Write your name here

Surname	Other names

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	1	2											3	4	5	6	7	0
	Group																	
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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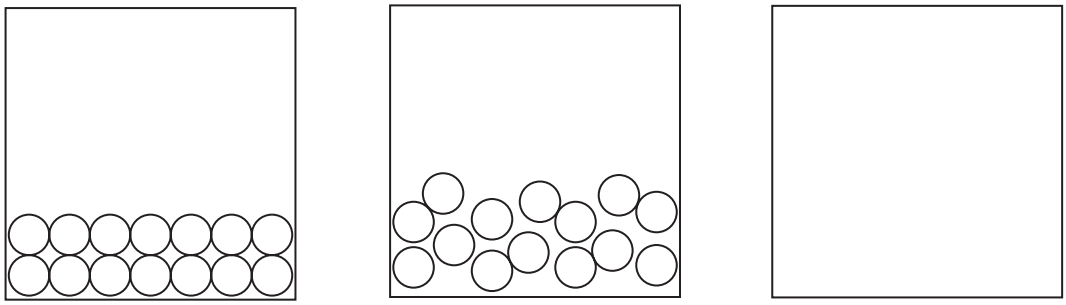
Answer ALL questions.

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.

(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)

☒ **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)

☒ **A** boiling

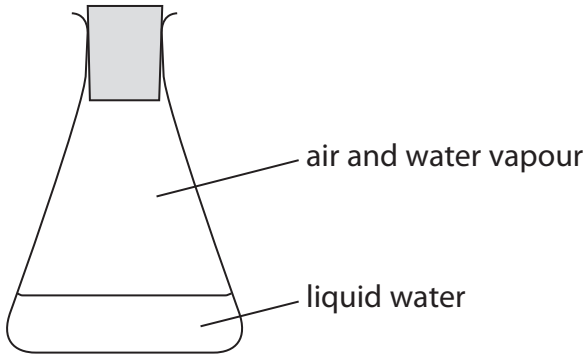
☒ **B** condensing

☒ **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)

☒ **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** $H_2O(g)$

☒ **B** $H_2O(l)$

☒ **C** $N_2(g)$

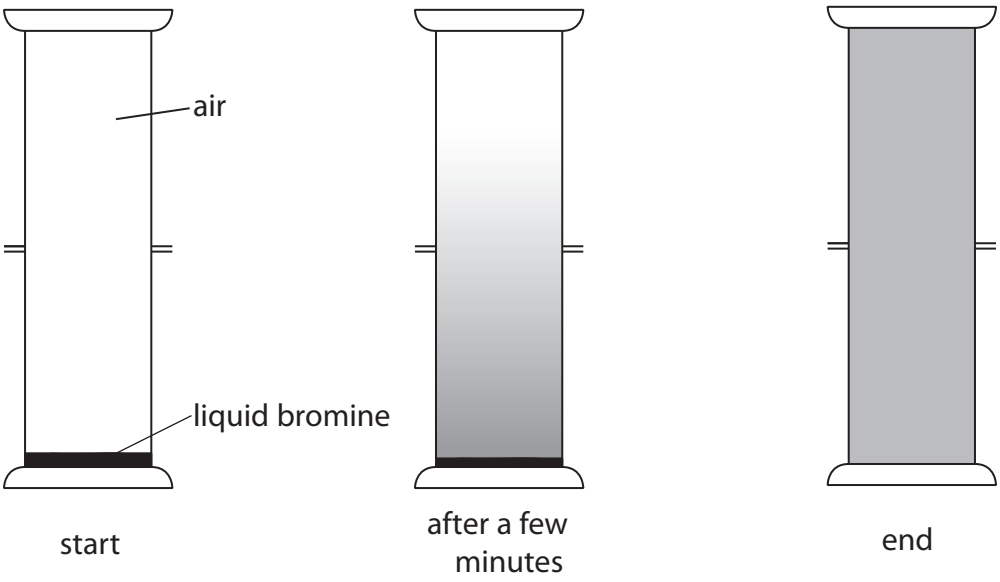
☒ **D** $N_2(l)$

(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)

☒ **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.

