12 06 T

Write your name here

| Surname | Other names |
|---|---|
| | |

**Edexcel Certificate**
**Edexcel International GCSE**

Centre Number | | | | | |

Candidate Number | | | | |

# Chemistry

## Unit: KCH0/4CH0
## Paper: 2C

Tuesday 29 May 2012 – Morning
**Time: 1 hour**

Paper Reference
**KCH0/2C**
**4CH0/2C**

**You must have:**
Ruler
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.

## 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* ▶

P40135A



1/1/1/1/

P 4 0 1 3 5 A 0 1 1 6

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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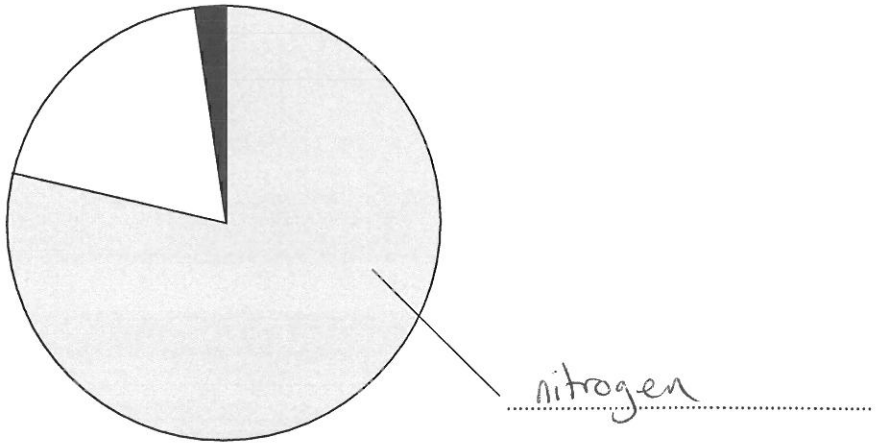
**Answer ALL questions.**

**1** Many chemical reactions occur in the atmosphere.

(a) The pie chart shows the relative amounts of some gases in air.




(i) Label the pie chart with the name of the gas that makes up most of the air.

(1)

(ii) What is the approximate percentage of oxygen in air?

Place a cross (☒) in one box.

(1)

- ☐ 1
- ☑ 20
- ☐ 25
- ☐ 78

(iii) Use words from the box to complete the sentences about some of the other gases in air.

Each word may be used once, more than once or not at all.

(2)

| | | | | | |
|---|---|---|---|---|---|
| **diatomic** | **dense** | **neon** | **nitrogen** | **unreactive** | **water** |

One of the gases in air is argon. It is called a noble gas because it is very unreactive.

The percentage of water vapour in air varies with the weather.

1 (b) Rain water is naturally slightly acidic because carbon dioxide dissolves in it.
The word equation for the reaction that occurs is:

carbon dioxide + water → carbonic acid

Acid rain is more acidic because pollutant gases in the atmosphere also dissolve in water.

(i) Identify the acid formed when sulfur dioxide reacts with water.

(1)

Sulfurous acid

(ii) Identify another pollutant gas that forms acid rain.

(1)

nitrogen oxide / nitrogen dioxide

(iii) State **two** problems caused by acid rain.

(2)

1 • Metal corrodes / rust.
• limestone corrodes

2 • plants die
• fish die

**(Total for Question 1 = 8 marks)**

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**2** Iron and aluminium are two important metals extracted from their ores on a large scale.

(a) In the extraction of iron, three different raw materials are put into the top of a blast furnace.

Name the main compound present in the following raw materials.

(i) Haematite

(1)

Iron oxide

(ii) Limestone

(1)

Calcium carbonate

(b) The following equations represent reactions in the blast furnace.

**A** $C + O_2 \rightarrow CO_2$

**B** $CaCO_3 \rightarrow CaO + CO_2$

**C** $C + CO_2 \rightarrow 2CO$

**D** $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

**E** $CaO + SiO_2 \rightarrow CaSiO_3$

Choose from the letters **A**, **B**, **C**, **D** or **E** to answer parts (i) – (iv).

Each letter may be used once, more than once or not at all.

(4)

(i) A reaction that is used to produce heat A

(ii) A neutralisation reaction E

(iii) A decomposition reaction B

(iv) A reaction that forms a reducing agent C

2 (c) Molten iron and another molten substance collect at the bottom of the blast furnace.

