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)

Tuesday 14 November 2023

Morning (Time: 2 hours)

Paper reference **4CH1/1C 4SD0/1C**

Chemistry

UNIT: 4CH1
Science (Double Award) 4SD0
PAPER: 1C

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 110.
- 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 ▶

P73423A

P 7 3 4 2 3 A 0 1 2 8

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.

BLANK PAGE

Answer ALL questions.

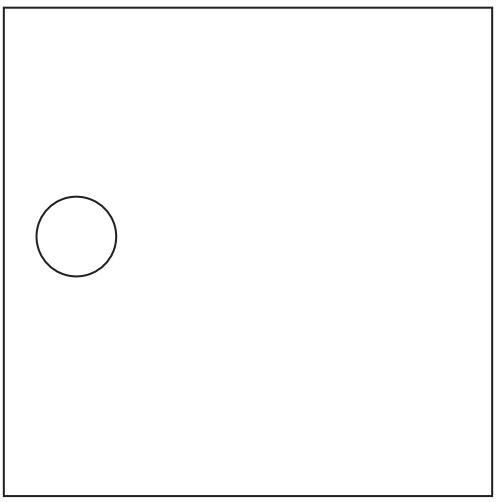
Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 A substance can exist in three states of matter, solid, liquid or gas.

When a liquid evaporates at room temperature it changes into a gas.

(a) Complete the diagram to show the arrangement of another four particles in a gas.

(1)



(b) Explain why heating a liquid causes it to evaporate more quickly.

(2)

.....

.....

.....

.....

(c) When the temperature decreases, water in the gas state changes to a liquid.

(i) Give the name of this change of state.

(1)

.....

(ii) Write an equation, including state symbols, to show the change of state of water from a gas to a liquid.

(1)

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(d) Describe the arrangement and movement of particles in a solid.

(2)

.....

.....

.....

.....

(Total for Question 1 = 7 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

2 (a) Table 1 shows some relative masses and charges of subatomic particles.

Complete table 1 by giving the missing information.

(2)

	Electron	Proton	Neutron
Relative mass	0.0005		
Relative charge			0

Table 1

(b) Table 2 gives the number of protons, neutrons and electrons in atoms and ions of some elements.

The letters are **not** the symbols of the elements.

Atom or ion	Protons	Neutrons	Electrons
P	3	4	2
Q	5	5	5
R	5	6	5
S	7	7	7
T	8	8	8
U	8	8	10

Table 2

(i) What is the atomic number of P in table 2?

(1)

☒ **A** 2

☒ **B** 3

☒ **C** 4

☒ **D** 7

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii) What is the mass number of U in table 2?

(1)

- ☒ **A** 8
- ☒ **B** 16
- ☒ **C** 18
- ☒ **D** 26

(iii) Give the letter in table 2 that represents an element in Group 5 of the Periodic Table.

(1)

.....

(c) Q and R represent isotopes of the same element.

(i) Explain, in terms of subatomic particles, why Q and R are isotopes.

(2)

.....

.....

.....

.....

(ii) A sample containing the isotopes Q and R has this percentage composition by mass.

Q = 20.6 % R = 79.4 %

Calculate the relative atomic mass (A_r) of this sample of the element.

Give your answer to one decimal place.

(3)

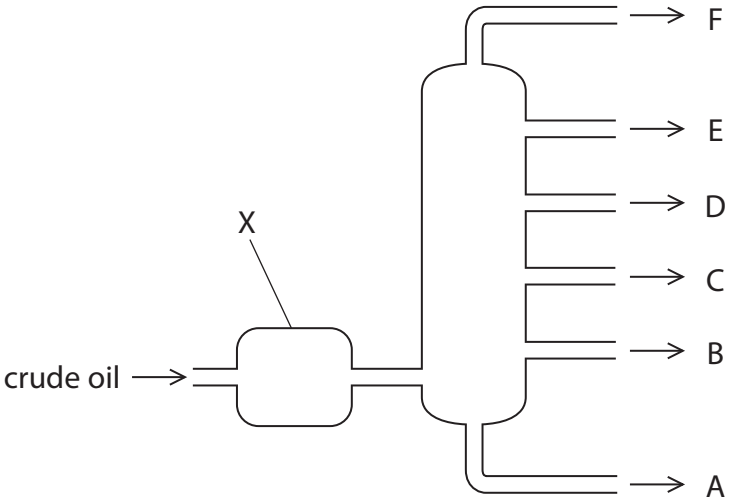
A_r = ...

