Write your name here

| Surname | Other names |
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| | |

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

Centre Number | | | | | |

Candidate Number | | | | |

# Chemistry

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

Wednesday 15 June 2016 – 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.
- 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 5 7 2 9 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 |

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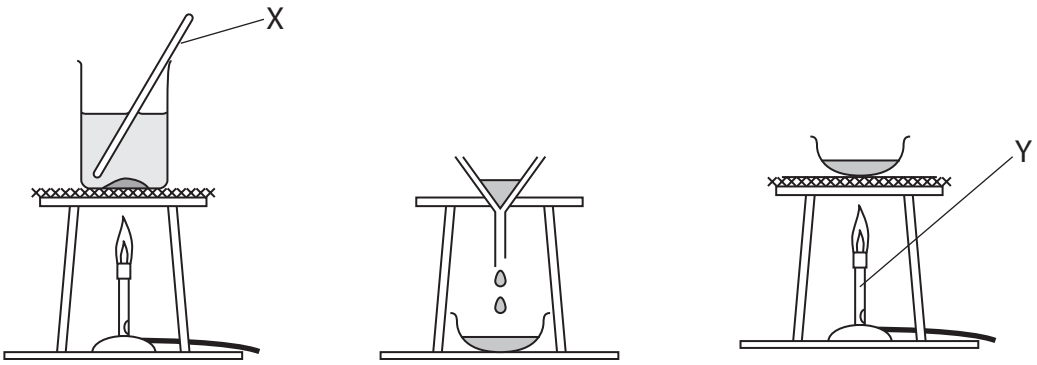
**Answer ALL questions.**

**1** The diagram shows the apparatus a student uses to separate a mixture of salt and sand.

She adds the mixture to water in a beaker and then carries out the three stages shown.




stage 1 stage 2 stage 3

(a) Give the names of the pieces of apparatus labelled X and Y.

**(2)**

X .....

Y .....

(b) (i) A liquid that dissolves substances is a

**(1)**

- ☒ **A** solute
- ☒ **B** solution
- ☒ **C** solvent
- ☒ **D** suspension

(ii) The clear liquid that forms in stage 1 is a

**(1)**

- ☒ **A** solute
- ☒ **B** solution
- ☒ **C** solvent
- ☒ **D** suspension

(c) (i) At which stage, 1, 2 or 3, is the sand collected?

**(1)**

.....

(ii) At which stage, 1, 2 or 3, is the salt collected?

**(1)**

.....

(d) What happens to the water in stage 3?

**(1)**

.....

.....

**(Total for Question 1 = 7 marks)**

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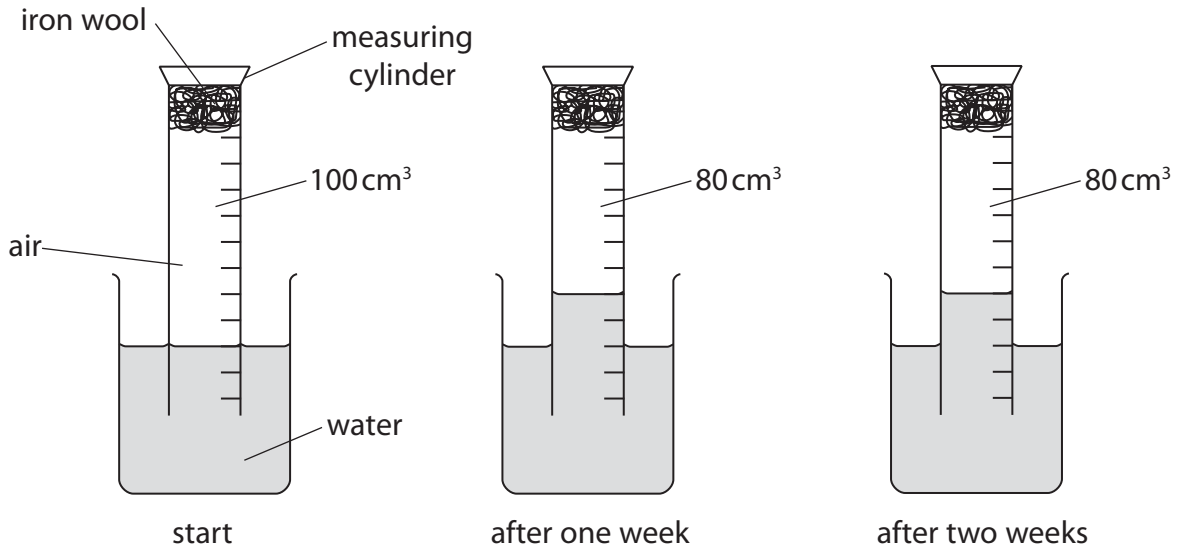
**2** The apparatus in the diagram was set up to demonstrate the rusting of iron.




