate solution in the test.

Suggest why the student does **not** need to add dilute nitric acid in the test.

(1)

2.48

Solution is acidic

(e) The calcium sulfate residue he obtains is impure because it contains some hydrochloric acid.

Describe how he can obtain a pure dry sample of calcium sulfate from this residue.

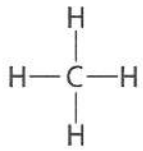
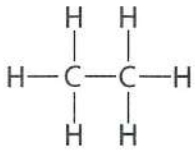
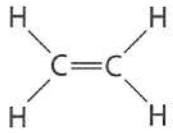
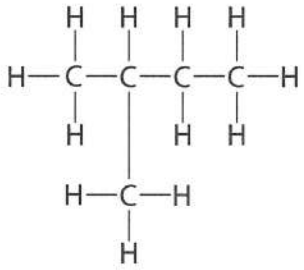
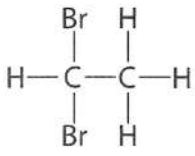
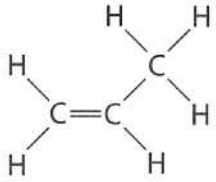
(2)

2.39

- Wash with water
- Leave in a warm place

**(Total for Question 4 = 10 marks)**

**5** The table shows the displayed formulae of six organic compounds, P, Q, R, S, T and U.

| | | |
|---|---|---|
| **P**  | **Q**  | **R**  |
| **S**  | **T**  | **U**  |

(a) (i) What is the molecular formula of compound S?

**(1)**

4.02

$C_5H_{12}$

(ii) What is the empirical formula of compound T?

**(1)**

4.02

$CH_2Br$

(b) (i) Give the letters of two compounds that belong to the homologous series of alkenes.

**(1)**

4.24

R and U

(ii) The general formula of this homologous series is

**(1)**

4.24

- ☐ **A** $C_nH_{2n-2}$
- ☐ **B** $C_nH_{2n+2}$
- ☐ **C** $C_n + H_{2n}$
- ☒ **D** $C_nH_{2n}$

(c) Which of these conversions is an example of an addition reaction?

(1)

☐ **A** compound P → compound Q

☐ **B** compound Q → compound T

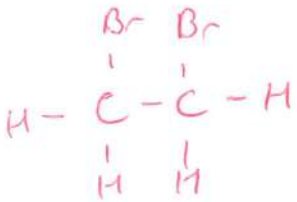
4.06 ☒ **C** compound R → compound Q

☐ **D** compound R → compound U

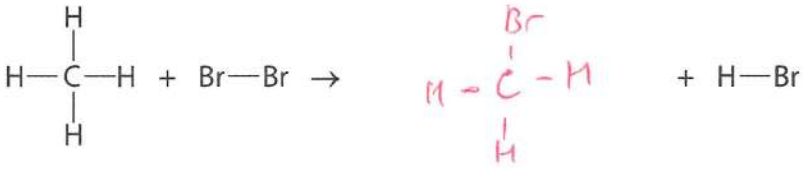
(d) Complete the table to show the displayed formula and name of the isomer of compound T.

(2)

4.21

| | |
|---|---|
| Displayed formula |  |
| Name | 1,2- dibromoethane |

(e) The equation represents a reaction between compound P and bromine.




4.21 (i) Complete the equation to show the displayed formula of the organic product.

(1)

(ii) State the name of this organic product.

(1)

4.21 Bromomethane

(iii) State the condition used in this reaction.

(1)

4.22 UV

(iv) What term is used for this type of reaction?

4.22 (1)

- ☐ **A** addition
- ☐ **B** hydration
- ☐ **C** neutralisation
- ☒ **D** substitution

(f) Old refrigerators may contain substances that harm the ozone layer in the atmosphere. Many new refrigerators use 152a, an organic compound that does not harm the ozone layer.

152a has the composition by mass C = 36.4%, H = 6.0% and F = 57.6%.

