

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Tuesday 13 June 2023

Morning (Time: 1 hour 10 minutes)

Paper reference **1SC0/2CH**

Combined Science

PAPER 5

Higher Tier

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.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- There is a periodic table on the back cover of the paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

P72563A

©2023 Pearson Education Ltd.

N:1/1/1/




Pearson

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross $\boxtimes$. 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 A student used the apparatus shown in Figure 1 to investigate the reaction between marble chips and dilute hydrochloric acid.

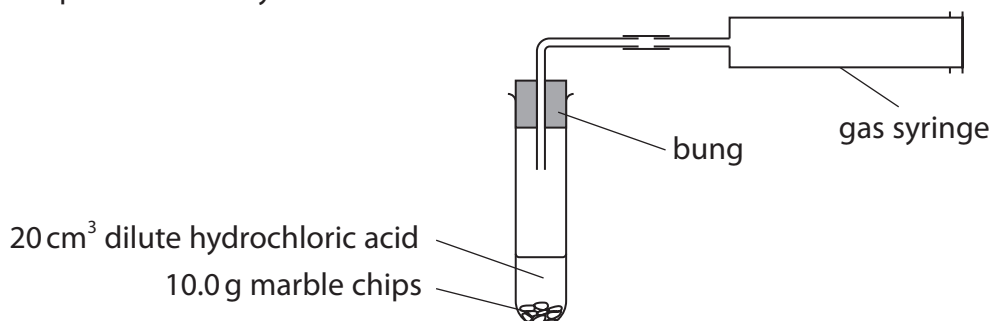


Figure 1

The student recorded the volume of gas every minute as shown in Figure 2.

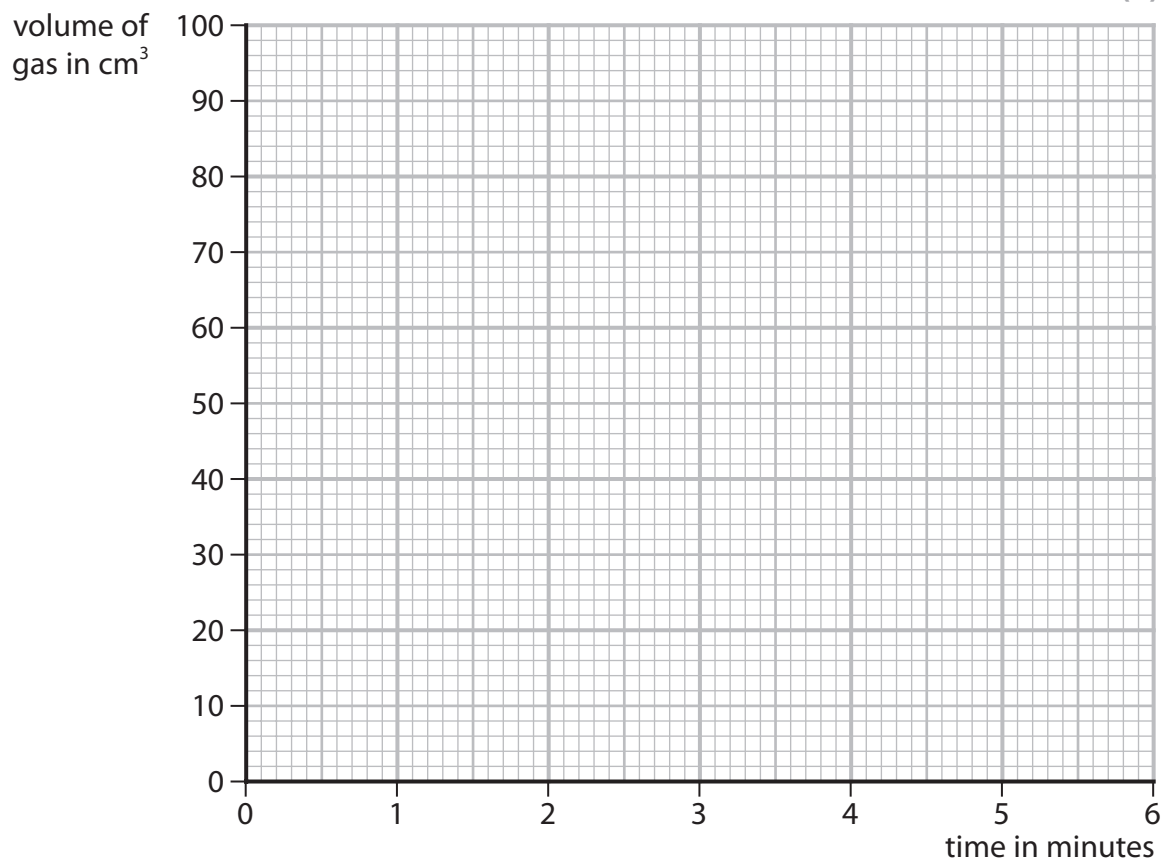
time in minutes	0	1	2	3	4	5	6
volume of gas in cm ³	0	52	78	91	97	100	100

Figure 2

- (a) On the grid, plot the results shown in Figure 2.

