InkChemistry

QUESTION WORKBOOK

# Covalent, dative covalent and metallic bonding

Bonding and structure · Unit C03

AQA 3.1.3.2, 3.1.3.3 · OCR A 2.2.2, 3.1.1

21 questions · 64 marks

PRINT EDITION

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## SECTION A · Short, 1 to 2 marks

**A1** CDC-Q1
State what is meant by a covalent bond. [2]

**A2** CDC-Q2
State what is meant by a dative covalent bond, and state how one is shown in a displayed formula. [2]

**A3** CDC-Q5
Give the number of bonding pairs and the number of lone pairs round the central atom in $H_2O$ and in $CO_2$. [2]

**A4** CDC-Q8
Explain why nitrogen gas, $N_2$, is very unreactive. [2]

**A5** CDC-Q20
Give the number of σ bonds and the number of π bonds in a molecule of hydrogen cyanide, HCN. [2]

## SECTION B · Standard, 3 to 5 marks

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**B1** CDC-Q9 Explain why magnesium has a higher melting point than sodium. [4]

**B2** CDC-Q10 Explain why metals conduct electricity and why they are malleable. [4]

**B3** CDC-Q18 Explain, using hybridisation, why the bond angles round each carbon atom in ethene, $C_2H_4$, are about 120° and why the molecule is planar. [4]

**B4** CDC-Q3 Describe the dot-and-cross diagram for ammonia, $NH_3$, showing outer electrons only. [3]

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**B5** CDC-Q4 Describe the dot-and-cross diagram for a nitrogen molecule, $N_2$. [3]

**B6** CDC-Q6 Explain how an ammonium ion forms from an ammonia molecule and a hydrogen ion, and why its four N–H bonds are identical. [3]

**B7** CDC-Q7 Explain how two $AlCl_3$ molecules join to form an $Al_2Cl_6$ molecule. [3]

**B8** CDC-Q11 Suggest how the bonding in a carbon monoxide molecule, CO, allows both atoms to have eight outer electrons, given that the molecule contains a triple bond. [3]

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**B9** CDC-Q12 Suggest why bronze, an alloy of copper with tin, is harder than pure copper. [3]

**B10** CDC-Q13 Suggest why phosphorus forms both $PCl_3$ and $PCl_5$, but nitrogen forms $NCl_3$ and no $NCl_5$. [3]

**B11** CDC-Q14 Calculate the number of delocalised electrons in 1.00 g of magnesium. Ar of Mg = 24.3; L = $6.022 \times 10^{23}$ $mol^{-1}$. [3]

**B12** CDC-Q15 Calculate the energy needed to break every N≡N bond in 2.40 $dm^3$ of nitrogen gas at room temperature and pressure. N≡N bond enthalpy = 945 kJ $mol^{-1}$; molar gas volume = 24.0 $dm^3$ $mol^{-1}$. [3]

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**B13** CDC-Q17 Evaluate the claim that the dative bond in an ammonium ion is weaker than its other three N–H bonds and can be identified in the ion. [3]

**B14** CDC-Q19 Calculate an estimate of the energy needed to break only the π bonds in 5.60 g of nitrogen gas, $N_2$, taking the σ part of the triple bond as equal to an N–N single bond. Bond enthalpies: N–N 163 kJ $mol^{-1}$, N≡N 945 kJ $mol^{-1}$; Mr of $N_2$ = 28.0. [3]

**B15** CDC-Q21 Suggest why a hot wire placed in hydrogen iodide produces violet fumes of iodine, but the same wire has no effect on hydrogen chloride. Bond enthalpies: H–Cl 432 kJ $mol^{-1}$, H–I 298 kJ $mol^{-1}$. [3]

## SECTION C · Long, 6 marks or more

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**C1** CDC-Q16 Compare the bonding in solid sodium with the bonding in solid sodium chloride, and use the comparison to explain the differences in their electrical conductivity and in how they respond to a hammer blow. [6]

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