

Exercise walk-through

1.3.2

Electron diagrams, coordinate bonds and shape

Pearson Edexcel · International A-Level · Chemistry

What does a jump establish?

Your turn

Three successive ionisation energies are close; the fourth is much larger. What follows from the jump alone?

- A. Three outer electrons; period still unknown
- B. Period 3; group still unknown
- C. Four outer electrons
- D. The atom has four occupied shells

Count pairs before naming shape

- 1** NH_4^+ and CH_4 : four bonding regions, tetrahedral, 109.5° .
- 2** NH_3 : three bonds and one lone pair, pyramidal, about 107° . H_2O : two bonds and two lone pairs, bent, about 104.5° .
- 3** Lone pairs repel more strongly; the angle reduction is not a fixed amount per pair.

Compare fuels using their whole pathway

- 1** Cracking makes smaller hydrocarbons including alkenes; balance atoms in proposed products.
- 2** CO reduces oxygen transport; nitrogen/sulfur oxides can contribute to acid pollution.
- 3** Bioethanol growth can absorb CO₂, but processing and transport still emit. Hydrogen production also matters.

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NaCl: bracketed ions; only each ion's outer shell shown.

CO₂: dots from C; crosses from O

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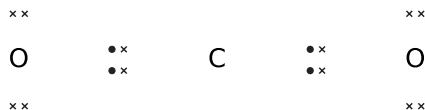
Full solution 2.1

2.1



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CO₂: dots from C; crosses from O



Two shared pairs per C–O bond; two lone pairs per O.

Award Na⁺ and Cl[−] charges/brackets, eight outer electrons on each ion, and chloride's gained electron distinguished from its seven original outer electrons. Only the upper panel answers this item.

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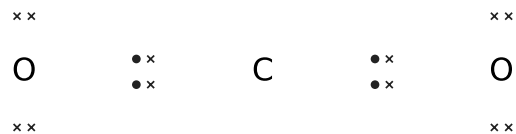
Full solution 2.2 (1/2)

2.2



NaCl: bracketed ions; only each ion's outer shell shown.

CO₂: dots from C; crosses from O



Two shared pairs per C–O bond; two lone pairs per O.

Full solution 2.2 (2/2)

N₂: dots from left N; crosses from right N



Three shared pairs and one lone pair per atom: ten outer electrons.

CO₂: two shared pairs per C–O bond and two lone pairs on each O, consistent electron origins. N₂: three shared pairs, one lone pair per N with consistent electron origins.

Exercise 2.3

2.3 In an aqueous ion-migration demonstration, a coloured cation moves toward the negative electrode. Explain what this shows and why movement in solution differs from solid ionic material. State one limitation of using conductivity alone to conclude a substance is ionic. [3]

3 Exam-style questions

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3 Exam-style questions

2.3 The migration supports the presence of mobile positively charged particles attracted to the negative electrode. Solid ionic lattices hold ions in fixed positions; solution permits movement. Metals and graphite can also conduct through mobile electrons, so conductivity alone does not identify the charge carriers or uniquely prove ionic bonding.

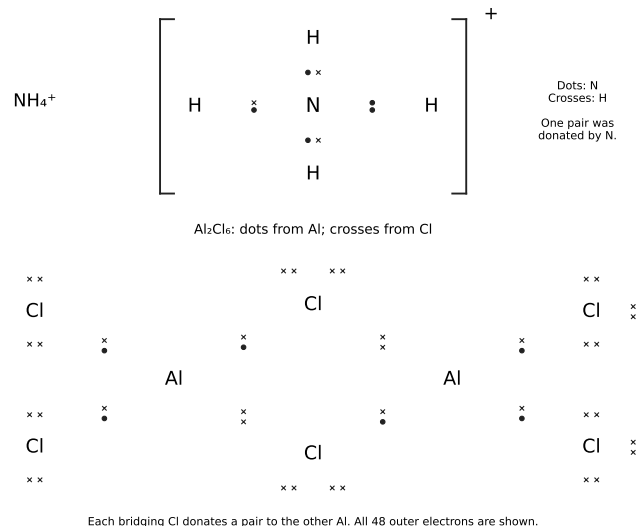
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NH_4^+ : four shared pairs/no N lone pair, one pair supplied entirely by N, bracket/+ and eight-electron total. Al_2Cl_6 : two bridging chlorines, one donor pair from each bridge to the other aluminium, all terminal/bridge lone pairs and 48-electron total.

Exercises 3.2·3.3

3.2 Give the shape and typical bond angle(s) for BeCl_2 , BCl_3 , NH_4^+ , gaseous PCl_5 and SF_6 . Explain why the double bonds in CO_2 do not make it a four-region tetrahedral molecule. [6]

3.3 A charged rod deflects a thin water jet more strongly than a cyclohexane jet. Explain how this supports a polarity comparison. Why can a molecule containing polar bonds still have no permanent overall dipole? Give an example. [4]

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3.2 BeCl_2 linear 180° ; BCl_3 trigonal planar 120° ; NH_4^+ tetrahedral 109.5° ; gaseous PCl_5

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3.3 Water has a permanent molecular dipole and interacts with the charged rod's field; non-polar cyclohexane lacks a permanent overall dipole, so the observations support the comparison. In a symmetrical molecule, bond-dipole vectors can cancel, as in CO_2 or

BCl_3 . The deflection comparison is qualitative and does not alone determine every bond or molecular structure.