

Pearson Edexcel International Advanced Level

Monday 12 January 2026

Afternoon (Time: 1 hour 30 minutes)

Paper
reference

WCH11/01A

Chemistry

International Advanced Subsidiary/Advanced Level

UNIT 1: Structure, Bonding and Introduction to

Organic Chemistry

Question Paper

You must have:

Scientific calculator, ruler, HB pencil and Answer Book (sent separately)

Turn over ►

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SECTION A

Answer ALL the questions in this section in the Answer Book.

You should aim to spend no more than 20 minutes on this section.

For each question, select one answer from A to D and put a cross in the box ☐ in the Answer Book. If you change your mind, put a line through the box ☐ and then mark your new answer with a cross ☐.

1 What is the empirical formula of butane?

- A C_4H_{10}
- B C_2H_5
- C $\text{CH}_{2.5}$
- D $\text{C}_n\text{H}_{2n+2}$

(Total for Question 1 = 1 mark)

2 When zinc is added to copper(II) sulfate solution, copper is formed.

(a) What is a possible name for this type of reaction?

(1)

- A addition
- B displacement
- C neutralisation
- D substitution

(b) Which is the ionic half-equation for a process that takes place during this reaction?

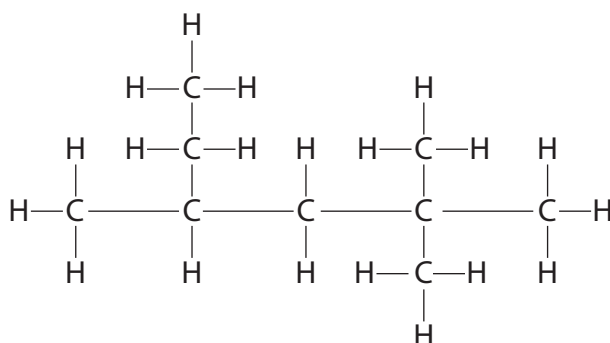
(1)

- A $\text{Cu}^{2+} + \text{e}^- \rightarrow \text{Cu}^+$
- B $\text{Cu}^+ + \text{e}^- \rightarrow \text{Cu}$
- C $\text{Zn} \rightarrow \text{Zn}^+ + \text{e}^-$
- D $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$

(Total for Question 2 = 2 marks)



3 What is the name of the hydrocarbon shown using IUPAC rules?



- A 2,2-dimethyl-4-ethylpentane
- B 2-ethyl-4,4-dimethylpentane
- C 3,5,5-trimethylhexane
- D 2,2,4-trimethylhexane

(Total for Question 3 = 1 mark)

4 Which element is in the **p-block** and has atoms containing **two** unpaired electrons in the ground state?

- A carbon
- B fluorine
- C lithium
- D titanium

(Total for Question 4 = 1 mark)

5 Sea water contains 2.7 mg of sulfate ions per kilogram.
What is the concentration of sulfate ions in parts per million by mass?

- A 2.7×10^{-6}
- B 2.7×10^{-3}
- C 2.7
- D 2.7×10^3

(Total for Question 5 = 1 mark)

6 How many ions are in 284 g of sodium sulfate, Na_2SO_4 ?

Data: Avogadro constant = $6.0 \times 10^{23} \text{ mol}^{-1}$
Molar mass of sodium sulfate = 142 g mol^{-1}

- A 1.2×10^{24}
- B 2.4×10^{24}
- C 3.6×10^{24}
- D 8.4×10^{24}

(Total for Question 6 = 1 mark)

7 100 cm^3 of methane, CH_4 , is completely burned in 400 cm^3 of oxygen.

What is the final volume of the gas mixture, in cm^3 , when all volumes are measured at room temperature and pressure?

- A 100
- B 200
- C 300
- D 500

(Total for Question 7 = 1 mark)

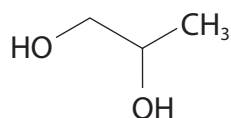
8 Which ion has the **largest** ionic radius?

- A Ca^{2+}
- B Cl^-
- C K^+
- D S^{2-}

(Total for Question 8 = 1 mark)



9 Which reagent reacts with propene to form the compound shown?



- A oxygen and water
- B hydrogen peroxide solution
- C aqueous sodium hydroxide
- D acidified potassium manganate(VII)

(Total for Question 9 = 1 mark)

10 How many straight chain (non-cyclic) isomers have the molecular formula C_3H_5Cl ?

- A 3
- B 4
- C 5
- D 6

(Total for Question 10 = 1 mark)

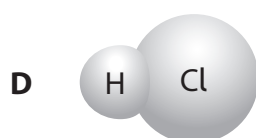
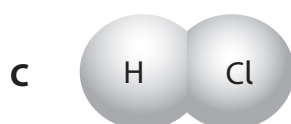
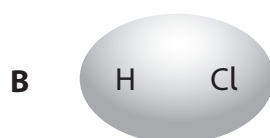
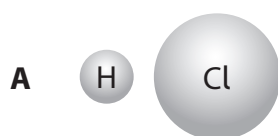
11 When ethane reacts with chlorine, a mixture of products forms.