(i) Calculate the empirical formula of 152a.

(3)

| C | H | F |
|---|---|---|
| $\frac{36.4}{12}$ | $\frac{6}{1}$ | $\frac{57.6}{19}$ |
| $\frac{3.03}{3.03}$ | $\frac{6.0}{3.03}$ | $\frac{3.03}{3.03}$ |
| 1 | 2 | 1 |

1.33

empirical formula $CH_2F$

(ii) The relative formula mass of 152a is 66

What is its molecular formula?

(1)

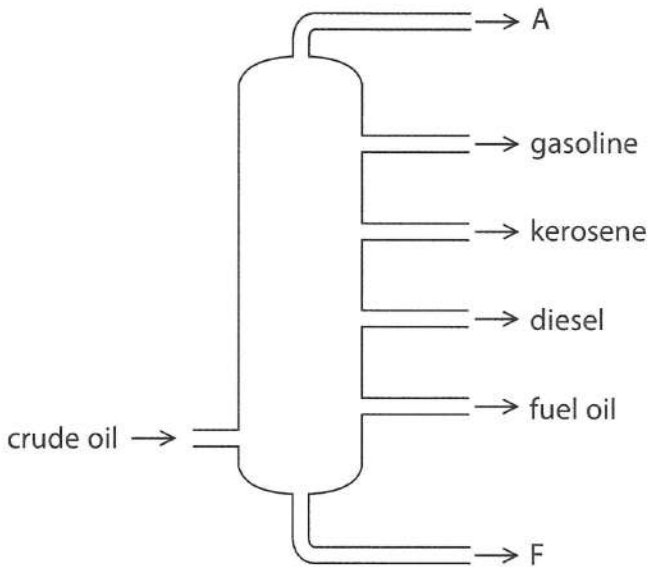
1.33

$$M_r \text{ of empirical formula} = (12\times1)+(2\times1)+(19\times1)$$
$$= 33$$
$$\frac{66}{33} = 2$$

molecular formula $C_2H_4F_2$

**(Total for Question 5 = 15 marks)**

**6** The diagram shows a typical fractionating column used to separate crude oil into fractions.




(a) The diagram shows the names of some of the fractions.

State the name of fraction A and the name of fraction F.

4.09

**(2)**

fraction A Refinery gases

fraction F Bitumen

(b) Most compounds in crude oil are hydrocarbons.

State the meaning of the term **hydrocarbons**.

**(2)**

4.01

contains hydrogen and carbon only

(c) Describe how the boiling point, colour and viscosity of the fuel oil fraction differ from those of the gasoline fraction.

(3)

4.10

- Higher boiling points
- Darker
- Higher viscosities

(d) Some fuel oil undergoes catalytic cracking. This involves the conversion of long-chain alkanes into alkenes and short-chain alkanes.

(i) A temperature of about 650 °C is used in this process.

Identify a catalyst that is used.

4.17

(1)

alumina / silica

(ii) The alkane tridecane can be cracked to produce octane and two different alkenes.

Complete the equation to show the formulae of the two alkenes.

(2)

1.25

$C_{13}H_{28} \rightarrow C_8H_{18} +$ $C_2H_4$ + $C_3H_6$

(e) When hydrocarbons undergo incomplete combustion, a poisonous gas can form.

(i) State the condition that causes incomplete combustion.

(1)

4.12 Lack of oxygen

(ii) Identify the poisonous gas.

(1)

4.12 CO

(iii) Explain why this gas is poisonous.

(1)

4.13 Decreases capacity of blood to carry oxygen

(f) Another problem with using hydrocarbon fuels is the formation of substances that cause an environmental problem. This sequence of equations shows how one of these substances forms.

$S + O_2 \rightarrow SO_2$

$2SO_2 + O_2 \rightarrow 2SO_3$

$SO_3 + H_2O \rightarrow H_2SO_4$

(i) State the name of the product of each of these reactions.

