Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Time 1 hour 15 minutes

Paper reference **4CH1/2CR**

Chemistry

UNIT: 4CH1
PAPER: 2CR

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.

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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Q:1/1/1/

P 7 0 9 4 8 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

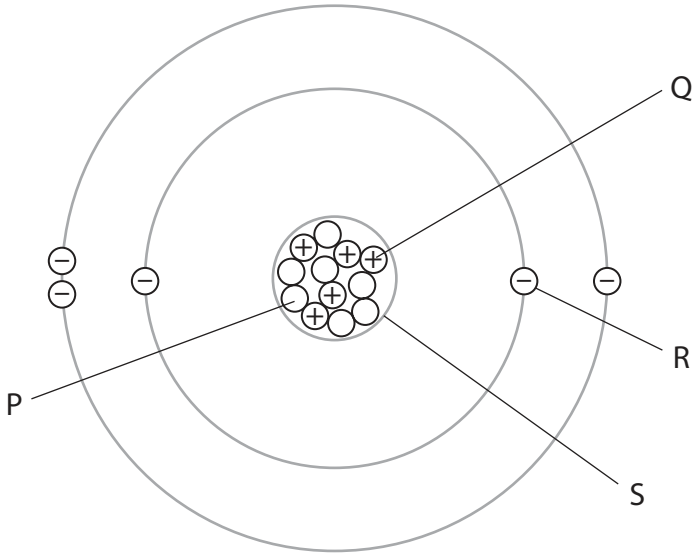
**** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.***

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

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 ☒.

1 The diagram shows the sub-atomic particles in an atom of an element.



(a) (i) Give the name of each of the sub-atomic particles labelled P, Q and R.

(3)

P .....

Q .....

R .....

(ii) Give the name of the part of the atom labelled S.

(1)

.....

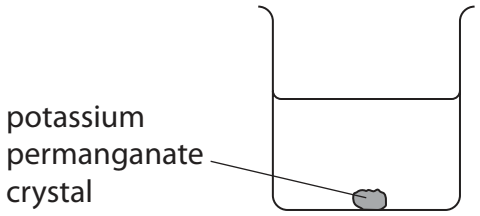
(b) Give the name of this element.

(1)

.....

(Total for Question 1 = 5 marks)

2 A potassium permanganate crystal is placed in a beaker of water.



After several days a coloured solution forms.

(a) Give the names of the two processes that cause the coloured solution to form.

(2)

1 .....

2 .....

(b) The formula of potassium permanganate is $KMnO_4$

(i) How many different types of atom are in $KMnO_4$?

(1)

☒ **A** 3

☒ **B** 4

☒ **C** 6

☒ **D** 7

(ii) Calculate the relative formula mass (M_r) of $KMnO_4$

(1)

M_r = ...

(c) Potassium permanganate can be used as an oxidising agent.

State what is meant by the term **oxidising agent**.

(1)

.....

.....

(Total for Question 2 = 5 marks)

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3 This question is about alkanes.

(a) (i) Which of these is the **molecular** formula of an alkane?

(1)

- ☒ **A** C_2H_5
- ☒ **B** C_4H_{10}
- ☒ **C** CH_2CH_2
- ☒ **D** $CH_3CH_2CH_3$

(ii) Which of these has the same empirical formula and molecular formula?

(1)

- ☒ **A** CH_2
- ☒ **B** C_2H_6
- ☒ **C** C_3H_8
- ☒ **D** C_4H_{10}

(b) In the presence of ultraviolet radiation, methane reacts with bromine to form bromomethane and hydrogen bromide.

(i) State the name of this type of reaction.

(1)

.....

(ii) Give a chemical equation for this reaction.

(1)

.....

(c) One mole of an alkane burns completely in oxygen.

The equation represents the reaction.

$$\text{alkane} + x\text{O}_2 \rightarrow y\text{CO}_2 + z\text{H}_2\text{O}$$

The numbers *x*, *y* and *z* are used to balance the equation.

(i) The complete combustion of one mole of the alkane produces 220 g of carbon dioxide and 108 g of water.

