MSJChem

Tutorials for IB Chemistry

Structure 2.4

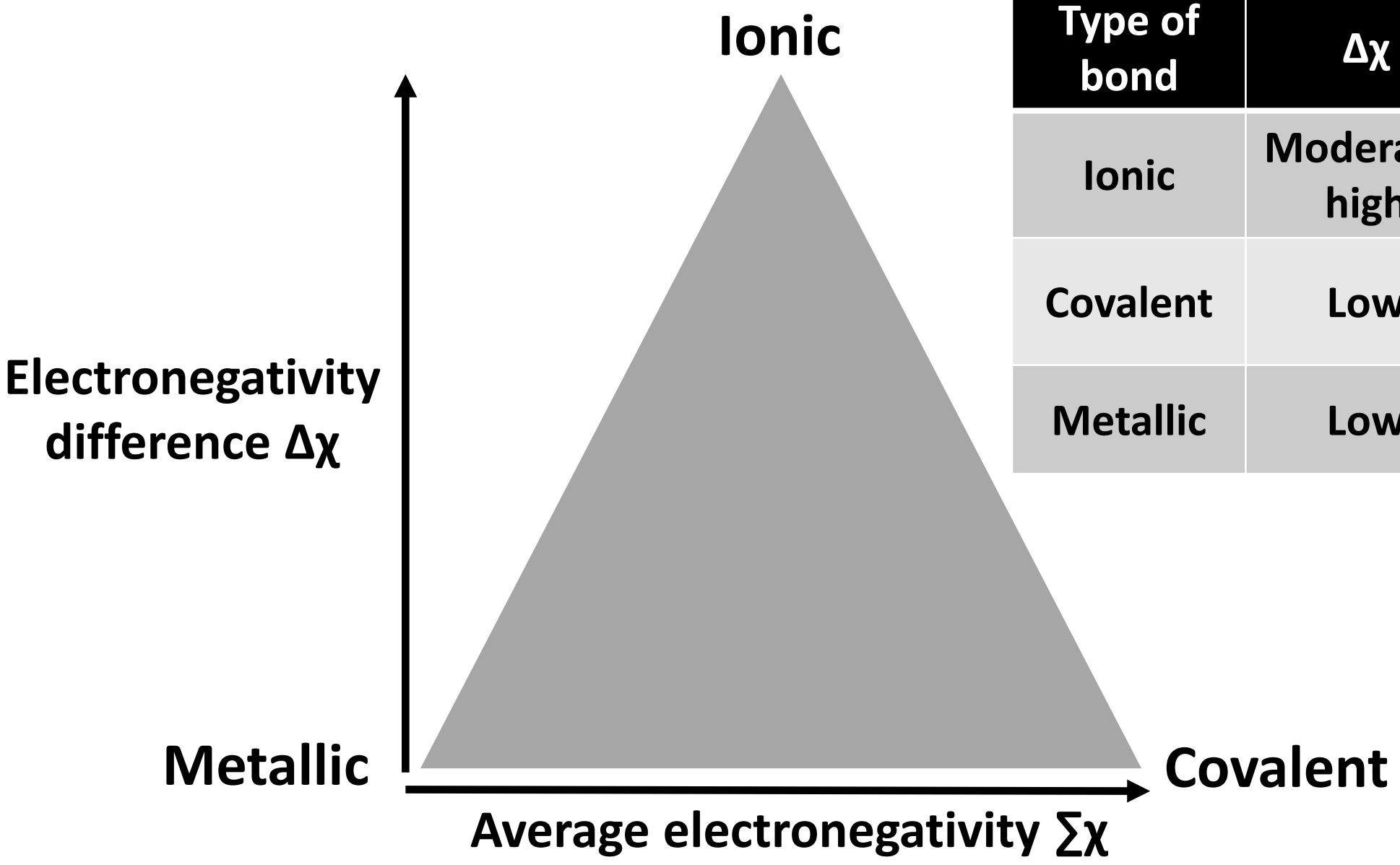
MSJChem

Tutorials for IB Chemistry

Bonding triangle

MSJChem
