Write your name here

Surname	Other names

Pearson Edexcel Certificate
Pearson Edexcel International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit: KCH0/4CH0
Paper: 2C

Thursday 21 January 2016 – Afternoon
Time: 1 hour

Paper Reference
KCH0/2C
4CH0/2C

You must have:
Calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 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.
- 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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P 4 6 8 1 3 A 0 1 2 0

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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

P 4 6 8 1 3 A 0 2 2 0

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Answer ALL questions.

1 The table shows the names of some common pieces of laboratory apparatus used to make measurements.

(a) Complete the table to show the name of the quantity that can be measured by each piece of apparatus, and a common unit used for that quantity. One example of each has been done for you.

(6)

Apparatus	Quantity	Unit
balance	mass	
stop clock		s
gas syringe		
ruler		

(b) Which piece of apparatus is needed to make measurements in a paper chromatography experiment?

(1)

☒ **A** balance

☒ **B** gas syringe

☒ **C** ruler

☒ **D** stop clock

(Total for Question 1 = 7 marks)

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2 The table shows the names of some substances. It also shows whether each substance is an element or a compound, and the type of bonding in the substance.

(a) Complete the table. One example of each has been done for you.

(3)

Substance	Element or compound	Type of bonding
ammonia		
hydrogen chloride	compound	
oxygen		covalent
magnesium oxide		

(b) What is the formula of magnesium oxide?

(1)

☒ **A** Mg_2O

☒ **B** MgO

☒ **C** MgO_2

☒ **D** Mg_2O_2

(c) Which state symbol represents the physical state of hydrogen chloride at room temperature?

(1)

☒ **A** aq

☒ **B** g

☒ **C** l

☒ **D** s

(Total for Question 2 = 5 marks)

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3 The table shows the electronic configurations of four elements.

Element	Electronic configuration
chlorine	2.8.7
argon	2.8.8
potassium	2.8.8.1
calcium	2.8.8.2

(a) Why is argon an unreactive element?

(1)

.....

.....

(b) Krypton is an unreactive element in the same group of the Periodic Table as argon, but in Period 4. It has an atomic number of 36.

Deduce the electronic configuration of krypton.

(1)

☒ **A** 2.8.8.8

☒ **B** 2.8.18.8

☒ **C** 2.8.8.2.8.8

☒ **D** 2.8.8.8.8.2

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(c) Calcium reacts with chlorine to form the ionic compound calcium chloride ($CaCl_2$).

(i) Describe, in terms of electrons, how an atom of calcium reacts with two chlorine atoms to form calcium chloride.

You may use a diagram in your answer.

(3)

(ii) Write the formula of a calcium ion.

(1)

(iii) In the reaction between calcium and chlorine, both oxidation and reduction occur.

Which row shows the element that is oxidised and the element that acts as the reducing agent in this reaction?

(1)

	Element that is oxidised	Element that acts as the reducing agent
☒ **A**	calcium	calcium
☒ **B**	calcium	chlorine
☒ **C**	chlorine	calcium
☒ **D**	chlorine	chlorine

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(d) A student uses a flame test to distinguish between separate samples of calcium chloride and potassium chloride.

This is the student's method.

There is one mistake in step 1 and one mistake in step 3.

step 1 dip a platinum wire into some concentrated sodium hydroxide solution

step 2 dip the platinum wire into the sample

step 3 place the wire and sample into a luminous Bunsen flame

step 4 record the colour of the flame

Describe a correct method for step 1 and step 3.

(2)

step 1 .....

.....

step 3 .....

.....

(e) What colour is the flame when the test on potassium chloride is carried out correctly?

(1)

☒ **A** green

☒ **B** lilac

☒ **C** orange

☒ **D** red

(Total for Question 3 = 10 marks)

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4 An industrial chemical company has supplies of ethene and ethanol.

The company considers using these two processes.

process 1 converting ethene to ethanol

process 2 converting ethanol to ethene

A chemical equation for process 1 is

$$C_2H_4 + H_2O \rightarrow C_2H_6O$$

(a) Which condition does the chemical company use in process 1?

(1)

☒ **A** aluminium oxide as a catalyst

☒ **B** a pressure of 65 atm

☒ **C** a temperature of 1000 °C

☒ **D** sodium hydroxide as a solvent

(b) The equation for process 1 shows the molecular formulae of ethene and ethanol.

Draw the displayed formulae of ethene and ethanol.

(2)

Compound	Displayed formula
ethene	
ethanol	

(c) Why is it correct to describe ethanol as saturated, but incorrect to describe it as a hydrocarbon?

(2)

.....

.....

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(d) A scientist working for the chemical company makes the following predictions that could affect processes 1 and 2 in the future:

- crude oil will be less available and more expensive
- the climate will be warmer and allow more sugar cane to be grown

Suggest how each of these predictions would affect the two processes.

