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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 18 May 2017 – 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.
- 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

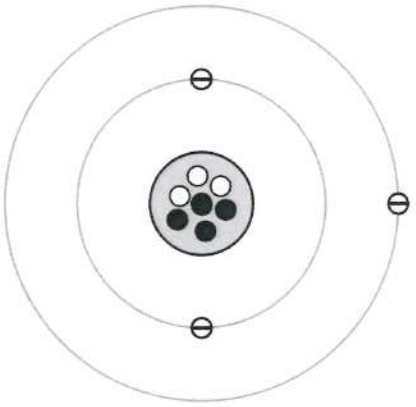
Period	1	2											3	4	5	6	7	0
	Group																	
1	1 H Hydrogen 1																	4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	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 The diagram represents an atom of an element.



Key:
- ⊖ electron
- ○ proton
- ● neutron

Use numbers from the box to complete the table.

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

1	2	3	4	5	6	7

(5)

atomic number of the atom	3
number of shells shown	2
mass number of the atom	7
number of protons in an isotope of this element	3
group where the element is found in the Periodic Table	1

1.15

(Total for Question 1 = 5 marks)

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2 Substances can be classified as elements, compounds or mixtures.

(a) Which of these is the formula for a molecule of an element? (1)

1.08

- ☐ **A** H
- ☒ **B** H_2
- ☐ **C** H_2O
- ☐ **D** H_2O_2

(b) Which of these is a mixture? (1)

1.08

- ☐ **A** sodium
- ☐ **B** chlorine
- ☐ **C** sodium chloride
- ☒ **D** sodium chloride solution

(c) Which method can be used to separate the dyes in a food colouring? (1)

1.11

- ☒ **A** chromatography
- ☐ **B** crystallisation
- ☐ **C** evaporation
- ☐ **D** filtration

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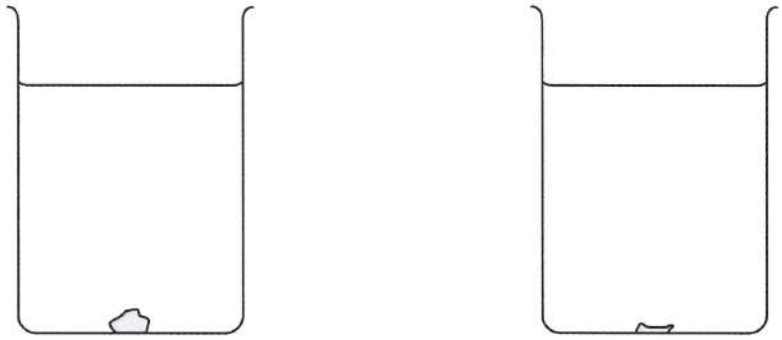
(d) A student adds a large crystal of sodium chloride to some water in a beaker and leaves the beaker for a day.

The diagram shows the beaker immediately after adding the crystal, and after one day.



immediately after adding crystal

after a day

After a day, the student takes a sample from the top of the liquid and tests it to see if it contains chloride ions.

The test is positive.

(i) Describe how the student should do the test.

Include the observation for a positive test in your answer.

(3)

2.48

- Add nitric acid
- Add silver nitrate
- White ppt

(ii) Name the process by which chloride ions move from the crystal to the top of the liquid.

(1)

1.03

Diffusion

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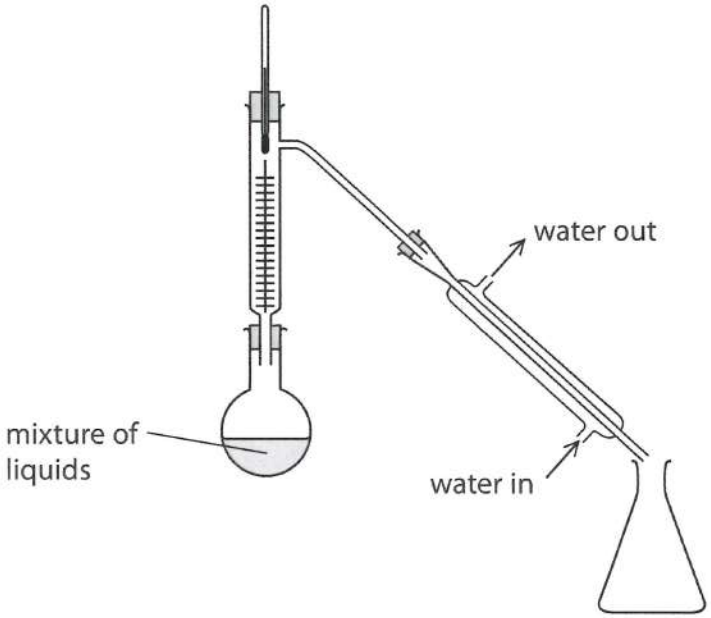
(e) This apparatus is used in a laboratory to separate a mixture of liquids with similar boiling points.



(i) The passage describes what happens when the apparatus is used.

Use words from the box to complete the passage.

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

(3)

0.00

beaker	burette	column
condenser	flask	thermometer

The mixture of liquids is placed in the Flask .

During heating, part of the mixture boils and passes up the column .