Tutorials for IB Chemistry

Bonding triangle

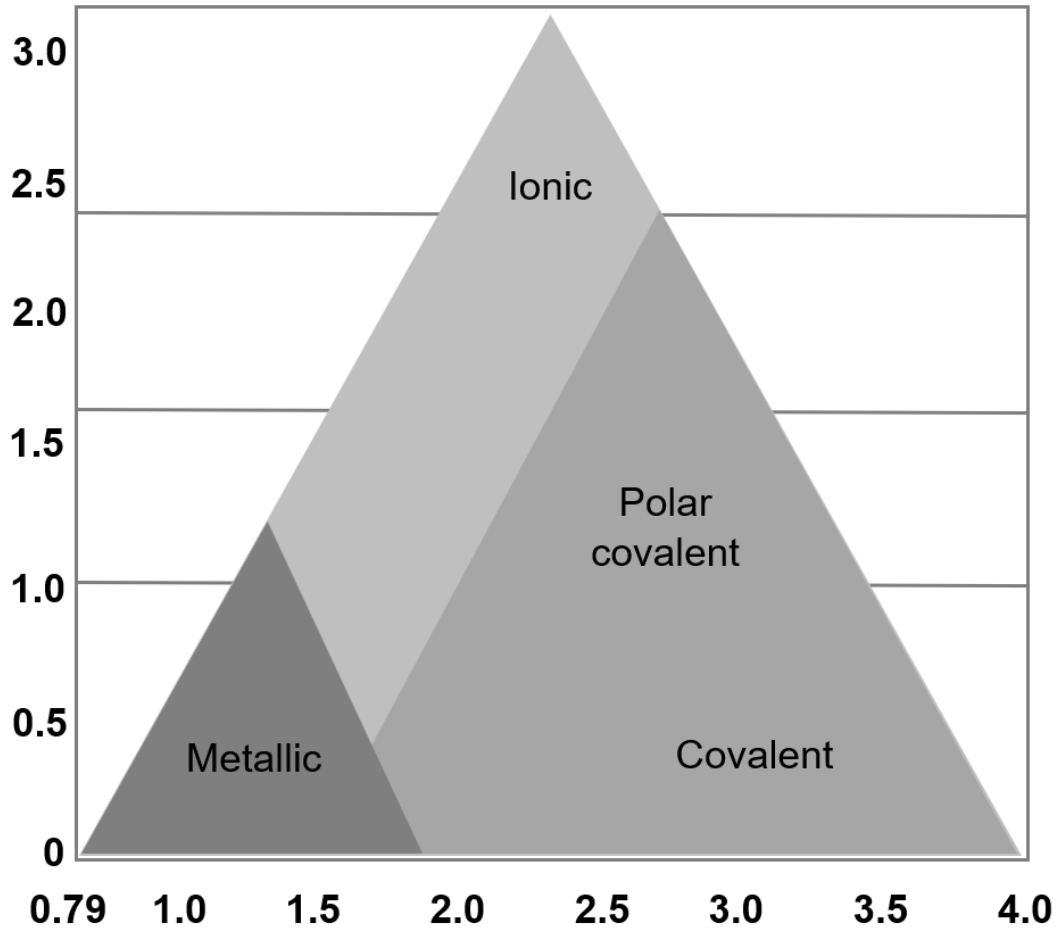


Type of bond	Δχ	Σχ
Ionic	Moderate-high	Moderate
Covalent	Low	Moderate-high
Metallic	Low	Low