Draw a curve of best fit.

(3)



(b) Rate of reaction can be calculated using

$$\text{rate of reaction} = \frac{\text{volume of gas produced in 1 minute}}{1 \text{ minute}}$$

Figure 3 shows the rates of reaction calculated from the results of this experiment.

The rate of reaction for the time interval 2 to 3 minutes is missing.

time interval	0 to 1 minute	1 to 2 minutes	2 to 3 minutes	3 to 4 minutes	4 to 5 minutes
rate of reaction in $\text{cm}^3 \text{ min}^{-1}$	52	26		6	3

Figure 3

(i) Calculate the rate of reaction for the time interval 2 to 3 minutes.

(1)

rate of reaction = $\text{cm}^3 \text{ min}^{-1}$

(ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.

(3)

(c) The student repeated the experiment using the same volume of acid and the same mass of marble chips but used smaller marble chips.

All other conditions remained the same.

The student found that the reaction with the smaller marble chips was faster to start with but produced the same volume of gas.

Using this information, draw a line on the grid to show the results for the reaction with the smaller marble chips.

Label this line 'C'.

(2)

(Total for Question 1 = 9 marks)



2 Figure 4 shows some information about the group 1 metals.

group 1 metal	atomic number	relative atomic mass
lithium	3	7
sodium	11	23
potassium	19	39
rubidium	37	85
caesium	55	133

Figure 4

(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.

(2)

.....

.....

.....

.....

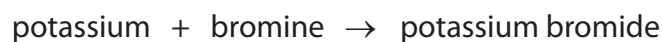
(b) Which row shows two correct properties of group 1 metals?

(1)

properties of group 1 metals		
☐ A	compounds are white in colour	high density
☐ B	low melting points	compounds are blue in colour
☐ C	soft enough to be cut by a knife	low melting points
☐ D	high density	conduct electricity

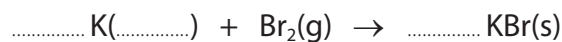


- (c) The word equation for the reaction of potassium with bromine is



Add the missing state symbol and balance the equation for this reaction.

(2)



- (d) A sample of potassium contains three isotopes, potassium-39, potassium-40 and potassium-41.

- (i) Explain the meaning of the term **isotopes**.

(2)

.....

.....

.....

.....

- (ii) This sample of potassium contains

93.25% potassium-39

0.02% potassium-40

6.73% potassium-41

Calculate the relative atomic mass of this sample of potassium.

(2)

.....

.....

.....

.....

relative atomic mass =

(Total for Question 2 = 9 marks)



- 3 (a) Figure 5 shows the percentage of three gases, **X**, **Y** and **Z**, in the Earth's early atmosphere.

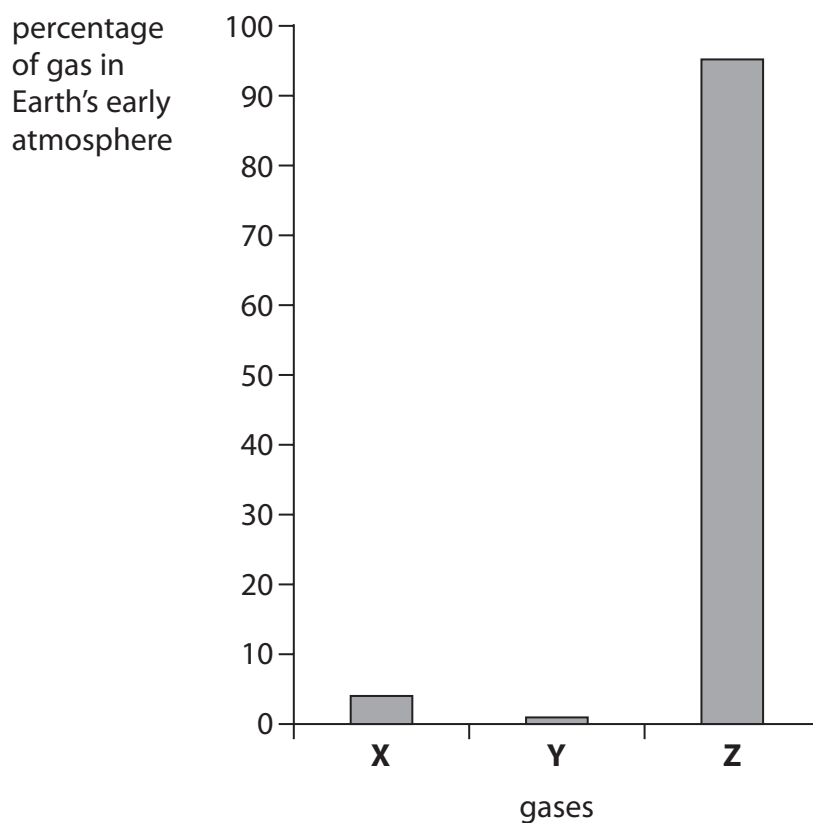


Figure 5

What is the name of gas **Z**?