(2)

1.39 $SO_2$ Sulfur dioxide

$SO_3$ Sulfur trioxide

$H_2SO_4$ Sulfuric acid

(ii) Describe one environmental problem caused by the $H_2SO_4$ formed.

(2)

4.16 • Acid rain, damages vegetation

**(Total for Question 6 = 17 marks)**

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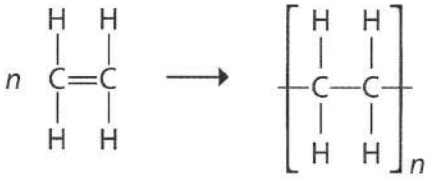
**7** This question is about polymers.

The formation of poly(ethene) can be represented as



4.06

(a) What is the name of this type of reaction?

(1)

- ☒ **A** addition
- ☐ **B** decomposition
- ☐ **C** reduction
- ☐ **D** substitution

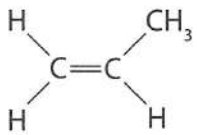
(b) Which of these is a correct description of a monomer?

(1)

4.44

- ☒ **A** a molecule used to make a polymer
- ☐ **B** a molecule with only single bonds
- ☐ **C** an atom in a polymer
- ☐ **D** a repeat unit in a polymer

(c) This compound is used to make a polymer.



4.26

(i) State the name of this compound.

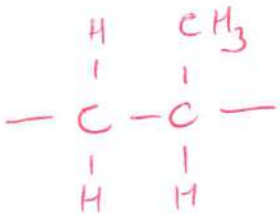
(1)

Propene

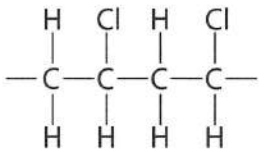
(ii) Draw the structure of the repeat unit of the polymer formed from this compound.

(2)

4.45



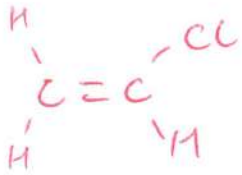
(d) This is part of the structure of another polymer.



Draw the displayed formula of the monomer used to make this polymer.

(1)

4.46



(e) Many polymers do not biodegrade when they are thrown away.

(i) State the meaning of the term **biodegrade**.

4.47

(2)

• Decomposes by bacteria

(ii) What property of these polymers prevents them from biodegrading?

4.47

(1)

Inert

**(Total for Question 7 = 9 marks)**

**8** A student carries out a titration to find the concentration of some dilute sulfuric acid.

She is given

- a supply of the dilute sulfuric acid
- sodium hydroxide solution of concentration 0.150 mol/dm$^3$
- apparatus suitable for carrying out a titration
- phenolphthalein indicator

She uses this method to do the titration.

step 1 add 25.0 cm$^3$ of the sodium hydroxide solution to a conical flask

step 2 add 3 drops of phenolphthalein indicator to the conical flask

step 3 fill a burette with the sulfuric acid

step 4 add the sulfuric acid to the conical flask until the phenolphthalein indicator just changes colour

(a) Name the piece of apparatus that the student should use to add the sodium hydroxide solution in step 1.

2.33C

(1)

Pipette

(b) What is the colour change of the phenolphthalein indicator in step 4?

2.28

(1)

☐ **A** colourless to pink

☒ **B** pink to colourless

☐ **C** red to yellow

☐ **D** yellow to red

(c) Why is it better to use phenolphthalein indicator rather than universal indicator in this titration?

2.28

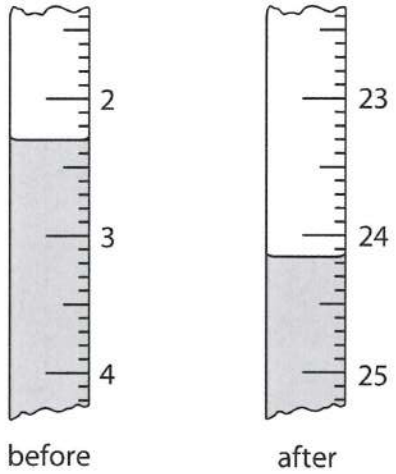
(1)

Universal colours • Phenolphthalein only one colour change

OR

• definite end point

(d) The diagram shows the burette readings in one titration.