(Total for Question 2 = 10 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

3 Crude oil is an important source of organic compounds.

(a) The diagram shows how crude oil can be separated into useful mixtures of hydrocarbons.



(i) Give the name of this method of separation.

(1)

.....

(ii) State what happens to the crude oil when it is in X.

(1)

.....

.....

(iii) Give the letter of the mixture that is most likely to contain a hydrocarbon with six carbon atoms.

(1)

.....

(iv) Give the name of mixture D.

(1)

.....

(v) Give a use for mixture B.

(1)

.....

.....

(b) Explain, in terms of intermolecular forces, why a hydrocarbon in mixture B has a higher boiling point than a hydrocarbon in mixture D.

(3)

(c) Catalytic cracking can be used to break down long-chain hydrocarbons to produce shorter-chain alkanes and alkenes.

(i) Give the name of a catalyst used in catalytic cracking.

(1)

(ii) Complete the equation to show two different alkenes that could be produced in this cracking reaction.

(2)

$C_{15}H_{32} \rightarrow C_8H_{18} +$ ..... $+$ .....

(iii) Give one important use for short-chain alkenes.

(1)

(Total for Question 3 = 12 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

4 This question is about gases.

(a) The table gives information about five gases.

Name of gas	argon	carbon dioxide	hydrogen	oxygen	nitrogen
Formula of gas	Ar	CO_2	H_2	O_2	N_2
M_r of gas	40		2	32	28

Use information from the table to answer these questions.
Each gas may be used once, more than once or not at all.

(i) Give the name of the gas that is about 79% of the atmosphere by volume.

(1)

.....

(ii) Give the name of the gas that is a compound.

(1)

.....

(iii) Give the name of the least reactive gas.

(1)

.....

(iv) Give the name of the gas that is not normally found in the atmosphere.

(1)

.....

(v) Give the name of the gas that affects global warming.

(1)

.....

(vi) Calculate the M_r for carbon dioxide.

(1)

M_r = ...

(vii) Give a reason why it is not possible to give information for air in the table.

(1)

.....

.....

(b) When copper(II) carbonate is heated, the products are copper(II) oxide and carbon dioxide.

(i) Give the name for this type of reaction.

(1)

.....

(ii) Give the colour change that occurs during this reaction.

(2)

..... to .....

(iii) Give a chemical equation for this reaction.

(1)

.....

(Total for Question 4 = 11 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

5 This question is about alkanes and alkenes.

(a) The alkane C_4H_{10} exists as two isomers.

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

(2)

.....

.....

.....

.....

(ii) Draw the displayed formulae for the two isomers of C_4H_{10}

(2)

Isomer 1	Isomer 2

(b) Ethane (C_2H_6) can react with bromine.

(i) State the condition needed for ethane to react with bromine.

(1)

.....

(ii) Complete the equation for this reaction.

(1)

$C_2H_6 + Br_2 \rightarrow$ ..... + ...

(iii) Give the name for this type of reaction.

(1)

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) Explain why ethane is described as a saturated compound.

(2)

(d) State what you would observe when ethane and ethene are added separately to two samples of bromine water.

(2)

ethane

ethene

(e) Explain why straight-chain alkenes always have the same empirical formula, but straight-chain alkanes have different empirical formulae.

Refer to the molecular formulae of the alkanes C_2H_6 and C_4H_{10} in your answer.

(3)

(f) An organic compound has this percentage composition by mass.

