Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit C3: Chemistry in Action

Higher Tier

Thursday 19 June 2014 – Afternoon
Time: 1 hour

Paper Reference
5CH3H/01

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.*

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.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 4 3 4 3 1 R A 0 1 2 0

PEARSON

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 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
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
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
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **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
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **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	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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Questions begin on next page.

Answer ALL questions

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 ☒.

Ethanol

1 Ethanol is present in alcoholic drinks.

(a) Ethanol is produced by fermentation of carbohydrates.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The conditions used for fermentation are

(1)

☒ **A** add manganese(IV) oxide, temperature below 20 °C

☒ **B** add yeast, temperature of about 35 °C

☒ **C** add manganese(IV) oxide, temperature of 45 °C

☒ **D** add yeast, temperature above 60 °C

(b) Ethanol, C_2H_5OH, is also produced by the reaction of ethene with steam.

Write the balanced equation for this reaction.

(2)

.....

(c) Ethanol is a member of the homologous series, the alcohols.

(i) Describe what is meant by an **homologous series**.

(2)

.....

.....

.....

.....

(ii) Draw the structure of a molecule of methanol, CH_3OH.

Show all the covalent bonds.

(1)

(d) When a bottle of wine is left open for a few days, ethanol in the wine changes into ethanoic acid.

(i) State the type of reaction that occurs when ethanol changes into ethanoic acid.

(1)

.....

(ii) Describe what you would **see** when a piece of magnesium ribbon is added to dilute ethanoic acid.

(2)

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.....

.....

.....

(Total for Question 1 = 9 marks)

Qualitative Analysis

2 (a) Three solids, **A**, **B**, and **C**, are analysed.

(i) Solid **A** is potassium iodide.

A small amount of solid **A** is dissolved in water to form a solution.

Describe the test to show that the solution of **A** contains iodide ions.

(2)

(ii) Solid **B** is ammonium chloride.

Describe the test to show that solid **B** contains ammonium ions.

(3)

(iii) Solid **C** is dissolved in water.

When sodium hydroxide solution is added to the solution of **C**, a red-brown precipitate is formed.

Complete the sentence by putting a cross (☒) in the box next to your answer.

This test shows that the ion present in solid **C** is

(1)

☒ **A** copper, Cu^{2+}

☒ **B** iron(II), Fe^{2+}

☒ **C** iron(III), Fe^{3+}

☒ **D** sodium, Na^{+}

(b) Sodium hydroxide solution can be used to test for aluminium ions and for calcium ions in solution.

Describe the results of these tests for aluminium ions and for calcium ions, explaining how the results distinguish between the two ions.

(3)

.....

.....

.....

.....

(Total for Question 2 = 9 marks)

Organic chemistry

3 (a) Margarine is made by hydrogenation of a liquid oil.

Complete the sentence by putting a cross (☒) in the box next to your answer.

In hydrogenation of a liquid oil

(1)

- ☒ **A** hydrogen is removed from the liquid oil
- ☒ **B** the liquid oil reacts with steam
- ☒ **C** double bonds are formed
- ☒ **D** the liquid oil is changed into a solid

(b) Soaps are made by boiling oils with concentrated solutions of alkalis.

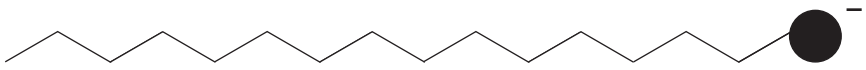
(i) Which of the following would be a suitable alkali to use in the production of soaps?

Put a cross (☒) in the box next to your answer.

(1)

- ☒ **A** sodium chloride
- ☒ **B** sodium hydroxide
- ☒ **C** sodium nitrate
- ☒ **D** sodium sulfate

(ii) The diagram shows a soap anion.



Explain how soap anions remove grease marks from clothes during washing with water.

(2)

.....

.....

.....

.....

.....

(c) Esters are made by reacting alcohols with carboxylic acids.

(i) Give the name of the carboxylic acid that has three carbon atoms in each molecule.

(1)

.....

(ii) When ethanoic acid, CH_3COOH, reacts with ethanol, C_2H_5OH, ethyl ethanoate is one of the products formed.

Write the balanced equation for the reaction.

(2)

.....

(d) Polyesters are used to make plastic bottles.

State another use of polyesters.

(1)

.....

(Total for Question 3 = 8 marks)

Making sodium chloride

4 To make pure sodium chloride from sodium hydroxide solution and dilute hydrochloric acid, a titration has to be used.

The equation for the reaction is

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(\ldots\ldots) + H_2O(\ldots\ldots)$$

(a) Which state symbols follow NaCl and H_2O to complete the equation?

Put a cross (☒) in the box next to your answer.

(1)

		NaCl	**H_2O**
☒	**A**	s	l
☒	**B**	aq	aq
☒	**C**	s	aq
☒	**D**	aq	l

(b) The reaction above is a neutralisation reaction.

Write the ionic equation for the reaction.

(2)

.....

(c) When sodium hydroxide solution is titrated with dilute hydrochloric acid, an acid-base indicator is used.
The hydrochloric acid is added from a burette to the sodium hydroxide solution in a conical flask.
At the end point the indicator changes colour.

(i) Give the name of a suitable indicator to use in this titration.

(1)

.....

(ii) State the colour change for this indicator at the end point.