Use the readings to complete the table, entering all values to the nearest 0.05 $cm^3$.

**(3)**

2.33C

| | |
|---|---|
| burette reading in $cm^3$ after adding acid | 24.15 |
| burette reading in $cm^3$ before adding acid | 2.30 |
| volume of acid added in $cm^3$ | 21.85 |

(e) The student repeats the experiment using the same sodium hydroxide solution but another solution of sulfuric acid of a different concentration.

The table shows her results.

| | | | | |
|---|---|---|---|---|
| burette reading in $cm^3$ after adding acid | 27.65 | 27.80 | 27.75 | 27.40 |
| burette reading in $cm^3$ before adding acid | 0.50 | 1.50 | 1.00 | 1.00 |
| volume of acid added in $cm^3$ | 27.15 | 26.30 | 26.75 | 26.40 |
| titration results to be used (✓) | | ✓ | | ✓ |

The average (mean) volume of acid should be calculated using only concordant results.

2.33C Concordant results are those volumes that differ from each other by 0.20 $cm^3$ or less.

(i) Identify the concordant results by placing ticks (✓) in the table where appropriate.

(1)

2.33C (ii) Use your ticked results to calculate the average volume of acid added.

(2)

$$= \frac{26.30 + 26.40}{2}$$

$$= 26.35$$

average volume of acid = 26.35 $cm^3$

(f) The student uses a similar method to find the concentration of a solution of phosphoric acid ($H_3PO_4$).

The equation for the reaction is

$$3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$$

The table shows her results.

| | |
|---|---|
| volume of sodium hydroxide solution added to conical flask | 25.0 $cm^3$ |
| concentration of sodium hydroxide solution | 0.180 $mol/dm^3$ |
| average volume of phosphoric acid solution added from burette | 28.30 $cm^3$ |

(i) Calculate the amount, in moles, of NaOH in 25.0 $cm^3$ of the sodium hydroxide solution.

(2)

1.34C

$n(NaOH) = \frac{0.180 \times 25.0}{1000}$

$= 0.0045 mol$

amount of NaOH = 0.0045 mol

(ii) Calculate the amount, in moles, of $H_3PO_4$ in the phosphoric acid solution.

(1)

1.28

$n(H_3PO_4) = \frac{0.0045}{3}$

$= 0.0015 mol$

amount of $H_3PO_4$ = 0.0015 mol

(iii) Calculate the concentration, in $mol/dm^3$, of the phosphoric acid.

(2)

1.34C

$conc(H_3PO_4) = \frac{0.0015 \times 1000}{28.3}$

$= 0.053 mol/dm^3$

concentration of phosphoric acid = 0.053 $mol/dm^3$

**(Total for Question 8 = 14 marks)**

**9** This question is about bonding, structures and properties.

(a) The box gives four types of structure.

| giant covalent | giant ionic | giant metallic | simple molecular |
|---|---|---|---|

The table shows some properties of four substances, A, B, C and D.

Complete the table by giving the correct type of structure for each substance.

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

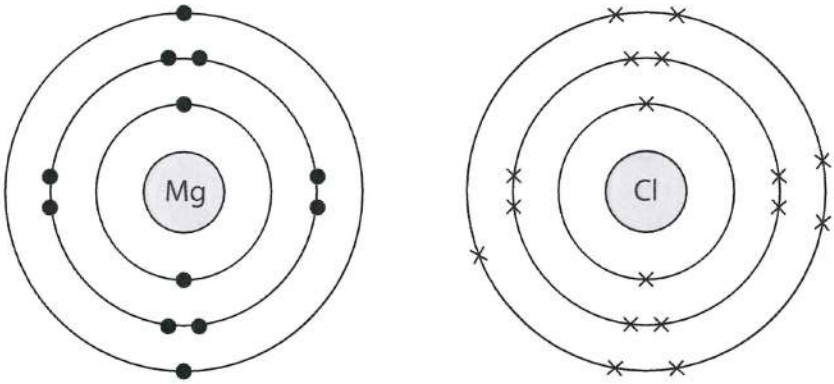
(4)

