Write your name here

Surname		Other names

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 ▶

P45729A
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THE PERIODIC TABLE

Group

1	2											3	4	5	6	7	0
																	4 **He** Helium 2

Period

1

1 **H** Hydrogen 1																	

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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P45729A0320

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.

X

stage 1   stage 2   stage 3

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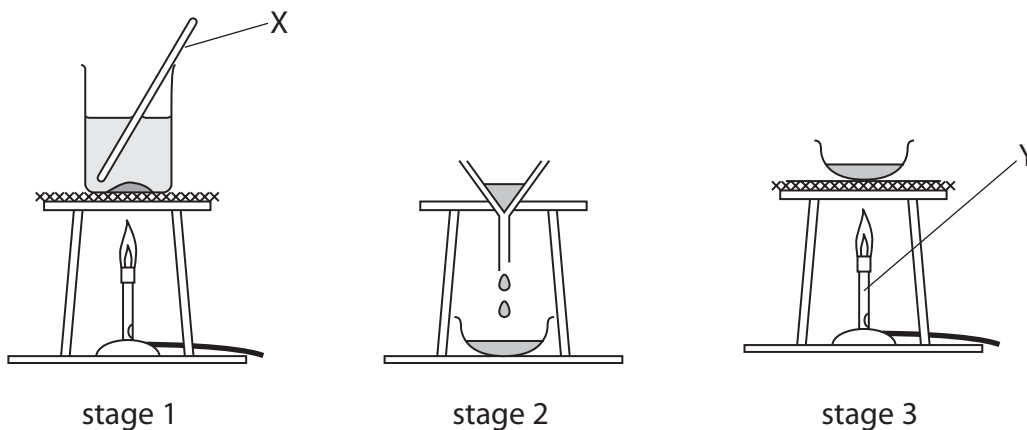
(a) Give the names of the pieces of apparatus labelled X and Y.

(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)

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

iron wool   measuring cylinder

100 cm^3 80 cm^3 80 cm^3

air

water

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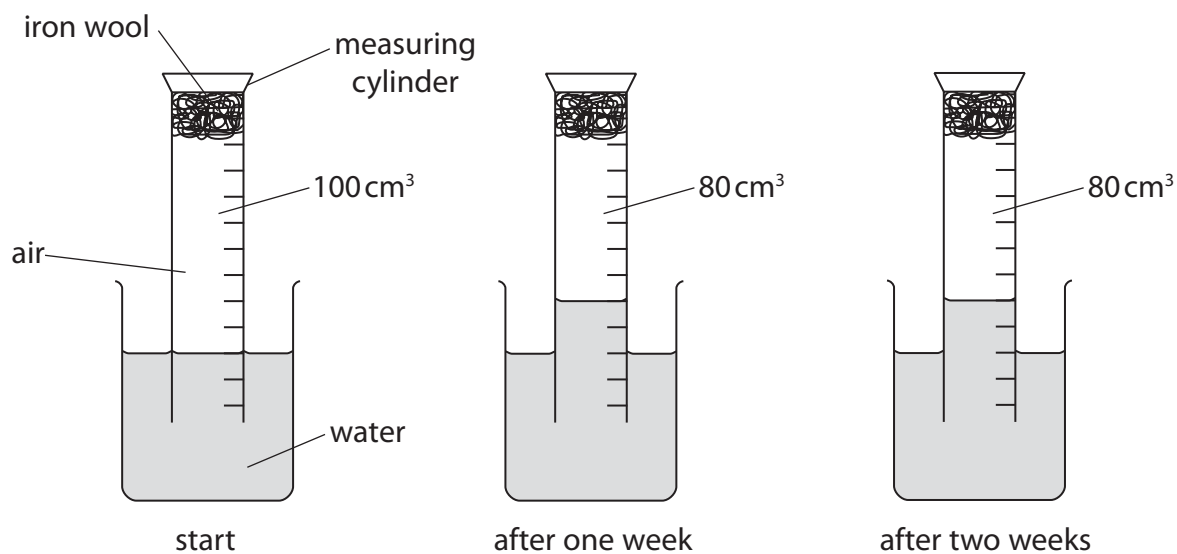
(a) One week after the start of the experiment the volume of gas in the measuring cylinder has decreased.

