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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 ▶

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1/1/1/1/

P 4 5 7 2 9 A 0 1 2 0

PEARSON

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															

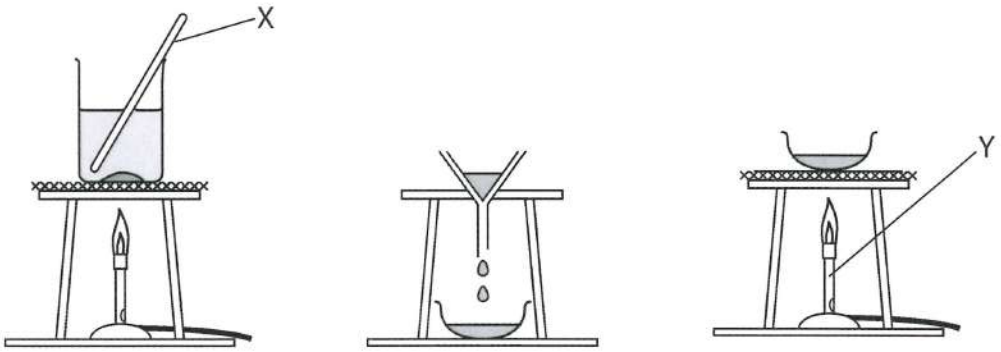
Key

Relative atomic mass
Symbol
Name
Atomic number

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)

0.00

X Stirring rod

Y Bunsen

1.04

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

(1)

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

1.04

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

(1)

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

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

(1)

2

1.10

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

(1)

3

1.10

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

(1)

Evaporated

1.10

(Total for Question 1 = 7 marks)

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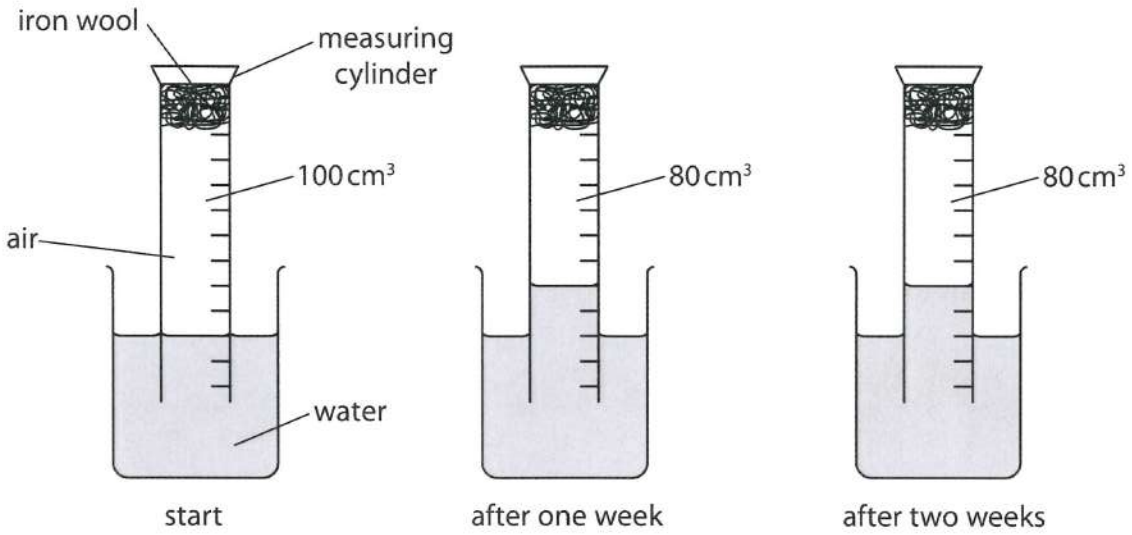
2 The apparatus in the diagram was set up to demonstrate the rusting of iron.