1.42
1.43
1.47
.49
.51
.54C

| Substance | Electrical conductivity | | Melting point | Type of structure |
|---|---|---|---|---|
| | of the solid | of the liquid | | |
| A | poor | poor | low | Simple molecular |
| B | poor | poor | high | giant covalent |
| C | good | good | high | giant metallic |
| D | poor | good | high | giant ionic |

(b) Magnesium chloride ($MgCl_2$) is an ionic compound.

The diagram shows the electronic configurations of atoms of magnesium and chlorine.




(i) Describe how magnesium atoms and chlorine atoms form magnesium ions and chloride ions.

1.37

(3)

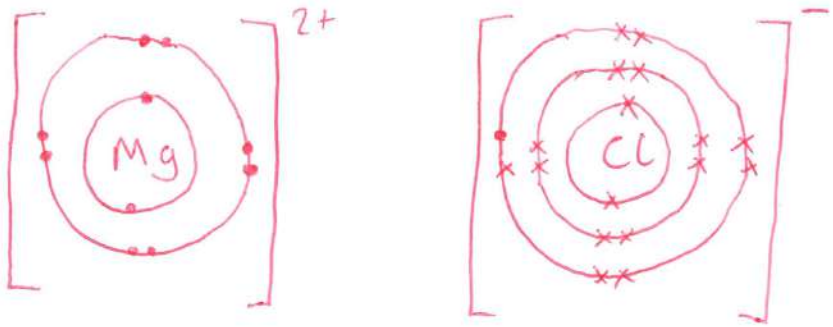
- Electrons transfer from Mg to Cl
- Mg atoms lose 2 electrons
- Each Cl atom gains 1 electron

(ii) Draw a diagram to represent the electronic configurations of each of the ions in magnesium chloride.

Show the charge on each ion.

1.19
1.40

(3)



(c) A molecule of carbon dioxide contains double covalent bonds.

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

1.46


(2)

(d) Indium is a metal in Group 3 of the Periodic Table.

(i) Describe the structure and bonding in indium.

(3)

1.53C

- Positive ions with delocalised electrons
- Giant lattice

(ii) Explain why indium is malleable.

1.54C

(2)

- Layers of ~~atoms~~ positive ions slide over each other

**(Total for Question 9 = 17 marks)**

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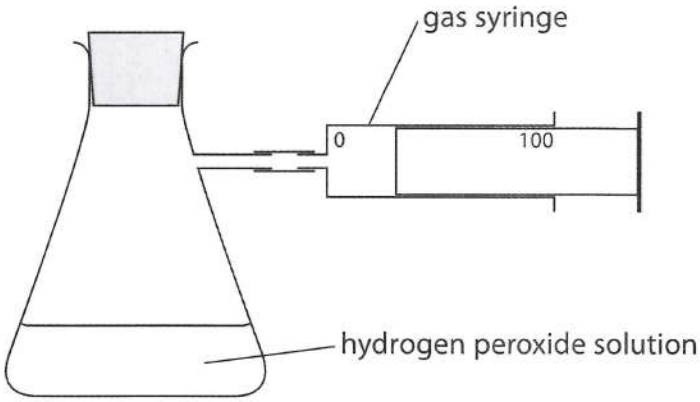
**10** A student investigates the rate of decomposition of hydrogen peroxide solution.

The diagram shows the apparatus he uses in his experiments.




The equation for the decomposition is

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

(a) The student keeps the amount, in moles, of $H_2O_2$ in the solution constant at the start of each experiment.

State two properties of the solution that he should keep the same to ensure that the amount of $H_2O_2$ is the same in each experiment.

