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 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 ▶

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Q:1/1/1/

P 7 0 9 4 5 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

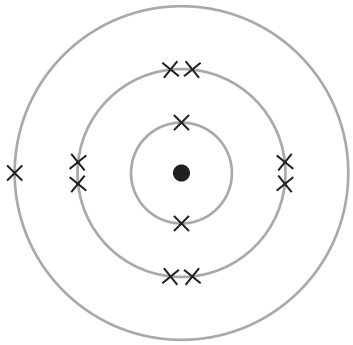
**** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.***

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

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 electronic configuration of an atom of an element.



(a) Name the part of the atom that contains the protons and neutrons.

(1)

.....

(b) Give the number of protons in this atom.

(1)

.....

(c) Give the number of the group that contains this element.

(1)

.....

(d) Give the number of the period that contains this element.

(1)

.....

(e) Give the charge on the ion formed from this atom.

(1)

.....

(Total for Question 1 = 5 marks)

2 (a) The box shows some changes of state.

boiling	condensation	evaporation
freezing	melting	sublimation

The table lists some physical changes.

Complete the table using words from the box to show the change of state for each physical change.

(4)

Physical change	Change of state
water to ice	
steam to water	
solid wax to liquid wax	
iodine crystals to iodine vapour	

(b) A student plans to obtain salt crystals from a mixture of salt and sand.

The student adds pure water to the mixture to dissolve the salt.

(i) State two things the student could do to make the salt dissolve quickly.

(2)

1 .....

2 .....

(ii) State what the student should do next to separate the sand from the salt solution.

(1)

.....

.....

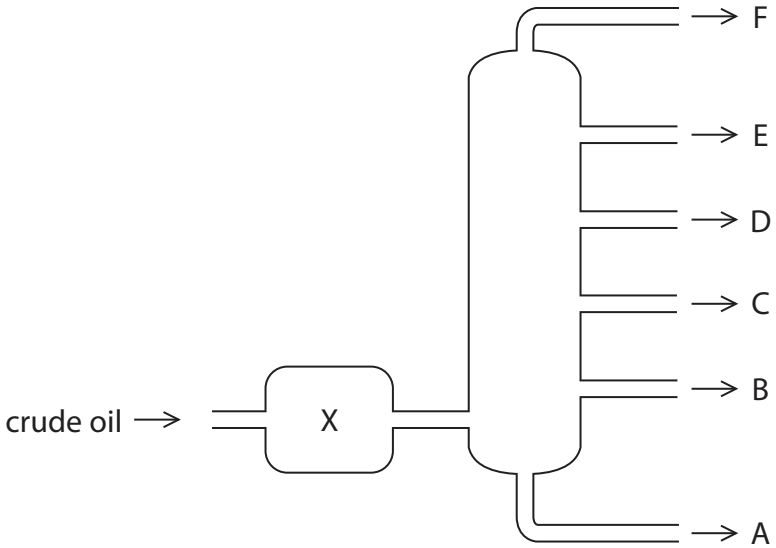
(iii) Describe how the student can obtain pure dry crystals of salt from the salt solution.

(4)

(Total for Question 2 = 11 marks)

3 Crude oil is an important source of organic compounds.

(a) The diagram shows how crude oil can be separated into fractions by fractional distillation.



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

(1)

.....

.....

(ii) Give the name of fraction E.

(1)

.....

(iii) Give a use for fraction A.

(1)

.....

(b) One of the compounds in fraction D is tridecane ($C_{13}H_{28}$) which can be cracked to form shorter-chain hydrocarbons.

(i) State the catalyst and temperature used in this cracking reaction.

(2)

catalyst

.....

temperature

.....

(ii) The equation shows an example of a catalytic cracking reaction.

$$C_{13}H_{28} \rightarrow C_8H_{18} + C_2H_4 + C_3H_6$$

Give two reasons why this reaction is important.

(2)

1 .....

.....

.....

2 .....

.....

.....

(c) Sulfur is an impurity in crude oil.
Explain why this is a problem for the environment.