(3)

(Total for Question 4 = 8 marks)

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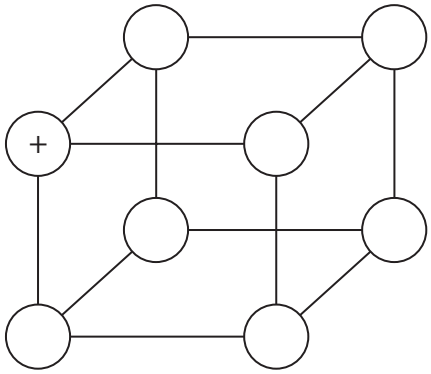
5 Potassium chloride, KCl, is very similar to sodium chloride, NaCl. They have the same type of crystal structure, and their aqueous solutions can be electrolysed to give similar products.

(a) The diagram shows part of the structure of potassium chloride.

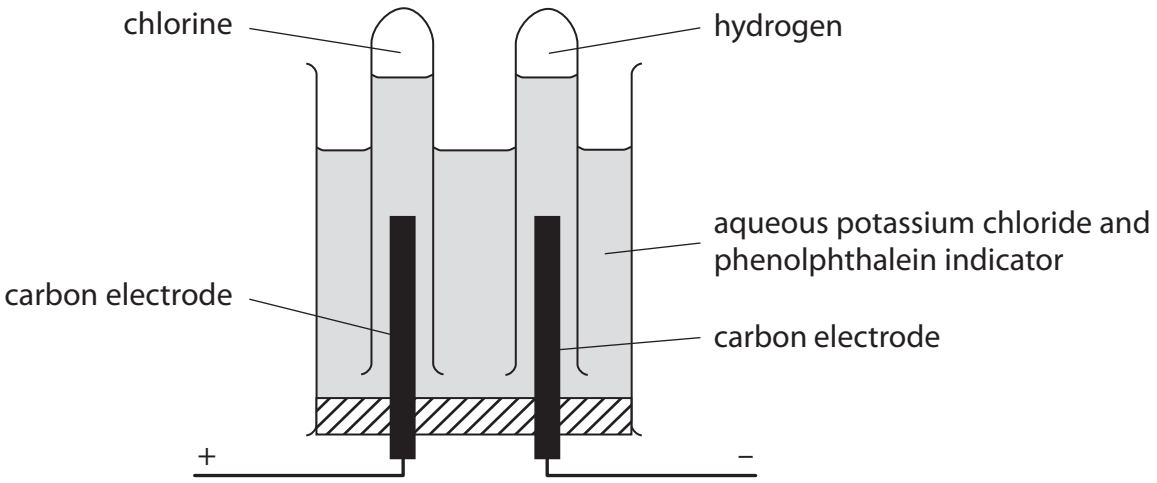


The plus (+) sign shows the position of one potassium ion.

Complete the diagram using a plus (+) sign to show the position of each potassium ion, and a minus (–) sign to show the position of each chloride ion.

(2)

(b) The diagram shows apparatus used to electrolyse aqueous potassium chloride in the laboratory.



(i) Chlorine is formed at the positive electrode.

Describe a test for chlorine gas.

(2)

.....

.....

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(ii) Hydrogen gas is formed at the negative electrode.

Write an ionic half-equation for the formation of hydrogen.

(2)

.....

(iii) The solution used in this electrolysis contains phenolphthalein. During the electrolysis, the colour of the solution around the negative electrode goes pink.

Explain why the solution goes pink, and give the formula of the ion responsible for causing the colour change.

(2)

.....

.....

.....

.....

(c) The ionic half-equation for the formation of chlorine at the positive electrode is

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

In one experiment a charge of 0.0250 faraday is passed through an aqueous solution of potassium chloride.

(i) Calculate the amount, in moles, of chlorine formed.

(1)

amount of chlorine = ... mol

(ii) Calculate the volume of chlorine formed at room temperature and pressure (rtp). [The molar volume of a gas is 24 dm^3 at rtp.]

Give the unit in your answer.

(2)

volume of chlorine = ... unit .....

(Total for Question 5 = 11 marks)

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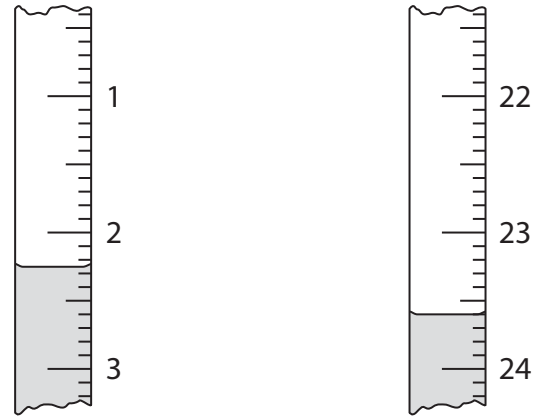
6 A student prepares a solution of the soluble salt lithium sulfate, using the neutralisation reaction between sulfuric acid and the alkali lithium hydroxide.

To make sure that she obtains a pure solution of the salt, she first carries out a titration to find the volumes of sulfuric acid and lithium hydroxide that react exactly together.

