

AS 91164

Demonstrate understanding of bonding, structure, properties and energy changes

Level 2, 5 Credits

This achievement standard involves demonstrating understanding of bonding, structure, properties and energy changes.

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of bonding, structure, properties and energy changes.	Demonstrate in-depth understanding of bonding, structure, properties and energy changes.	Demonstrate comprehensive understanding of bonding, structure, properties and energy changes.

Bonding and structure

- ☐ Bonding and structure
 - ionic bonding (ions)
 - covalent bonding
 - molecular (molecules)
 - covalent network (atoms)
 - metallic bonding (atoms)

- ☐ Properties
 - hardness
 - malleability
 - ductility
 - electrical conductivity
 - movement of electrons
 - movement of ions
 - melting and boiling points
 - solubility
 - correlation of solubility of types of solid with solvent polarity (polar & non-polar)
 - explanation in terms of attractive forces in the solute, solvent and the solution

- ☐ Intermolecular forces (different types of intermolecular forces is not required)
 - distinction between inter and intramolecular forces

- ☐ Lewis structures of simple molecules (restricted to molecules with no more than four electron pairs about any atom)
 - single bonded molecules

- bonding electrons may be represented using – or : e.g.

$\begin{array}{c} \cdot\cdot \\ \text{F} \\ \cdot\cdot \end{array} - \begin{array}{c} \cdot\cdot \\ \text{F} \\ \cdot\cdot \end{array}$
 or
 $\begin{array}{c} \cdot\cdot \\ \text{F} \\ \cdot\cdot \end{array} : \begin{array}{c} \cdot\cdot \\ \text{F} \\ \cdot\cdot \end{array}$

- multiple bonded molecules

- bonding electrons may be represented using = or :: e.g.

$\begin{array}{c} \cdot\cdot \\ \text{O} \\ \cdot\cdot \end{array} = \begin{array}{c} \cdot\cdot \\ \text{O} \\ \cdot\cdot \end{array}$
 or
 $\begin{array}{c} \cdot\cdot \\ \text{O} \\ \cdot\cdot \end{array} :: \begin{array}{c} \cdot\cdot \\ \text{O} \\ \cdot\cdot \end{array}$

- shape of simple molecules, based on arrangement of electron pairs & the repulsion of regions of negative charge
 - linear
 - angular / bent / v-shaped
 - trigonal planar
 - trigonal pyramid
 - tetrahedral
- bond angles – 180° , 120° , 109°
- polarity of simple molecules
 - bond polarity (in terms of the electronegativity of the bonded atoms)
 - effect of shape on polarity of molecule

Energy Changes

- Exothermic and endothermic reactions
 - energy profile diagrams
 - enthalpy H, reaction progress, reactants, products, ΔH , activation energy
 - energy (enthalpy) changes associated with changes of state
 - fusion (solid \rightarrow liquid)
 - vaporisation (liquid \rightarrow gas)
 - enthalpy changes associated with the making and breaking of chemical bonds
 - bond breaking is endothermic, $+\Delta H$
 - bond making is exothermic, $-\Delta H$
- Calculations of energy changes using $\Delta_r H$ and reaction stoichiometry, and bond enthalpy
 - energy (enthalpy) changes associated with differing amounts of substances
 - moles of substance
 - mass of substance
 - bond enthalpy calculations
 - $\Delta_r H^\circ$, standard enthalpy of reaction when reactants and products are in their standard state (usually the state at 25°C). e.g. $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$ $\Delta_r H^\circ (\text{H}_2\text{O}, \text{l}) = -570 \text{ kJ mol}^{-1}$

Note:

Enthalpy changes, ΔH units commonly used kJ mol^{-1}

All working should be shown in calculations

Numerical answers should be rounded to an appropriate number of significant figures (usually three significant figures)