(1)

from ..... to .....

(d) A sodium hydroxide solution was made up by dissolving 20.0 g of sodium hydroxide in water and making the volume of the solution up to 1.00 dm^3. Calculate the concentration of sodium hydroxide, NaOH, in this solution in mol dm^{-3}.

(relative atomic masses: H = 1.00, O = 16.0, Na = 23.0)

(2)

concentration = ... mol dm^{-3}

(e) In another experiment, a titration was carried out.
25.0 cm^3 of 1.50 mol dm^{-3} sodium hydroxide solution, NaOH, was titrated with hydrochloric acid.
The volume of the hydrochloric acid required to neutralise the sodium hydroxide solution was 30.0 cm^3.

Calculate the concentration of the hydrochloric acid, HCl, in mol dm^{-3}.

$$HCl + NaOH \rightarrow NaCl + H_2O$$

(3)

concentration = ... mol dm^{-3}

(Total for Question 4 = 10 marks)

Electrolysis

5 (a) Some metal objects are electroplated to improve their appearance.

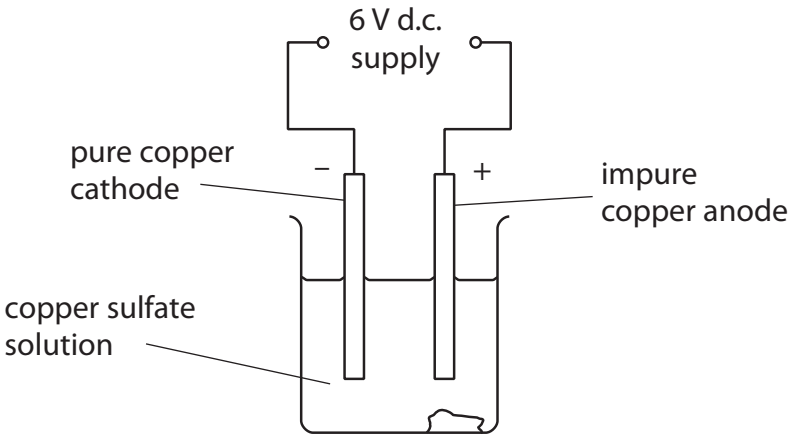
Give another reason why some metal objects are electroplated.

(1)

.....

.....

(b) Copper sulfate solution was electrolysed using copper electrodes.
The mass of each electrode was determined before it was placed in the solution.



The electrolysis was carried out for a period of time.
The electrodes were removed, washed, dried and their masses redetermined.

The table shows the masses of the electrodes before and after electrolysis.

	mass of electrode before electrolysis / g	mass of electrode after electrolysis / g	change in mass
mass of impure copper anode	40.0	35.0	5.0 g decrease
mass of pure copper cathode	10.0	14.8	4.8 g increase

Explain these results.

(3)

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.....

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.....

.....

(c) In an electrolysis experiment, oxide ions, O^{2-}, form oxygen gas, O_2.

Write the balanced half equation for the reaction.

(2)

*(d) Sodium chloride is an ionic compound.
It contains sodium ions, Na^+, and chloride ions, Cl^-.

When molten sodium chloride is electrolysed, sodium metal and chlorine gas are formed.

Describe how the sodium ions and chloride ions in solid sodium chloride are converted into sodium and chlorine by electrolysis.

(6)

(Total for Question 5 = 12 marks)

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Gases and ammonia

6 (a) Hydrogen reacts with oxygen to form water vapour.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

If 200 cm^3 of hydrogen react completely with 100 cm^3 of oxygen, what is the maximum volume of water vapour formed, if all volumes are measured at the same temperature and pressure?

Put a cross (☒) in the box to show your answer.

(1)

☒ **A** 100 cm^3

☒ **B** 200 cm^3

☒ **C** 300 cm^3

☒ **D** 400 cm^3

(b) Zinc reacts with dilute hydrochloric acid to form zinc chloride and hydrogen.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

Calculate the maximum volume of hydrogen formed, at room temperature and pressure, when 13.0 g of zinc reacts completely with excess hydrochloric acid.
(relative atomic mass: Zn = 65.0,
1 mol of any gas occupies 24 dm^3 at room temperature and pressure)

(2)

.....

.....

.....

.....

volume of hydrogen = ... dm^3

(c) In industry, ammonia is produced by the Haber process.

$$\text{nitrogen} + \text{hydrogen} \rightleftharpoons \text{ammonia}$$

(i) What is the source of the hydrogen used in the Haber process?

Put a cross (☒) in the box to show your answer.

(1)

☒ **A** air

☒ **B** reaction of zinc with dilute sulfuric acid

☒ **C** electrolysis of water

☒ **D** natural gas

(ii) When nitrogen reacts with hydrogen, the amount of ammonia gradually increases until it becomes constant.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Explain why the amount of ammonia remains constant.

(2)

.....

.....

.....

.....

*(d) The reaction between nitrogen and hydrogen is exothermic.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

If nitrogen and hydrogen were reacted at 90 atm pressure and 300 °C, without a catalyst, some ammonia would be formed eventually.

In the Haber process a pressure of 150 atm and a temperature of 450 °C are used, in the presence of an iron catalyst.

Explain, with reasons, why the Haber process conditions are better for the manufacture of ammonia.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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