C = 19.2 % H = 4.0 % O = 12.8 % Br = 64.0 %

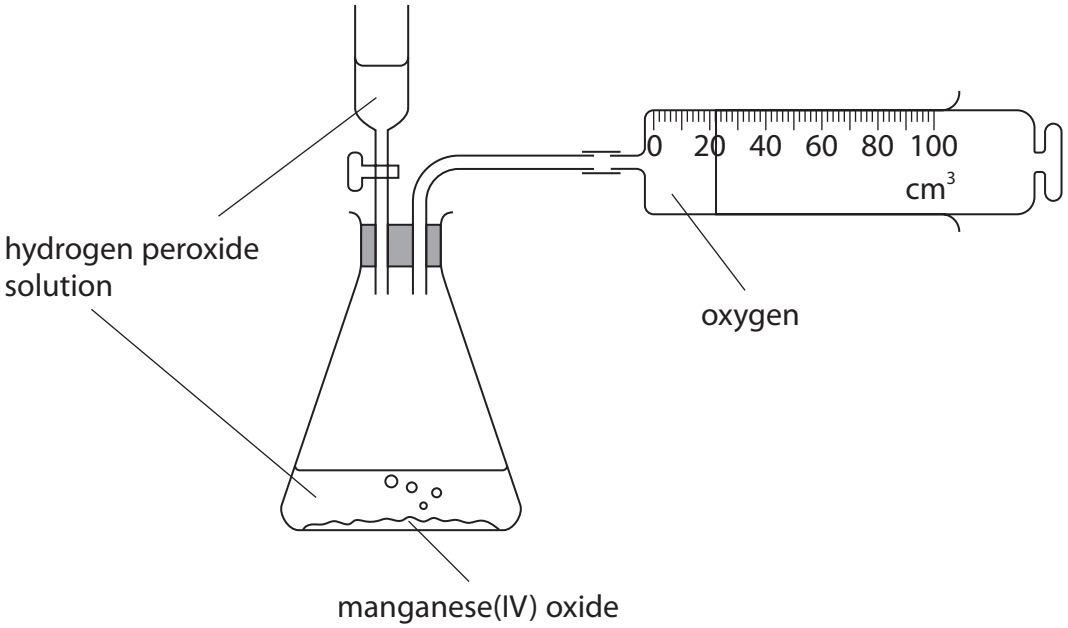
Calculate the empirical formula of this compound.

(3)

empirical formula = ...

(Total for Question 5 = 17 marks)

6 A student uses this apparatus to investigate the decomposition of hydrogen peroxide solution.



This is the equation for the reaction.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

(a) Give the test for oxygen.

(1)

.....

.....

(b) Complete the dot-and-cross diagram for a molecule of hydrogen peroxide.

Show outer electrons only.

(2)

H O O H

(c) The student measures the volume of oxygen collected at regular intervals until the reaction stops.

The table shows the student's results.