MSJChem
Tutorials for IB Chemistry

Bonding triangle

Electronegativity difference: $\Delta\chi = \chi_a - \chi_b$



% covalent	% ionic
8	92
25	75
50	50
75	25
100	0

Average electronegativity: $\Sigma\chi = \frac{(\chi_a + \chi_b)}{2}$

Bond triangle diagram

Electronegativity difference: $\Delta\chi = \chi_a - \chi_b$

Chlorine, Cl_2

$\Delta\chi = 3.2 - 3.2$

$\Delta\chi = 0$

Cesium fluoride, CsF_2

$\Delta\chi = 4.0 - 0.8$

$\Delta\chi = 3.2$

Magnesium, Mg

$\Delta\chi = 1.3 - 1.3$

$\Delta\chi = 0$

Hydrogen chloride, HCl

$\Delta\chi = 3.2 - 2.2$

$\Delta\chi = 1.0$

Bond triangle diagram

Average electronegativity: $\Sigma\chi = \frac{(\chi_a + \chi_b)}{2}$

Chlorine, Cl_2

$$\Sigma\chi = \frac{(3.2 + 3.2)}{2}$$

$$\Sigma\chi = 3.2$$

Cesium fluoride, CsF_2

$$\Sigma\chi = \frac{(4.0 + 0.8)}{2}$$

$$\Sigma\chi = 2.4$$

Magnesium, Mg

$$\Sigma\chi = \frac{(1.3 + 1.3)}{2}$$

$$\Sigma\chi = 1.3$$

Hydrogen chloride, HCl

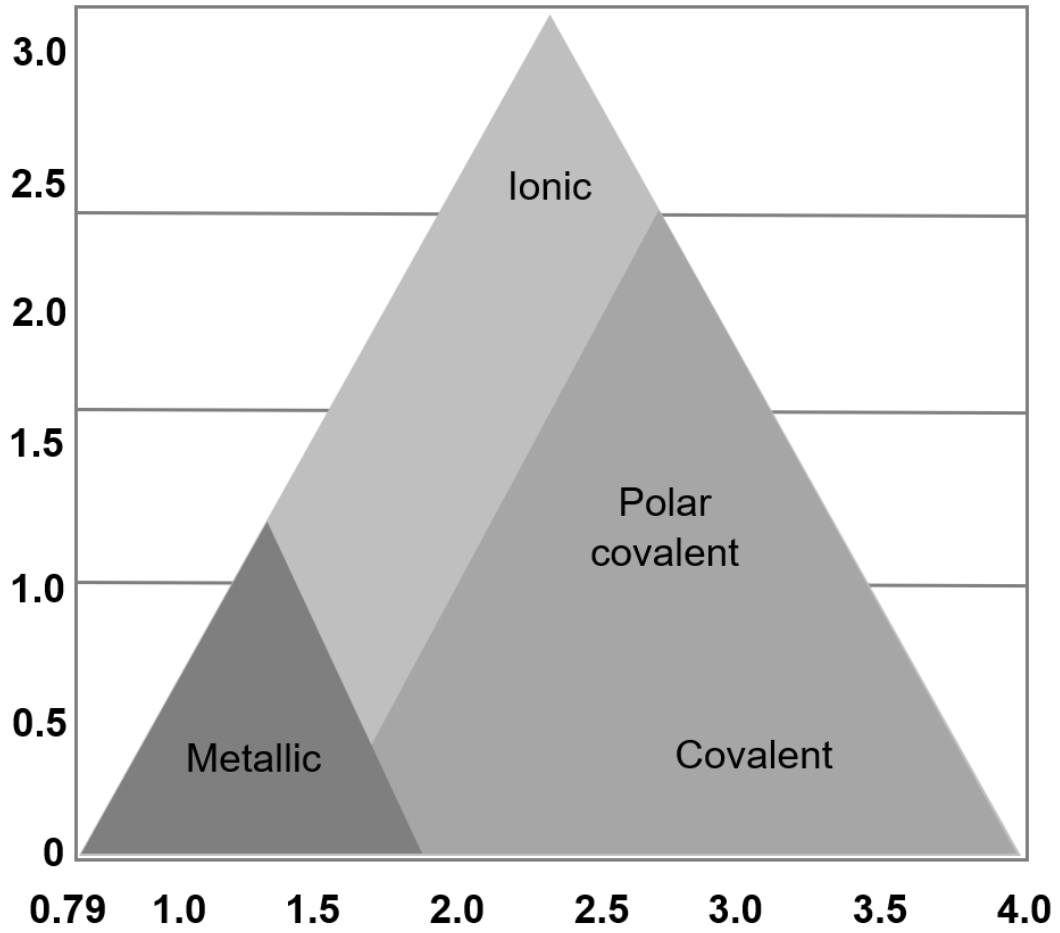
$$\Sigma\chi = \frac{(3.2 + 2.2)}{2}$$

$$\Sigma\chi = 2.7$$

