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Please check the examination details below before entering your candidate infor on

Candidate surname | Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Tuesday 13 June 2023

Morning (Time: 1 hour 15 minutes)

Paper reference **4CH1/2C**

Chemistry

UNIT: 4CH1
PAPER: 2C

You must have:
Calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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.

Information

- The total mark for this paper is 70.
- 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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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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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind t an answer, put a line through the box ☒ and then mark your new answer with a cross ◺

1 Use the Periodic Table to help you answer this question.

(a) (i) Name the element with atomic number 14.

(1)

(ii) Name the element in Group 2 and Period 3.

(1)

(iii) Name an element that is a liquid at room temperature.

(1)

(iv) Give the electronic configuration of an atom of phosphorus.

(1)

(v) Give the formula of sodium sulfide.

(1)

(b) Explain, in terms of electron configuration, why neon is unreactive.

(2)

(Total for Question 1 = 7 marks)

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2 This question is about gases in the atmosphere.

(a) Which of these gases has the lowest percentage by volume in the atmosphere?

(1)

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

(b) When copper(II) carbonate is heated, copper(II) oxide and carbon dioxide form.

(i) What is the name of this type of reaction?

(1)

- ☒ **A** addition
- ☒ **B** decomposition
- ☒ **C** oxidation
- ☒ **D** substitution

(ii) Which colour change occurs when copper(II) carbonate is heated?

(1)

- ☒ **A** blue to black
- ☒ **B** blue to orange
- ☒ **C** green to black
- ☒ **D** green to orange

(iii) Give the chemical equation for this reaction.

(1)

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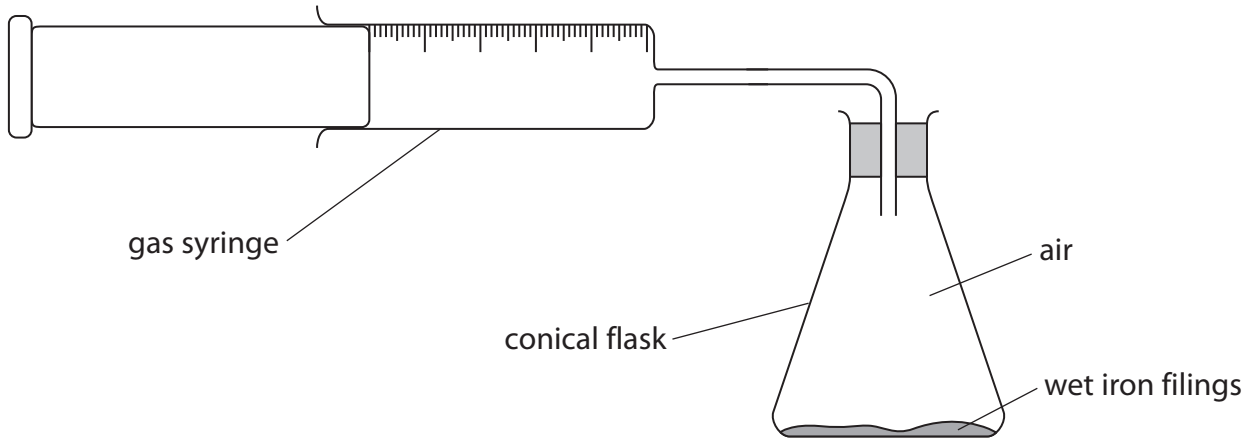
(c) A student uses this apparatus to find the percentage of oxygen in a sample of



The student leaves the apparatus until there is no further change in volume of gas in the syringe.

These are the student's results.

volume of gas in flask and connecting tube in cm^3	280
volume of gas in syringe at start in cm^3	100
volume of gas in syringe at end in cm^3	27

Calculate the percentage of oxygen in the sample of air.

Give your answer to two significant figures.

