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Write your name here

Surname	Other names

Pearson Edexcel International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit: 4CH0
Paper: 2CR

Wednesday 15 June 2016 – Afternoon
Time: 1 hour

Paper Reference
4CH0/2CR

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.
- 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 ▶

P45944A

1/1/1/1/1/

P 4 5 9 4 4 A 0 1 2 0

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

Answer ALL questions.

1 Hydrated copper(II) sulfate is a soluble blue solid. A large crystal of this solid is placed at the bottom of a beaker of water.

The diagram shows the beaker immediately after placing the crystal in it, and after two days.

after placing the crystal

after two days

(a) After two days, the crystal becomes smaller and the liquid near the bottom of the beaker becomes blue.

Which statement explains these observations?

(1) 1.03

☒ **A** the crystal dissolves

☐ **B** the crystal freezes

☐ **C** the crystal melts

☐ **D** the crystal sublimes

(b) After two weeks, the crystal has disappeared.

Which statement best describes the appearance of the liquid in the beaker after two weeks?

(1) 1.03

☒ **A** it is all blue

☐ **B** it is all brown

☐ **C** only the lower part is blue

☐ **D** only the upper part is blue

(c) The formula of the compound in the crystal is $CuSO_4.5H_2O$

(i) How many different elements are shown in the formula?

(1) 1.08

4

(ii) How many atoms are shown in the formula?

1.14

21

(Total for Question 1 = 4 marks)

2 Iron is a metal with many uses. One problem with using iron is that it rusts.

(a) Name two substances needed for iron to rust.

[2]

2.18

Oxygen and Water

(b) State the name of the main compound present in rust.

[1]

2.18

Iron (III) oxide

(c) The table shows three methods used to protect iron from rusting.

Choose three of the objects from the box to complete the table.
You may choose an object only once.

[3]

bicycle chain	bucket	car body
car engine	food can	railway bridge

Method	Example of use
galvanising	bucket / car body / railway bridge
oiling	bicycle chain / car engine
painting	carbody / railway bridge

2.19

(d) An iron object is coated with zinc to protect it from rusting. This protection continues even if the zinc coating becomes scratched.

Explain how the zinc coating protects iron from rusting.

[2]

2.1

- Zinc oxidises in preference to iron
- Zinc more reactive than iron / lose electrons more easily

(Total for Question 2 = 8 marks)

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3 This question is about some gases present in air.

(a) Which is the most common gas in dry air?

2.09

- ☐ **A** argon
- ☐ **B** carbon dioxide
- ☒ **C** nitrogen
- ☐ **D** oxygen

(b) Which gas makes up about 1 % of dry air?

2.09

- ☒ **A** argon
- ☐ **B** carbon dioxide
- ☐ **C** nitrogen
- ☐ **D** oxygen

(c) A piece of copper is heated in air.