Calculate the values of *y* and *z*.

[M_r of $CO_2 = 44$ M_r of $H_2O = 18$]

(2)

y = ...

z = ...

(ii) Determine the molecular formula of the alkane and the value of *x*.

(2)

molecular formula = ...

x = ...

(d) When an alkane burns in a limited supply of air, incomplete combustion occurs.

Explain why incomplete combustion of an alkane could be harmful to humans.

(2)

.....

.....

.....

.....

(Total for Question 3 = 10 marks)

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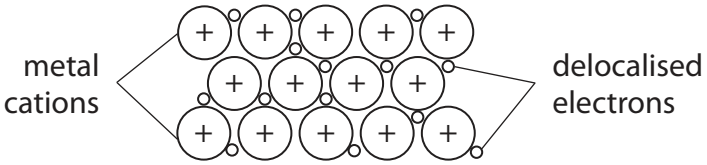
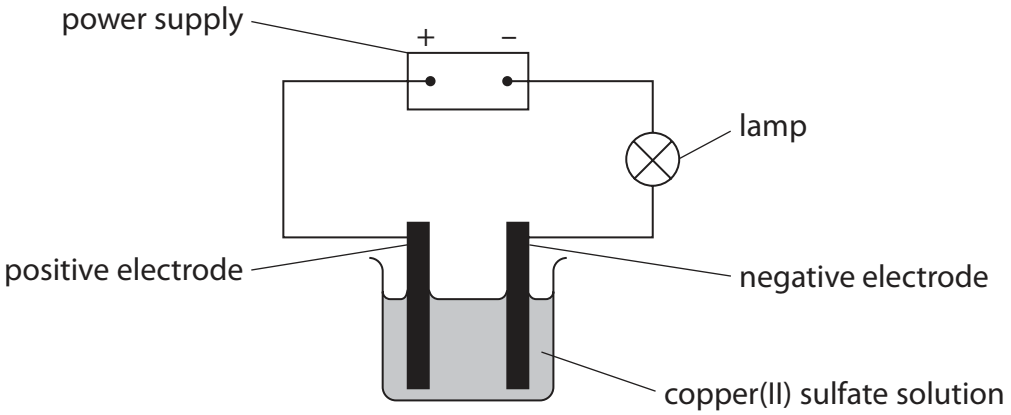
4 (a) The diagram represents the structure of copper metal.



Explain three properties of copper that make it a suitable metal to use in electrical wiring.

(5)

(b) The diagram shows the electrolysis of copper(II) sulfate solution, using graphite electrodes.



Copper forms at the negative electrode and oxygen forms at the positive electrode.

(i) Give the formula of the copper ion and the formula of the sulfate ion in copper(II) sulfate.

(1)

copper ion

.....

sulfate ion

.....

(ii) State what would be seen at the positive electrode.

(1)

.....

.....

(iii) Give a test for oxygen.

(1)

.....

.....

(iv) Give an ionic half-equation for the formation of oxygen at the positive electrode.

(2)

.....

(v) Suggest why the copper(II) sulfate solution contains some OH^- ions.

(1)

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(Total for Question 4 = 11 marks)

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5 This question is about alcohols, carboxylic acids and esters.

(a) Ethanol can be manufactured by the fermentation of a solution of glucose.

(i) Write a word equation for this reaction.

(1)

.....

(ii) State the substance that needs to be added for the reaction to occur.

(1)

.....

(iii) State two conditions needed for this reaction.

(2)

1 .....

2 .....

(b) In the presence of an acid catalyst, ethanoic acid is heated with butanol to form an ester.

(i) Which of these is the formula of the ester?

(1)

☒ **A** $CH_3COOC_3H_7$

☒ **B** $CH_3COOC_4H_9$

☒ **C** $C_2H_5COOC_4H_9$

☒ **D** $C_3H_7COOC_2H_5$

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

(1)

.....

.....

(iii) Give one use of an ester.

(1)

.....

.....

(c) Aspirin is a compound used to reduce pain.