(4)

percentage of oxygen = ... %

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(d) Explain why an increasing amount of carbon dioxide in the atmosphere is likel cause a problem for the environment.

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(Total for Question 2 = 10 marks)

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3 This question is about alcohols.

Ethanol can be manufactured using two different methods.

- hydration of ethene
- fermentation of glucose

This is the equation for hydration.

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

(a) Complete the equation for fermentation.

(2)

$C_6H_{12}O_6 \rightarrow$ ..... + ...

(b) The table gives some information about the two methods.

	Hydration	**Fermentation**
Reagents	ethene and steam	aqueous glucose
Catalyst		enzymes in yeast
Temperature in °C	300	
Pressure in atmospheres		1
Rate of process	fast	slow
Purity of product	pure	impure

(i) Complete the table by giving the missing information.

(3)

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(ii) Explain one advantage and one disadvantage of using fermentation rather than hydration to produce ethanol.

You should use information from the table to help your answer.

(4)

advantage

disadvantage

(c) Explain why fermentation needs to occur in the absence of air.

(2)

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(d) Propanol has this percentage composition by mass.

C = 60.0% H = 13.3% O = 26.7%

(i) Show by calculation that the empirical formula of propanol is C_3H_8O.

(3)

(ii) Draw the displayed formula of propanol.

(1)

(Total for Question 3 = 15 marks)

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4 A student does a titration to find the concentration of potassium hydroxide solutio

This is the student's method.

- add 25.0 cm^3 of the potassium hydroxide solution to a conical flask
- add a few drops of methyl orange indicator to the conical flask
- fill a burette with dilute sulfuric acid and record the initial burette reading
- place the conical flask on a white tile
- add the acid from the burette to the mixture in the conical flask, swirling the flask continuously
- when the indicator changes colour at the end point, record the final burette reading

Repeat the titration to obtain concordant results.

(a) Give the name of the most suitable piece of apparatus to measure out 25.0 cm^3 of potassium hydroxide solution.

(1)

.....

(b) Give the colour of methyl orange in potassium hydroxide solution and in dilute sulfuric acid.

(2)

colour in potassium hydroxide solution

.....

colour in dilute sulfuric acid

.....

(c) State why the student places the conical flask on a white tile.

(1)

.....

.....

(d) State why the student swirls the flask continuously.

(1)

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(e) State what is meant by the term **concordant results**.

.....

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(f) The student finds that 15.00 cm^3 of sulfuric acid of concentration 0.180 mol / dm^3 neutralises 25.0 cm^3 of potassium hydroxide solution.

This is the equation for the reaction.

$$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$$

Calculate the concentration of the potassium hydroxide solution.

(3)

concentration = ... mol / dm^3

(g) This is the ionic equation for the reaction between an acid and an alkali.

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

Explain why the OH^- ion is a proton acceptor in this reaction.

(2)

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(Total for Question 4 = 11 marks)

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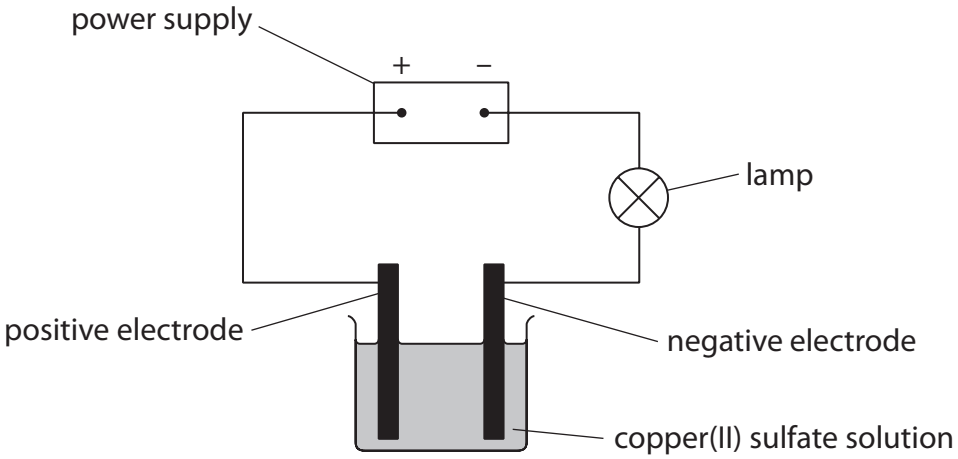
5 When copper(II) sulfate solution is electrolysed, copper forms at the negative electrode.