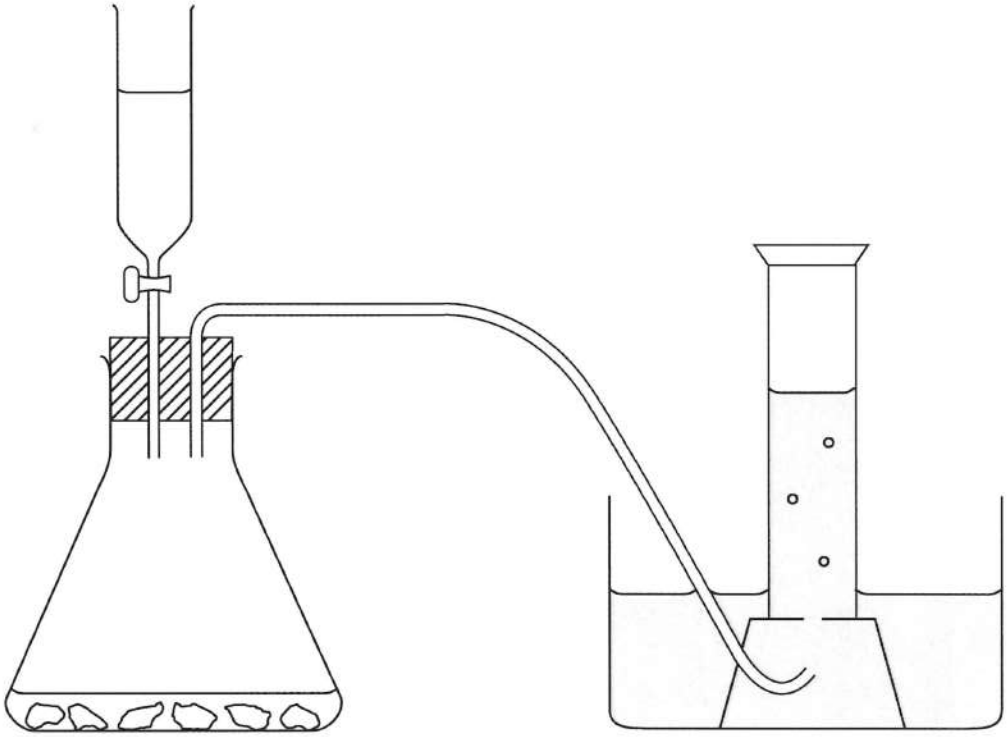
State the formula and colour of the compound formed.

2.11

formula CuO

colour Black

(d) The diagram shows apparatus that can be used to prepare carbon dioxide in the laboratory.



(i) The liquid in the tap funnel is

(1)

2.37

- ☐ **A** calcium chloride solution
- ☐ **B** concentrated sulfuric acid
- ☒ **C** dilute hydrochloric acid
- ☐ **D** hydrogen peroxide solution

(ii) The solid in the conical flask is

(1)

2.37

- ☒ **A** calcium carbonate
- ☐ **B** calcium sulfate
- ☐ **C** copper(II) oxide
- ☐ **D** manganese(IV) oxide

(iii) The diagram shows the gas being collected over water.

Suggest another way to collect the gas.

(1)

2.37

Gas Syringe

(e) Limewater can be used in a test for carbon dioxide.

2.44 max

(i) Complete this equation, by inserting state symbols, for the reaction used to test for carbon dioxide.

CO_2(g) + $Ca(OH)_2$(aq) → $CaCO_3$(s) + H_2O(l)

2.44

(ii) State the observation made in this test.

white ppt

(Total for Question 3 = 9 marks)

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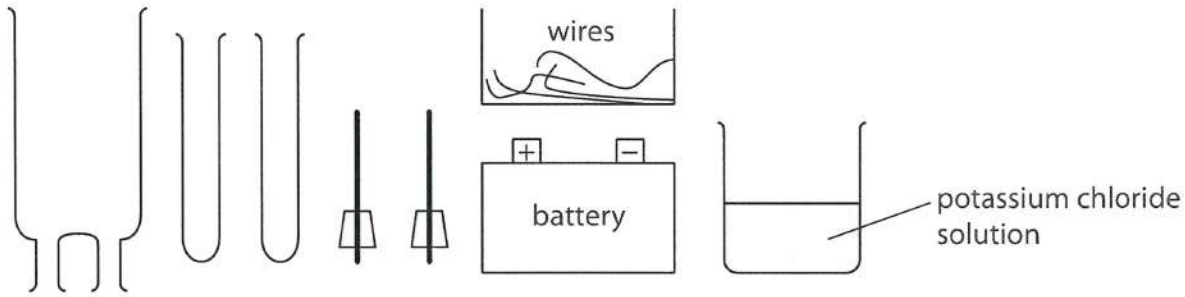
4 A student investigates electrolysis using this apparatus.