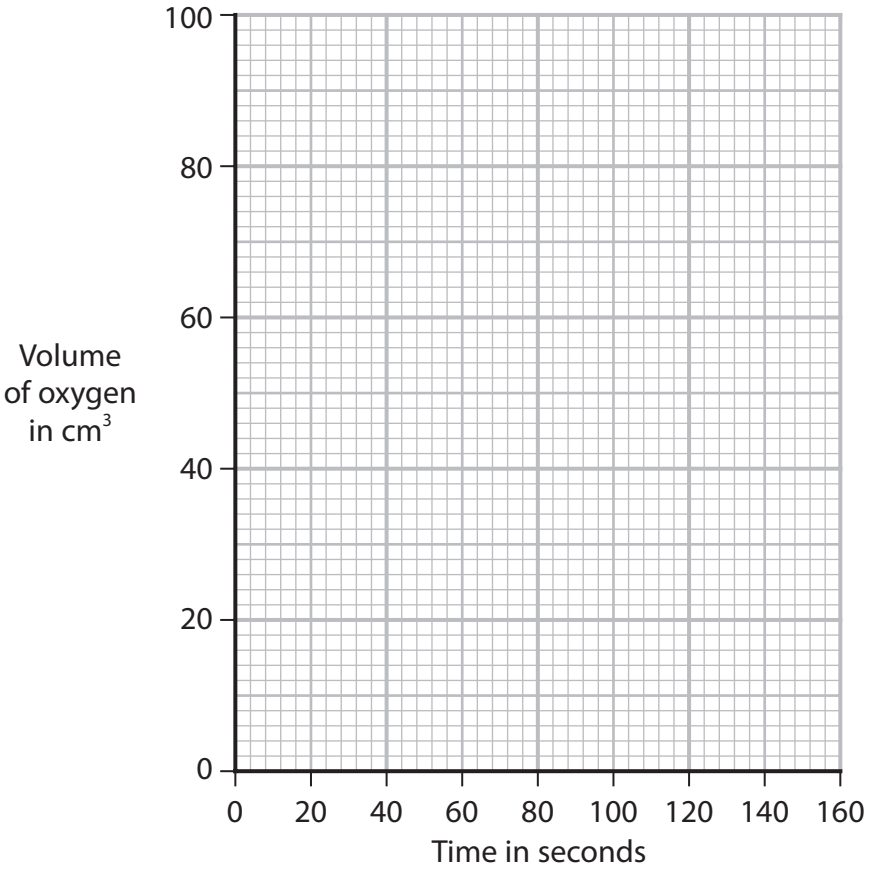
Time in seconds	0	20	40	60	80	100	120	140	160
Volume of oxygen in cm^3	0	24	44	62	78	88	94	94	94

(i) Plot the student's results on the grid.

(1)

(ii) Draw a curve of best fit.

(1)



(d) (i) Explain in terms of particle collision theory how decreasing the concentration affects the rate of a reaction.

(3)

(ii) The student repeats the experiment using the same volume of hydrogen peroxide solution but with half the original concentration.

All other conditions are kept the same.

On the grid, draw the curve you would expect the student to obtain.

(2)

(e) In this reaction, the manganese(IV) oxide acts as a catalyst.

Explain how a catalyst works.

(2)

(Total for Question 6 = 12 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

7 (a) A technician needs to identify the solution in an unlabelled bottle.

The technician knows that the solution contains one of these compounds.

- iron(II) bromide
- iron(II) chloride
- iron(III) bromide
- iron(III) chloride

Describe how the technician can use chemical tests to identify the compound.

(6)

(b) When chlorine gas is passed over heated iron powder, iron(III) chloride forms.

This is the equation for the reaction.

$$2Fe + 3Cl_2 \rightarrow 2FeCl_3$$

0.060 mol of chlorine gas is passed over 2.8 g of iron powder.

Show by calculation that the iron powder is in excess.

(3)

(c) When iron(III) chloride dissolves in water, an acidic solution forms.

(i) Give the colour of litmus in this solution.

(1)

.....

(ii) Give the formula of the ion that causes the solution to be acidic.

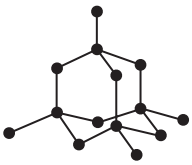
(1)

.....

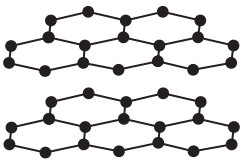
(Total for Question 7 = 11 marks)

8 Diamond and graphite are made of carbon atoms, joined together by covalent bonds.

The diagram shows their structures.



diamond



graphite

(a) State, in terms of electrostatic attractions, what is meant by a covalent bond.

(2)

(b) Explain why diamond has a high melting point.

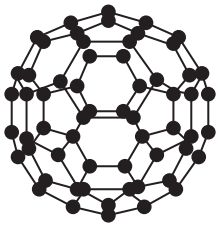
(3)

(c) Explain why graphite is a good conductor of electricity.

(2)

(d) C_{60} fullerene is a molecule made of 60 carbon atoms.