(1)

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



- (b) It is thought that small quantities of hydrogen sulfide, H_2S , were also in the Earth's early atmosphere.

Draw the dot and cross diagram for a molecule of hydrogen sulfide.

Show outer electrons only.

(2)

- (c) Acid rain is caused by some pollutant gases present in the atmosphere.

Explain how impurities in fossil fuels can result in acid rain.

(3)

.....

.....

.....

.....

.....

.....



(d) A student investigates the effect of acid rain on cress plants.

The student uses this method.

step 1 grow 20 cress plants in each of two dishes, **A** and **B**

step 2 water the cress plants in dish **A** with 10 cm^3 of dilute hydrochloric acid with a pH of 2

step 3 water the cress plants in dish **B** with 10 cm^3 of pure water with a pH of 7

step 4 repeat steps 2 and 3 every day for one week

step 5 count how many plants are still alive after one week.

- (i) State what piece of equipment the student could use to measure the pH of each liquid.

(1)

- (ii) Explain **one** improvement that the student could make to the method to make the results more valid.

(2)

(Total for Question 3 = 9 marks)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE



- 4 Chlorine gas can be prepared by reacting concentrated hydrochloric acid with solid potassium manganate(VII).

Figure 6 shows the apparatus used.

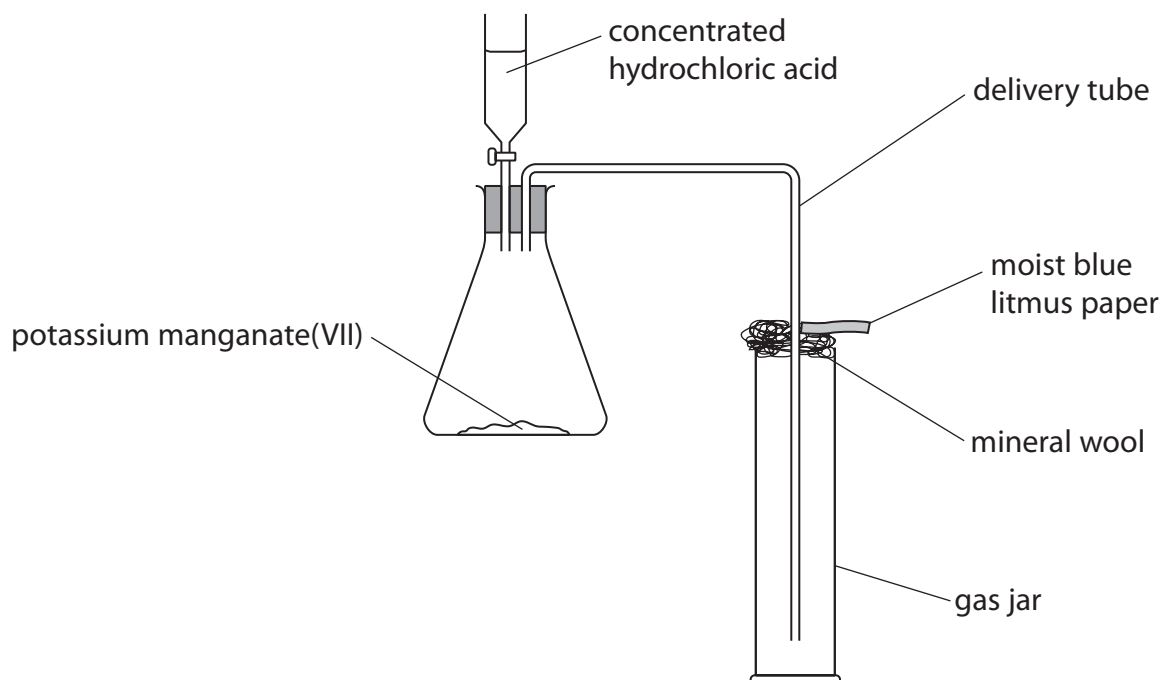


Figure 6

- (a) Figure 7 shows the hazard symbols for concentrated hydrochloric acid, potassium manganate(VII) and chlorine gas.

substance	hazard symbol
concentrated hydrochloric acid	 
potassium manganate(VII)	  
chlorine gas	  

Figure 7

Use the information in Figure 7 to help you answer (a)(i) and (a)(ii).

(i) What are the hazards associated with potassium manganate(VII)?