(3)

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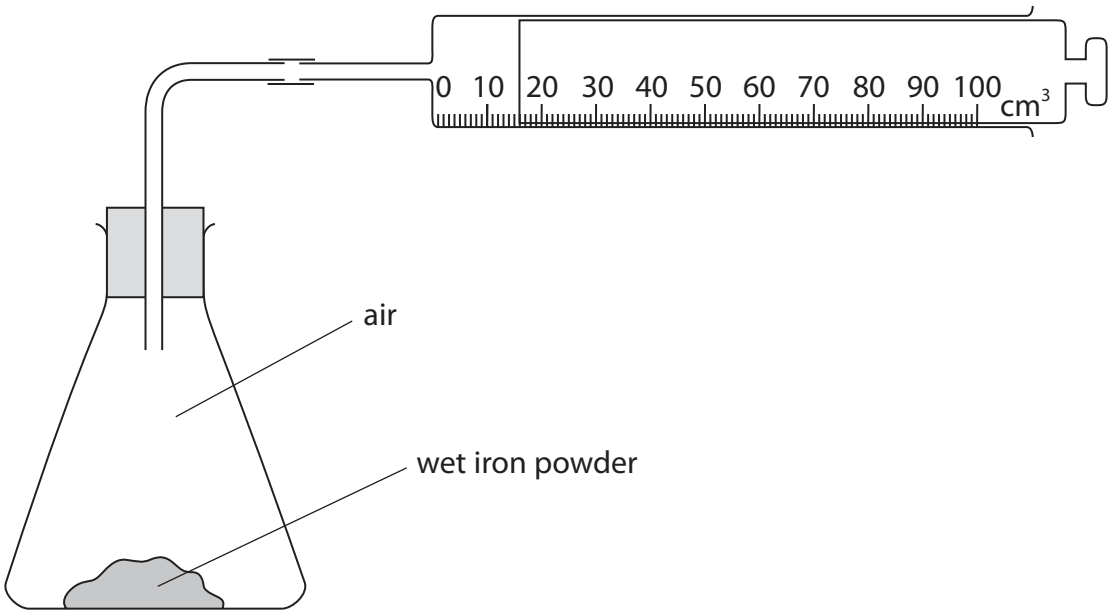
(Total for Question 3 = 10 marks)

4 A student uses the reaction between iron and oxygen to find the percentage of oxygen in air.

The diagram shows the apparatus the student uses.



(a) (i) State why the iron powder needs to be wet.

(1)

.....

.....

(ii) State the colour of the compound formed in the reaction between iron and oxygen.

(1)

.....

(iii) Give the formula of the compound formed.

(1)

.....

(iv) Explain the advantage of using iron powder rather than pieces of iron.

(2)

.....

.....

.....

.....

(b) The syringe in the diagram shows the reading at the end of the experiment.

Complete table 1 to show the readings on the syringe.

Give both values to the nearest 1 cm^3.

(2)

syringe reading at start	
syringe reading at end	
change in volume in cm^3	65

Table 1

(c) The student repeats the experiment and obtains a different set of results.

Table 2 shows these results.

volume of air in conical flask and glass tube in cm^3	260
syringe reading at start	90
syringe reading at end	22

Table 2

Use the results from table 2 to calculate the percentage by volume of oxygen in the air.

(3)

percentage by volume of oxygen in air = ... %

(Total for Question 4 = 10 marks)

5 This question is about alkanes and alkenes.

(a) The alkane C_5H_{12} has three isomers.

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

(2)

.....

.....

.....

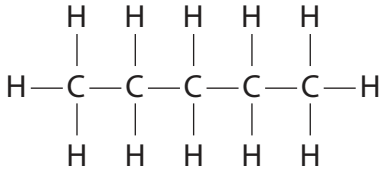
.....

(ii) Calculate the relative formula mass (M_r) of C_5H_{12}

(1)

M_r of C_5H_{12} = ...