Which of the products gives the **best** evidence for a free radical mechanism?

- A HCl
- B C_4H_{10}
- C C_2H_5Cl
- D $C_2H_4Cl_2$

(Total for Question 11 = 1 mark)

12 Which diagram **best** represents the electron density in a molecule of hydrogen chloride?



(Total for Question 12 = 1 mark)

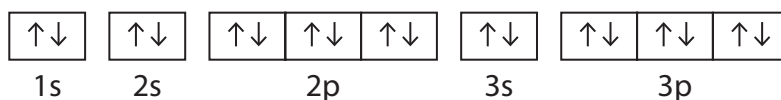
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13 Which pair of ions will form the compound with the most covalent character?

- A Li^+ and I^-
- B Na^+ and Br^-
- C K^+ and Cl^-
- D Rb^+ and F^-

(Total for Question 13 = 1 mark)

14 Which ion does **not** have the electronic configuration shown?



- A K^+
- B Ca^{2+}
- C Ti^{2+}
- D Sc^{3+}

(Total for Question 14 = 1 mark)

15 What is the electronic configuration of the nitride ion, N^{3-} ?

- A $1s^2 2s^2$
- B $1s^2 2s^2 2p^3$
- C $1s^2 2s^2 2p^4$
- D $1s^2 2s^2 2p^6$

(Total for Question 15 = 1 mark)

16 The first five ionisation energies of an element, in kJ mol^{-1} , are

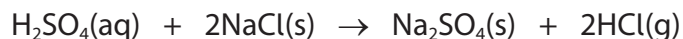
578	1817	2745	11 578	14 831
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Which element could this be?

- A sodium
- B magnesium
- C aluminium
- D silicon

(Total for Question 16 = 1 mark)

- 17** Sodium sulfate is formed when concentrated sulfuric acid reacts with excess sodium chloride at very high temperatures.



Data: M_r 98.1 58.5 142.1 36.5

What is the atom economy by mass for the formation of sodium sulfate?

- A** 64%
- B** 66%
- C** 80%
- D** 91%

(Total for Question 17 = 1 mark)

- 18** Which hazard symbol must be displayed on a bottle containing hexane?



(Total for Question 18 = 1 mark)

Use this space for any rough working. Anything you write in this space will gain no credit.

19 Which is a free radical?

- A** OH
- B** OH⁻
- C** OH₂
- D** OH₃⁺

(Total for Question 19 = 1 mark)

TOTAL FOR SECTION A = 20 MARKS



SECTION B

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

20 This question is about the bonding, structure and properties of the elements in Period 3 of the Periodic Table and their compounds.

(a) The melting temperatures of the elements across Period 3 are shown.

element	Na	Mg	Al	Si	P	S	Cl	Ar
melting temperature / K	371	922	933	1683	317	386	172	84

(i) Plot a graph of melting temperatures against elements in Period 3 on the grid in the Answer Book.

(3)

(ii) Explain, with reference to structure and bonding, why silicon has a very high melting temperature.

(3)

(b) Sodium has the lowest electrical conductivity of the Period 3 elements.

(i) Describe how metals conduct electricity.

(2)

(ii) Give a possible reason why sodium has a lower electrical conductivity than aluminium.

(1)

(c) Aluminium is extracted by the electrolysis of molten aluminium oxide.

(i) Draw a dot-and-cross diagram to show the bonding in aluminium oxide. Use dots(●) for aluminium electrons and crosses(×) for oxygen electrons. Show outer shell electrons only.

(3)

(ii) Give a reason why aluminium oxide must be molten before electrolysis can occur.

(1)

(Total for Question 20 = 13 marks)

21 This question is about a preparation of hydrated zinc sulfate crystals.

An excess of powdered zinc is added to 25.0 cm^3 of 1.25 mol dm^{-3} sulfuric acid.

