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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THE PERIODIC TABLE

Group								
1	**2**		**3**	**4**	**5**	**6**	**7**	**0**

Period

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 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)

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

(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)

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(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

(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)

....

....

....

....

(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)

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(Total for Question 4 = 8 marks)

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.

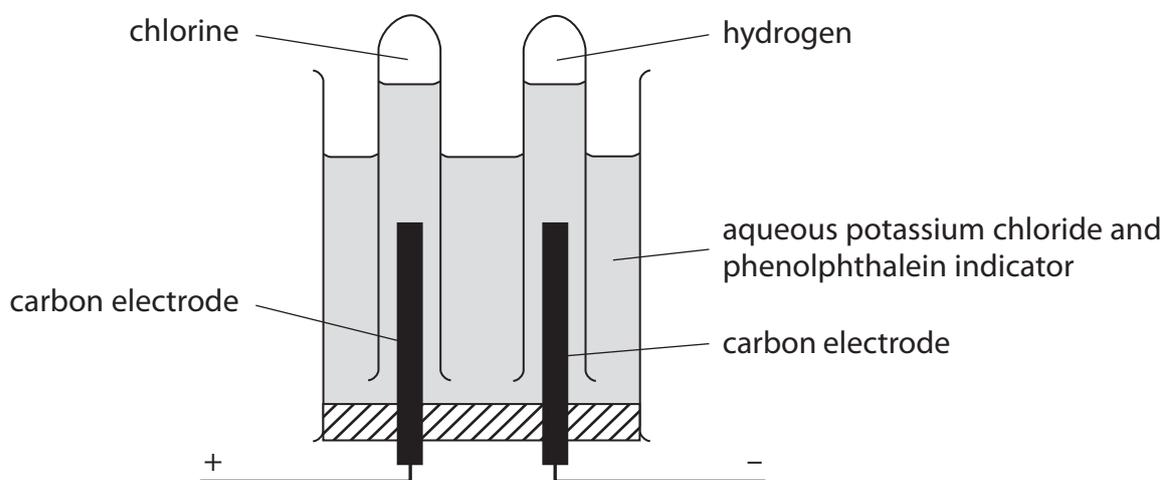(a) The diagram shows part of the structure of potassium chloride.
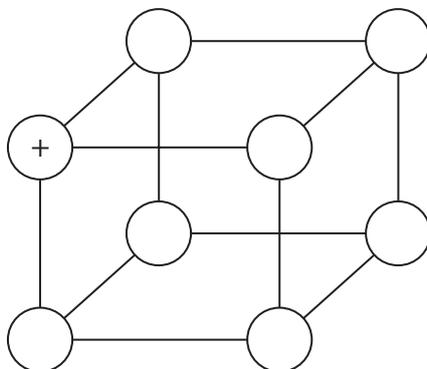
The plus (+) sign shows the position of one potassium ion.

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)

....

....

....

....

(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 dm³ at rtp.]

Give the unit in your answer.

(2)

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

(Total for Question 5 = 11 marks)

GradeMax

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 cm³ 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.
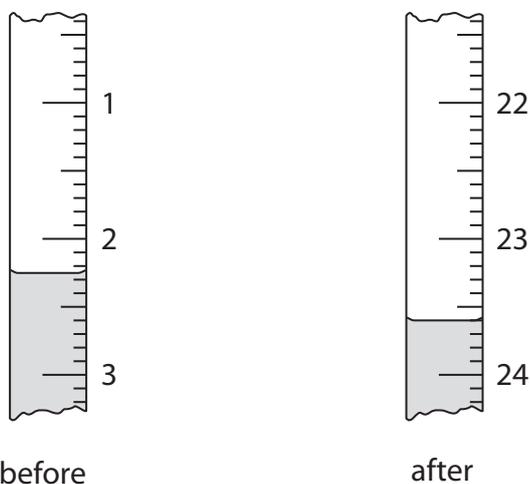
before   after

Use these readings to complete the table, giving all values to the nearest 0.05 cm³.

(3)

Burette reading in cm³ after adding alkali	
Burette reading in cm³ before adding alkali	
Volume in cm³ of alkali added	

(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

(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 cm³

concentration of sulfuric acid = 0.107 mol/dm³

average (mean) volume of lithium hydroxide solution = 22.85 cm³

The equation for the reaction is

$$2LiOH + H_2SO_4 \rightarrow Li_2SO_4 + 2H_2O$$
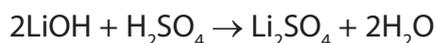
(i) Calculate the amount, in moles, of H_2SO_4 in 25.0 cm³ of 0.107 mol/dm³ sulfuric acid.

(2)

amount of H_2SO_4 = ... mol

(ii) Calculate the amount, in moles, of LiOH in the 22.85 cm³ of lithium hydroxide solution.

(1)

amount of LiOH = ... mol

(iii) Calculate the concentration, in mol/dm³, of LiOH in the lithium hydroxide solution.

(2)

concentration of LiOH = ... mol/dm³

(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)

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.
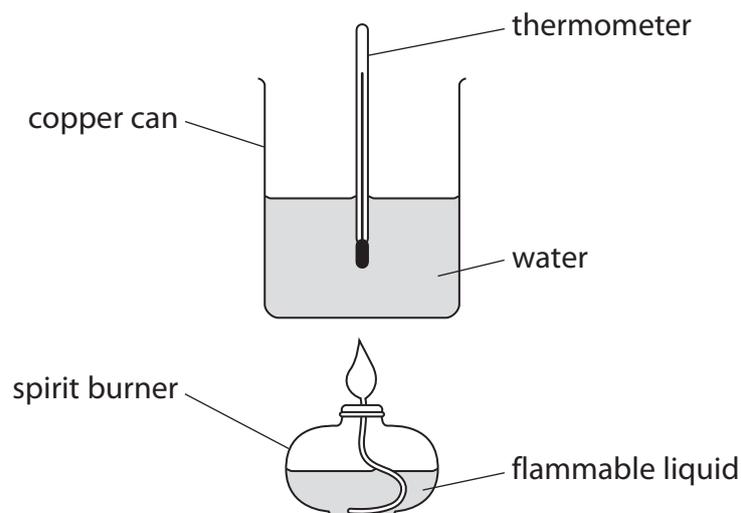
This is the student's method.

- 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	

(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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