(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)

2.11

- Iron reacted with oxygen
- All oxygen reacted

(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)

1.25

Iron + sulfuric acid → Iron (II) Sulfate + Hydrogen

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(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)

2·47

$Fe^{2+}(aq)$ Green ppt

$Fe^{3+}(aq)$ Brown ppt

(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)

2.38

Na / Mg

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

(1)

2.35

Si / P / S / Cl

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

The equation for the reaction is

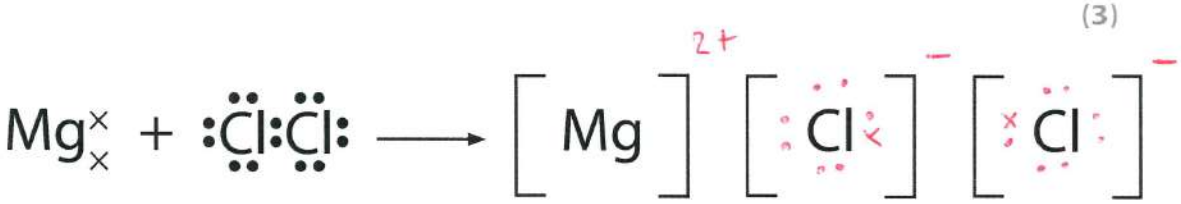
$$Mg + Cl_2 \rightarrow MgCl_2$$

(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)

1.40



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

(2)

1.41

Electrostatic attraction between oppositely charged ions

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

(3)

- Strong attraction
- Giant ionic lattice

∴ Lots of energy required to overcome attraction

1.42

(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)

1.28

$n(Al) = \frac{20}{3}$

$= 6.67$ mol

$m(Al) = 6.67 \times 27$

$= 180$g

mass of aluminium = 180 g

(Total for Question 3 = 12 marks)

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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.

1.25

(1)

$CuO + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O$

(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?

2.33C

(1)

Increase rate of reaction

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

2.33C

(1)

copper (II) oxide stops disappearing

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

(1)

A drop of solution forms crystals when removed

2·33

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

(1)

3

2·33

(Total for Question 4 = 5 marks)

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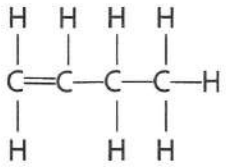
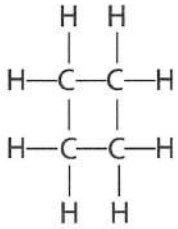
5 But-1-ene is a member of the homologous series of alkenes.

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)

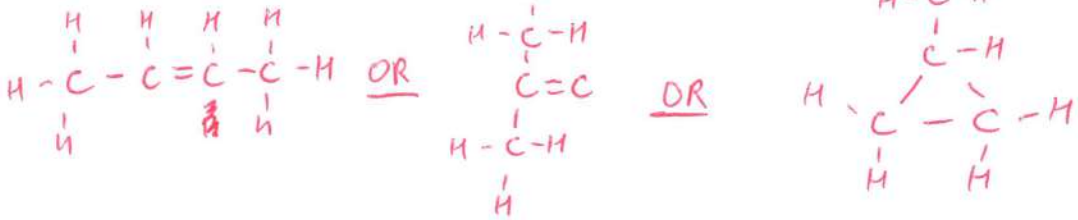
4.03

- same molecular formula but different structural formula

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

(1)

4.26



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

(3)

4.28

- Bromine water
- But-1-ene, orange to colourless
- cyclobutane no change (unless UV light present)

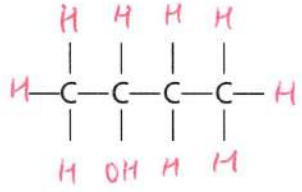
(b) Using your knowledge of the reactions of ethene, complete the two chemical equations to show the formula of the organic product.

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

(1)

4.30C

$$CH_2 = CHCH_2CH_3 + H_2O \rightarrow$$

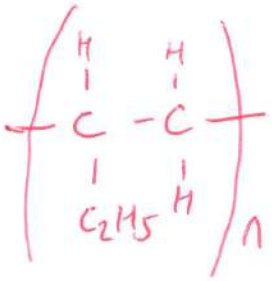


(ii) The polymerisation of but-1-ene.

(2)

4.45

$$n \quad \begin{matrix} H & H \\ | & | \\ C{=}C \\ | & | \\ H & C_2H_5 \end{matrix} \rightarrow$$



(Total for Question 5 = 9 marks)

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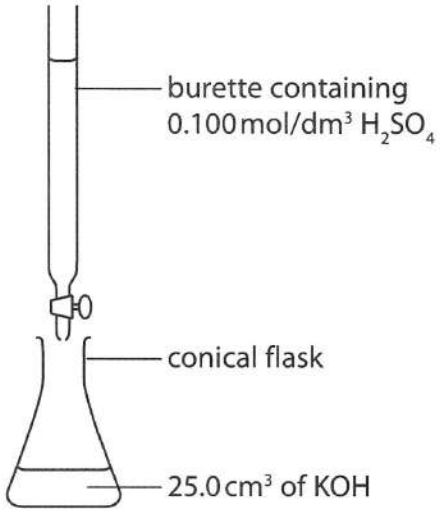
6 This apparatus can be used in a method to find the volume of sulfuric acid required to neutralise a solution of potassium hydroxide (KOH).