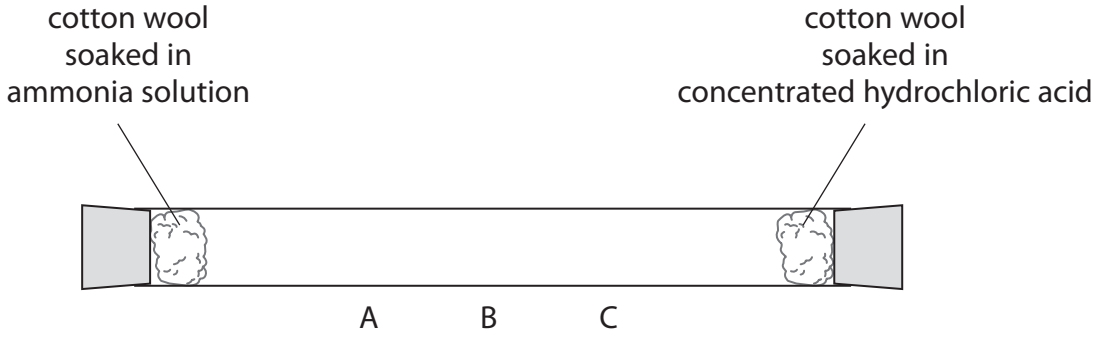
☒ **D** Bromine vapour diffuses upwards.

☒ **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)

.....

(ii) Explain your choice.

(2)

.....

.....

.....

.....

(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)

1 .....

.....

2 .....

.....

(b) Magnesium oxide is

(1)

☒ **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)

.....

(ii) Identify the ion responsible for this colour.

(1)

.....

(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)

$CaCl_2$(.....) + H_2SO_4(.....) → $CaSO_4$(.....) + 2HCl(.....)

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

filter funnel

conical flask

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)

.....

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

(1)

.....

.....

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

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

(1)

.....

.....

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

(1)

.....

(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)

.....

.....

(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)

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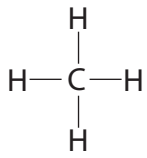
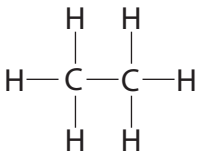
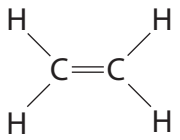
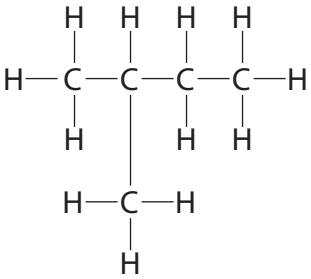
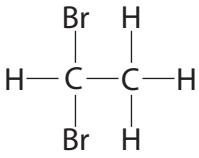
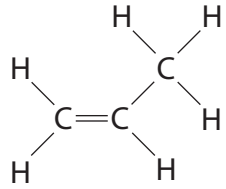
(Total for Question 4 = 10 marks)

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)

.....

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

(1)

.....

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

(1)

..... and .....

(ii) The general formula of this homologous series is

(1)

☒ **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

☒ **C** compound R → compound Q

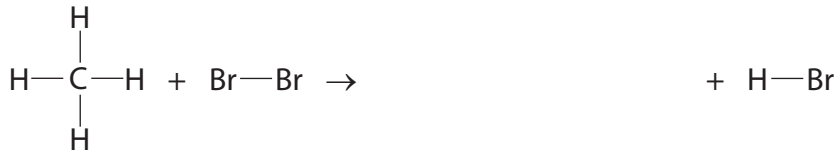
☒ **D** compound R → compound U

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

(2)

Displayed formula	
Name	

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



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

(1)

(ii) State the name of this organic product.

(1)

.....

(iii) State the condition used in this reaction.

(1)

.....

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

(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)

empirical formula .....