Water is used to cool the vapour in the condenser .

(ii) Which of these changes of state occurs in the separation?

(1)

1.02

☐ **A** (s) → (aq)

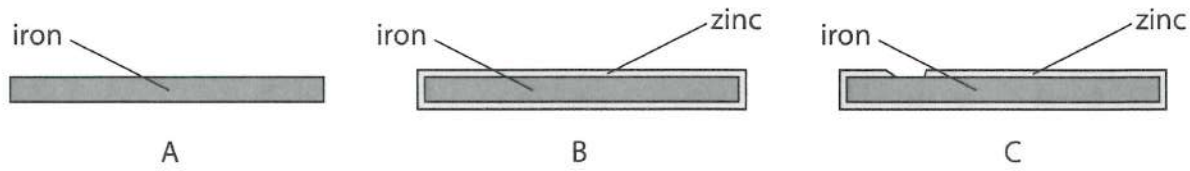
☐ **B** (l) → (s)

☒ **C** (g) → (l)

☐ **D** (aq) → (s)

(Total for Question 2 = 11 marks)

3 The diagram shows three pieces of iron.



A is a piece of iron.

B is a piece of iron with a thin coating of zinc.

C is a piece of iron with some of the zinc coating missing.

(a) Name the process used to coat iron with zinc.

(1)

2.19 Galvanisation

(b) The three pieces of iron are left in separate troughs of water and exposed to the atmosphere for several weeks.

The table shows the appearance of the pieces of iron after several weeks.

	Appearance
A	covered in a brown solid
B	shiny and unchanged in appearance
C	shiny and unchanged in appearance

(i) The brown solid contains hydrated iron(III) oxide.

What is the common name for this brown solid?

(1)

2.18 Rust

(ii) Identify the two substances that react with iron to form the brown solid.

(2)

2.18 1 Oxygen

2 Water

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(iii) Explain, with reference to the symbols in the box, why the brown solid does not form on C.

Fe	Fe^{2+}	Zn	Zn^{2+}	e^-

(3)

2.17 + 2.2C

- Zn is more reactive than Fe
- Zn loses 2 electrons

∴ prevents Fe from losing electrons

(Total for Question 3 = 7 marks)

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4 The table shows the formulae of some positive and negative ions.

It also shows the formulae of some compounds containing these ions.

	Cu^{2+}	Fe^{3+}	NH_4^+
Cl^-	$CuCl_2$	$FeCl_3$	NH_4Cl
SO_4^{2-}	$CuSO_4$	$Fe_2(SO_4)_3$	$(NH_4)_2SO_4$
CO_3^{2-}	$CuCO_3$	$Fe_2(CO_3)_3$	$(NH_4)_2CO_3$

(a) Complete the table by giving the formulae of the three missing compounds.

(3)

(b) The correct name of the compound with the formula $CuSO_4$ is

(1)

- ☐ **A** copper(I) sulfate
- ☐ **B** copper(I) sulfite
- ☒ **C** copper(II) sulfate
- ☐ **D** copper(II) sulfite

(c) Which of these descriptions is correct for $NH_4Cl(s)$ and for $NH_4Cl(aq)$?

(1)

	$NH_4Cl(s)$	$NH_4Cl(aq)$
☐ **A**	colourless	colourless
☐ **B**	colourless	white
☒ **C**	white	colourless
☐ **D**	white	white

(d) These tests are carried out on two separate samples of iron(III) sulfate solution.

test 1 add sodium hydroxide solution

test 2 add dilute hydrochloric acid, then add barium chloride solution

(i) Which observation is correct for test 1?

(1) 2.47

☒ **A** brown precipitate

☐ **B** brown solution

☐ **C** green precipitate

☐ **D** green solution

(ii) Give the names of the two products formed in test 1.

(2) 1.39

Iron (III) hydroxide and sodium sulfate

(iii) In test 2, there is no visible change after adding dilute hydrochloric acid.

State why the acid is added. 2.48

(1)

Remove carbonate ions

(iv) In test 2, barium sulfate is formed after adding barium chloride solution.

State the observation that is made. 2.48

(1)

White ppt

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(e) Describe a test to show that a sample of $CuCO_3$ contains the CO_3^{2-} ion.

(3)

2.48

- Add H^+ OR Heat
- Bubble CO_2 into limewater
- Turns milky

(Total for Question 4 = 13 marks)