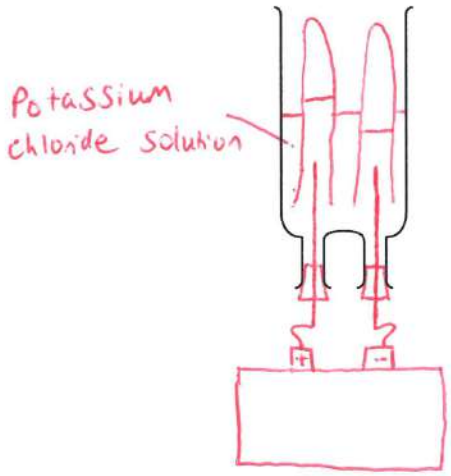


(a) The student electrolyses KCl(aq) and collects samples of any gases formed.

1.60C

Complete the following diagram to show how to assemble the apparatus.
Label the diagram to show the potassium chloride solution.

[3]



(b) The table shows the half-equation for the reaction at one electrode.

1.59C

Complete the table to show the half-equation for the reaction at the other electrode and the polarity (+ or –) of each electrode.

[2]

Polarity	Equation
–	$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$
+	$2Cl^- \rightarrow Cl_2 + 2e^-$

(c) Describe a test to show that the gas collected is hydrogen.

(1)

• Burns with squeaky pop

2.44

(Total for Question 4 = 6 marks)

5 Potassium and lithium are Group 1 metals that exist as isotopes.

(a) (i) Complete the table of information about two isotopes of potassium.

Atomic number	Mass number	Number of protons	Number of neutrons
19	39	19	20
19	41	19	22

(ii) A sample of lithium has this percentage composition by mass.

$^{6}Li = 7.4\%$ $^{7}Li = 92.6\%$

Use this information to calculate the relative atomic mass of lithium.
Give your answer to one decimal place.

$$= \frac{(6 \times 7.4) + (7 \times 92.6)}{100}$$

$$= 6.9$$

relative atomic mass of lithium = 6.9

(b) A reaction occurs when a small piece of potassium is added to water in a trough.

State two observations that could be made during the reaction.

ANY 2

1 • Effervescence

• Potassium moves / forms into a ball

2 • Potassium leaves white trail

• Flame

(c) A few drops of phenolphthalein are added to the liquid in the trough at the end of the reaction. A colour change occurs.

(i) State the final colour of the liquid in the trough.

pink

(ii) Give the formula of the ion formed during the reaction that causes this colour change.

OH^-

(d) The electronic configurations of lithium and potassium are

Li 2,1 K 2,8,8,1

Explain why potassium is more reactive than lithium.

(2)

2.02

- Potassium loses electron more easily
- Further from attraction of nucleus

(Total for Question 5 = 11 marks)

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6 Lithium hydroxide (LiOH) and lithium peroxide (Li_2O_2) have been used in spacecraft to remove the carbon dioxide astronauts breathe out.

The equations for the reactions with carbon dioxide are

$$2LiOH + CO_2 \rightarrow Li_2CO_3 + H_2O$$

$$2Li_2O_2 + 2CO_2 \rightarrow 2Li_2CO_3 + O_2$$

(a) Explain, with reference to these equations, two advantages of using lithium peroxide, rather than lithium hydroxide, to remove carbon dioxide from the air in a spacecraft.

[2]

0.00

- Twice as much carbon dioxide removed
- Produces oxygen

(b) (i) Calculate the mass of lithium hydroxide needed to react with 100 g of carbon dioxide.

[M_r of LiOH = 24]

$n(CO_2) = \frac{100}{44}$

$= 2.27 mol$

$n(LiOH) = 2.27 \times 2$

$= 4.54 mol$

$M(LiOH) = 4.54 \times 24$

$= 110g$

1.29

mass of lithium hydroxide = 110 g

(ii) Calculate the volume of carbon dioxide, at room temperature and pressure, removed by 100 g of lithium peroxide.

[M_r of Li_2O_2 = 46]

Assume that one mole of gas has a volume of 24 000 cm^3 at rtp.