(a) One week after the start of the experiment the volume of gas in the measuring cylinder has decreased.

After two weeks there is no further decrease in volume of gas in the measuring cylinder.

Explain these observations.

**(2)**

.....

.....

.....

.....

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.....

(b) Iron reacts with dilute sulfuric acid. The chemical equation for this reaction is

$$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$$

Complete the word equation for the reaction.

**(2)**

Iron + sulfuric acid → ..... + .....

(c) Aqueous sodium hydroxide can be used to distinguish between solutions containing iron(II) ions ($Fe^{2+}$) and iron(III) ions ($Fe^{3+}$).

State the observation made when aqueous sodium hydroxide is added separately to each solution.

**(2)**

$Fe^{2+}$(aq) .....

$Fe^{3+}$(aq) .....

**(Total for Question 2 = 6 marks)**

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**3** The diagram shows the elements in Period 3 of the Periodic Table.

| Na | Mg | Al | Si | P | S | Cl | Ar |
|---|---|---|---|---|---|---|---|

(a) (i) Identify an element in Period 3 that forms a basic oxide.

**(1)**

.....

(ii) Identify an element in Period 3 that forms an acidic oxide.

**(1)**

.....

(b) Magnesium and chlorine react together to form magnesium chloride, a compound with ionic bonding.

The equation for the reaction is

$$Mg + Cl_2 \rightarrow MgCl_2$$

(i) Complete the dot and cross diagram to show the arrangement of the outer electrons in the magnesium and chloride ions formed.

Show the charge on each ion.

**(3)**


(ii) State what is meant by the term **ionic bonding**.

**(2)**

.....

.....

.....

.....

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(iii) Explain why magnesium chloride has a high melting point.

**(3)**

(c) Aluminium is extracted from aluminium oxide using electrolysis.

Calculate the mass, in grams, of aluminium formed when a charge of 20 faradays is passed through aluminium oxide dissolved in molten cryolite.

The ionic half-equation for the formation of aluminium is

$$Al^{3+} + 3e^- \rightarrow Al$$

**(2)**

mass of aluminium = ..... g

**(Total for Question 3 = 12 marks)**

**4** Crystals of copper(II) nitrate, $Cu(NO_3)_2$, can be prepared by reacting solid copper(II) oxide, CuO, with dilute nitric acid.

(a) Write a chemical equation for this reaction.

**(1)**

.....

(b) A student is given a sample of copper(II) oxide containing small amounts of insoluble impurities.

The passage is from her notebook and describes the method she uses to prepare some pure, dry crystals of copper(II) nitrate from her sample of copper(II) oxide.

Stage 1: Place 50 $cm^3$ of dilute nitric acid into a beaker and warm.

Stage 2: Add the impure copper(II) oxide a little at a time and stir, until it is in excess.

Stage 3: Filter the mixture.

Stage 4: Heat the filtrate until the crystallisation point is reached.

Stage 5: Allow the filtrate to cool.

Stage 6: Filter off the crystals and dry with filter paper.

(i) Why is the acid warmed in stage 1?

**(1)**

.....

.....

(ii) How will the student know when the copper(II) oxide is in excess in stage 2?

**(1)**

.....

.....

(iii) How will the student know when the crystallisation point is reached in stage 4?

**(1)**

.....

.....

(iv) In which stage are the insoluble impurities removed?

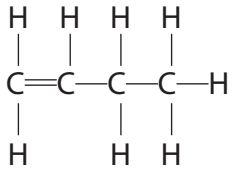
**(1)**

.....