(a) What name is given to this method?

(1)

2.33C

Titration

(b) Which piece of apparatus should be used to measure the 25.0 cm³ of KOH?

(1)

2.33C

- ☐ **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)

2.28

colour before adding the acid Yellow

colour after KOH is neutralised Orange

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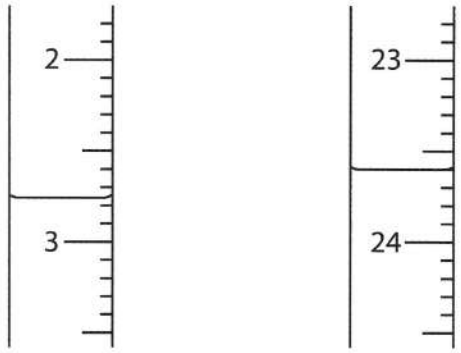
(d) A student carries out the experiment. His burette readings are shown in the diagram.



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

(3)

Burette reading after adding the acid	23.60
Burette reading before adding the acid	2.75
Volume in cm^3 of acid added	20.85

2.33(

(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)

2.33(

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

(2)

2.33(

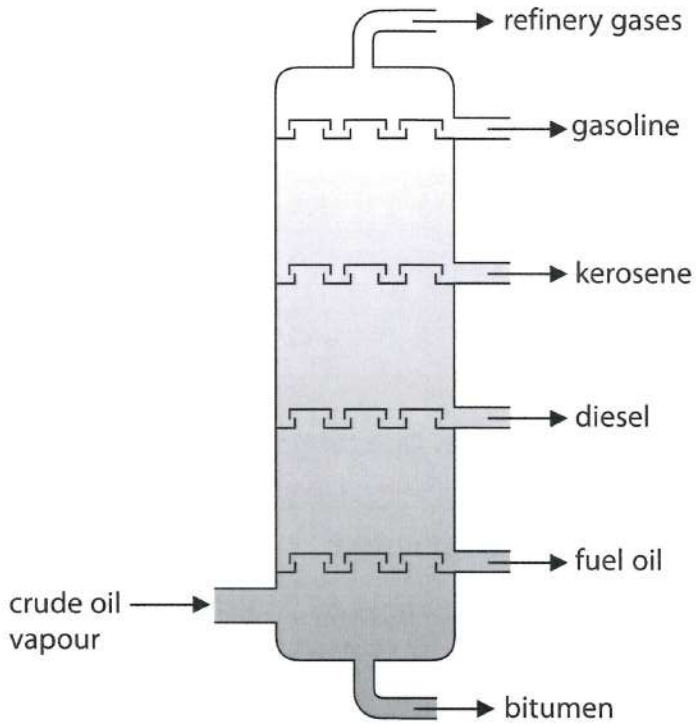
$= \frac{22.60 + 22.45 + 22.55}{3}$

$= 22.53$

average (mean) volume of acid = 22.53 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)

4.10

Gases

(b) Which fraction is the most viscous?

(1)

4.10

Bitumen

(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)

1.25

$C_{18}H_{38} \rightarrow C_8H_{18} + C_{10}H_{20}$

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

(2)

4.18

ANY 2

- over supply of long-chain hydrocarbons
- Higher demand for short-chain hydrocarbons
- ✓ used as fuels / polymers / plastics

short-chain hydrocarbons

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

The equation for the complete combustion of octane is

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

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)

1.25

$C_8H_{18} + 8\frac{1}{2}O_2 \rightarrow 8CO + 9H_2O$

(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]

1.28

$n(NaHCO_3) = \frac{10.5}{84}$

$= 0.125 mol$

$Mass(CO_2) = \frac{0.125}{2} \times 44$

$= 2.8g$

(2)

mass of carbon dioxide = 2.8 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 24000 cm^3 at room temperature and pressure.

1.35C

(2)

$n(CO_2) = \frac{2.75}{44}$

$= 0.0625 mol$

$V(CO_2) = 0.0625 \times 24000$

$= 1500 cm^3$

volume of carbon dioxide = 1500 cm^3

(Total for Question 8 = 4 marks)

TOTAL FOR PAPER = 60 MARKS

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