(iii) This is the displayed formula of one of the isomers.



Give the name of this isomer.

(1)

.....

(iv) Draw the displayed formulae of the other two isomers.

(2)

Isomer 1	Isomer 2

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(b) Ethane (C_2H_6) and ethene (C_2H_4) both react with bromine.

Describe the differences in the reactions of ethane and ethene with bromine.

Refer to the conditions, the products and the types of reaction involved.

(5)

(Total for Question 5 = 11 marks)

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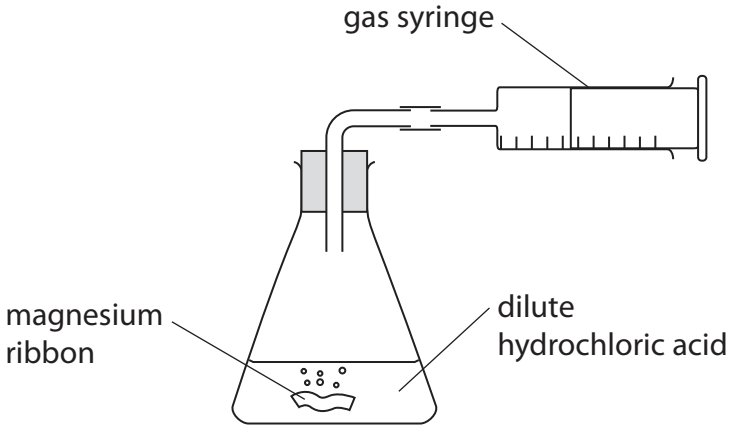
6 A student uses this apparatus to investigate the reaction between magnesium and dilute hydrochloric acid.



(a) The word equation for the reaction is

magnesium + hydrochloric acid → magnesium chloride + hydrogen

(i) Complete the chemical equation for this reaction.

(1)

Mg + 2HCl → ..... + ...

(ii) Give the test for hydrogen.

(1)

.....

.....

(iii) The student uses 0.090 g of magnesium and 0.025 mol of hydrochloric acid.

Show by calculation that the hydrochloric acid is in excess.

(2)

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

The table shows the student's results.

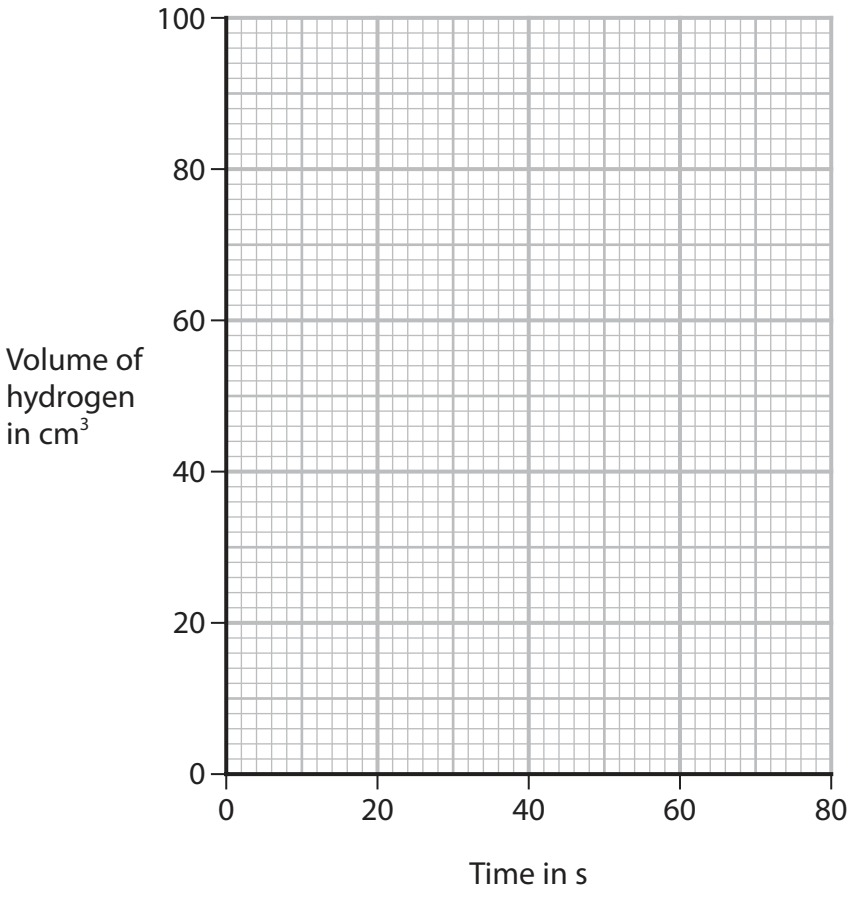
Time in s	0	15	30	45	60	75
Volume of hydrogen in cm^3	0	40	68	80	88	88