(1)

- ☐ A flammable, harmful and corrosive
- ☐ B flammable, toxic and hazardous to the environment
- ☐ C oxidising, harmful and hazardous to the environment
- ☐ D oxidising, toxic and corrosive

(ii) Explain **one** precaution that should be taken when preparing the sample of chlorine gas.

(2)

precaution

reason

(b) State the purpose of the delivery tube.

(1)

(c) Suggest why damp blue litmus is placed at the top of the gas jar.

(2)

(d) In the reaction, potassium manganate(VII), KMnO_4 , reacts with hydrochloric acid to form manganese chloride, MnCl_2 , potassium chloride, chlorine and water.

Write the balanced equation for the reaction.

(3)

(Total for Question 4 = 9 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



5 Ammonia can be produced from the reaction of hydrogen with nitrogen.

(a) What is the percentage by mass of nitrogen in ammonia, NH_3 ?

(relative atomic masses: $\text{H} = 1.0$, $\text{N} = 14$)

(1)

- ☐ **A** 18%
- ☐ **B** 42%
- ☐ **C** 51%
- ☐ **D** 82%

(b) The reaction between hydrogen and nitrogen is exothermic.

Figure 8 shows the reaction profile of this exothermic reaction.

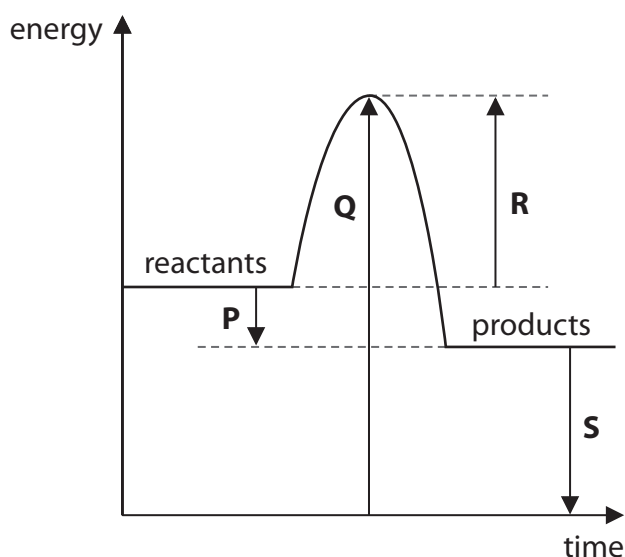


Figure 8

(i) Which arrow represents the activation energy for the reaction?

(1)

- ☐ **A** arrow P
- ☐ **B** arrow Q
- ☐ **C** arrow R
- ☐ **D** arrow S



- (ii) Describe what the reaction profile shows about the energy involved in bond breaking and bond making in this reaction.

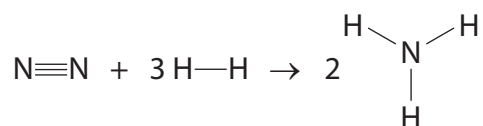
(2)

- (iii) Figure 9 shows the energies of some bonds.

bond	bond energy in kJ mol^{-1}
$\text{N}\equiv\text{N}$	944
$\text{H}-\text{H}$	436
$\text{H}-\text{N}$	388

Figure 9

The equation for the reaction between nitrogen and hydrogen to form ammonia is



Calculate the energy change, in kJ mol^{-1} , for this reaction.

(4)

energy change = kJ mol^{-1}

- (c) Ammonia, NH_3 , and silicon dioxide, SiO_2 , are both compounds that are made of two non-metallic elements.

Ammonia has a boiling point of -33°C .

Silicon dioxide has a boiling point of 2230°C .

Explain why the boiling points of ammonia and silicon dioxide are so different.

(3)

(Total for Question 5 = 11 marks)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE



6 Crude oil is a mixture of hydrocarbons.

Crude oil can be separated into useful fractions by the process of fractional distillation in a fractionating column.

- (a) Figure 10 shows a fractionating column, the fractions obtained and the trend in viscosity of the fractions.