(a) (i) State **two** observations you would make during this reaction. (2)

(ii) Write the **ionic** equation for this reaction.
Include state symbols. (2)

(b) (i) The formula of the hydrated zinc sulfate crystals is $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$.
Calculate the molar mass of $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$. (1)

(ii) Calculate the number of moles of sulfuric acid in 25.0 cm^3 of a
 1.25 mol dm^{-3} solution. (1)

(iii) 3.75 g of hydrated zinc sulfate crystals form.
Calculate the percentage yield of hydrated zinc sulfate.
Give your answer to an appropriate number of significant figures. (2)

(Total for Question 21 = 8 marks)

22 A sample of an element, **X**, was extracted from a meteorite.

The percentage abundances by mass of the isotopes of **X** in the mass spectrum of the sample are shown.

m/z	Percentage abundance
54	5.45
56	92.1
57	2.45

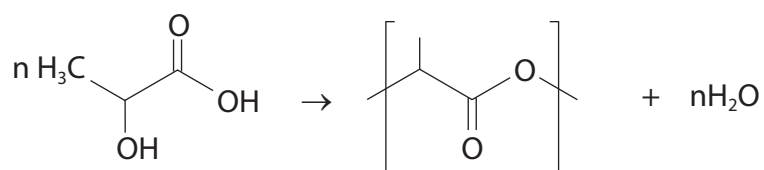
- (a) (i) Calculate the relative atomic mass of the **X** in this sample.
Give your answer to **three** significant figures. (2)
- (ii) Identify **X** and hence give the numbers of particles present in the species at $m/z = 56$ in the mass spectrum. (2)
- (iii) A peak at $m/z = 28$ was also detected in the mass spectrum of **X**.
Identify the species which produced this peak. (1)
- (b) Explain why the three isotopes of **X** will have the same chemical properties. (2)

(Total for Question 22 = 7 marks)

23 This question is about polymers.

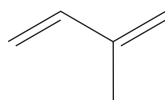
- (a) Plastic bags can be made from poly(lactic acid), PLA, which is biodegradable. PLA is obtained from corn.

An equation for the polymerisation of lactic acid is shown.

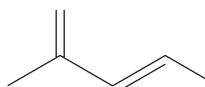


- (i) Write a balanced equation for the polymerisation of propene using displayed formulae. (2)
- (ii) Give **two** differences between the polymerisation of propene and that of lactic acid. (2)
- (iii) Identify what in the environment breaks down biodegradable polymers. (1)
- (iv) Biodegradable polymers reduce waste going to landfill. Give **two other** advantages of biodegradable polymers. (2)

- (b) Isoprene is used to make synthetic rubber. A skeletal formula for isoprene is shown.



- (i) State why isoprene does **not** have geometric isomers. (1)
- (ii) A related molecule does show geometric isomerism.

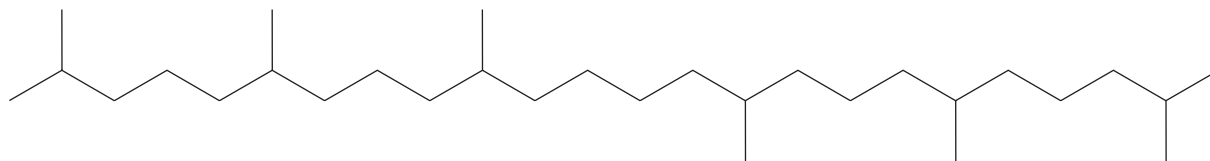


Draw the **skeletal** formula of the geometric isomer of this molecule. (1)

- (iii) Give the reason why a carbon-carbon double bond may result in geometric isomerism. (1)

Total for Question 23 = 10 marks)

24 This question is about the production of squalane, a liquid alkane which occurs naturally in human skin and is used in cosmetic products.



squalane

- (a) Squalane is odourless and colourless.

Suggest **two other** properties that make squalane useful in cosmetics.

(2)

- (b) Give the **molecular** formula of squalane.

(1)

- (c) Squalane can be produced from squalene, an alkene present in various oils, by reaction with hydrogen gas in the presence of a suitable catalyst.

- (i) Give the name of a suitable catalyst for the hydrogenation of squalene.

(1)

- (ii) Squalane used in cosmetic products must contain no more than 0.2 ppm of catalyst.

Calculate the maximum permitted mass of catalyst in a cosmetic product containing 40 g of squalane.

Give your answer in **standard form**.

(1)

- (iii) A reactor at 200 °C contains 6800 mol of squalene, and hydrogen gas at a pressure of 4.0×10^5 Pa.

Under these conditions, the complete hydrogenation of squalene requires 400 m³ of hydrogen gas.

Calculate the number of C=C bonds in one molecule of squalene.

Use the ideal gas equation, $pV = nRT$.

[Data: $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$]

(4)

- (iv) Write the equation, using molecular formulae, for the complete hydrogenation of squalene to squalane.

State symbols are **not** required.

(1)

(d) Globally, several million dm^3 of squalene is consumed each year. Traditionally, squalene was obtained exclusively from shark liver oil. The liver of a typical shark yields 290 g squalene.

- (i) Suggest the name of a suitable technique to obtain squalene from shark liver oil.