Aspirin contains a carboxylic acid functional group and an ester functional group.

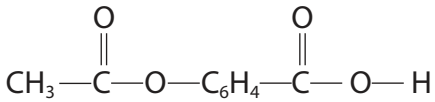
(i) State what is meant by the term **functional group**.

(1)

.....

.....

(ii) This is the structural formula of aspirin.



Draw a circle around the carboxylic acid functional group.

(1)

(iii) Aspirin has this percentage composition by mass.

C = 60.00 % H = 4.44 % O = 35.56 %

Show by calculation that the empirical formula of aspirin is $C_9H_8O_4$

(3)

(Total for Question 5 = 12 marks)

6 A student uses this method to do a titration.

- use a measuring cylinder to obtain 25 cm^3 of sodium hydroxide solution
- transfer the solution to a conical flask
- add a few drops of universal indicator to the flask
- fill a burette with dilute sulfuric acid and record the initial burette reading
- add the acid to the flask, swirling the flask continuously
- add the acid slowly near the end-point
- record the final burette reading at the end-point

The student repeats the titration until at least two concordant results are obtained.

(a) State what is meant by concordant results.

(1)

(b) Explain two improvements to the student's method so that more accurate results are obtained.

(4)

(c) The student makes the improvements and repeats the titration.

The sulfuric acid has a concentration of 0.600 mol/dm^3.

The sodium hydroxide solution has a concentration of 1.50 mol/dm^3.

This is the equation for the reaction.

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

Calculate the volume, in cm^3, of sulfuric acid that the student needs to completely react with 25.0 cm^3 of the sodium hydroxide solution.

(3)

volume of sulfuric acid = ... cm^3

(d) The student plans to obtain pure dry crystals of hydrated sodium sulfate.

They add the calculated volume of sulfuric acid to 25.0 cm^3 of the sodium hydroxide solution to form sodium sulfate solution.

Describe what the student should do to obtain pure dry crystals of hydrated sodium sulfate from the solution.

(4)

(Total for Question 6 = 12 marks)

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7 In the presence of an iron catalyst, nitrogen reacts with hydrogen to form ammonia.

The reaction conditions used are a temperature of 450 °C and a pressure of 200 atmospheres.

This is the equation for the reaction.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3 \qquad \Delta H = -92\,\text{kJ/mol}$$

(a) (i) State what the symbol $\rightleftharpoons$ represents.

(1)

.....

.....

(ii) Give the reason for using a catalyst.

(1)

.....

.....

(b) (i) The reaction mixture is kept at a pressure of 200 atmospheres, but the temperature is increased to 550 °C.

Explain the effect of this change on the yield of ammonia at equilibrium.

(2)

.....

.....

.....

.....

(ii) The reaction mixture is kept at a temperature of 450 °C, but the pressure is increased to 300 atmospheres.

Explain the effect of this change on the yield of ammonia at equilibrium.

(2)

.....

.....

.....

.....

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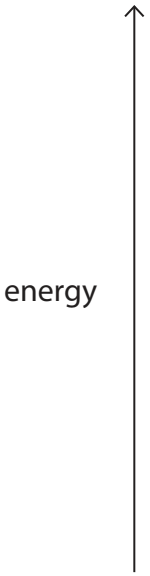
(c) Draw an energy level diagram for the reaction between nitrogen and hydrogen.

Include the reactants, products and ΔH in your diagram.

(3)



QUESTION 7 CONTINUES ON NEXT PAGE

(d) At the start of the reaction, 48 dm^3 of nitrogen is added to 120 dm^3 of hydrogen at rtp.

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

[molar volume of any gas at rtp = 24 dm^3]

(i) Show by calculation that the nitrogen is in excess.

(3)

(ii) The yield of ammonia at equilibrium is 20 %.

Calculate the volume, in dm^3, of ammonia formed from 120 dm^3 of hydrogen.

(3)

volume of ammonia = ... dm^3

(Total for Question 7 = 15 marks)

TOTAL FOR PAPER = 70 MARKS