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

Explain these observations.

(2)

....

....

....

....

....

....

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

$$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$$
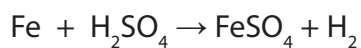
Complete the word equation for the reaction.

(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)

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

$$Mg + Cl_2 \rightarrow MgCl_2$$
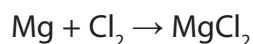
(i) Complete the dot and cross diagram to show the arrangement of the outer electrons in the magnesium and chloride ions formed.

Show the charge on each ion.

(3)

$$Mg^{\times}_{\times} \ + \ \ddot{C}l\!:\!\ddot{C}l\!: \longrightarrow \ \left[Mg \right] \ \left[Cl \right] \ \left[Cl \right]$$

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

(2)

....

....

....

....

(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 50cm³ 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

$$\begin{array}{c} \overset{\displaystyle H}{|} \quad \overset{\displaystyle H}{|} \quad \overset{\displaystyle H}{|} \quad \overset{\displaystyle H}{|} \\ C {=} C {-} C {-} C {-} H \\ \underset{\displaystyle H}{|} \qquad \underset{\displaystyle H}{|} \quad \underset{\displaystyle H}{|} \end{array}$$
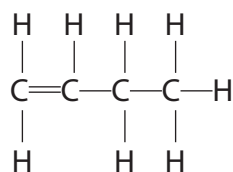
The saturated compound cyclobutane is an isomer of but-1-ene.

The displayed formula of cyclobutane is

$$\begin{array}{c} \overset{\displaystyle H}{|} \quad \overset{\displaystyle H}{|} \\ H {-} C {-} C {-} H \\ | \qquad | \\ H {-} C {-} C {-} H \\ \underset{\displaystyle H}{|} \quad \underset{\displaystyle H}{|} \end{array}$$
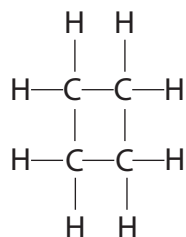
(a) (i) State what is meant by the term **isomers**.

(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)

....

....

....

....

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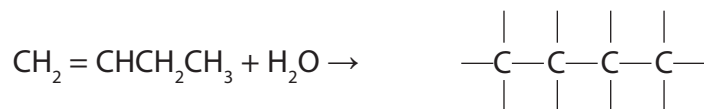
(b) Using your knowledge of the reactions of ethene, complete the two chemical equations to show the formula of the organic product.

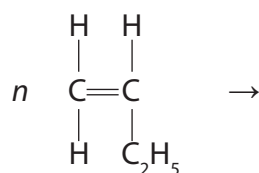(i) The reaction between but-1-ene and steam.

(1)

$$CH_2 = CHCH_2CH_3 + H_2O \rightarrow$$

$$-\overset{|}{\underset{|}{C}} - \overset{|}{\underset{|}{C}} - \overset{|}{\underset{|}{C}} - \overset{|}{\underset{|}{C}} -$$

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

(2)

$$n \quad \begin{array}{c} H \quad H \\ | \quad | \\ C = C \\ | \quad | \\ H \quad C_2H_5 \end{array} \quad \rightarrow$$

(Total for Question 5 = 9 marks)

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).

burette containing
0.100 mol/dm³ H_2SO_4

conical flask
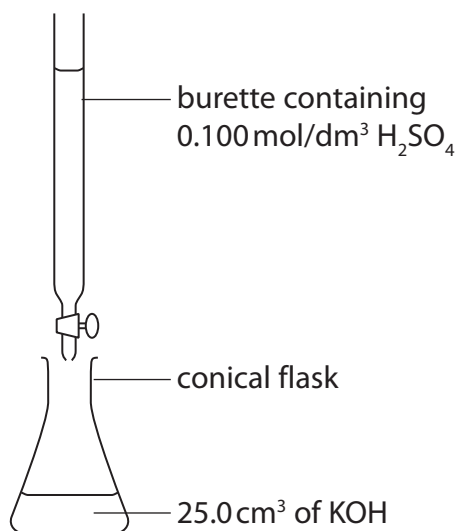
25.0 cm³ of KOH

(a) What name is given to this method?