3.16

**(2)**

1 volume

2 concentration

(b) The student carries out the experiment five times.

He uses a different solid in each experiment to see how effective each solid is as a catalyst in the decomposition.

He removes the bung, adds a small amount of one of the solids and quickly replaces the bung.

He records the time taken to collect 100 $cm^3$ of oxygen in the syringe.

| Solid | Time to collect 100 $cm^3$ of oxygen, in seconds |
|---|---|
| A | 76 |
| B | no oxygen collected |
| C | 35 |
| D | 11 |
| E | 54 |

(i) Which solid does not seem to act as a catalyst?

3.12

(1)

B

(ii) Which solid is the most effective catalyst?

3.12

(1)

D

(c) In the first experiment the student added 1 g of solid A.

Describe what he could do with the contents of the conical flask at the end of the experiment to show that A was a catalyst, and not a reactant.

(2)

3.12

- Filter and weigh solid
- Mass unchanged

(d) The student repeats the experiment using the same apparatus, but this time he records the volume of oxygen collected at intervals of 20 seconds.

The table shows his results for two new solids F and G.

| Time in seconds | Volume of oxygen collected in $cm^3$ | |
|---|---|---|
| | solid F | solid G |
| 0 | 0 | 0 |
| 20 | 69 | 36 |
| 40 | 89 | 58 |
| 60 | 98 | 74 |
| 80 | 100 | 86 |
| 100 | 100 | 96 |
| 120 | 100 | 100 |