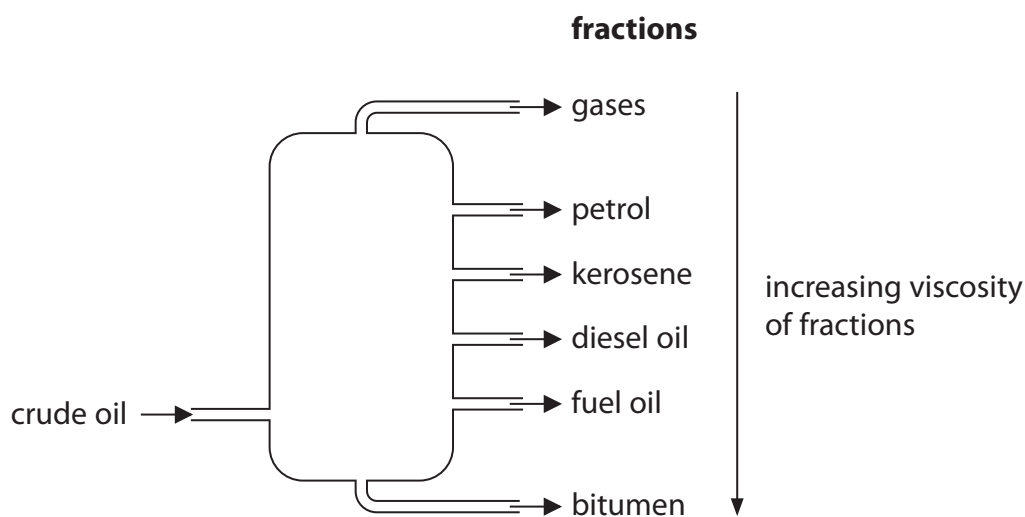


Figure 10

- (i) Which row shows the correct uses for bitumen, diesel oil and fuel oil?

(1)

	bitumen	diesel oil	fuel oil
☐ A	fuel for large ships	surfacing roads	fuel for trains
☐ B	fuel for large ships	fuel for trains	surfacing roads
☐ C	surfacing roads	fuel for trains	fuel for large ships
☐ D	surfacing roads	fuel for large ships	fuel for trains

- (ii) Explain the trend in the viscosity of the fractions.

(2)

.....

.....

.....

.....

.....

- (b) Hydrocarbon **X** was cracked to form one molecule of hexane, C_6H_{14} , and one molecule of alkene **Y**.



The relative formula mass of **Y** is 56.

The empirical formula of **Y** is CH_2 .

Deduce the molecular formula of hydrocarbon **X**.

Show your working.

(relative atomic masses: $H = 1.0$, $C = 12$)

(4)

molecular formula of **X** =



*(c) Large quantities of methane are used as a fuel.

Figure 11 shows a Bunsen burner.

Methane can be used as fuel for the Bunsen burner.

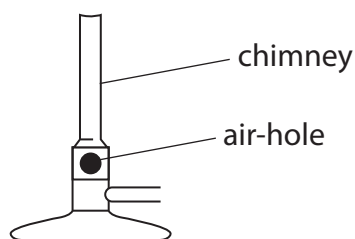


Figure 11

The air-hole on the chimney of the Bunsen burner can be opened and closed.

Explain the effect of opening and closing the air-hole of the Bunsen burner on the products of combustion of methane and the harm that using large quantities of methane as a fuel can cause.

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS



1	2	Key										3	4	5	6	7	0
1 H hydrogen 1		relative atomic mass atomic symbol name atomic (proton) number															
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	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	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	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86	

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



Mark Scheme (Results)

Summer 2023

Pearson Edexcel GCSE
In Combined Science (1SC0)
Paper 2CH

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2023

Publications Code 1SC0_2CH_2306_MS

All the material in this publication is copyright

© Pearson Education Ltd 2023

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.

Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.

When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

Assessment Objective		Command Word	
Strand	Element	Describe	Explain
AO1		An answer that combines the marking points to provide a logical description	An explanation that links identification of a point with reasoning/justification(s) as required
AO2		An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding	An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding)
AO3	1a and 1b	An answer that combines points of interpretation/evaluation to provide a logical description	
AO3	2a and 2b		An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning
AO3	3a	An answer that combines the marking points to provide a logical description of the plan/method/experiment	
AO3	3b		An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning

2306 1SC0_2CH
Paper 2CH

Question number	Answer	Additional guidance	Mark
1(a)	6 or 7 points plotted correctly (2) or 4 or 5 points plotted correctly (1) best fit curve starting at (0,0) (1)	allow +/- half a square for MP3, curve must be a single smooth curved line going through most or all of THEIR plotted points (ecf allowed), or if the points are not visible, through most or all of the correct values reject curves going above or below 100cm ³ by more than half a square reject straight line / dot to dot straight lines bar charts – max 2 marks for plotting points if time value is clear	(3) A02-1

Question number	Answer	Additional guidance	Mark
1(b)(i)	13	answer may be given in table	(1) A02-1

Question number	Answer	Additional guidance	Mark
1(b)(ii)	An explanation linking - rate of reaction decreases / reaction is slower (1) - as {reactants /acid/ marble chips} are used up (1) - so less frequent collisions (1)	Note: a comparison of the rate of marble chips with that of marble powder is ignored ignore anything about rate increasing at the beginning / starts fast allow (rate of) reaction slows down ignore references to volumes of gas produced ignore reaction stops allow {concentration/amount} of acid decreases / marble chips getting smaller allow {marble chips <u>have</u> / acid <u>has</u>} reacted allow less {reactants/ marble chips/ acid} available ignore limiting factor/ reaction is ending allow fewer (successful) collisions ignore less particles have less energy	(3) A03-2

