

OCR A-Level Chemistry A

Electrons, bonding and structure

Questions only

The newest questions, about an hour. All 24 are in the exam generator.

Questions

9

Total marks

42

Time allowed

57 min

Name

Class or teacher

Date

Instructions

- Answer all questions in the spaces provided.
- Use black ink. Show your working for every calculation.
- You may use a scientific calculator and the OCR Data Sheet.
- Print the separate mark scheme when you are ready to mark your answers.

For marking

Q	Source	Marks	Score
1	2017 P1 Q16	7	
2	2024 P1 Q1	1	
3	2024 P1 Q14	1	
4	2024 P1 Q18	12	
5	2024 P1 Q2	1	
6	2024 P1 Q5	1	
7	2024 P2 Q4	1	
8	2025 P1 Q16	17	
9	2025 P1 Q7	1	

Total _____ / 42 Percentage _____ %

Questions from OCR past papers, 2017–2025, reproduced for revision. Practise these topics online, with instant marking:

whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/?topics=electrons-bonding-and-structure&len=0

Questions

Electrons, bonding and structure · 9 questions · 42 marks · time allowed 57 min

Q1 · June 2017 · Paper 1 (Periodic table, elements and physical chemistry) · Q16 · [7 marks]

This question is about ions and compounds containing hydrogen.

16(a) Lithium aluminium hydride, LiAlH_4 , contains the AlH_4^- ion.

Draw a 'dot-and-cross' diagram to show the bonding in an AlH_4^- ion.

Show outer electrons only.

[1 mark]

16(b) Nitrogen forms NH_4^+ and NH_2^- ions.

Predict the name of the shape of, and H–N–H bond angle in, NH_4^+ and NH_2^- .

Ion	Name of shape	H–N–H bond angle
NH_4^+		
NH_2^-		

[2 marks]

Nitrogen, phosphorus and arsenic are in Group 15 (5) of the periodic table.

The boiling points of their hydrides are shown below.

Element	Hydride	Boiling point / °C
N	NH ₃	-33
P	PH ₃	-88
As	AsH ₃	-55

16(c)(i) Explain why the boiling point of PH₃ is lower than the boiling point of NH₃.

[2 marks]

16(c)(ii) Explain why the boiling point of PH₃ is lower than the boiling point of AsH₃.

[2 marks]

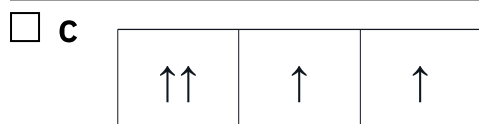
Q2 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q1 · [1 mark]

Oxygen has the electron configuration $1s^2 2s^2 2p^4$.

How are the electrons in an atom of oxygen arranged in the p-orbitals?

Tick (✓) one box.





Q3 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q14 · [1 mark]

Chlorine has the electron configuration $[\text{Ne}]3s^23p^5$.

Which statement(s) about chlorine is/are correct when it reacts in redox reactions?

- 1 It can gain one electron to form $1-$ ions.
- 2 It can lose its $3s^2$ electrons to form $2+$ ions.
- 3 It can lose its $3p^5$ electrons to form $5+$ ions.

Tick (✓) one box.

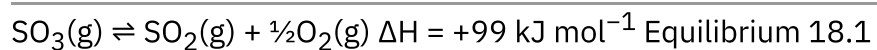
- ☐ **A** 1, 2 and 3
- ☐ **B** Only 1 and 2
- ☐ **C** Only 2 and 3
- ☐ **D** Only 1

Q4 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q18 · [12 marks]

This question also needs Equilibrium constants K_c and K_p .

This question is about two oxides of sulfur: sulfur dioxide, SO_2 , and sulfur trioxide, SO_3 .

SO_3 decomposes to form SO_2 and O_2 , as shown in Equilibrium 18.1.



18(a)(i) 2.25 moles of SO_3 is heated to 550°C in the presence of a catalyst and the resulting mixture allowed to reach equilibrium.

The equilibrium mixture contains 0.900 mol of SO_2 and the total pressure is 2.80 atm.