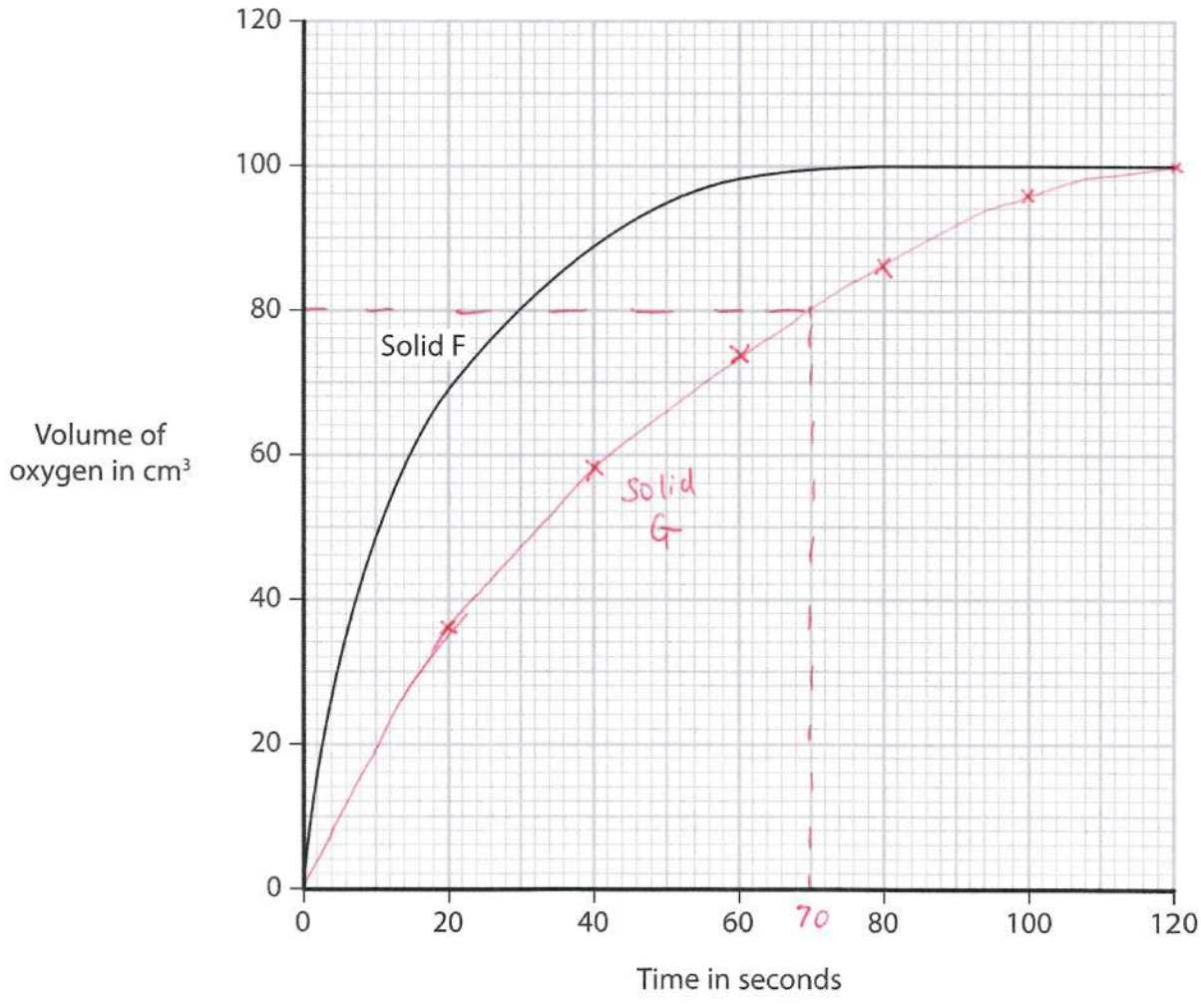
3 16

(i) The grid shows the results plotted for solid F.

On the grid, plot the results for solid G.

Draw a curve of best fit.

(3)



(ii) Use your graph to estimate the volume of oxygen collected after 70 seconds for solid G.

Show on your graph how you obtained your answer.

(2)

80cm$^3$

3.16

(iii) How do the curves on the graph show that the reaction is faster with solid F than with solid G?

(1)

3.16

* Steeper gradient OR curve levels off earlier

**(Total for Question 10 = 12 marks)**

**11** A manufacturer investigates some reactions that produce hydrogen.

The table shows three possible reversible reactions that he could use. The enthalpy changes are also shown.

| Reaction | Equation | $\Delta H$ in kJ/mol |
|---|---|---|
| 1 | $CH_4(g) + 2H_2O(g) \rightleftharpoons CO_2(g) + 4H_2(g)$ | +165 |
| 2 | $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ | −41 |
| 3 | $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$ | −206 |

(a) (i) For reaction 1, predict whether the pressure should be low or high to give the greatest yield of products.

3.22C

(1)

Low

(ii) Give a reason for your choice.

(1)

3.22C

Fewer molecules on left

(b) (i) For reaction 1, predict whether the temperature should be low or high to give the greatest yield of products.

3.22C

(1)

High

(ii) Give a reason for your choice.

3.22C

(1)

Forward reaction endothermic

(c) For reaction 2, suggest why changing the temperature will have less effect on the yield of products than in reactions 1 and 3.

3.10

(1)

ΔH smaller OR Reaction not very exothermic

(d) (i) For reaction 3, predict the effect on the rate of the forward reaction of increasing the pressure, without changing the temperature.

3.22C

(1)

Increases

(ii) Explain your prediction in terms of the particle collision theory.

3.11

(2)

- Particles closer together
- Particles successfully collide more frequently

(e) The manufacturer makes a batch of ethanoic acid from methanol and carbon monoxide using this reaction.

1.28

$$CH_3OH + CO \rightarrow CH_3COOH$$

He starts with 64 kg of methanol.

Calculate the maximum mass of ethanoic acid he could obtain.

(3)

$M_r(CH_3OH) = 32$

$M_r(CH_3COOH) = 60$

$n(CH_3OH) = \frac{64}{32}$

$= 2$

Ratio 1:1

$m(CH_3COOH) = 2 \times 60$

$= 120$ kg

maximum mass of ethanoic acid = 120 kg

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

**TOTAL FOR PAPER = 120 MARKS**

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