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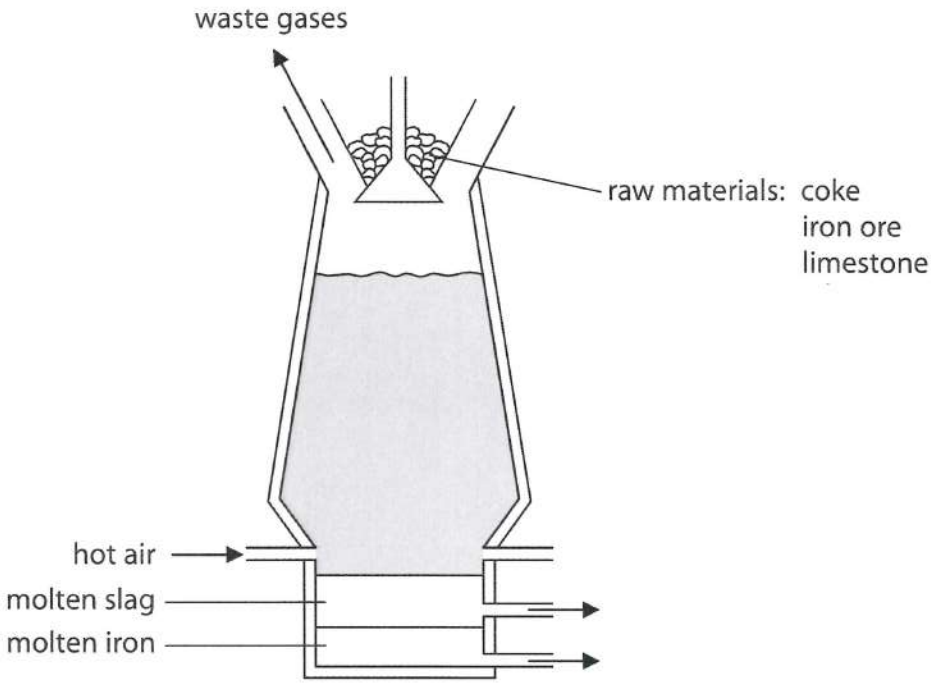
5 The diagram shows a blast furnace used to extract iron from its ore.



(a) State the purpose of these reactions in the blast furnace.

(i) $C + O_2 \rightarrow CO_2$

(1)

Produce heat

(ii) $C + CO_2 \rightarrow 2CO$

(1)

Produce reducing agent

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(b) Iron ore contains the impurity silicon dioxide. The purpose of the limestone is to remove this impurity.

The word equations for the reactions that occur are

reaction 1 calcium carbonate → calcium oxide + carbon dioxide

reaction 2 calcium oxide + silicon dioxide → calcium silicate

Write a chemical equation for each of these reactions.

(2)

1.25

reaction 1 $CaCO_3 \rightarrow CaO + CO_2$

reaction 2 $CaO + SiO_2 \rightarrow CaSiO_3$

(c) The equation for a reaction that occurs in the blast furnace is

$$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$$

Explain, with reference to the reactants in this equation, why this is a redox reaction.

(2)

2.20

- Fe is reduced and C is oxidised
- Fe loses oxygen and C gains oxygen

(Total for Question 5 = 6 marks)

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6 Poly(ethene) is a common polymer. It is obtained from crude oil by fractional distillation, cracking and polymerisation.

(a) The passage is about the fractional distillation of crude oil.

Use words from the box to complete the passage.

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

(4)

boiling point	condensation	melting point
sublimation	temperature	vaporisation

4.17

The crude oil is heated so that Vaporisation occurs. The column has a temperature gradient. The compounds in the crude oil pass up the column and condensation occurs at different heights depending on the boiling point of each fraction.

(b) The table lists some statements about cracking.

Place ticks (✓) in the boxes to show the three correct statements.

(3)

4.17 + 4.18

the molecules that are cracked are hydrocarbons	✓
catalytic cracking uses iron as the catalyst	
cracking is used because of different demands for hydrocarbons	✓
cracking reactions are examples of addition reactions	
cracking produces molecules with shorter chains	✓
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ is an equation for a cracking reaction	

(c) When one molecule of butane is cracked, there are three possible reactions.

The equations for these reactions are

reaction 1 $C_4H_{10} \rightarrow C_3H_6 + CH_4$

reaction 2 $C_4H_{10} \rightarrow C_2H_6 + C_2H_4$

reaction 3 $C_4H_{10} \rightarrow C_4H_8 + H_2$

(i) One product in each of these reactions is an alkene.

What is the general formula for the homologous series of alkenes?

(1)

C_nH_{2n}

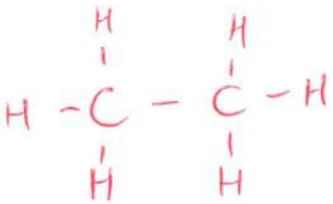
(ii) What are the names of the products of reaction 1?

(2)

Propene and Methane

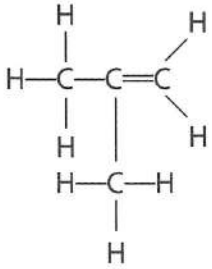
(iii) Draw the displayed formula of the saturated product of reaction 2.

(1)



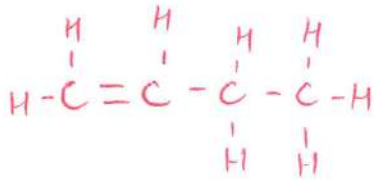
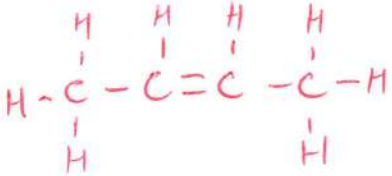
(iv) The hydrocarbon formed in reaction 3 has three isomers.

The displayed formula for one of the isomers is

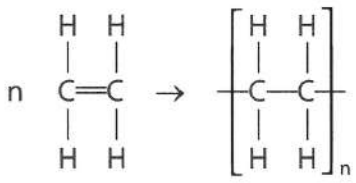


Draw the displayed formula for each of the two other isomers.