MSJChem
Tutorials for IB Chemistry

Bonding triangle

Electronegativity difference: $\Delta\chi = \chi_a - \chi_b$



% covalent	% ionic
8	92
25	75
50	50
75	25
100	0

Average electronegativity: $\Sigma\chi = \frac{(\chi_a + \chi_b)}{2}$

Chlorine, Cl_2

$$\Delta\chi = 3.2 - 3.2$$

$$\Delta\chi = 0$$

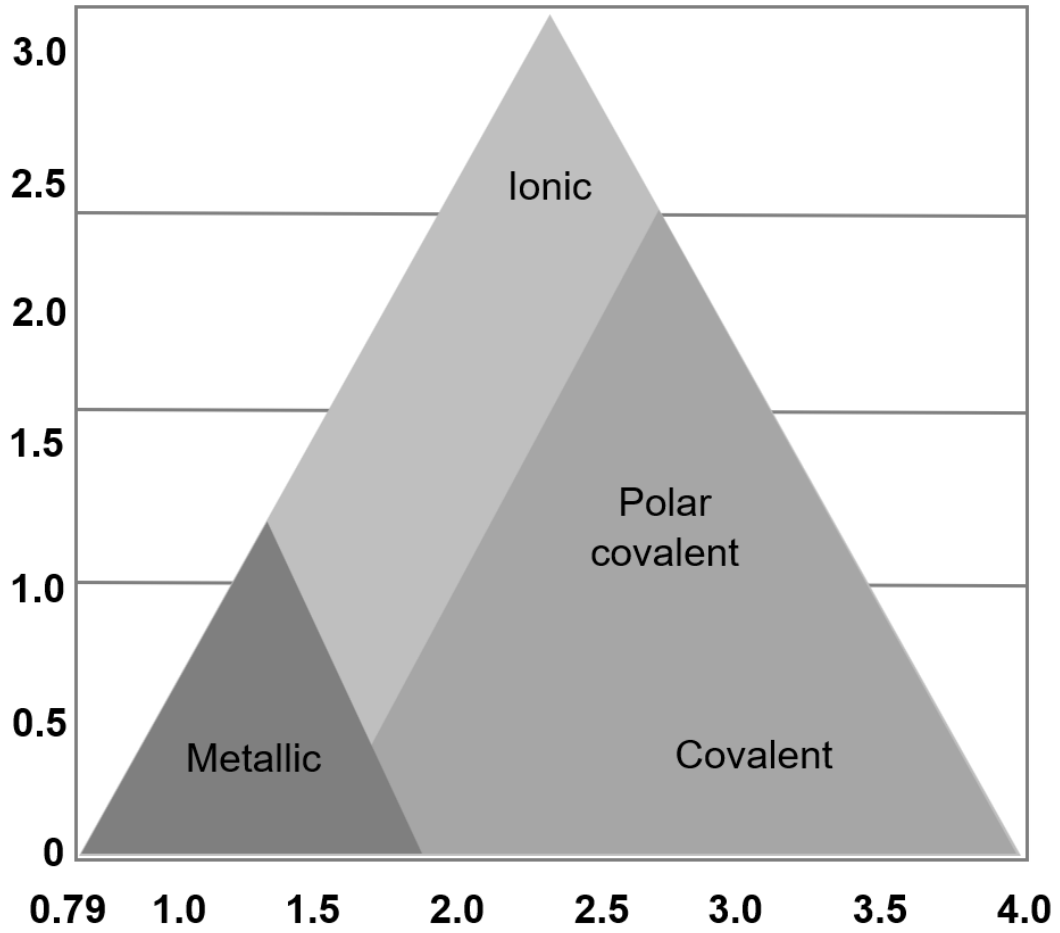
$$\Sigma\chi = \frac{(3.2 + 3.2)}{2}$$

$$\Sigma\chi = 3.2$$

MSJChem
Tutorials for IB Chemistry

Bonding triangle

Electronegativity difference: $\Delta\chi = \chi_a - \chi_b$



% covalent	% ionic
8	92
25	75
50	50
75	25
100	0

Average electronegativity: $\Sigma\chi = \frac{(\chi_a + \chi_b)}{2}$

Hydrogen chloride, HCl

$$\Delta\chi = 3.2 - 2.2$$

$$\Delta\chi = 1.0$$

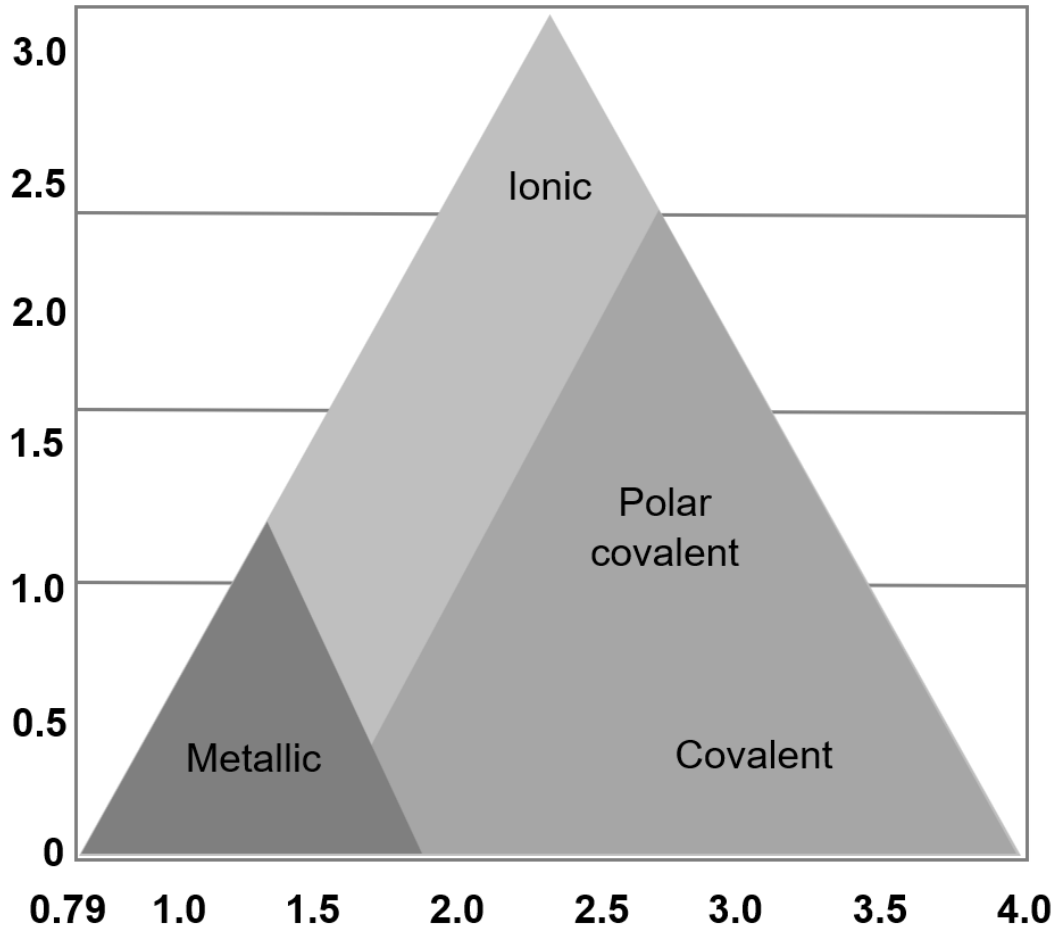
$$\Sigma\chi = \frac{(3.2 + 2.2)}{2}$$

$$\Sigma\chi = 2.7$$

MSJChem
Tutorials for IB Chemistry

Bonding triangle

Electronegativity difference: $\Delta\chi = \chi_a - \chi_b$



% covalent	% ionic
8	92
25	75
50	50
75	25
100	0

Average electronegativity: $\Sigma\chi = \frac{(\chi_a + \chi_b)}{2}$

