1506 T

Write your name here

Surname	Other names

Pearson Edexcel Certificate
Pearson Edexcel International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit: KCH0/4CH0
Paper: 2C

Tuesday 9 June 2015 – Afternoon
Time: 1 hour

Paper Reference
KCH0/2C
4CH0/2C

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 60.
- 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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1/1/1/1/

P 4 4 2 6 9 A 0 1 2 0

PEARSON

THE PERIODIC TABLE

Period	1	2					Group						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 The table shows the numbers of protons, neutrons and electrons in some atoms and ions.

Atom or ion	Protons	Neutrons	Electrons
P	6	8	6
Q	5	6	5
R	9	10	10
S	3	4	2
T	6	6	6

1.15

(a) (i) Which particles have the same mass?

(1)

☐ **A** electrons and protons

☐ **B** electrons and neutrons

☒ **C** neutrons and protons

☐ **D** electrons, neutrons and protons

1.16

(ii) What is the atomic number of P?

(1)

☒ **A** 6

☐ **B** 8

☐ **C** 12

☐ **D** 14

1.16

(iii) What is the mass number of Q?

(1)

☐ **A** 5

☐ **B** 6

☐ **C** 10

☒ **D** 11

1.18

(b) Which group of the Periodic Table contains element T?

(1)

4

1.16

(c) (i) Which two letters represent isotopes of the same element?

(1)

P and T

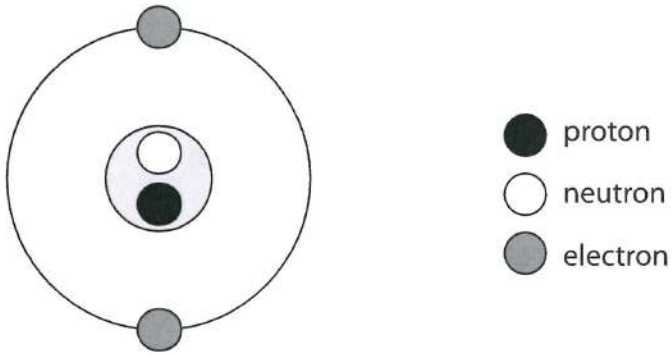
(ii) Which letter represents a positive ion?

(1)

1.15

S

(d) The diagram shows the arrangement of particles in another ion.



1.15

How does the diagram show that this ion has a negative charge?

(1)

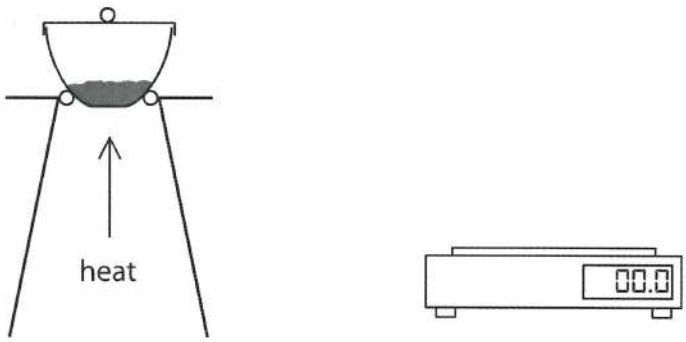
• 1 more electron than proton

(Total for Question 1 = 7 marks)

2 The equation for the thermal decomposition of copper(II) carbonate is

$$CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$$

A student investigates the decomposition of copper(II) carbonate using this apparatus.



She uses this method.

- weigh the crucible, lid and copper(II) carbonate
- heat the crucible, lid and contents for 2 minutes
- allow to cool and then reweigh
- heat for a second period of 2 minutes
- allow to cool and then reweigh
- heat for a third period of 2 minutes
- allow to cool and then reweigh

The table shows the student's results.

	Mass of crucible, lid and contents in grams			
Experiment	**before heating**	**after heating for 2 minutes**	**after heating for 4 minutes**	**after heating for 6 minutes**
1	26.3	23.0	21.9	21.4
2	25.8	22.7	21.5	21.5
3	26.0	23.0	21.2	21.2
4	26.1	23.2	21.8	21.8

2.12

(a) Why does the mass decrease during heating?

(1)

Gas escapes

(b) State the colours of the solids in the reaction.