(2)

isomer 1	isomer 2
	

(d) The reaction used to make poly(ethene) can be represented by this equation.



Describe the differences between the reactant and product in this reaction.

In your answer, you should refer to carbon chain length, type of bond and state of matter.

(3)

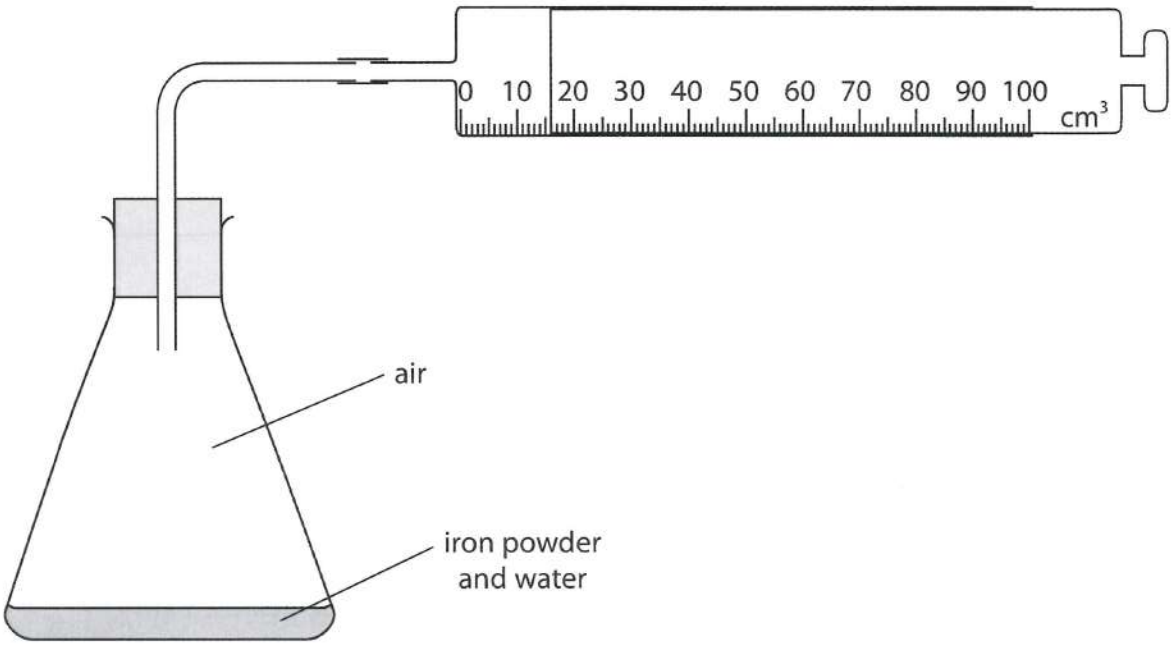
4.23

- Product has longer chain
- only product has single C-C bonds
- only product is solid (reactant is gas)

(Total for Question 6 = 16 marks)

7 A student uses the reaction between iron and oxygen in an experiment to find the percentage by volume of oxygen in air.

The diagram shows his apparatus.



(a) State the advantage of using iron powder rather than pieces of iron.

(1)

3.10

Faster reaction

(b) Why is it necessary for the student to mix the iron powder with water?

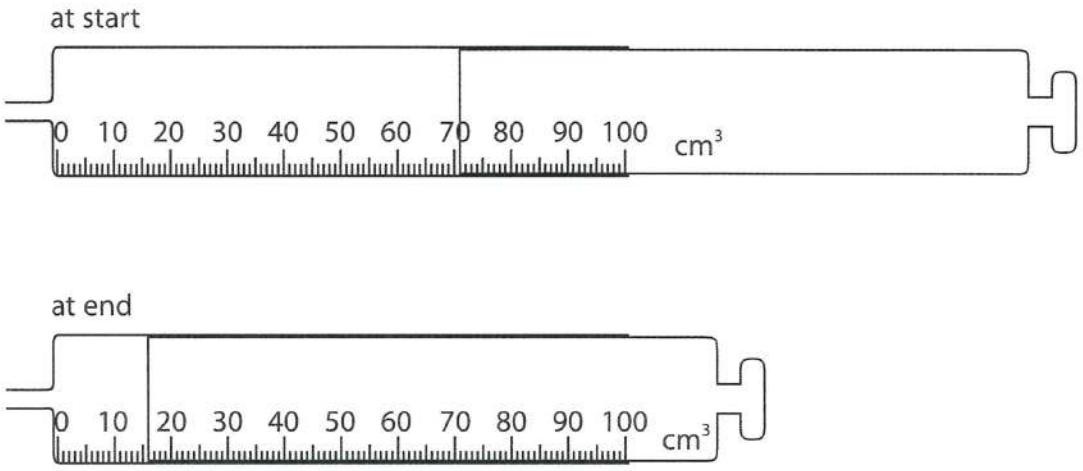
(1)

3.11

Reaction too slow without water

(c) The student records the reading on the syringe at the start of the experiment. He then records the reading every day until there is no further change.

The diagram shows the syringe at the start and at the end of the experiment.