Cesium fluoride, CsF_2

$$\Delta\chi = 4.0 - 0.8$$

$$\Delta\chi = 3.2$$

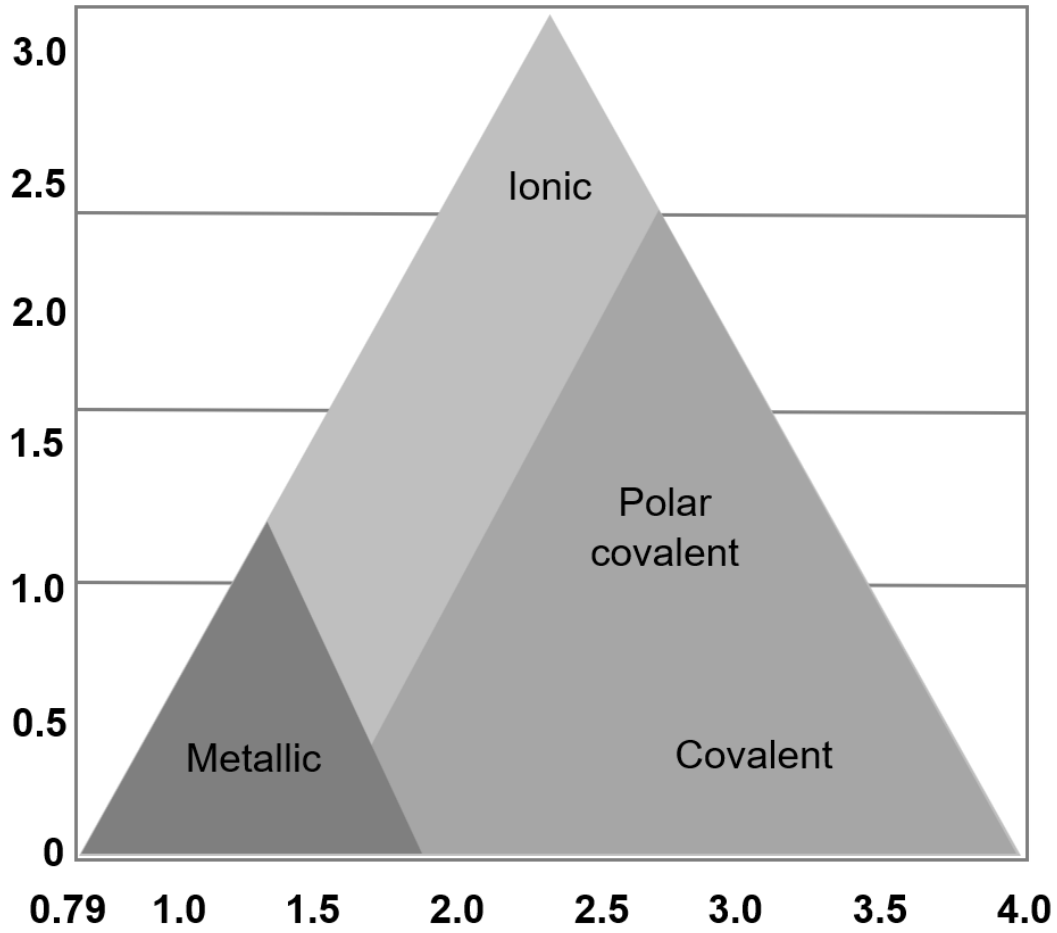
$$\Sigma\chi = \frac{(4.0 + 0.8)}{2}$$

$$\Sigma\chi = 2.4$$

MSJChem
Tutorials for IB Chemistry

Bonding triangle

Electronegativity difference: $\Delta\chi = \chi_a - \chi_b$



% covalent	% ionic
8	92
25	75
50	50
75	25
100	0

Average electronegativity: $\Sigma\chi = \frac{(\chi_a + \chi_b)}{2}$

Magnesium, Mg

$$\Delta\chi = 1.3 - 1.3$$

$$\Delta\chi = 0$$

$$\Sigma\chi = \frac{(1.3 + 1.3)}{2}$$

$$\Sigma\chi = 1.3$$

Bonding triangle

Species	$\Delta\chi$	$\Sigma\chi$	Type of bonding
Chlorine	0	3.2	Non-polar covalent
Hydrogen chloride	1.0	2.7	Polar covalent
Cesium fluoride	3.2	2.4	Ionic
Magnesium	0	1.3	Metallic

Bonding triangle

Type of bonding	State at room temperature	Boiling and melting points	Electrical conductivity	Solubility in water
Covalent	Mainly gases and liquids	Low	Low	Low
Ionic	Solid	High	Depends on state	Most are soluble
Metallic	Solid	High	High	Insoluble