(2)

2.12

$CuCO_3(s)$ Green

$CuO(s)$ Black

(c) (i) In which experiment might the decomposition **not** be complete?

(1)

2.12 1

(ii) Give a reason for your choice.

(1)

2.12 Last 2 masses not the same

(iii) Which statement could explain why the decomposition might not be complete?

(1)

2.12

☐ **A** The student used a higher temperature than in the other experiments.

☐ **B** The student used less copper(II) carbonate than in the other experiments.

☐ **C** The student heated the crucible without a lid on.

☒ **D** The student used a spirit burner instead of a Bunsen burner.

(d) In another experiment, the student calculates that she should obtain a mass of 3.7 g of $CuO(s)$ after completely decomposing a sample of $CuCO_3(s)$.

1.30

She actually obtains a mass of 3.4 g of $CuO(s)$.

Calculate the percentage yield in her experiment.

(2)

$\%\ \text{yield} = \frac{3.4}{3.7} \times 100$

$= 92\%$

percentage yield = 92 %

(Total for Question 2 = 8 marks)

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3 This question is about halogens and halides.

(a) At room temperature bromine is

(1)

- ☐ **A** a brown gas
- ☒ **B** a red-brown liquid
- ☐ **C** a colourless liquid
- ☐ **D** a grey solid

2.05

(b) Sodium reacts with bromine to form sodium bromide.

Balance the equation for this reaction.

(1)

1.25

2 Na + Br_2 → 2 NaBr

(c) A student carries out some experiments to investigate displacement reactions.

She adds some halogen solutions to halide solutions and observes whether a reaction occurs.

The table shows her results.

	Halogen solution added		
Halide solution	**bromine**	**chlorine**	**iodine**
lithium chloride	no reaction	(not done)	no reaction
sodium bromide	(not done)	reaction occurs	no reaction
potassium iodide	reaction occurs	reaction occurs	(not done)

(i) The table shows that she did not do three experiments.

Suggest why she did not do these experiments.

2.07

(1)

- No reaction would occur

(ii) The table shows that there was no reaction in three experiments.

Why was there no reaction in these experiments?

2.07

(1)

A Halogen cannot displace a more reactive halogen

(iii) The student writes this word equation for one of the experiments in which a reaction occurs.

bromine + potassium iodide → potassium bromine + iodine

The name of one of the substances is incorrect.

Write the correct name of this substance.

(1)

2.07

Potassium bromide

(iv) A reaction occurs when the student adds chlorine solution to potassium iodide solution.

Complete the chemical equation for this reaction.

(2)

1.25

Cl_2 + 2 KI → 2KCl + I_2

(v) All displacement reactions are examples of redox reactions.

State the meaning of the term **redox**.

(1)

2.20

Both reduction and oxidation occur

(vi) The ionic equation for another reaction is

$$Br_2 + 2I^- \rightarrow 2Br^- + I_2$$

Explain which species is oxidised in this reaction.

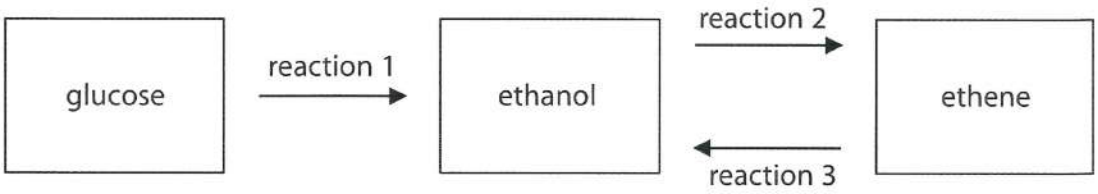
(2)

2.20

I^-, loss of electrons

(Total for Question 3 = 10 marks)

4 The scheme shows some reactions involving ethanol.



(a) (i) Two conditions used in reaction 1 are

- a temperature of about 30 °C
- the use of water as a solvent for the glucose

State the name of the catalyst used in this reaction.

(1)

4.32C

Zymase (yeast)

(ii) Complete the equation for reaction 1.

(1)

1.25

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + \text{2CO}_2$$

(b) Ethanol can also be manufactured by reaction 3, which uses steam, a catalyst of phosphoric acid and a pressure of about 65 atm.

State the temperature used in reaction 3.