Question number	Answer	Additional guidance	Mark
1(c)	graph to show - initial line steeper and to the left (1) - line levelling off at 100 cm³ before 5 minutes (1)	there must be a line from part (a) to award these marks if lines are not labelled, make a reasonable assumption about which is C mark independently. line should start from start of original line all levelling off within half a square of original line	(2) A03-2

Question number	Answer	Additional guidance	Mark
2(a)	An explanation linking 1 <u>electron</u> (1) - in outer shell(s) (1)	allow 1 is the last number of the electronic configuration (1) ignore electronic configurations written out reject incorrect number of electrons MP2 depends on MP1 for outer allow {highest energy / last} for shell allow ring, energy level, orbital allow: 1 outer electron (2) 1 valence electron (2) have to lose 1 electron to get full outer shell (2) same number of electrons in outer shell (1) forms a +1 ion by losing one electron (1)	(2) AO1-1

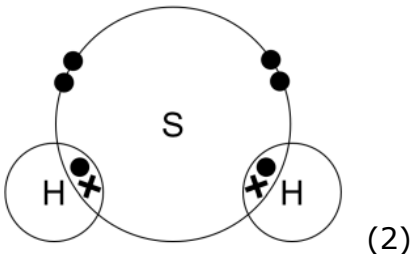
Question number	Answer	Mark
2(b)	C soft enough to be cut by a knife / low melting point is the only correct answer A and D are incorrect because alkali metals do not have a high density B is incorrect because alkali metal compounds are not blue in colour	(1) AO1-1

Question number	Answer	Additional guidance	Mark
2(c)	$2 \text{ K(s)} + \text{Br}_2(\text{g}) \rightarrow 2 \text{ KBr(s)}$ balancing (1) state symbol s (1)	allow multiples ignore 'two' ignore 'solid'	(2) AO2-1

Question number	Answer	Additional guidance	Mark
2(d)(i)	An explanation linking (atoms) {of same element / with same number of protons} / all contain 19 protons / same atomic number (1) - different number of neutrons / different mass <u>number</u> / have 20, 21, 22 neutrons (1)	reject compound/ molecule/ ion / elements <u>s</u> once allow same protons ignore electrons reject different protons allow different / extra / more / fewer neutrons ignore different mass / relative atomic mass reject different electrons	(2) A01-1

Question number	Answer	Additional guidance	Mark
2(d)(ii)	39.1348/39.135/ 39.13/ 39.1 with or without working scores 2 $93.25 \times 39 + 40 \times 0.02 + 6.73 \times 41 = 3913.48$ (1) $\frac{3913.48}{100} = 39.1348$ (1) OR $\frac{39 \times 93.25}{100}$ and $\frac{0.02 \times 40}{100}$ and $\frac{6.73 \times 41}{100}$ (1) $36.3675 + 0.008 + 2.7593 = 39.1348$ (1)	Final answer of 39 with no working scores 0. Final answer of 39 rounded from correct working scores 2. allow rounding of values in the 3 sums allow ecf for MP2 if transcription error(s) e.g 93.52 allow ecf for MP2 if formula is correct but error in calculation	(2) A02-1

Question number	Answer	Mark
3(a)	B carbon dioxide is the only correct answer A, C and D are incorrect because the gas thought to be the highest percentage in the Earth's early atmosphere is carbon dioxide	(1) A03-2b

Question number	Answer	Additional guidance	Mark
3(b)	 OR one shared pair of electrons between S atom and each of two H atoms (1) rest of molecule correct (1)	for any marks must be molecule with two H and one S atom, but ignore shape/ bond angles unlabelled atoms can be assumed to be H and S max 1 mark if charge on molecule allow dots or crosses or a mixture of both allow with no circles ignore inner shells even if incorrect MP2 dependent on MP1	(2) A02-1

Question number	Answer	Additional guidance	Mark
3(c)	An explanation linking any 3 from: sulfur/ S (is present as an impurity) (1) (when fuel burns) {impurity/sulfur} is {burned/ combusted/ oxidised/ reacts with oxygen} (1) - sulfur dioxide/ SO₂ (formed) (1) - sulfur dioxide dissolves in {rain/ water/ clouds} (1) - sulfuric acid is formed (1)	ignore any references to nitrogen oxides/ nitric acid S + O₂ → SO₂ scores MP1, MP2 and MP3 allow sulfur dioxide <u>reacts</u> with {rain/ water/ clouds} ignore sulfur dioxide mixes with {rain/ water/ clouds} allow forms sulfurous acid. suitable equation forming H₂SO₃ or H₂SO₄ scores MP3, MP4 and MP5	(3) A01-1