What is the common name of this other molten substance?

(1)

Slag

(d) Aluminium is extracted from its ore by electrolysis. This is a more expensive process than using a blast furnace.

(i) Why is a different method used for aluminium?

(1)

It is above carbon in the reactivity series

(ii) State the major reason for the high cost of extracting aluminium.

(1)

electricity

(e) Coke used in the blast furnace contains carbon. Carbon is also used in the extraction of aluminium, but for a different purpose.

What is this purpose?

(1)

electrodes / to conduct electricity

(f) The extraction of aluminium can be represented by the chemical equation:

$$2Al_2O_3 \rightarrow 4Al + 3O_2$$

Write the two ionic half-equations that can also be used to represent this extraction.

(3)

Half-equation 1 $Al^{3+} + 3e^{-}$ (not needed) $\longrightarrow Al$

Half-equation 2 $2O^{2-} \longrightarrow O_2 + 4e^{-}$

**(Total for Question 2 = 13 marks)**

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**3** A group of students planned an experiment to find the temperature rise in a neutralisation reaction. This is their method.

- Use a measuring cylinder to add 25 $cm^3$ of an alkali to a 100 $cm^3$ beaker
- Record the temperature of the alkali
- Use a burette to add an acid to the alkali in 5.0 $cm^3$ portions
- Record the temperature of the mixture after adding each portion of acid
- Stop the experiment when the neutralisation is complete

(a) The teacher asked the students about their method.

Suggest an answer to each of her questions.

(i) Why would it be better to use a pipette instead of a measuring cylinder?

(1)

more accurate / precise

(ii) It would be better if a polystyrene cup were used instead of a beaker.

What property of polystyrene makes this an improvement?

(1)

insulator

(iii) What extra step should there be between adding each portion of acid and measuring the temperature?

(1)

stirring

(iv) How would you know when the neutralisation was complete?

(1)

temp does down / constant.

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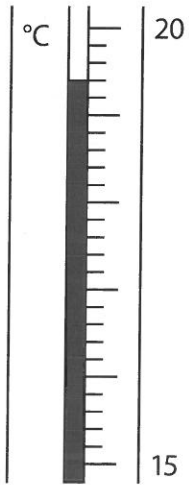
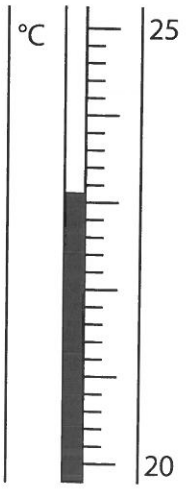
3 (b) The diagrams show the readings on the thermometer before and after one of the students added a portion of acid.




before adding acid




after adding acid

Write down the thermometer readings and calculate the temperature change.

(3)