(1)

4.32C

300 (250-350)

(c) State the type of reaction that occurs in

(2)

4.32C

reaction 1 Fermentation

reaction 3 Hydration

(d) State two advantages of using reaction 3 to manufacture ethanol rather than reaction 1.

ANY 2 (2)

4.33C

1 • Product is purer

• Reaction is faster

2 • continuous process is more efficient

• Greater atom economy

(e) Give a reason why some countries use reaction 1 to manufacture ethanol.

ANY 1 (1)

4.33C

• Sugar cane available

• No crude oil

• Sugar cane renewable

(f) Reaction 2 may be used in the future to manufacture ethene.

(i) Write an equation for this reaction.

(1)

NOT IN SPEC

$C_2H_5OH \rightarrow C_2H_4 + H_2O$

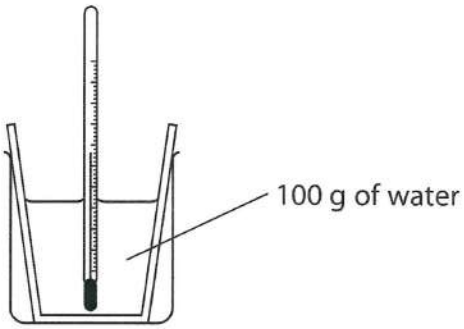
(ii) What type of reaction is this?

(1)

dehydration

(Total for Question 4 = 10 marks)

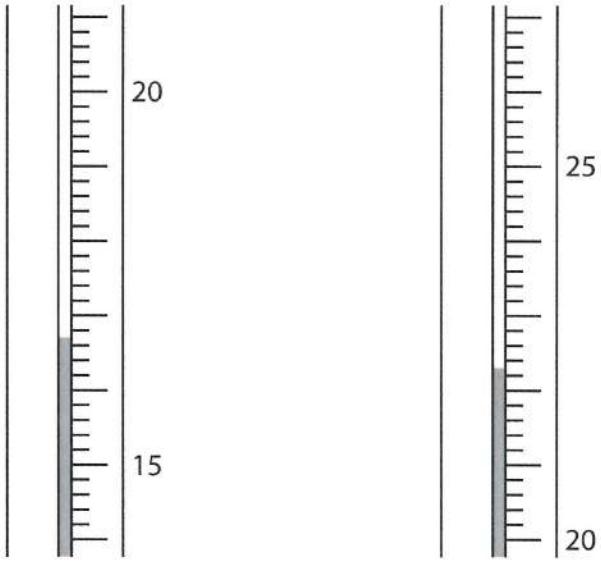
5 A student uses this apparatus to measure the temperature change when lithium iodide dissolves in water.



He measures the steady temperature of the water before adding the lithium iodide.

He then adds the lithium iodide, stirs the mixture until all the solid dissolves and records the maximum temperature reached.

The diagram shows the thermometer readings before and after dissolving the lithium iodide.



before after

3.08

(a) Use the readings to complete the table.

(3)

Temperature in °C after adding lithium iodide	22.3
Temperature in °C before adding lithium iodide	16.7
Temperature change in °C	5.6

(b) In a second experiment, using the same mass of water, the student records a temperature increase of 4.9 °C.

(i) Use this expression to calculate the heat energy change in this experiment.

heat energy change (in joules) = mass of water (in grams) × 4.2 × temperature change (in °C)

(2)

3.03

$Q = 100 \times 4.2 \times 4.9$

$= 2058\text{J}$

heat energy change = 2058 J

(ii) In this experiment, 6.3 g of lithium iodide were used.

Calculate the amount, in moles, of lithium iodide in 6.3 g.

[M_r of lithium iodide = 134]

1.28

(2)

$n(\text{LiI}) = \frac{6.3}{134}$

$= 0.047$

amount of LiI = 0.047 mol

(c) In a third experiment the student obtains these results.

heat energy change in J	2400
amount of lithium iodide in mol	0.048

(i) Calculate the molar enthalpy change, in kJ/mol, in this experiment.