(1)

- (ii) Calculate the minimum number of sharks that would be needed to produce 2.6 million dm^3 of squalene.

[Data: Density of squalene = 0.86 g cm^{-3}]

(2)

- (iii) Many large corporations now use squalane obtained entirely from plants.

Squalane can be obtained sustainably from corn starch with a yield of 22.6% by mass.

The production of 1 tonne of corn starch requires 0.093 hectares of land.

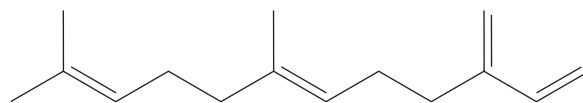
Calculate the area of land, **in km^2** , required to produce 3500 tonnes of squalane from corn starch.

[Data: 1 tonne = 1000 kg; 1 hectare = 0.01 km^2]

(3)

- (e) The alkene, **X**, with the molecular formula, $C_{15}H_{24}$, can also be obtained from corn starch.

X is the *E* geometric isomer and only has one geometric isomer.



X

- (i) State why **X** is the *E* isomer.

(1)

- (ii) The structure of **X** can be simplified to $R-CH=CH_2$.

Draw the mechanism for the formation of the **major** product of the reaction between **X** and hydrogen bromide.

Use the simplified structure.

Include curly arrows, and relevant lone pairs and dipoles.

(4)

- (iii) Complete the diagram in the Answer Book to show another structural isomer of $C_{15}H_{24}$.

(1)

(Total for Question 24 = 22 marks)

TOTAL FOR SECTION B = 60 MARKS

TOTAL FOR PAPER = 80 MARKS

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International Advanced Level

Monday 12 January 2026

Afternoon (Time: 1 hour 30 minutes) **Paper reference** **WCH11/01A**

Chemistry ▲ ▲
International Advanced Subsidiary/Advanced Level
UNIT 1: Structure, Bonding and Introduction to Organic Chemistry
Answer Book

You must have:
 Scientific calculator, ruler, HB pencil and
 Question Paper (sent separately)

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
 – *use this as a guide as to how much time to spend on each question.*
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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SECTION A

Answer ALL the questions in this section.

You should aim to spend no more than 20 minutes on this section.

For each question, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box [X] and then mark your new answer with a cross ☒.

1

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 1 = 1 mark)

2

(a)

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(b)

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 2 = 2 marks)

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3

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 3 = 1 mark)**4**

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 4 = 1 mark)**5**

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 5 = 1 mark)

6

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 6 = 1 mark)

7

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 7 = 1 mark)

8

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 8 = 1 mark)



9

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 9 = 1 mark)

10

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 10 = 1 mark)

11

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 11 = 1 mark)



12

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 12 = 1 mark)

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13

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 13 = 1 mark)

14

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 14 = 1 mark)

15

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 15 = 1 mark)

16

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 16 = 1 mark)



17

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 17 = 1 mark)

18

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 18 = 1 mark)

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19

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 19 = 1 mark)

TOTAL FOR SECTION A = 20 MARKS



SECTION B

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

20 (a) (i)

(3)

A large grid of graph paper for writing answers. The grid is composed of small squares, with a larger square grid pattern overlaid on it. The grid is intended for the student to write their answer to question 20(a)(i).

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(ii)

(3)

(b)

(i)

(2)

(ii)

(1)

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(c)

(i)

(3)

(ii)

(1)

(Total for Question 20 = 13 marks)



21

(a) (i)

(2)

(ii)

(2)

(b) (i)

(1)

(ii)

(1)

(iii)

(2)

(Total for Question 21 = 8 marks)

22

(a) (i)

(2)

(ii)

(2)

X

Number of particles present in the species at $m / e = 56$		
protons	electrons	neutrons

(iii)

(1)

(b)

(2)

(Total for Question 22 = 7 marks)

23

(a)

(i)

(2)

(ii)

(2)

(iii)

(1)

(iv)

(2)



P 8 7 6 3 4 A 0 1 5 2 4

(b)

(i)

(1)

(ii)

(1)

(iii)

(1)

(Total for Question 23 = 10 marks)



24

(a)

(2)

(b)

(1)

(c)

(i)

(1)

(ii)

(1)



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(iii)

(4)

(iv)

(1)

(d)

(i)

(1)

(ii)

(2)



(iii)

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(e)

(i)

(1)

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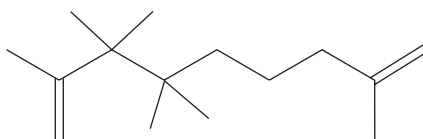


(ii)

(4)

(iii)

(1)



(Total for Question 24 = 22 marks)

TOTAL FOR SECTION B = 60 MARKS
TOTAL FOR PAPER = 80 MARKS



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24

* Lanthanide series

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