Please check the examination details below before entering your candidate information			
Candidate surname		Other names	
Centre Number Candidate Number			
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	
33.33.430,74.63			

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 ▶





The Periodic Table of the Elements

0	4 He helium 2	20 Ne neon 10	40 Ar argon 18	84 Kr krypton 36	131 Xe xenon 54	[222] Rn radon 86	fully
7		19 F fluorine 9	35.5 CI chlorine 17	80 Br bromine 35	127 	[210] At astatine 85	orted but not
9		16 Oxygen 8	32 S sulfur 16	79 Se selenium 34	128 Te tellurium 52	[209] Po polonium 84	ve been repo
2		14 N nitrogen 7	31 P phosphorus 15	75 As arsenic 33	122 Sb antimony 51	209 Bi bismuth 83	s 112–116 ha authenticated
4		12 C carbon 6	28 Si silicon 14	73 Ge germanium 32	Sn tin 50	207 Pb lead 82	Elements with atomic numbers 112–116 have been reported but not fully authenticated
က		11 boron 5	27 AI aluminium 13	70 Ga gallium 31	115 In indium 49	204 T thallium 81	ents with ator
	'			65 Zn zinc 30	112 Cd cadmium 48	201 Hg mercury 80	Eleme
				63.5 Cu copper 29	108 Ag silver 47	197 Au gold 79	[272] Rg roentgenium
				59 Ni nickel 28	106 Pd palladium 46	195 Pt platinum 78	Ds dermstadtium 110
				59 Co cobalt 27	103 Rh rhodium 45	192 Ir iridium 77	[268] Mt meitherium 109
	1 hydrogen			56 Fe	101 Ru ruthenium 44	190 Os osmium 76	[277] Hs hassium 108
1				55 Mn manganese 25	[98] Tc technetium 43	186 Re rhenium 75	[264] Bh bohium 107
		nass Iol umber		52 Cr chromium 24	96 Mo molybdenum 42	184 W tungsten 74	[266] Sg seaborgium 106
	Key relative atomic mass atomic symbol name atomic (proton) number			51 V vanadium 23	93 Nb niobium 41	181 Ta tantalum 73	[262] Db dubnium 105
		relativ ato atomic		48 Ti titanium 22	91 Zr zirconium 40	178 Hf hafhium 72	[261] Rf rutherfordium 104
	'			45 Sc scandium 21	89 × yttrium 39	139 La* lanthanum 57	[227] Ac* actinium 89
7		9 Be beryllium 4	24 Mg magnesium	40 Ca calcium 20	Sr strontium 38	137 Ba barium 56	[226] Ra radium 88
—		7 Li lithium 3	23 Na sodium 11	39 K potassium 19	85 Rb rubidium 37	133 Cs caesium 55	[223] Fr francium 87

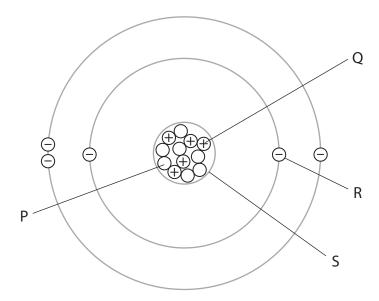
* The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.

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 \boxtimes . If you change your mind about an answer, put a line through the box \boxtimes and then mark your new answer with a cross \boxtimes .

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)

(1)

0

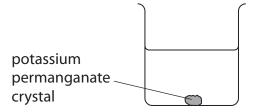
Q

(ii) Give the name of the part of the atom labelled S. (1)

(b) Give the name of this element.

(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)

- (b) The formula of potassium permanganate is KMnO₄
 - (i) How many different types of atom are in KMnO₄?

(1)

- X **A** 3

- D
- (ii) Calculate the relative formula mass (M_r) of KMnO₄

(1)

(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)

- \square A C_2H_5
- B C₄H₁₀
- C CH₂CH₂
- ☑ D CH₃CH₂CH₃
- (ii) Which of these has the same empirical formula and molecular formula?

(1)

- A CH₂
- B C₂H₆
- \square **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.

alkane +
$$xO_2 \rightarrow yCO_2 + zH_2O$$

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.

$$[M_r \text{ of } CO_2 = 44 \qquad M_r \text{ of } H_2O = 18]$$

(2)

$$z =$$

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

(2)

(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)

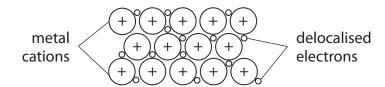
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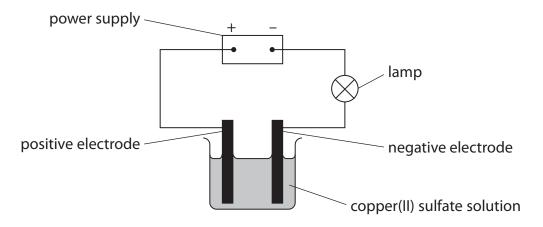
4 (a) The diagram represents the structure of copper metal.



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.

(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)

- (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)

- \blacksquare **A** CH₃COOC₃H₇
- \square **B** CH₃COOC₄H₉
- \Box **C** $C_2H_5COOC_4H_9$
- \square **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 C₉H₈O₄

(3)

(Total for Question 5 = 12 marks)

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- **6** A student uses this method to do a titration.
 - use a measuring cylinder to obtain 25 cm³ 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)

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

The sulfuric acid has a concentration of 0.600 mol/dm³.

The sodium hydroxide solution has a concentration of 1.50 mol/dm³.

This is the equation for the reaction.

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

Calculate the volume, in cm³, of sulfuric acid that the student needs to completely react with 25.0 cm³ of the sodium hydroxide solution.

(3)

volume of sulfuric acid =cm³



(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)
	(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)



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

Include the reactants, products and ΔH in your diagram.

(3)

energy

QUESTION 7 CONTINUES ON NEXT PAGE

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(d) At the start of the reaction, $48\,\mathrm{dm^3}$ of nitrogen is added to $120\,\mathrm{dm^3}$ 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 dm³, of ammonia formed from 120 dm³ of hydrogen.

(3)

volume of ammonia =dm³

(Total for Question 7 = 15 marks)

TOTAL FOR PAPER = 70 MARKS

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