A student uses this apparatus to investigate the electrolysis of copper(II) sulfate solution.



(a) Describe how the student could test a sample of copper(II) sulfate solution to show that it contains copper(II) ions.

(2)

(b) Describe how copper metal forms at the negative electrode.

(3)

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(c) State the appearance of the copper that forms on the negative electrode.

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(d) Oxygen forms at the positive electrode.

(i) Give a test for oxygen.

(1)

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(ii) Complete the half-equation for the formation of oxygen at the positive electrode.

(2)

$2H_2O \rightarrow$ ..... + ... + ...

(iii) State why the formation of oxygen at the positive electrode is an oxidation reaction.

(1)

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(Total for Question 5 = 10 marks)

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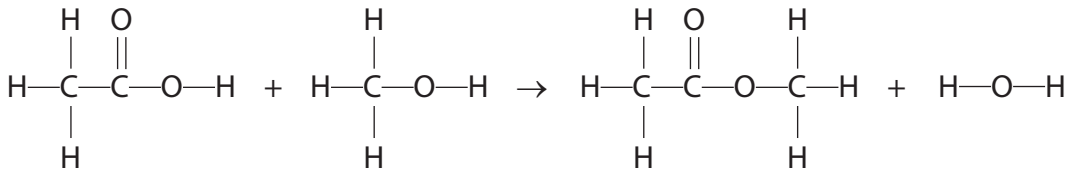
6 Ethanoic acid reacts with methanol to form an ester.

The equation shows the displayed formulae for the reactants and products.



(a) (i) Give the name of a suitable catalyst to increase the rate of this reaction.

(1)

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(ii) State how you would know that an ester has formed.

(1)

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(iii) Give the name of this ester.

(1)

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(b) The table shows the number of bonds in the reactants and the number of bon in the products.

Bond	C—H	C—C	C—O	C═O	O—H
Number of bonds in reactants	6	1	2	1	2
Number of bonds in products	6	1	2	1	2

(i) State which two bonds need to be broken in the reactants.

(1)

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(ii) Explain why the enthalpy change in this reaction is approximately 0 kJ / mol.

(2)

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(Total for Question 6 = 6 marks)

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7 Methane reacts with steam to form carbon monoxide and hydrogen.

This is the equation for the reaction.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H = +206 \text{ kJ / mol}$$

(a) State why carbon monoxide is poisonous to humans.

(1)

(b) Explain the effect, if any, on the yield of hydrogen at equilibrium when a nickel catalyst is used.

(2)

(c) The reaction conditions for this reaction are a temperature of 700 °C and a pressure of 5 atmospheres.

(i) The temperature of the reaction mixture is reduced to 600 °C, but the pressure is kept at 5 atmospheres.

Explain the effect on the yield of hydrogen at equilibrium.

(2)

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(ii) The pressure of the reaction mixture is reduced to 4 atmospheres, but the temperature is kept at 700 °C.

Explain the effect on the yield of hydrogen at equilibrium.

(2)

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(d) Calculate the volume, in dm^3, of methane gas at rtp needed to produce 6.6 tonnes of hydrogen gas.

[at rtp, molar volume = 24 dm^3 1 tonne = 10^6 g]

Give your answer in standard form.

(4)

volume of methane = ... dm^3

(Total for Question 7 = 11 marks)

TOTAL FOR PAPER = 70 MARKS

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