MSJChem

Tutorials for IB Chemistry

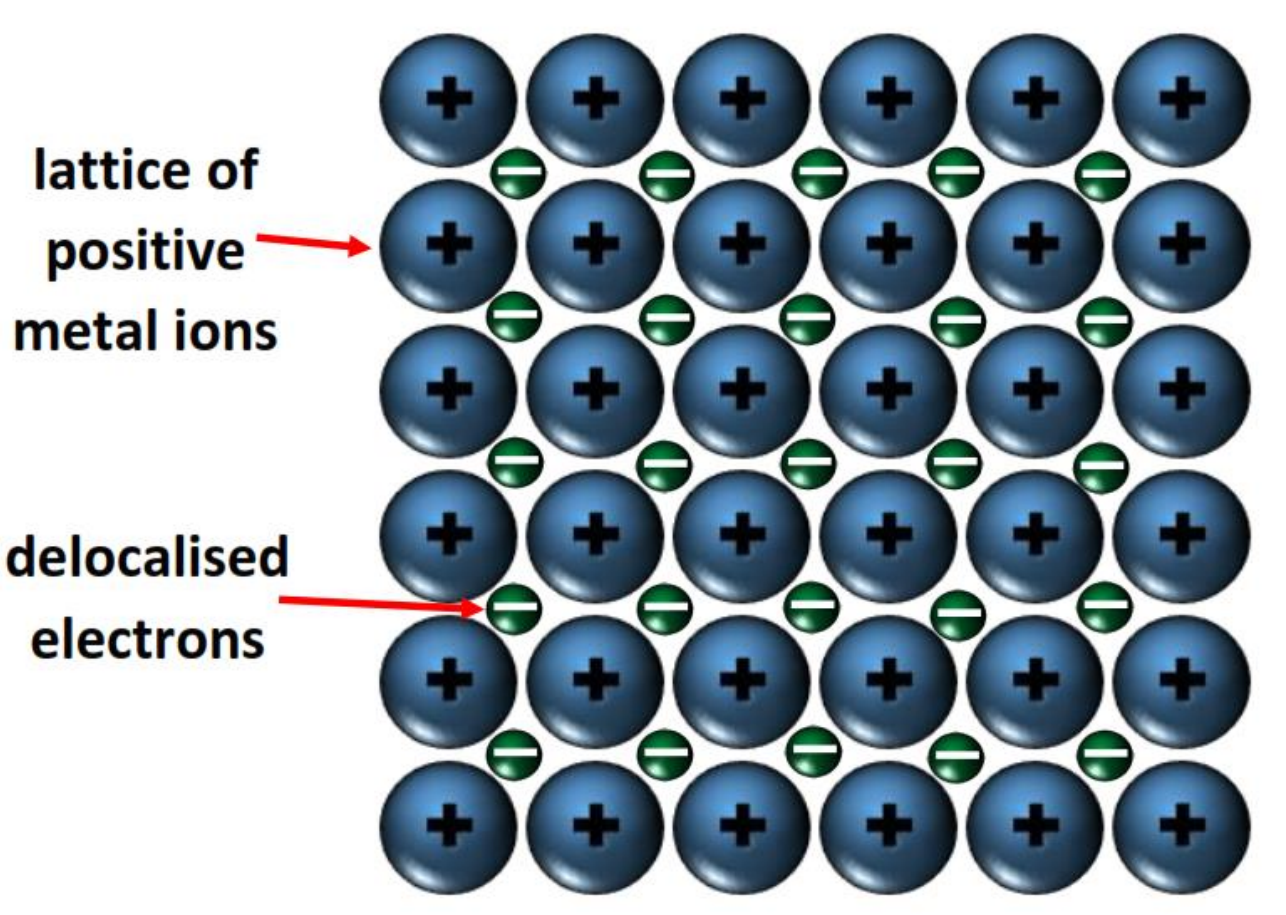
Alloys

MSJChem
Tutorials for IB Chemistry

Alloys

Alloys are materials that are composed of two or more metals or a metal and a non-metal.

Alloys



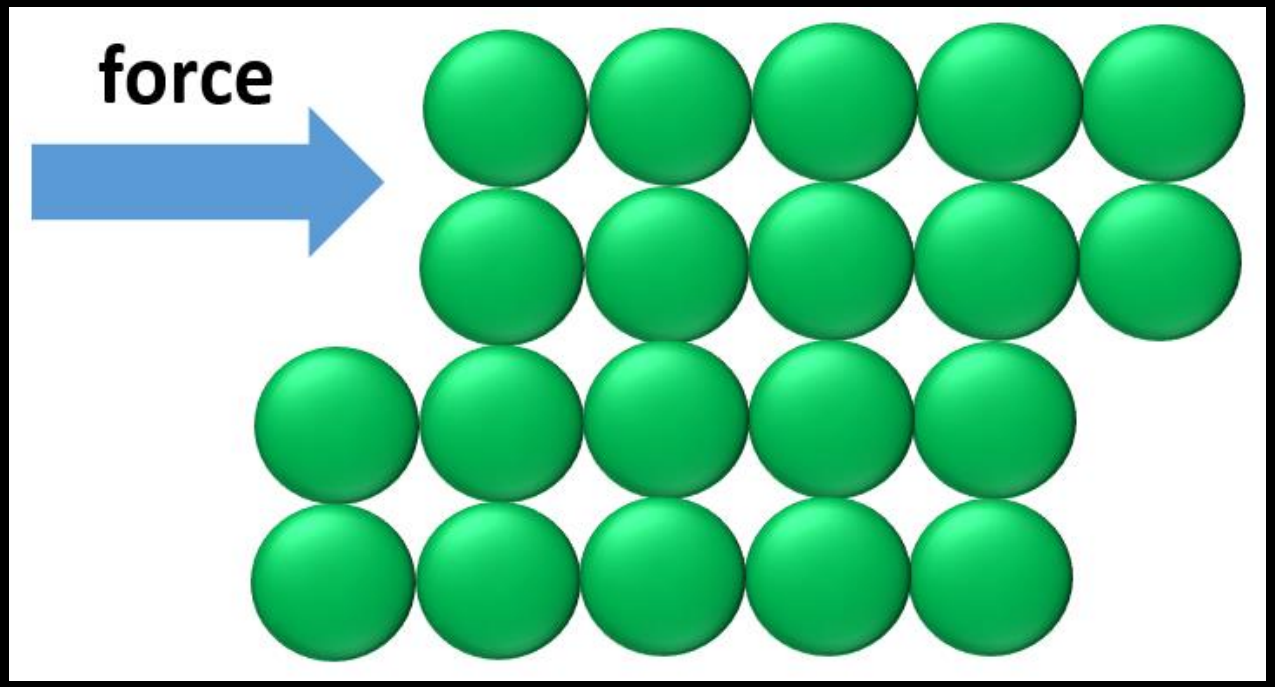
The bonding in metals is non-directional.
The force of attraction between the positive metal ions and the delocalised electrons acts in every direction around the fixed metal ions.