Use the readings to complete the table, entering all values to the nearest 1 cm^3.

(3)

0.00

volume reading at start in cm^3	71
volume reading at end in cm^3	16
change in volume in cm^3	-55

(d) The student repeats the experiment but obtains a much smaller change in volume.

Which of these could be a reason for the smaller change in volume?

(1)

0.00

- ☐ **A** he uses 10 cm^3 of water instead of 5 cm^3
- ☐ **B** he leaves the apparatus for a longer time
- ☐ **C** he leaves the apparatus in a warmer place
- ☒ **D** he uses a smaller mass of iron powder

(e) During another experiment, the student writes down these values.

volume of air in conical flask and glass tube	250 cm^3
syringe reading at start	90
syringe reading at end	20
volume of oxygen reacting	70 cm^3

The student incorrectly calculates the percentage by volume of oxygen in air.

This is his working.

$$\frac{70 \times 100}{90} = 78\%$$

(i) Identify the mistake in his working.

(1)

Divided by syringe reading at the start OR
Should divide by total volume

2.10

(ii) Use values from the table to correctly calculate the percentage by volume of oxygen in air.

(2)

2.10

$$\%\ O_2 = \frac{70 \times 100}{340}$$

$$= 21\%$$

percentage = 21 %

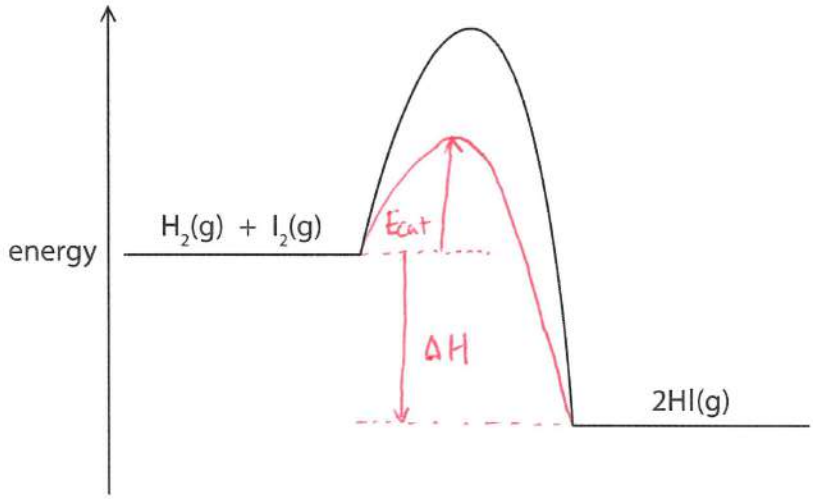
(Total for Question 7 = 9 marks)

8 Hydrogen iodide can be manufactured from its elements using this reaction.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g) \qquad \Delta H = -9 \text{ kJ/mol}$$

A temperature of 500 °C, a pressure of 4 atm and a platinum catalyst are used in this manufacturing process.

(a) The diagram shows the reaction profile if a catalyst is not used.



3.14C B1 05K

(i) On the diagram, draw the reaction profile when a platinum catalyst is used.

(1)

(ii) Label the diagram to show the enthalpy change (ΔH) and the activation energy (E_{cat}) for the reaction with the catalyst.

(2)

(b) A manufacturer carries out this reaction using the same catalyst, a pressure of 4 atm, but a temperature of 400 °C.

3.22C

(i) State the effect of this change in temperature on the rate of the reaction.

(1)

Rate decreases

(ii) Explain the effect of this change on the yield of hydrogen iodide.

(2)

3.22C

- Forward reaction exothermic
- At lower temp, equilibrium shifts to right

∴ Yield of Hydrogen Iodide increases

(c) The manufacturer then carries out this reaction using the same catalyst, a temperature of 500 °C, but a pressure of 2 atm.

(i) Suggest what effect this change in pressure would have on the rate of the reaction.

(1)

Decreases

3.10

(ii) Explain the effect of this change on the yield of hydrogen iodide.

(2)

3.22c

• Equal no. of molecules on both sides

∴ NO effect

(Total for Question 8 = 9 marks)

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9 Bromine, chlorine and iodine are elements in Group 7 of the Periodic Table.

(a) Place ticks (✓) in the boxes to show the three correct statements about the elements in Group 7.

(3)

2.05

the elements can be obtained by electrolysing molten metal halides	✓
the elements with paler colours are lower down the group	
the boiling points decrease down the group	
the elements form covalent compounds with other non-metals	✓
their molecules contain two atoms	✓
all are gases at room temperature	

(b) Group 7 elements are called halogens because they react with metals to form salts.

1.25

Write a chemical equation to show the formation of the salt potassium iodide from a metal and a halogen.

(1)

$2K + I_2 \rightarrow 2KI$

(c) The equation for the reaction between hydrogen and chlorine is

$$H_2 + Cl_2 \rightarrow 2HCl$$

1.25

At room temperature, hydrogen chloride and hydrochloric acid can both be represented by the formula HCl.

Insert the state symbol after each formula.

(2)

hydrogen chloride, HCl(g)

hydrochloric acid, HCl(aq)

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(d) Hydrogen chloride is dissolved in methylbenzene.