Calculate the numerical value for K_p for Equilibrium 18.1 under these conditions and state the units of K_p .

Give your answer to **3** significant figures.

$K_p =$

units

[5 marks]

18(a)(ii) The numerical values of K_p for Equilibrium 18.1 at temperatures T_1 and T_2 are shown below.

Temperature	K_p
T_1	3.3×10^{-5}
T_2	7.7×10^{-2}

Explain why T_2 is a higher temperature than T_1 .

[2 marks]

18(a)(iii) Suggest how the value of K_p would change if the reaction was repeated with no catalyst added and the pressure of the system increased.

Tick (✓) one box in each row.

Change	Decrease	No change	Increase
No catalyst			
Increased pressure			

[2 marks]

SO₂ and SO₃ both have molecules with sulfur in the centre and bond angles of approximately 120°.

18(b)(i) Explain why the bond angles in SO₃ are 120°.

[1 mark]

18(b)(ii) Explain why both SO₂ and SO₃ have polar bonds, but only SO₂ has polar molecules.

[2 marks]

Q5 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q2 · [1 mark]

Water has the anomalous properties below.

- Water has relatively high melting and boiling points.
- Ice is less dense than water.

Which statement explains these anomalous properties?

Tick (✓) one box.

- ☐ **A** The covalent bonding within water molecules.
- ☐ **B** The hydrogen bonding between water molecules.
- ☐ **C** The induced dipole–dipole interactions (London forces) between water molecules.
- ☐ **D** The ionic bonding between water molecules.

Q6 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q5 · [1 mark]

This question also needs Group 2 and the halogens.

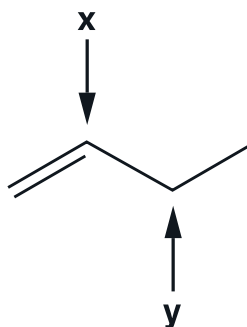
Which statement explains the trend in boiling points down the halogens group?

Tick (✓) one box.

- ☐ **A** The bond enthalpy of the covalent bonds increases.
- ☐ **B** The halogens become less electronegative.
- ☐ **C** The induced dipole–dipole interactions (London forces) become stronger.
- ☐ **D** The reactivity of the halogens decreases.

Q7 · June 2024 · Paper 2 (Synthesis and analytical techniques) · Q4 · [1 mark]

The structure of but-1-ene is shown below.



Which row has the correct **shape** around carbon atoms labelled x and y?

Tick (✓) one box.

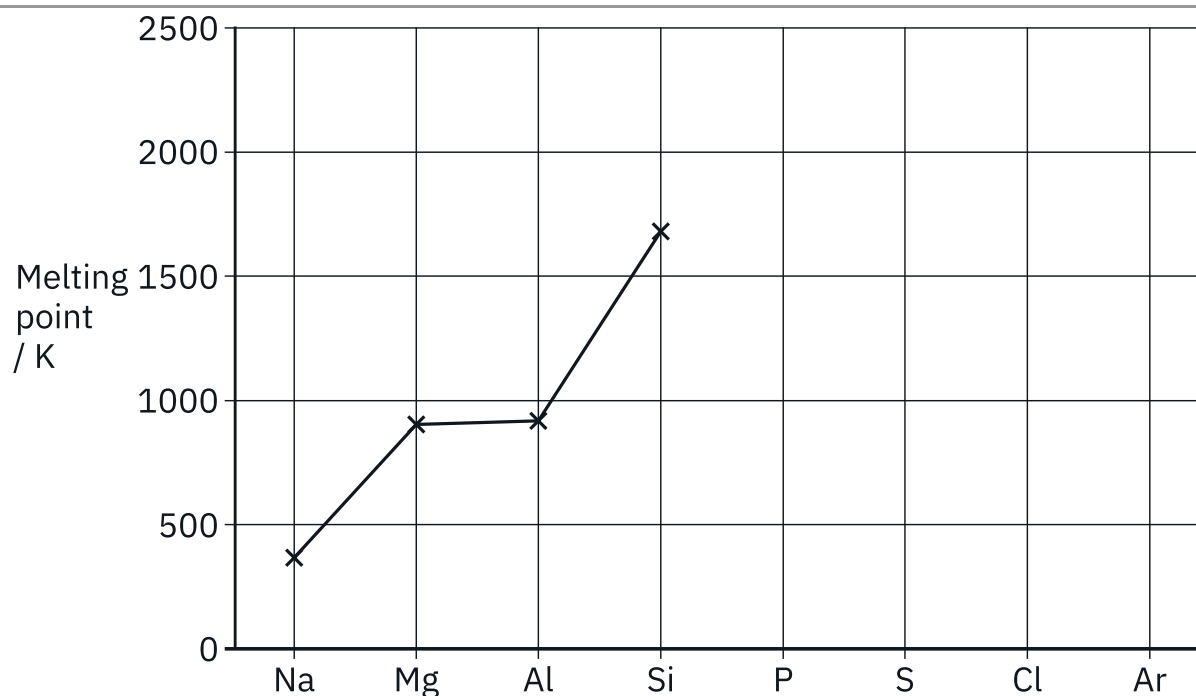
- ☐ **A** x: Tetrahedral · y: Pyramidal
- ☐ **B** x: Trigonal planar · y: Tetrahedral
- ☐ **C** x: Trigonal planar · y: Pyramidal
- ☐ **D** x: Pyramidal · y: Tetrahedral