Question number	Answer	Additional guidance	Mark
3(d)(i)	pH meter	allow pH probe allow universal indicator/ UI reject any other indicators ignore pH paper/ pH strips/ pH scale/ pH indicator	(1) A03-3a

Question number	Answer	Mark
4(a)(i)	C oxidising, harmful and hazardous to the environment is the only correct answer A, B are incorrect because none of the substances are flammable D is incorrect because the third symbol does not mean corrosive	(1) A01-1

Question number	Answer	Additional guidance	Mark
4(a)(ii)	An explanation linking one pair from: • use a fume cupboard (1) • because (chlorine/it) is a toxic gas (1) OR • wear gloves/ goggles/ safety glasses (1) • because the concentrated hydrochloric acid is corrosive (1) OR • do not dispose of any reactants / products down the drain (1) • because {potassium manganate/ chlorine /it} is hazardous to the environment (1)	mark independently ignore any other suggestions not included in markscheme ignore masks/ breathing apparatus/ well ventilated room allow poisonous allow acids 'burns' skin/ eyes allow dispose of substances correctly allow specific hazards e.g. kills fish	(2) A02-2

Question number	Answer	Additional guidance	Mark
4(b)	so {gas / chlorine} moves (from flask) to gas jar	ignore to deliver substances ignore to connect the apparatus / to stop gas escaping	(1) A01-1

Question number	Answer	Additional guidance	Mark
4(c)	An explanation linking: chlorine will turn the damp litmus paper (red then) white / bleached (1) - so that you can see when the jar is full (1)	reject chloride once reject bleaches then turns red for MP1 allow so you know {when to stop the reaction/ when enough chlorine has been made}/ to detect chlorine / to show that chlorine has been made / to see if chlorine is escaping allow gas for chlorine in MP2 reject to test pH for MP2	(2) A02-2

Question number	Answer	Additional guidance	Mark
4(d)	$2\text{KMnO}_4 + 16\text{HCl} \rightarrow 2\text{MnCl}_2 + 2\text{KCl} + 5\text{Cl}_2 + 8\text{H}_2\text{O}$ all 6 formulae on correct sides of arrow (2) 4 or 5 formulae on correct sides of arrow (1) balancing of correct formulae only (1)	allow multiples do not penalise incorrect cases, subscripts e.g allow Cl^2 ignore state symbols	(3) A02-1

Question number	Answer	Mark
5(a)	D 82% is the only correct answer A is not correct as this is percentage of hydrogen in ammonia B is not correct as this is the mass of hydrogen multiplied by the mass of nitrogen C is not correct as this is the mass of hydrogen multiplied by the mass of ammonia	(1) AO2-1

Question number	Answer	Mark
5(b)(i)	C arrow R is the only correct answer A, B and D are incorrect because they do not show the activation energy	(1) AO2-1

Question number	Answer	Additional guidance	Mark
5(b)(ii)	A description to include: any two for 1 mark all three for 2 marks - energy is taken in breaking bonds (in the reactants) - energy is given out making bonds (in the products) - more energy is given out than taken in	allow breaking bonds is endothermic allow forming bonds is exothermic allow less energy taken in than given out ignore products have less energy than reactants ignore reaction is exothermic / gives out energy alone for energy taken in allow : absorbed / needed / used /required for energy given out allow: released	(2) AO1-1

Question number	Answer	Additional guidance	Mark
5(b)(iii)	-76 with or without working scores 4 BROKEN $944 + (3 \times 436) = 2252$ (1) MADE $2 \times (3 \times 388) = 2328$ (1) DIFFERENCE (broken) 2252 – (made) 2328 (1) ANSWER = - 76 (1)	allow ecf ignore sign ignore sign MP3 for difference between their 2 values MP4 for correct evaluation, including correct sign, of <u>bonds broken – bonds made</u> using their values (+)76 scores 3 (+)1088 scores 3 (+)604 scores 3 (+)1476 scores 3 -1088 scores 2 -604 scores 2	(4) A02-1

Question number	Answer	Additional guidance	Mark
5(c)	an explanation linking AMMONIA ammonia {is simple molecular / has weak intermolecular forces} SILICON DIOXIDE silicon dioxide is {giant covalent / has strong covalent bonds} (1) DIFFERENCE more {heat / energy} to break bonds in silicon dioxide than intermolecular forces in ammonia	Mark independently allow weak {forces / bonds} <u>between molecules</u> allow <u>intermolecular</u> bonds reject anything ionic for MP1 allow macromolecular reject anything ionic / simple molecular for MP2 in MP3 mark is for saying more energy/ heat needed to break the 'attractions' <u>in silicon dioxide</u> than in ammonia. The 'attractions' do not have to be correct. allow the energy required to break the attractions in ammonia is small and the energy required to break the attractions in silicon dioxide is large	(3) AO1-1