When a piece of magnesium ribbon is then added to this solution there is no reaction.

When water is added to this mixture and it is shaken, a reaction occurs.

Explain the observation in this reaction.

(3)

2.37

- Effervescence
- In water, hydrogen chloride forms H^+ ions
- Magnesium reacts to form Hydrogen (H_2)

OR

- Magnesium disappears
- In water, hydrogen chloride forms H^+ ions
- Magnesium reacts to form Magnesium chloride ($MgCl_2$)

(e) Halogens can take part in displacement reactions with halides.

The table gives information about the addition of halogen solutions to halide solutions.

Test	Halogen solution added	Halide solution	Result
1	bromine	sodium iodide	displacement reaction occurs
2	chlorine	sodium chloride	no reaction
3	iodine	sodium chloride	no reaction

(i) Explain which test gives a result that **cannot** be used to compare the reactivities of halogens.

(2)

2.07

Test 2, Chlorine does not react with chloride ions

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(ii) Which observation shows that a displacement reaction occurs in test 1?

(1)

2.07

- ☐ **A** effervescence is seen
- ☐ **B** purple fumes appear
- ☒ **C** the solution becomes darker
- ☐ **D** a white precipitate forms

(f) Astatine is an element in Group 7 that could also be involved in displacement reactions.

The ionic half-equations for one of these reactions would be

$$Cl_2 + 2e^- \rightarrow 2Cl^-$$

$$2At^- \rightarrow At_2 + 2e^-$$

(i) Write an ionic equation for this displacement reaction.

(1)

1.59C

$Cl_2 + 2At^- \rightarrow At_2 + 2Cl^-$

(ii) Explain, with reference to the appropriate species and to electrons, why this reaction is described as a redox reaction.

(2)

2.20

- Cl_2 is reduced, At^- is oxidised
- Cl_2 gains electrons, At^- loses electrons

(Total for Question 9 = 15 marks)

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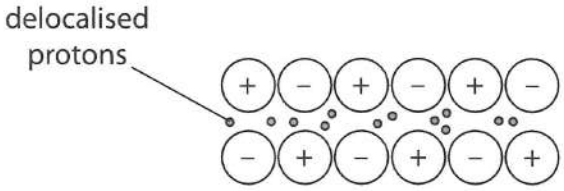
10 This question is about magnesium and its compounds.

(a) A student draws this labelled diagram to show the particles in magnesium metal.



He makes two mistakes.

State the two corrections he should make to his labelled diagram.

(2) 1.52c

1 Replace - signs by + signs

2 Replace protons by electrons

(b) Explain why magnesium metal is malleable and a good conductor of electricity.

(4) 1.54c

- Magnesium ions in layers slide over each other
- Delocalised electrons can move

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(c) Magnesium is a reactive metal. Its reactivity can be seen in its reactions with oxygen and dilute sulfuric acid.

The chemical equations for these reactions are

reaction 1 $2Mg + O_2 \rightarrow 2MgO$

reaction 2 $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

(i) In reaction 1, some magnesium is ignited and then placed in a jar of oxygen gas.

State two observations that would be made.

(2)

2.11

1 Bright flame

2 White solid

(ii) Which of these is a correct statement about the gas formed in reaction 2?

(1)

2.44

☒ **A** it makes a squeaky pop with a lighted splint

☐ **B** it relights a glowing splint

☐ **C** it turns damp blue litmus paper red

☐ **D** it turns limewater milky

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(d) The student used this method to obtain a sample of magnesium sulfate crystals from the solution formed in reaction 2.

- heat the solution in a beaker for several minutes
- dip a glass rod into the hot solution for a few seconds and then remove it
- allow the solution to cool to room temperature
- filter off the crystals and then dry them

(i) Why does the student heat the solution?

(1)

1.10

TO evaporate some of the water

(ii) Explain why the student dips a glass rod into the heated solution.

(2)

1.10

- See when crystals form
- Indicates crystallisation point

(iii) Give the formulae of the two compounds that pass through the filter paper.

(2)

1.31

ANY 2

1 - $MgSO_4$

2 - H_2O

- H_2SO_4

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(e) After drying the crystals, the student weighs them and then heats them until they reach a constant mass.

This equation represents the change that occurs during heating.

$$MgSO_4.xH_2O \rightarrow MgSO_4 + xH_2O$$

These are the student's results.

mass of dry crystals before heating = 17.2 g

mass of crystals after heating to a constant mass = 8.3 g

Use these results to find the value of x in the formula of $MgSO_4.xH_2O$
[M_r values: $MgSO_4 = 120$, $H_2O = 18$]

(4)

1.33

Moles = Mass / Mr

$n(H_2O) = 17.2 - 8.3$

$= 8.9g$

$n(MgSO_4) = \frac{8.3}{120}$

$= 0.069mol$

$n(H_2O) = \frac{8.9}{18}$

$= 0.49mol$

Ratio = $\frac{0.49}{0.069}$

$= 7$

$\therefore x = 7$

value of x = 7

(Total for Question 10 = 18 marks)