(i) Plot the student's results.

(1)

(ii) Draw a curve of best fit.

(1)



(iii) Determine the volume of hydrogen collected in the first 10 seconds.

Show on the graph how you obtained your answer.

(2)

volume of hydrogen = ... cm^3

(iv) Explain why the rate of reaction is greatest at the start of the reaction.

(2)

(c) The student repeats the experiment at a temperature 5 °C higher than the original temperature.

All other conditions are kept the same.

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

(2)

(ii) Explain, in terms of particle collision theory, how increasing the temperature affects the rate of reaction.

(3)

(Total for Question 6 = 15 marks)

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7 This question is about copper and copper compounds.

(a) A sample of copper contains two isotopes.

- Cu-63 with relative abundance 69.5%
- Cu-65 with relative abundance 30.5%

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

(2)

.....

.....

.....

.....

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

Give your answer to three significant figures.

(3)

A_r of copper = ...

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

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

(1)

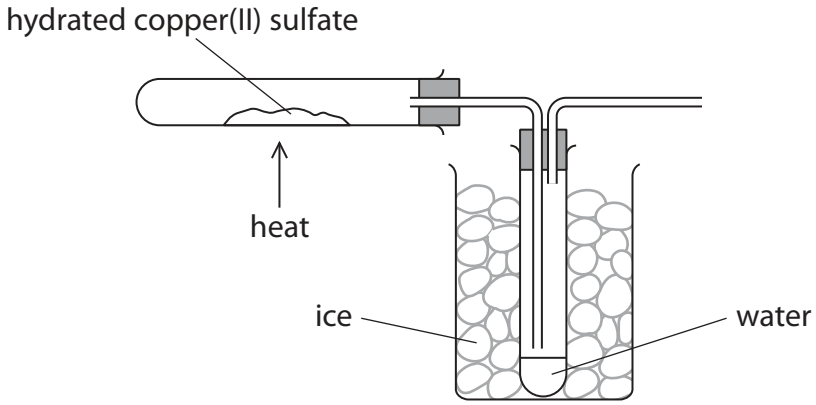
- ☒ **A** decomposition
- ☒ **B** neutralisation
- ☒ **C** oxidation
- ☒ **D** reduction

(ii) Which colour change occurs during this reaction?

(1)

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

(c) A student uses this apparatus to find the value of x in the formula $CuSO_4.xH_2O$



This is the student's method.

- find the mass of an empty boiling tube
- add hydrated copper(II) sulfate to the tube and record the new mass
- heat the hydrated copper(II) sulfate until it changes colour
- allow the tube to cool and record the mass again

The table shows the student's results.

mass of empty tube in g	20.52
mass of tube and $CuSO_4.xH_2O$ in g	31.77
mass of tube and $CuSO_4$ in g	28.20

(i) Calculate the mass of $CuSO_4$ formed.

(1)

mass of $CuSO_4$ = ... g

(ii) Calculate the mass of water formed.

(1)

mass of water = ... g

(iii) Show that the value of x is approximately 4

[M_r of $CuSO_4$ = 159.5 M_r of H_2O = 18]

(3)

(iv) The actual value of x is 5

Give a reason why the calculated value of x is lower than the actual value.