(1)

....

(b) Which piece of apparatus should be used to measure the 25.0 cm³ 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.
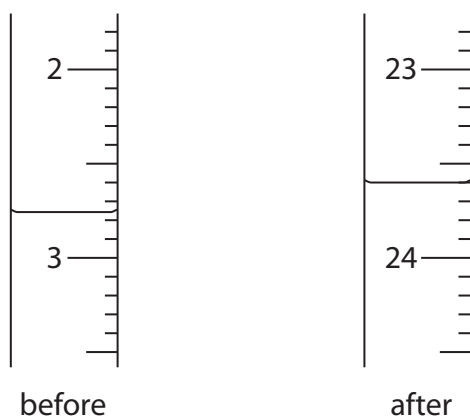
before   after

Use the diagram to complete the table. Give the readings to the nearest 0.05 cm³.

(3)

Burette reading after adding the acid	
Burette reading before adding the acid	
Volume in cm³ 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 cm³ of acid added	22.90	22.60	22.45	22.55
Concordant results (✓)				

Concordant results are those within 0.20 cm³ 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 = ... cm³

(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.
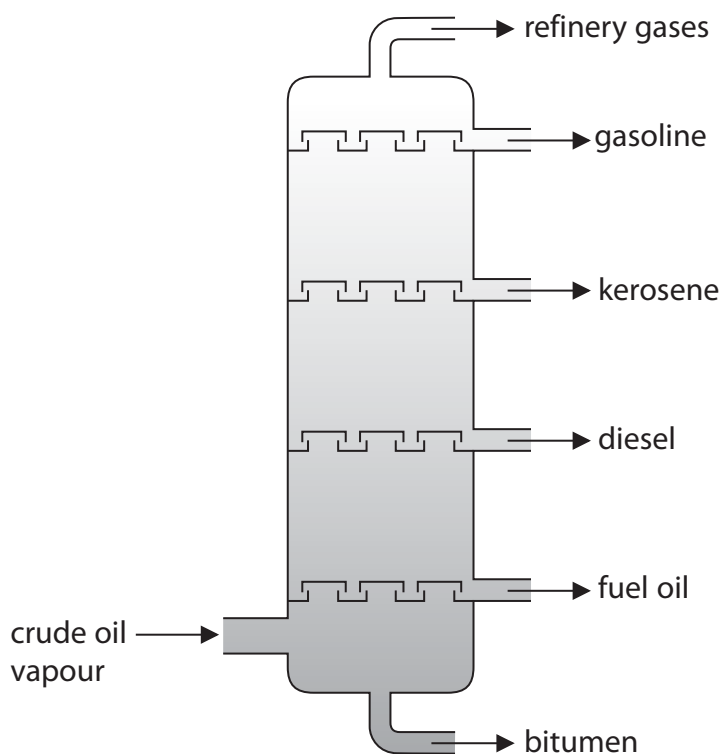
(a) Which fraction has the lowest boiling point?

(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.

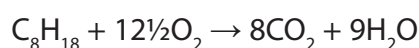Write a chemical equation for this cracking reaction.

(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

$$C_8H_{18} + 12\tfrac{1}{2}O_2 \rightarrow 8CO_2 + 9H_2O$$

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)

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 cm³ 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.

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$
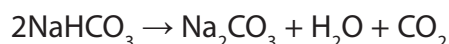
(a) Calculate the mass, in grams, of carbon dioxide that would be produced by completely decomposing 10.5 g of sodium hydrogencarbonate.
[M_r of $NaHCO_3$ = 84]

(2)

mass of carbon dioxide = ... g

(b) Use your answer from part (a) to calculate the volume, in cm³, 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 cm³ at room temperature and pressure.

(2)

volume of carbon dioxide = ... cm³

(Total for Question 8 = 4 marks)

TOTAL FOR PAPER = 60 MARKS

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