Q8 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q16 · [17 marks]

This question also needs Periodicity.

This question is about trends in the periodic table.

The graph shows the melting points for Period 3 elements from sodium to silicon.



16(a)(i) Complete the graph to show approximate melting points for P, S, Cl and Ar.

[2 marks]

16(a)(ii) Explain why silicon has a higher melting point than aluminium.

Use ideas about structure and bonding in your answer.

[3 marks]

The table shows the first ionisation energies for the elements in Period 3.

Element	Na	Mg	Al	Si	P	S	Cl	Ar
First ionisation energy / kJ mol ⁻¹	496	738	578	789	1012	1000	1251	1521

16(b)(i) Write an equation to represent the first ionisation energy of sulfur. Include state symbols.

[1 mark]

16(b)(ii) The table shows that there is a general increase in first ionisation energies across Period 3, but that this trend is **not** followed by phosphorus to sulfur.

Explain why the first ionisation energy of sulfur is **lower** than the first ionisation energy of phosphorus.

[2 marks]

16(c) A student adds an aqueous solution of bromine, $\text{Br}_2(\text{aq})$, to two test tubes.

The student adds aqueous sodium iodide, $\text{NaI}(\text{aq})$, to the $\text{Br}_2(\text{aq})$ in one test tube, and aqueous sodium chloride, $\text{NaCl}(\text{aq})$, to the $\text{Br}_2(\text{aq})$ in the other test tube.

Complete the table to show the student's observations.

Write ionic equation(s) for any reaction(s) that take place.

Solutions	Observations
$\text{Br}_2(\text{aq}) + \text{NaI}(\text{aq})$	
$\text{Br}_2(\text{aq}) + \text{NaCl}(\text{aq})$	

Ionic equation(s)

[3 marks]

16(d) The hydrides of silicon, phosphorus and sulfur have simple molecular structures, but their molecules have different shapes.

Explain why molecules of SiH_4 , PH_3 and H_2S have different shapes.

Your answer should include 'dot-and-cross' diagrams (outer shells only), the names of the shapes and an explanation of why the bond angles are different.

[6 marks]

Q9 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q7 · [1 mark]

The table below shows the boiling points of some hydrogen halides.

Hydrogen halide	Boiling point / K
HCl	188
HBr	206
HI	238

What is the best explanation for the trend in boiling points from HCl to HI?

Tick (✓) one box.

- ☐ **A** The strength of the covalent bonds increases.
- ☐ **B** The strength of the hydrogen bonds increases.
- ☐ **C** The strength of the induced dipole–dipole interactions (London forces) increases.
- ☐ **D** The strength of the permanent dipole–dipole interactions increases.

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Mark scheme:

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