**(Total for Question 4 = 5 marks)**

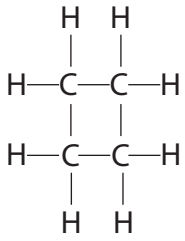
**5** But-1-ene is a member of the homologous series of alkenes.

The displayed formula of but-1-ene is



The saturated compound cyclobutane is an isomer of but-1-ene.

The displayed formula of cyclobutane is



(a) (i) State what is meant by the term **isomers**.

**(2)**

(ii) Draw the displayed formula of another isomer of but-1-ene.

**(1)**

(iii) Describe a test that would distinguish between but-1-ene and cyclobutane.

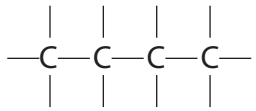
**(3)**

(b) Using your knowledge of the reactions of ethene, complete the two chemical equations to show the formula of the organic product.

(i) The reaction between but-1-ene and steam.

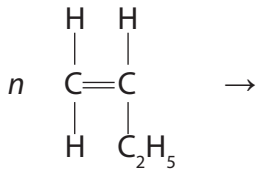
**(1)**

$$CH_2 = CHCH_2CH_3 + H_2O \rightarrow$$



(ii) The polymerisation of but-1-ene.

**(2)**



**(Total for Question 5 = 9 marks)**

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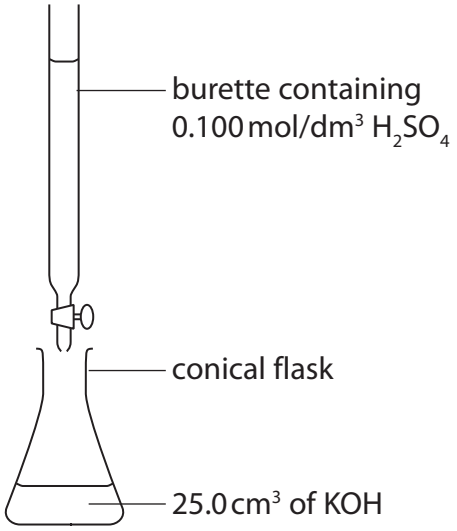
**6** This apparatus can be used in a method to find the volume of sulfuric acid required to neutralise a solution of potassium hydroxide (KOH).




(a) What name is given to this method?

**(1)**

.....

(b) Which piece of apparatus should be used to measure the 25.0 $cm^3$ of KOH?

**(1)**

☒ **A** beaker

☒ **B** measuring cylinder

☒ **C** pipette

☒ **D** syringe

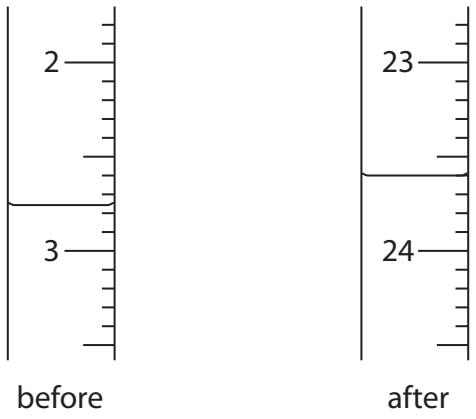
(c) State the colours that are seen if methyl orange is used as the indicator.

**(2)**

colour before adding the acid .....

colour after KOH is neutralised .....

(d) A student carries out the experiment. His burette readings are shown in the diagram.




Use the diagram to complete the table. Give the readings to the nearest 0.05 $cm^3$.

**(3)**

| | |
|---|---|
| Burette reading after adding the acid | |
| Burette reading before adding the acid | |
| Volume in $cm^3$ of acid added | |

(e) A second student did the experiment four times, using a different solution of potassium hydroxide. The table shows her results.

| | | | | |
|---|---|---|---|---|
| Volume in $cm^3$ of acid added | 22.90 | 22.60 | 22.45 | 22.55 |
| Concordant results (✓) | | | | |

Concordant results are those within 0.20 $cm^3$ of one another.

(i) Place ticks in the table to indicate which results are concordant with one another.