$n(Li_2O_2) = \frac{100}{46}$

$= 2.17 mol$

$V(CO_2) = 2.17 \times 24000$

$= 52000 cm^3$

1.35

volume of carbon dioxide = 52000 cm^3

(Total for Question 6 = 8 marks)

7 This question is about the laboratory preparation of salts.

(a) A student writes this plan for preparing a sample of hydrated magnesium sulfate crystals.

step 1 Pour about 100 cm^3 of dilute nitric acid into a 250 cm^3 beaker.

step 2 Add a solution of magnesium carbonate to the acid until there is no more effervescence.

step 3 Heat the solution until all of the water has boiled off.

This plan will not succeed because there is one mistake in each step.

2.34
2.41C

Identify the mistake in each of the steps.

[3]

step 1 Nitric acid

step 2 Magnesium carbonate insoluble

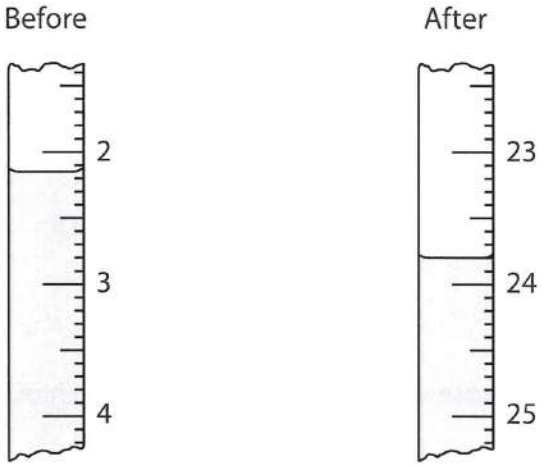
step 3 Boiling off all the water

(b) Another student uses the following plan to prepare a sample of ammonium hydrogenphosphate, formed in this reaction between aqueous ammonia and dilute phosphoric acid

$$2NH_3(aq) + H_3PO_4(aq) \rightarrow (NH_4)_2HPO_4(aq)$$

- use a pipette to transfer 25.0 cm^3 of phosphoric acid to a conical flask
- add 3 drops of indicator
- use a burette to add aqueous ammonia until the indicator just changes colour permanently

(i) The diagram shows the burette readings in one experiment before and after adding aqueous ammonia.



Use the readings to complete the table, entering all values to the nearest 0.05 cm^3.

(3)

2.33

burette reading in cm^3 after adding aqueous ammonia	23.80
burette reading in cm^3 before adding aqueous ammonia	2.15
volume in cm^3 of aqueous ammonia added	21.65

(ii) In another titration, the student made a mistake. After he filled the burette, he noticed that the space between the tap of the burette and the tip contained air. After adding the aqueous ammonia, he noticed that it now contained liquid.

Explain how, if at all, this mistake affects the calculated volume of aqueous ammonia added.

(2)

2.33

• volume will be higher as it includes the air

(c) He repeats the experiment until he obtains concordant results.

The table shows the results.

burette reading in cm^3 after adding ammonia	27.95	28.05	28.00	26.75
burette reading in cm^3 before adding ammonia	0.80	1.60	1.20	0.50
volume in cm^3 of aqueous ammonia added	27.15	26.45	26.80	26.25
concordant results (✓)		✓		✓

Concordant results are those volumes that differ from each other by 0.20 cm^3 or less.

2.33C

2.33C

(i) Identify the concordant results by placing ticks (✓) in the table where appropriate.

[1]

(ii) Use the concordant results to calculate the average (mean) volume of aqueous ammonia added.

[2]

$$= \frac{26.45 + 26.25}{2}$$

$$= 26.35$$

average volume of aqueous ammonia = 26.35 cm^3

(d) The student then mixed the volumes of aqueous ammonia and phosphoric acid found in the titration.

Describe how to use the method of crystallisation to obtain a pure dry sample of the salt from this mixture.

(3)

2.4c

(M1) • Heat until crystals form in a sample of solution that has been removed

(M2) • Leave solution to cool

(M3) • Filter and leave to dry in a warm place

(Total for Question 7 = 14 marks)

TOTAL FOR PAPER = 60 MARKS

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