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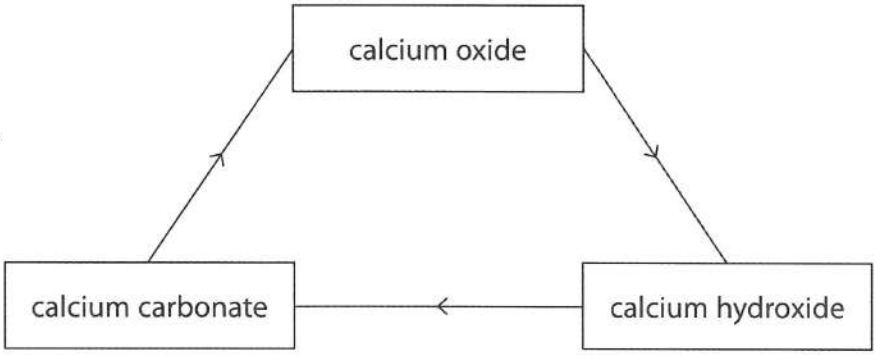
11 This question is about calcium compounds.

(a) The diagram gives information about the reactions of some calcium compounds used to make mortar.

Mortar contains calcium hydroxide and is used to join bricks together when building walls.



These reactions occur when the calcium hydroxide in mortar is obtained from calcium carbonate.

- calcium carbonate is strongly heated to form calcium oxide
- water is added to calcium oxide to form calcium hydroxide

The calcium hydroxide in mortar reacts with carbon dioxide from the atmosphere to form calcium carbonate.

(i) The equation for one of these reactions is

$$CaO + H_2O \rightarrow Ca(OH)_2$$

Calculate the mass of water needed to react exactly with 28 kg of calcium oxide.

(3)

$n(CaO) = \frac{28 \times 1000}{56}$

$= 500 \text{ mol}$

Moles $= \frac{\text{Mass}}{Mr}$

$n(H_2O) = 500 \text{ mol}$

$\therefore m(H_2O) = 500 \times 18$

$= 9000 \text{ g}$

$= 9 \text{ kg}$

1.29

mass of water = 9kg

(ii) Explain why the reaction between carbon dioxide and calcium hydroxide can be described as neutralisation.

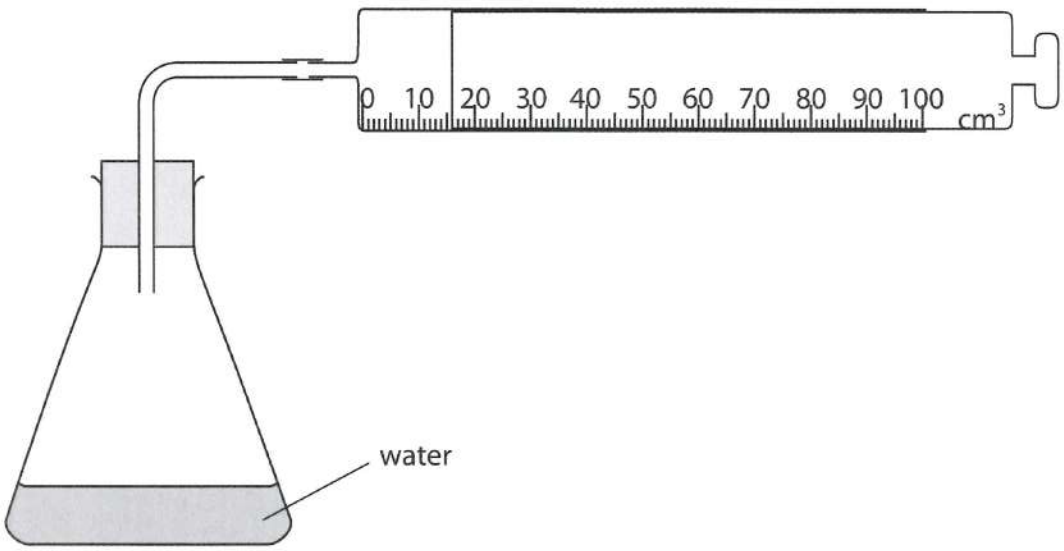
(2)

2.32

- Carbon dioxide is acidic
- Calcium hydroxide is a base

(b) Calcium carbide is a reactive solid. When water is added to it, a gas (ethyne) is formed.

A teacher uses this apparatus to investigate the rate of reaction between calcium carbide and water.



This is the teacher's method.

- record the temperature of the water in the flask
- add a known mass of calcium carbide and replace the bung in the flask
- record the time taken to collect 100 cm^3 of gas in the syringe