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

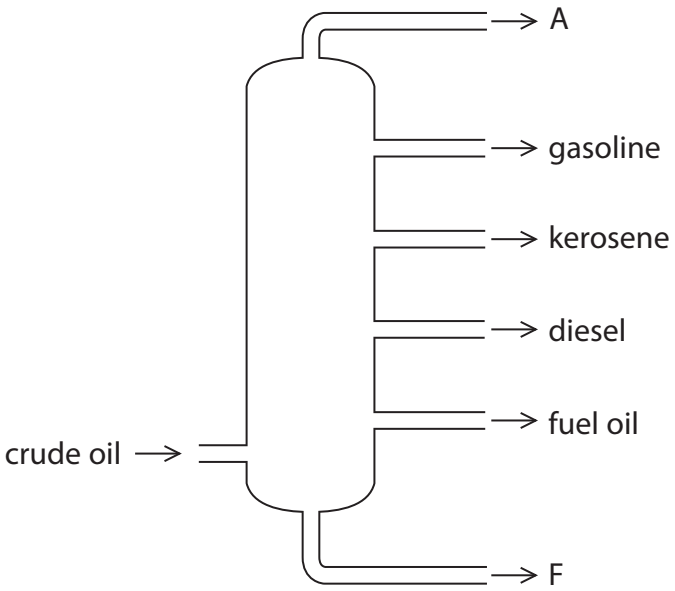
What is its molecular formula?

(1)

molecular formula.....

(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.

(2)

fraction A .....

fraction F .....

(b) Most compounds in crude oil are hydrocarbons.

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

(2)

.....

.....

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

(3)

.....

.....

.....

.....

.....

.....

(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.

(1)

.....

(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)

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

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

(i) State the condition that causes incomplete combustion.

(1)

.....

(ii) Identify the poisonous gas.

(1)

.....

(iii) Explain why this gas is poisonous.

(1)

.....

.....

.....

(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)

SO_2 .....

SO_3 .....

H_2SO_4 .....

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

(2)

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(Total for Question 6 = 17 marks)

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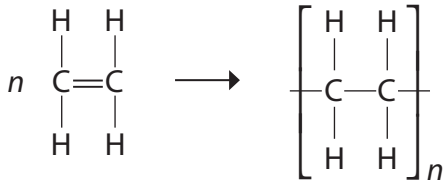
7 This question is about polymers.

The formation of poly(ethene) can be represented as



(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)

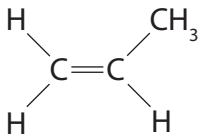
☒ **A** a molecule used to make a polymer

☒ **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.



(i) State the name of this compound.

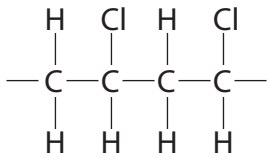
(1)

.....

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

(2)

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



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

(1)

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

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

(2)

.....

.....

.....

.....

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

(1)

.....

.....

(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.

(1)

.....

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

(1)

☒ **A** colourless to pink

☒ **B** pink to colourless

☒ **C** red to yellow

☒ **D** yellow to red

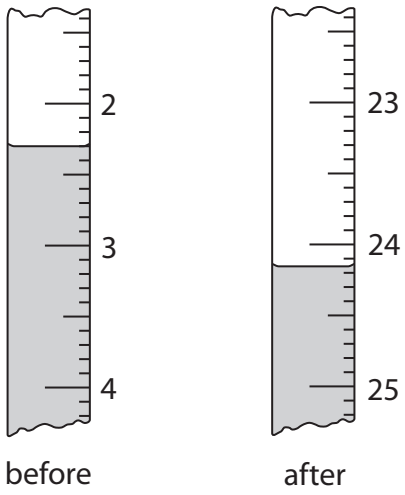
(c) Why is it better to use phenolphthalein indicator rather than universal indicator in this titration?

(1)

.....

.....

(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)

burette reading in cm^3 after adding acid	
burette reading in cm^3 before adding acid	
volume of acid added in cm^3	

(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.