Temperature before adding acid 19.4 °C

Temperature after adding acid 23.1 °C

Temperature change 3.7 °C

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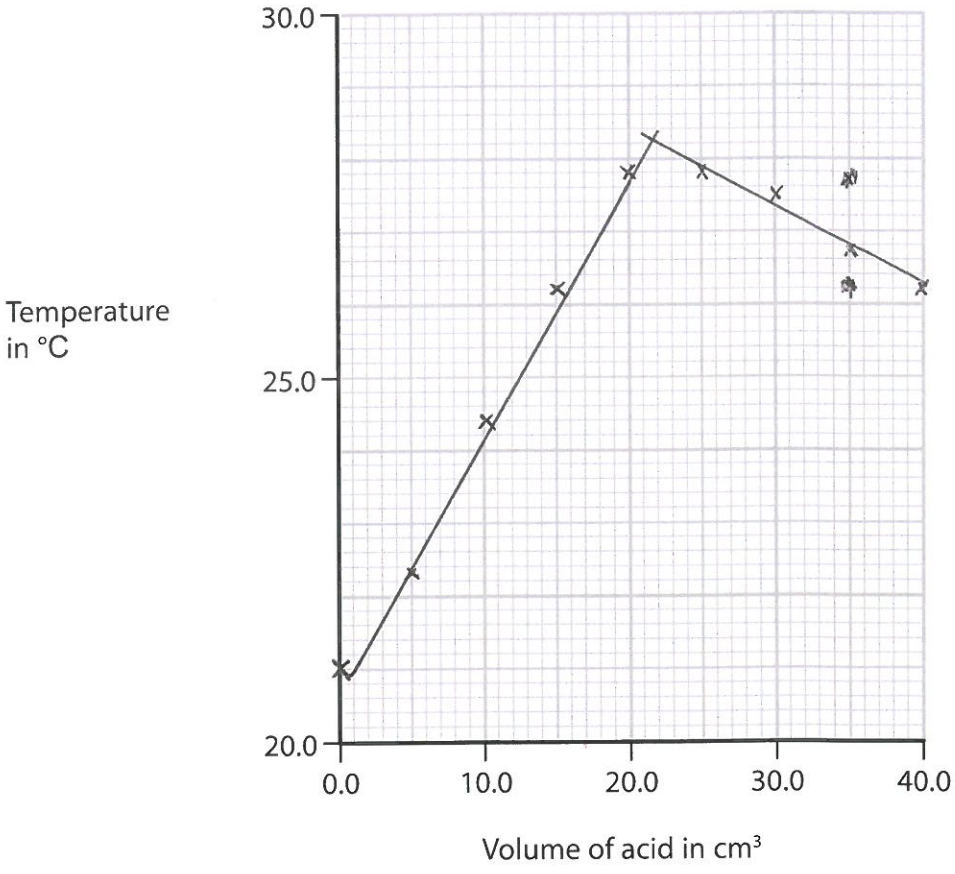
3 (c) One student obtained these results from an experiment in which she added a total of 40.0 $cm^3$ of hydrochloric acid to 25 $cm^3$ of sodium hydroxide solution.

| **Volume of acid in $cm^3$** | 0.0 | 5.0 | 10.0 | 15.0 | 20.0 | 25.0 | 30.0 | 35.0 | 40.0 |
|---|---|---|---|---|---|---|---|---|---|
| **Temperature in °C** | 21.0 | 22.3 | 24.4 | 26.2 | 27.8 | 27.8 | 27.5 | 26.7 | 26.2 |

(i) Plot a graph of these results on the grid below.

Draw a straight line of best fit through the first five points and another straight line of best fit through the last four points. Make sure that the two lines cross.

(4)




(ii) The point where the lines cross indicates the volume of acid needed to exactly neutralise the alkali, and also the maximum temperature reached.

Use your graph to record these values.

(2)

Volume of acid 22.0 $cm^3$

Maximum temperature 27.2 °C

3 (d) A second student used the same method and found that 30.0 $cm^3$ of acid were needed to neutralise 25 $cm^3$ of alkali.

He obtained a temperature rise of 5.5 °C in his experiment.

Calculate the heat energy change in this experiment using the expression:

heat energy change = total volume of mixture × 4.2 × temperature change

**(2)**

$= 55 \times 4.2 \times 5.5$

Heat energy change = 1270.5 J

(e) A third student calculated that the heat energy change in her experiment was 1800 J. This heat energy was released by the neutralisation of 25 $cm^3$ of 1.50 $mol/dm^3$ sodium hydroxide solution.

(i) Calculate the amount, in moles, of sodium hydroxide neutralised.

**(2)**

$\text{moles} = \frac{c \times v}{1000} = \frac{1.5 \times 25}{1000}$

Amount = 0.0375 mol

(ii) Calculate the molar enthalpy change, in kJ/mol, for the neutralisation of sodium hydroxide.

**(2)**

$\Delta H = \frac{1800}{0.0375}$

Molar enthalpy change = 48 kJ/mol

**(Total for Question 3 = 19 marks)**

12 06 [7]

**4** There are two important ways to manufacture ethanol.

Reaction 1 $C_2H_4 + H_2O \rightarrow C_2H_5OH$

Reaction 2 $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

(a) (i) Identify one raw material that could be used as the source of $C_6H_{12}O_6$

(1)

Sugar

(ii) Reaction 2 uses a catalyst called zymase, which is present in yeast.

Identify the catalyst used in reaction 1.

(1)

Phosphoric acid

(iii) In both reactions it is important to control the temperature.

State why the temperature in reaction 2 is kept below 35 °C.

(1)

Prevent 35 enzyme being denatured

4 (b) A manufacturing company plans to build a factory to produce ethanol on a large scale. The factory will be near an oilfield. The ethanol will be used as a solvent for perfume.