**(1)**

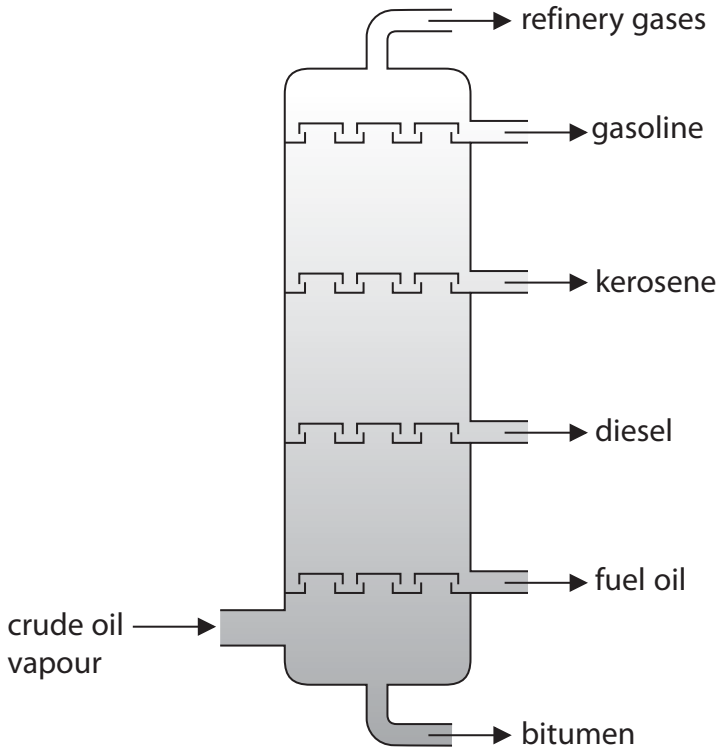
(ii) Use your ticked results to calculate the average (mean) volume of acid added.

**(2)**

average (mean) volume of acid = ..... $cm^3$

**(Total for Question 6 = 10 marks)**

**7** Crude oil is a complex mixture of organic compounds called hydrocarbons. It is separated into fractions using a fractionating tower.




(a) Which fraction has the lowest boiling point?

**(1)**

.....

(b) Which fraction is the most viscous?

**(1)**

.....

(c) (i) Some fractions containing long-chain hydrocarbons are cracked. The cracking of octadecane, ($C_{18}H_{38}$), produces octane, ($C_8H_{18}$), and one other product.

Write a chemical equation for this cracking reaction.

**(1)**

.....

(ii) Explain why it is important to crack long-chain hydrocarbon fractions.

**(2)**

.....

.....

.....

.....

(d) Octane is one of the hydrocarbons in the petrol used in cars.

The equation for the complete combustion of octane is

$$C_8H_{18} + 12½O_2 \rightarrow 8CO_2 + 9H_2O$$

The incomplete combustion of octane produces a poisonous gas that reduces the capacity of blood to carry oxygen.

Write a chemical equation for this incomplete combustion of octane.

**(2)**

.....

**(Total for Question 7 = 7 marks)**

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**8** This is a recipe for making Irish soda bread.

- add 170 g of wholemeal flour, 170 g of plain flour, 10 g of salt and 10.5 g of bicarbonate of soda (sodium hydrogencarbonate, $NaHCO_3$) to a bowl and stir
- pour in 290 $cm^3$ of buttermilk and stir quickly to form a soft dough
- form the dough into a round ball and slightly flatten it
- cut a cross in the top and bake for 30 minutes in an oven at 200 °C

When sodium hydrogencarbonate is heated, it forms carbon dioxide gas.

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

(a) Calculate the mass, in grams, of carbon dioxide that would be produced by completely decomposing 10.5 g of sodium hydrogencarbonate.
[$M_r$ of $NaHCO_3$ = 84]

**(2)**

mass of carbon dioxide = ..... g

(b) Use your answer from part (a) to calculate the volume, in $cm^3$, at room temperature and pressure, of carbon dioxide that would be produced by completely decomposing 10.5 g of sodium hydrogencarbonate.

Assume one mole of carbon dioxide has a volume of 24 000 $cm^3$ at room temperature and pressure.

**(2)**

volume of carbon dioxide = ..... $cm^3$

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

**TOTAL FOR PAPER = 60 MARKS**

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