Question number	Answer	Mark
6(a)(i)	C surfacing roads fuel for trains fuel for large ships is the only correct answer A and B are incorrect as bitumen is not used as a fuel for large ships D is not correct as diesel oil is not used for fuel for large ships	(1) AO1-1

Question number	Answer	Additional guidance	Mark
6(a)(ii)	An explanation linking • (viscosity increases down the column) as molecules are {larger/ longer/ more carbons} (1) • because there are stronger {intermolecular forces / forces between molecules} (1)	allow ORA allow stronger intermolecular bonds/ forces of attraction/ (surface area of) contact allow more intermolecular forces	(2) AO1-1

Question number	Answer	Additional guidance	Mark
6(b)	$M_r \text{ of } \text{CH}_2 = 12 + (2 \times 1) = 14 \text{ (1)}$ $\frac{56}{14} = 4 \text{ (1)}$ formula of Y = $4 \times \text{CH}_2 = \text{C}_4\text{H}_8 \text{ (1)}$ formula of X = $(\text{C}_6\text{H}_{14} + \text{C}_4\text{H}_8 =) \text{C}_{10}\text{H}_{22} \text{ (1)}$	allow ecf throughout MP1 must be for CH_2 allow $14 \times 4 = 56$ allow Y has 4C and 8H C_4H_8 without working scores MP3 only. $\text{C}_4\text{H}_8 = (4 \times 12) + (8 \times 1) = 56$ scores MP1, 2 and 3 for MP4 must be written as formula $\text{C}_{10}\text{H}_{22}$ without working scores MP4 only ecf can be awarded for MP4 as long as working for alkene to be added is seen ignore formula of X = $(\text{C}_6\text{H}_{14} + \text{CH}_2 =) \text{C}_7\text{H}_{16}$	(4) A03-1

Question number	Indicative content	Mark
6(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 (3 marks) and AO2 (3 marks) Ignore any issues with methane itself e.g. it is a greenhouse gas. Ignore different colours of flame with open/ closed air hole. OPEN AIR-HOLE • air-hole open, allows lots of oxygen to mix with methane • therefore complete combustion takes place • $\text{CH}_4 + 2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{CO}_2$ • carbon dioxide and water are produced. CLOSED AIR-HOLE • air-hole closed, less oxygen can enter to mix with methane • therefore incomplete combustion takes place • e.g $2\text{CH}_4 + 3\text{O}_2 \rightarrow 2\text{CO} + 4\text{H}_2\text{O}$ (allow other correct examples) • carbon monoxide can be produce HARMFUL EFFECTS • CO is odourless and colourless • carbon monoxide combines with haemoglobin in place of oxygen/ reduces capacity of blood for oxygen • therefore toxic • carbon/ soot can also be produced • can aggravate asthma / respiratory problems • soot makes buildings dirty • carbon dioxide and water are greenhouse gases • absorb heat energy radiated from Earth which is re-radiated back into the atmosphere • increases greenhouse effect • causes global warming/ climate change • melt polar ice caps / sea levels rise	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1 A description of open or closed air -hole or description of one harmful effect	1–2	closed air-hole gives less oxygen (1) closed air-hole gives less oxygen, open air-hole gives more oxygen (1) closed air-hole gives incomplete combustion (1) closed air-hole has less oxygen so incomplete combustion (2) complete combustion gives carbon dioxide (1) when the air-hole is open, oxygen allows complete combustion gives carbon dioxide and water (2)
Level 2 Description of two of: open air-hole/ closed air hole/ harmful effect	3–4	A closed air-hole gives less oxygen which produces soot and carbon monoxide which is toxic because it bonds to haemoglobin. (3) More oxygen gives carbon dioxide and water and incomplete combustion gives carbon monoxide and water. (4) Complete combustion produces carbon dioxide and water which are both greenhouse gases. Greenhouse gases absorb heat energy radiated from the earth and re-radiates it, this causes global temperatures to rise and leads to an increase in polar ice caps melting. (4)
Level 3 All three aspects must be covered Description of all three of: open air-hole/ closed air-hole/ harmful effect(s)	5–6	Incomplete combustion makes carbon monoxide but complete combustion produces carbon dioxide and water which are both greenhouse gases. Greenhouse gases absorb heat energy radiated from the earth and re-radiates it, this causes global temperatures to rise and leads to an increase in polar ice caps melting. (5) A closed air-hole gives incomplete combustion which produces carbon monoxide which is an odourless and colourless toxic gas. Complete combustion produces carbon dioxide and water which are both greenhouse gases. Greenhouse gases absorb heat energy radiated from the earth and re-radiates it, increases the greenhouse effect and temperature of the Earth's atmosphere. (6)

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	- Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) - The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3-4	- Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) - The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5-6	- Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) - The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)