She uses this method in the titration.

- use a pipette to add 25.0 cm^3 of dilute sulfuric acid to a conical flask
- add a few drops of phenolphthalein indicator
- fill a burette with lithium hydroxide solution
- add the lithium hydroxide solution from the burette until the indicator just changes colour

(a) The diagram shows the burette readings in the experiment before and after adding the lithium hydroxide solution.



Use these readings to complete the table, giving all values to the nearest 0.05 cm^3.

(3)

Burette reading in cm^3 after adding alkali	
Burette reading in cm^3 before adding alkali	
Volume in cm^3 of alkali added	

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(b) The student repeats the experiment using a different concentration of sulfuric acid
The table shows her results.

Burette reading in cm^3 after adding alkali	25.05	25.65	24.85	26.10
Burette reading in cm^3 before adding alkali	0.75	1.70	1.35	2.40
Volume in cm^3 of alkali added	24.30	23.95	23.50	23.70
Titration results to be used (✓)				

The average (mean) volume of alkali 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 titration results to be used by placing ticks (✓) in the table where appropriate.

(1)

(ii) Use the titration results you ticked in (i) to calculate the average (mean) volume of alkali added.

(2)

average volume = ... cm^3

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(c) In a titration using solutions of the same acid and alkali but of different concentrations, she recorded these results.

volume of sulfuric acid = 25.0 cm^3

concentration of sulfuric acid = 0.107 mol/dm^3

average (mean) volume of lithium hydroxide solution = 22.85 cm^3

The equation for the reaction is

$$2LiOH + H_2SO_4 \rightarrow Li_2SO_4 + 2H_2O$$

(i) Calculate the amount, in moles, of H_2SO_4 in 25.0 cm^3 of 0.107 mol/dm^3 sulfuric acid.

(2)

amount of H_2SO_4 = ... mol

(ii) Calculate the amount, in moles, of LiOH in the 22.85 cm^3 of lithium hydroxide solution.

(1)

amount of LiOH = ... mol

(iii) Calculate the concentration, in mol/dm^3, of LiOH in the lithium hydroxide solution.

(2)

concentration of LiOH = ... mol/dm^3

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(d) To prepare the solution of lithium sulfate, the student mixes together the volumes of acid and alkali obtained from the titration results.

She then tests a sample of the lithium sulfate solution formed by adding a few drops of barium chloride solution.

(i) Describe the observation she makes.

(1)

.....

.....

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

(1)

.....

(Total for Question 6 = 13 marks)

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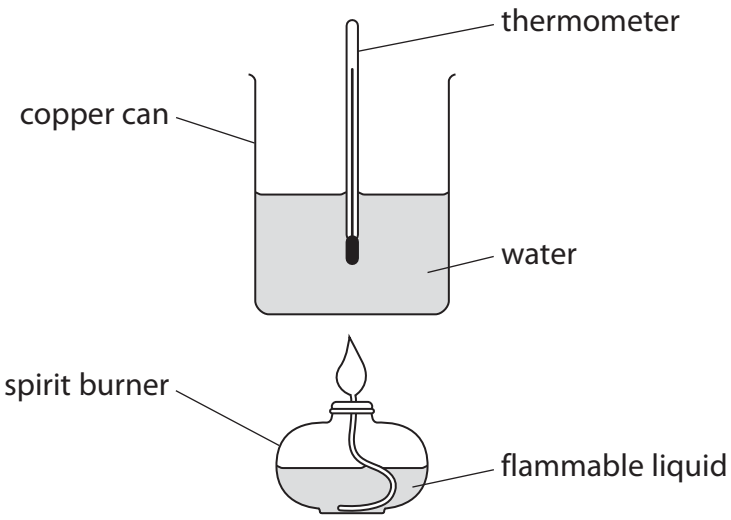
7 A student investigates the temperature rise of water in a copper can placed above a spirit burner containing a flammable liquid. The diagram shows the apparatus he uses.



This is the student's method.

- place 200 g of water in the copper can and record the temperature of the water
- weigh the spirit burner containing the flammable liquid
- place the spirit burner underneath the copper can and light the burner
- after two minutes extinguish the flame and record the maximum temperature of the water
- reweigh the spirit burner containing the remaining flammable liquid

(a) State whether each of the changes listed in the table would increase, decrease or have no effect on the value of the maximum temperature of the water.

(3)

Change	Effect on the value of the maximum temperature of the water
increasing the distance between the spirit burner and the copper can	
using a thermometer with divisions at 0.2 °C instead of 0.5 °C	
adding insulation to the side of the copper can	

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(b) In one experiment pentane was used as the flammable liquid. The calculated heat energy change was 51 900 J.

In the experiment the mass of pentane burned was 1.88 g.

The relative molecular mass of pentane is 72

Use this information to calculate the molar enthalpy change of combustion, in kJ/mol, of pentane.

(3)

molar enthalpy change = ... kJ/mol

(Total for Question 7 = 6 marks)

TOTAL FOR PAPER = 60 MARKS

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