Suggest why the company should use reaction 1 rather than reaction 2.

**(3)**

- power to product / higher % yield
- faster reaction
- ethene available (from oil refinery)
- Reaction continuous

Reaction 2 • needs land to grow sugar
• needs warm climate.

(c) In the future, it may be necessary to convert the ethanol (produced by reaction 2) into ethene.

Write the equation for this reaction and state the type of reaction that occurs.

**(2)**

Equation $C_2H_5OH \longrightarrow C_2H_4 + H_2O$

Type of reaction Dehydration

**(Total for Question 4 = 8 marks)**

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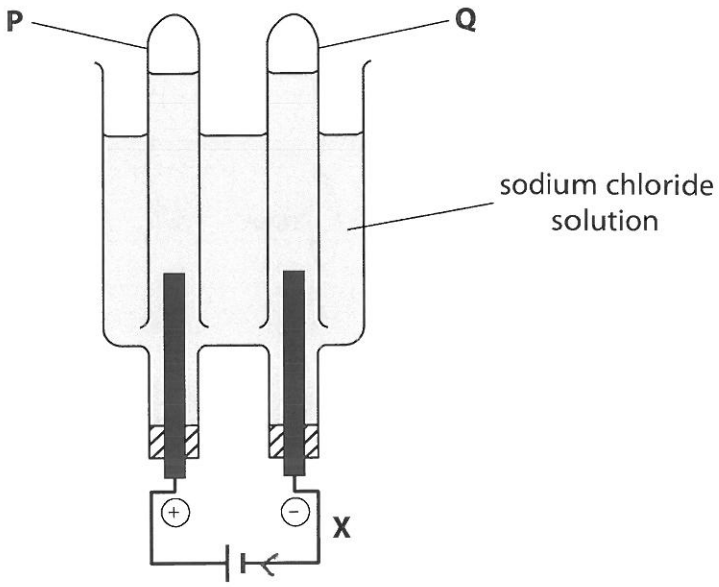
**5** The diagram shows how sodium chloride solution can be electrolysed and the products of electrolysis collected.




(a) (i) Draw an arrow on the diagram to show the direction of electron flow at point **X**.

(1)

(ii) The diagram shows one of the gases being collected in test tube **Q**.

Identify this gas.

(1)

hydrogen

(iii) When the concentration of the sodium chloride solution is low, the gas collected in test tube **P** is mostly oxygen. The formation of this gas can be represented by an ionic half-equation.

Balance the equation.

(1)

4 $OH^-$ → 2 $H_2O$ + $O_2$ + 4 $e^-$

5 (b) When the concentration of sodium chloride solution is high, the gas that collects in test tube **P** is mostly chlorine. The equation for its formation is:

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

In one experiment, the volume of chlorine gas collected was 18 $cm^3$.

(i) Calculate the amount, in moles, of chlorine gas in 18 $cm^3$.

(The volume of 1 mol of a gas at room temperature and pressure is 24 000 $cm^3$)

(2)

$\frac{18}{24000}$

Amount = 0.00075 mol

(ii) Calculate the quantity of electricity, in coulombs, needed to produce this volume of chlorine gas.

(1 faraday = 96 500 coulombs)

(2)

0.00075 × 96500 × 2

Quantity = 144.75 C

(c) Chlorine reacts with potassium bromide solution. The equation for this reaction is:

$$Cl_2(g) + 2Br^-(aq) \rightarrow 2Cl^-(aq) + Br_2(aq)$$

This reaction can be described as both a displacement reaction and a redox reaction.

(i) Identify the element that is displaced in this reaction.

(1)

Bromine

(ii) State the meaning of the term **redox**.

(1)

reduction and oxidations.

**QUESTION 5 CONTINUES ON THE NEXT PAGE**

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5 (d) Chlorine is used in the manufacture of phosphorus pentachloride, $PCl_5$

The equation for the reaction is:

$$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g) \qquad \Delta H = -124 \text{ kJ/mol}$$

(i) What does the $\rightleftharpoons$ symbol indicate about this reaction?

**(1)**

Reversible

(ii) Predict and explain the effect of increasing the pressure on the equilibrium position of this reaction.

**(2)**

Prediction shifts to the right

Explanation fewer molecules on the right

**(Total for Question 5 = 12 marks)**

**(TOTAL FOR PAPER = 60 MARKS)**