Alloys have enhanced properties (increased tensile strength and increased resistance to corrosion).

MSJChem
Tutorials for IB Chemistry

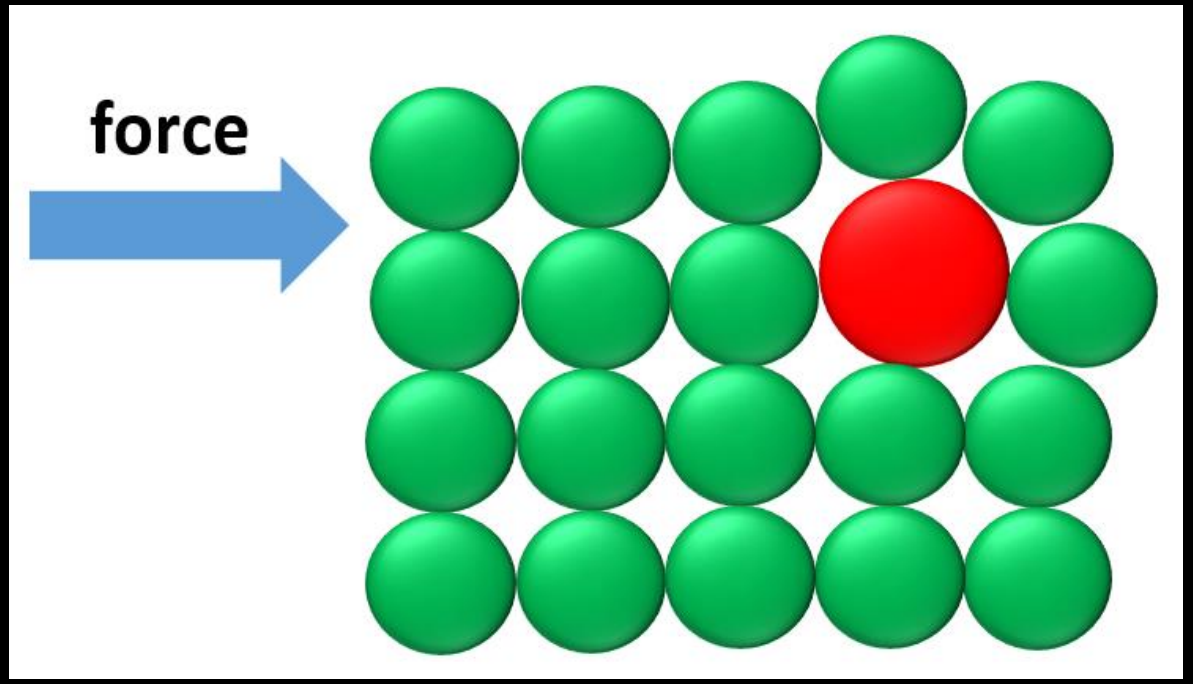
Alloys

pure metal



In a pure metal the layers can slide over each other.

alloy



The presence of different metal atoms means the layers cannot slide over each other as easily.

Alloys

Alloys have different properties to the metals that they are made from.

They tend to be harder (less malleable) and have greater tensile strength (stronger).

The added metal atoms can distort the lattice structure.

The distortion of the lattice structure makes it more difficult for the layers to slide over each other.

MSJChem

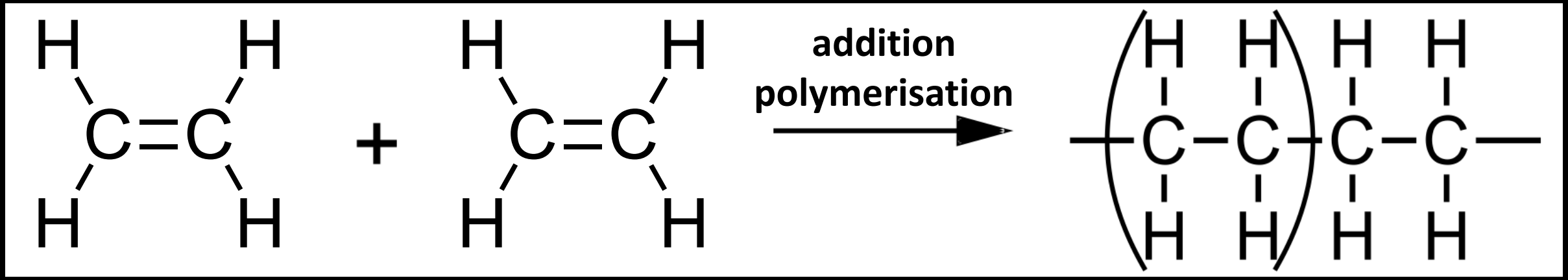
Tutorials for IB Chemistry

Introduction to polymers

MSJChem
Tutorials for IB Chemistry

Polymers

A polymer is a substance that consists of very large molecules called macromolecules, composed of many repeating subunits, which are known as monomers.



ethene monomers

polyethene

Polymers

Polymers can be natural or synthetic; some examples are shown in the table below.