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)

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

(2)

average volume of acid = ... 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)

amount of NaOH = ... mol

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

(1)

amount of H_3PO_4 = ... mol

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

(2)

concentration of phosphoric acid = ... 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.

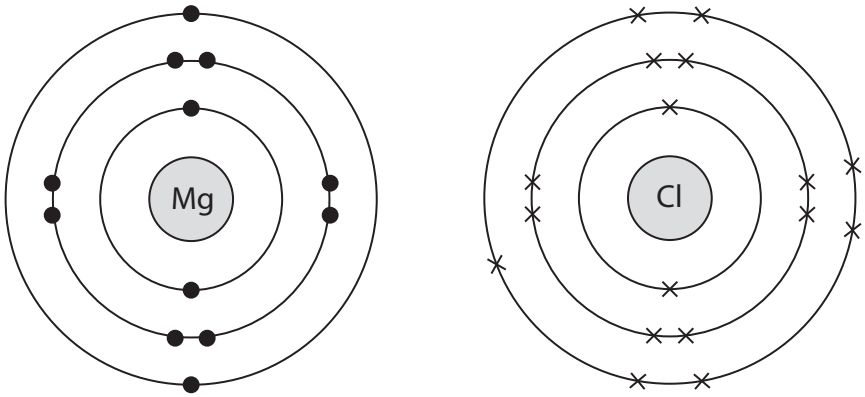
You may use each structure once, more than once or not at all.

(4)

Substance	Electrical conductivity		Melting point	Type of structure
	of the solid	of the liquid		
A	poor	poor	low	
B	poor	poor	high	
C	good	good	high	
D	poor	good	high	

(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.

(3)

.....

.....

.....

.....

.....

.....

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

Show the charge on each ion.

(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.

O C O

(2)

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

(i) Describe the structure and bonding in indium.

(3)

(ii) Explain why indium is malleable.

(2)

(Total for Question 9 = 17 marks)

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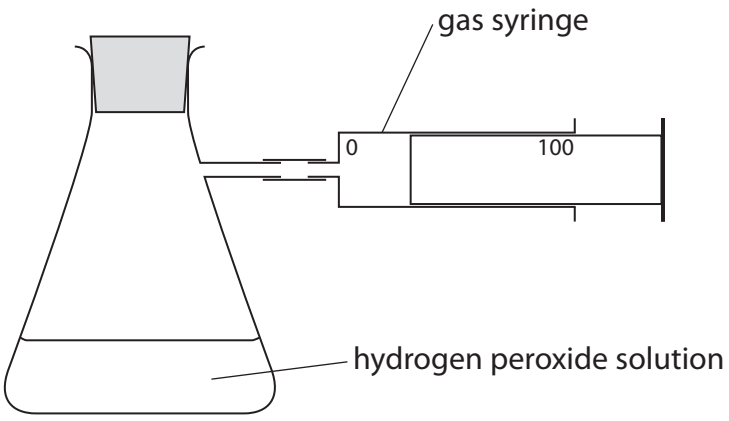
10 A student investigates the rate of decomposition of hydrogen peroxide solution.

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.

(2)

1 .....

2 .....

(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?

(1)

.....

(ii) Which solid is the most effective catalyst?

(1)

.....

(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)

.....

.....

.....

.....

(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.