(1)

.....

.....

(Total for Question 7 = 13 marks)

8 Diamond and graphite are giant covalent structures made of carbon atoms.

The diagram shows their structures.

Diamond Graphite

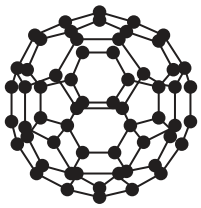
(a) Discuss the differences between diamond and graphite.

Refer to structure and bonding, electrical conductivity and hardness in your answer.

(6)

(b) C_{60} fullerene is a simple molecular substance made of 60 carbon atoms.

The diagram shows its structure.



The table shows the approximate melting points of diamond, graphite and C_{60} fullerene.

Substance	Approximate melting point in °C
diamond	4000
graphite	3600
C_{60} fullerene	600

Explain why C_{60} fullerene has a much lower melting point than diamond and graphite.

(4)

(Total for Question 8 = 10 marks)

9 This question is about the oxides of lead.

(a) Yellow lead oxide (PbO) can be reacted with hydrogen to produce lead.

(i) Complete the equation for the reaction by adding the missing state symbols.

(1)

$$PbO(s) + H_2(\ldots\ldots) \rightarrow Pb(\ldots\ldots) + H_2O(\ldots\ldots)$$

(ii) What is the charge on the lead ion in PbO?

(1)

☒ **A** 1–

☒ **B** 1+

☒ **C** 2–

☒ **D** 2+

(iii) Explain why the reaction of yellow lead oxide with hydrogen is a redox reaction.

(2)

.....

.....

.....

.....

(iv) Describe a physical test to show that the water produced in this reaction is pure.

(2)

.....

.....

.....

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(b) When red lead oxide (Pb_3O_4) is heated, yellow lead oxide forms.

The equation for the reaction is

$$2Pb_3O_4 \rightarrow 6PbO + O_2$$

A scientist heats a known mass of red lead oxide in a crucible in a fume cupboard.

The scientist leaves the crucible to cool, then records the total mass of the crucible and its contents.

(i) Describe what the scientist should do next to make sure that all the red lead oxide has reacted.

(2)

.....

.....

.....

.....

(ii) The red lead oxide used in the reaction has a mass of 5.48 g.

Calculate the maximum mass of yellow lead oxide that could form.

[M_r of Pb_3O_4 = 685 M_r of PbO = 223]

(3)

maximum mass of PbO = ... g

(Total for Question 9 = 11 marks)

10 This question is about ammonia and ammonium compounds.

(a) Ammonia (NH_3) is a simple covalent molecule.

Draw a dot-and-cross diagram to show the bonding in a molecule of ammonia.

(2)

(b) The table shows the names and formulae of some ammonium compounds.

Name	ammonium sulfate		ammonium carbonate
Formula	$(NH_4)_2SO_4$	NH_4Cl	

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

(2)

(ii) When ammonia reacts with sulfuric acid, ammonium sulfate is formed.

Write a chemical equation for this reaction.

(1)

(iii) Describe a test for ammonium ions.

(3)

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(c) The table gives some information about ammonia and ammonium compounds.

Name	Formula	Percentage of nitrogen (%)	Approximate pH in solution
ammonia	$NH_3(g)$	82	11
ammonium nitrate	$NH_4NO_3(s)$		5.5
ammonium sulfate	$(NH_4)_2SO_4(s)$	21	5.5

(i) Calculate the percentage of nitrogen in ammonium nitrate.

[M_r of NH_4NO_3 = 80]

(2)

percentage of nitrogen = ... %

(ii) Fertilisers add nitrogen to the soil to help plants grow.

Ammonia and ammonium sulfate can both be used as fertilisers.

Discuss the advantages and disadvantages of using each of these compounds as fertilisers.

Use information from the table in your answer.

[pH of rainwater is approximately 5.6]

(4)

(Total for Question 10 = 14 marks)

TOTAL FOR PAPER = 110 MARKS

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