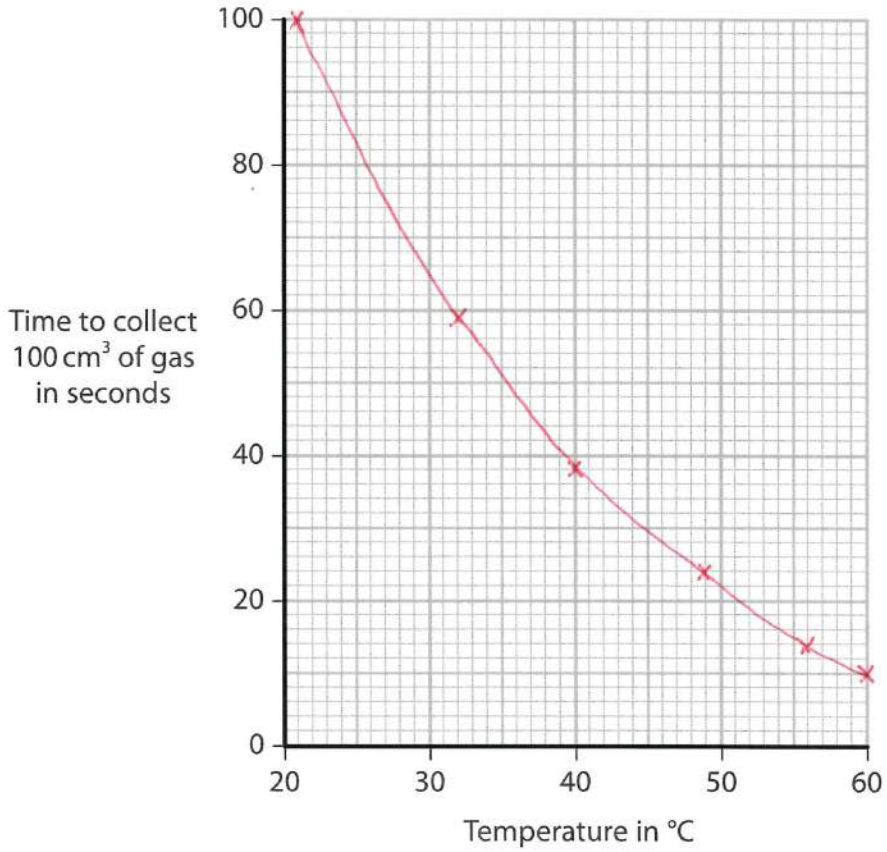
The teacher repeats the experiment using the same volume of water and the same mass of calcium carbide, but with the water at different temperatures.

The table shows the results for six different temperatures.

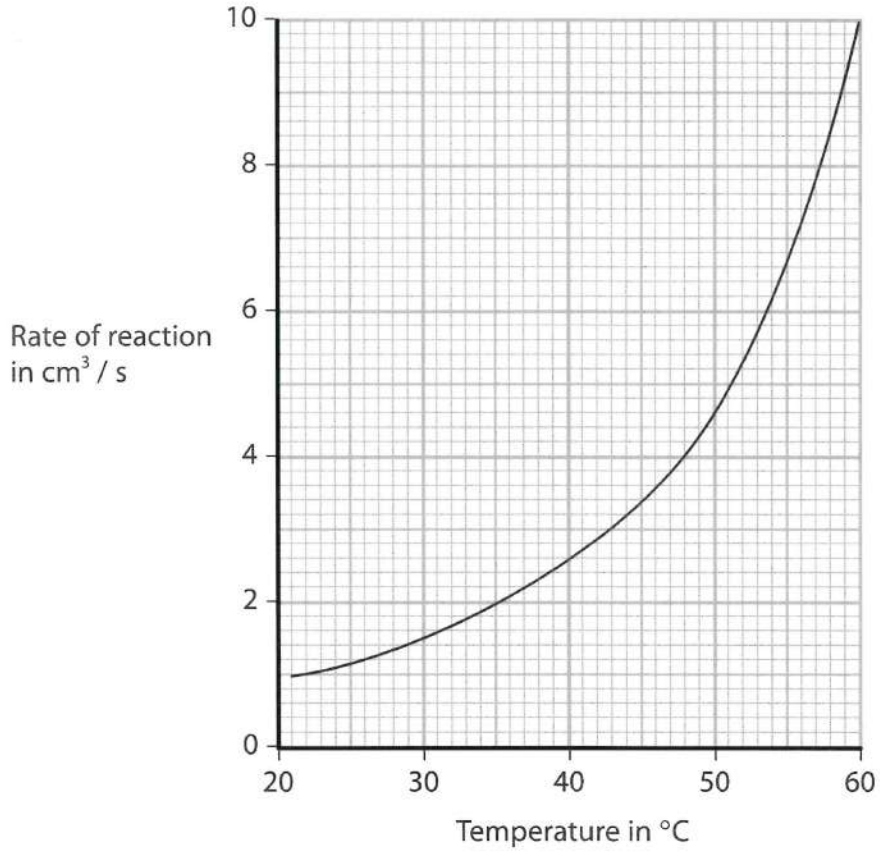
Temperature of water in °C	21	32	40	49	56	60
Time to collect 100 cm³ of gas in seconds	100	59	38	24	14	10

Plot these results on the grid and draw a curve of best fit.

(3)



(c) The teacher plots this graph to show how the rate of reaction varies with temperature.



Her graph shows that the rate of reaction is not directly proportional to temperature.

There are two reasons why the rate of reaction increases as the temperature increases.

One reason is that the water molecules move more quickly and collide more frequently with calcium carbide particles.

Explain the other reason for the increase in the rate of reaction.

(3)

3.11

- Particles have more energy
- More collisions have energy greater than the activation energy

∴ More successful collisions per second

(Total for Question 11 = 11 marks)

TOTAL FOR PAPER = 120 MARKS

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