(2)

3.04

$\Delta H = \frac{2400}{0.048 \times 1000}$

$= 50$

molar enthalpy change = 50 kJ/mol

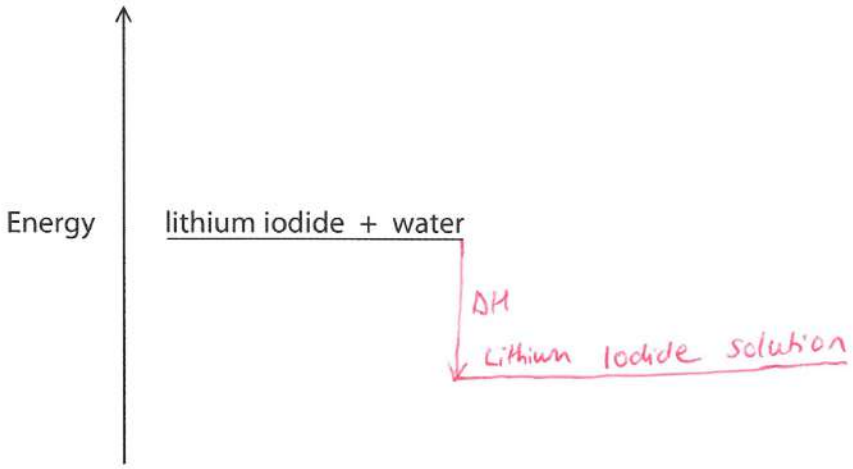
(ii) The temperature change in this experiment shows that dissolving lithium iodide in water to form lithium iodide solution is an exothermic process.

Complete the energy level diagram to show the position of the lithium iodide solution.

Label the diagram to show ΔH, the molar enthalpy change.

(2)

3.05C



(Total for Question 5 = 11 marks)

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6 Magnesium and its compounds have many uses.

Magnesium is never found as an element in the Earth's crust, but its compounds occur naturally in rocks and seawater.

(a) Suggest why magnesium is not found as an element in the Earth's crust.

2.17

(1)

Too reactive

(b) Magnesium can be extracted from seawater by a multi-stage process.

stage 1 calcium hydroxide reacts with magnesium chloride in seawater to form a precipitate of magnesium hydroxide

stage 2 the magnesium hydroxide is filtered off and converted into magnesium chloride solution by reacting it with hydrochloric acid

stage 3 the magnesium chloride solution is converted into solid magnesium chloride

stage 4 the solid magnesium chloride is melted and electrolysed

(i) Which stage involves a neutralisation reaction?

2.32

(1)

☐ **A** stage 1

☒ **B** stage 2

☐ **C** stage 3

☐ **D** stage 4

(ii) Suggest the name of the other product formed in stage 1.

(1)

1.39

$CaCl_2$

(iii) What happens to the ions in magnesium chloride during melting?

(1)

1.43

Ions are mobile

(iv) The ionic half-equation for the reaction at the negative electrode in stage 4 is

$$Mg^{2+} + 2e^- \rightarrow Mg$$

Write the ionic half-equation for the reaction at the positive electrode.

(1)

1.59C

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

(c) A manufacturer makes a batch of magnesium by electrolysing magnesium chloride.

(i) Calculate the mass of magnesium chloride ($MgCl_2$) needed to make 48 kg of magnesium.

(2)

1.29

$Mr\ (MgCl_2) = 24 + (35.5 \times 2)$

$= 95$

$n(Mg) = \frac{48}{24}$

$= 2$

$m\ (MgCl_2) = 95 \times 2$

$= 190\ kg$

mass of magnesium chloride = 190 kg

(ii) Calculate the amount, in moles, of electrons needed to make 48 kg of magnesium.

(2)

1.28

Ratio Mg : e^-

1 : 2

$= \frac{48000}{24} \times 2$

$= 4000$

amount of electrons = 4000 mol

QUESTION 6 CONTINUES ON THE NEXT PAGE

(d) Magnesium oxide can be used to make magnesium sulfate by this reaction.

$$MgO(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l)$$

A student is provided with a beaker of dilute sulfuric acid.

Outline the steps she should use to obtain a pure sample of hydrated magnesium sulfate crystals using this reaction.

(5)

2.40C

- Mix magnesium oxide and sulfuric acid
- Use excess MgO
- Filter
- Heat solution to remove some water
- Leave to crystallise

(Total for Question 6 = 14 marks)

TOTAL FOR PAPER = 60 MARKS