The diagram shows the structure of C_{60} fullerene.



One mole of atoms contains 6.0×10^{23} atoms.

Determine the number of atoms in one mole of C_{60} fullerene.

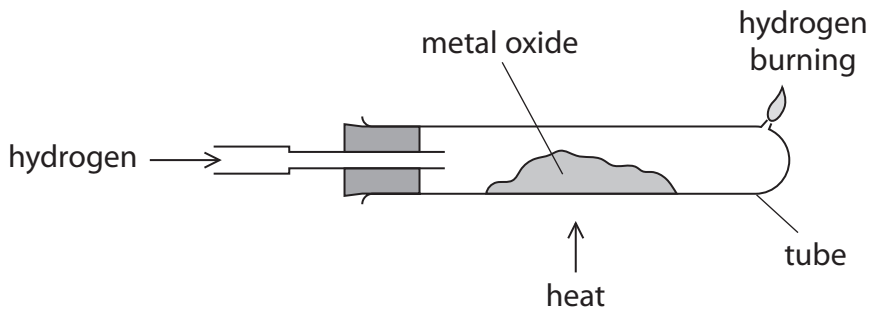
Give your answer in standard form.

(2)

number of atoms = ...

(Total for Question 8 = 9 marks)

9 A scientist uses this apparatus in an experiment to reduce a metal oxide to a metal.



Before heating the mass of the empty tube and the mass of the tube and the metal oxide are recorded.

After heating, the tube is allowed to cool and the mass of the tube and its contents is recorded again.

(a) (i) State why the reaction of the metal oxide to form a metal is described as a reduction reaction.

(1)

.....

.....

(ii) State why it is important to relight the hydrogen at the end of the tube if the flame goes out.

(1)

.....

.....

(iii) Explain why it is important to continue passing hydrogen into the tube and burning the hydrogen at the end of the tube until the contents have cooled.

(2)

.....

.....

.....

.....

(iv) Describe what should be done next to ensure that all the metal oxide has been converted into the metal.

(2)

.....

.....

.....

.....

(b) In this experiment a mass of 4.14 g of metal is formed from 4.46 g of the metal oxide.

(i) Calculate the amount, in moles, of oxygen atoms in the sample of the metal oxide.

(2)

amount of oxygen atoms = ... mol

(ii) The formula of the metal oxide is MO, where M represents the symbol of the metal.

Deduce the amount, in moles, of M in the sample of the metal oxide.

(1)

amount of M = ... mol

(iii) Calculate the relative atomic mass of M.

(2)

relative atomic mass of M = ...

(iv) Use the Periodic Table to identify metal M.

(1)

.....

(Total for Question 9 = 12 marks)

10 This method is used in an experiment to produce hydrated zinc nitrate crystals.

- pour 50 cm^3 of dilute nitric acid into a beaker
- add a spatula of zinc powder to the acid
- add more zinc until it is in excess
- filter the mixture
- obtain crystals of zinc nitrate from the filtrate

(a) State why the mixture is filtered.

(1)

(b) Describe how a pure, dry sample of hydrated zinc nitrate crystals could be obtained from the filtrate.

(4)

(c) This equation represents the formation of hydrated zinc nitrate in the experiment.

$$Zn(s) + 2HNO_3(aq) + 6H_2O(l) \rightarrow Zn(NO_3)_2.6H_2O(aq) + H_2(g)$$

(i) In another experiment, 9.75 g of zinc is completely reacted with nitric acid.

Show that the maximum possible mass of hydrated zinc nitrate crystals that could be formed is approximately 45 g.

[for $Zn(NO_3)_2.6H_2O$, $M_r = 297$]

(2)

(ii) The actual yield of hydrated zinc nitrate crystals is 36.4 g.

Calculate the percentage yield of hydrated zinc nitrate crystals.

(2)

percentage yield = ... %

(Total for Question 10 = 9 marks)

TOTAL FOR PAPER = 110 MARKS

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

BLANK PAGE

BLANK PAGE