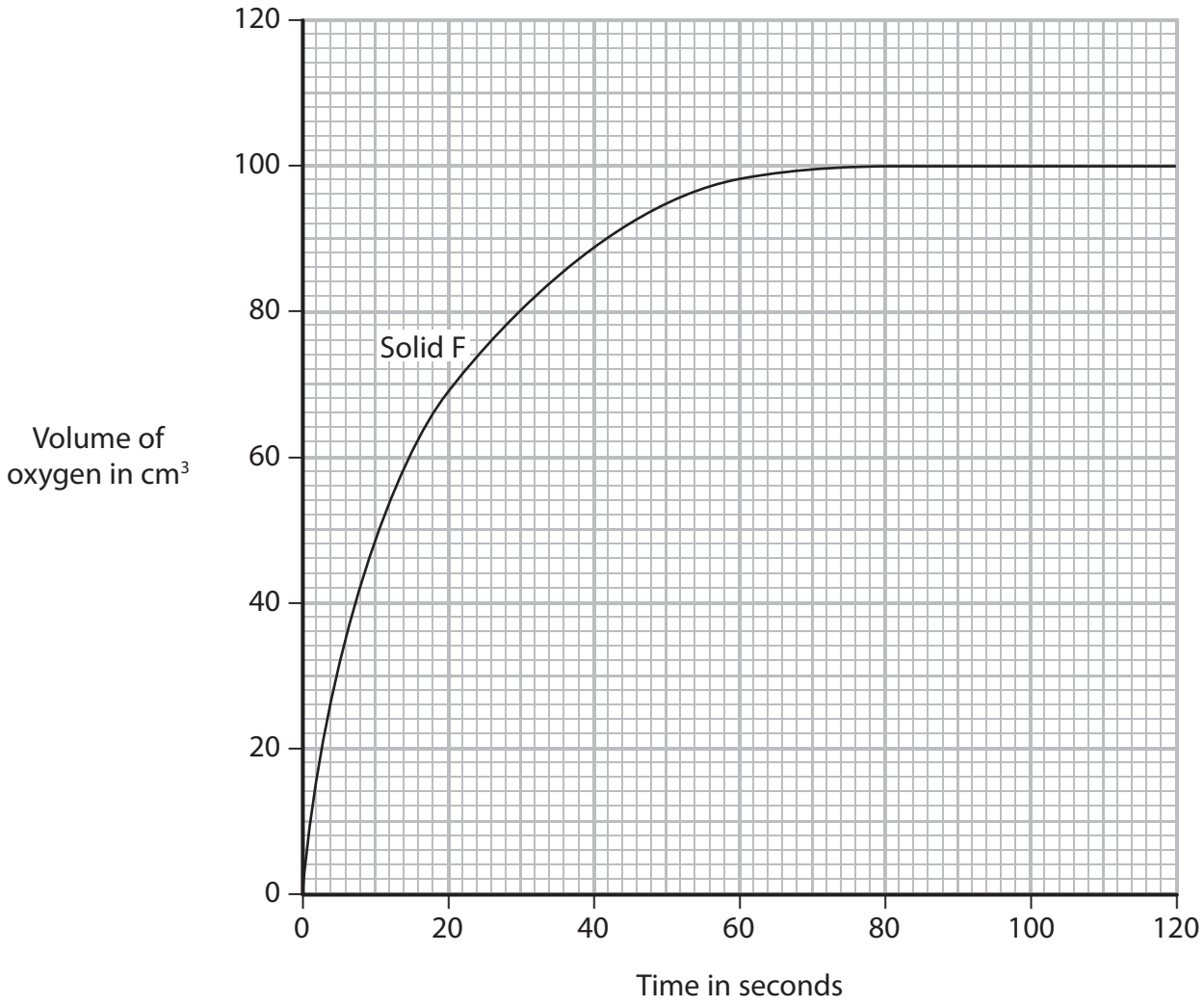
Time in seconds	Volume of oxygen collected in cm^3	
	solid F	solid G
0	0	0
20	69	36
40	89	58
60	98	74
80	100	86
100	100	96
120	100	100

(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)

.....

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

(1)

.....

.....

(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	ΔH 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.

(1)

.....

(ii) Give a reason for your choice.

(1)

.....

.....

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

(1)

.....

(ii) Give a reason for your choice.

(1)

.....

.....

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

(1)

.....

.....

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

(1)

.....

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

(2)

.....

.....

.....

.....

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

$$CH_3OH + CO \rightarrow CH_3COOH$$

He starts with 64 kg of methanol.

Calculate the maximum mass of ethanoic acid he could obtain.

(3)

maximum mass of ethanoic acid = ... kg

(Total for Question 11 = 11 marks)

TOTAL FOR PAPER = 120 MARKS

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