Natural polymers	Synthetic polymers
Cellulose	Nylon
Starch	Polyethene
Collagen	PVC (polyvinyl chloride)

Polymers

Property of polymer	Explanation
Electrical and heat insulator	No delocalised electrons to conduct electricity or heat
Flexible	Weak intermolecular forces between the polymer chains
Durable	Strong covalent bonds between the atoms in the polymer chains
Can be moulded into different shapes	The weak intermolecular forces between the polymer chains can be overcome by heat
Lightweight / low densities	Polymer chains do not pack closely together

MSJChem

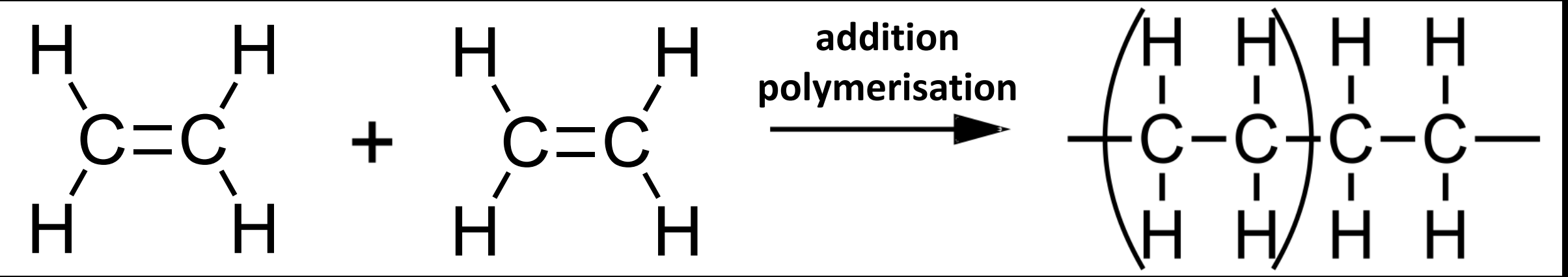
Tutorials for IB Chemistry

Addition polymerisation

MSJChem
Tutorials for IB Chemistry

Addition polymerisation

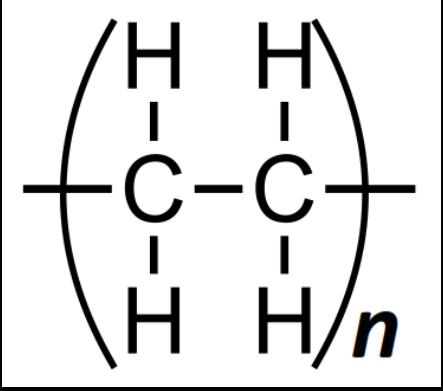
Addition polymers are formed when smaller unsaturated molecules (monomers) react together.



ethene monomers

polymer polyethene

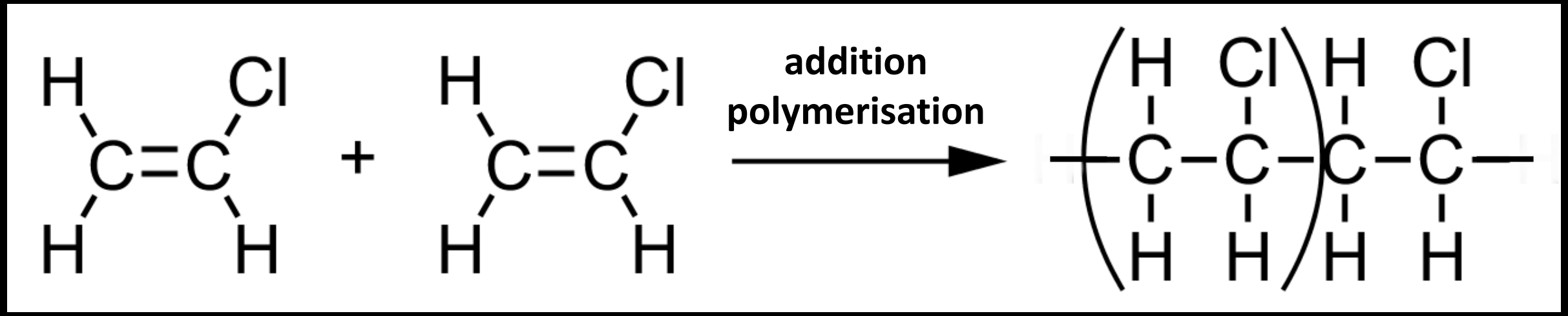
repeating unit



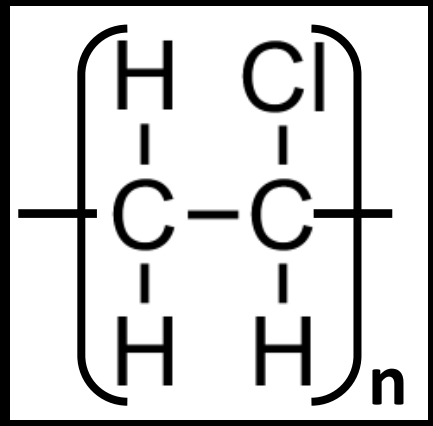
MSJChem
Tutorials for IB Chemistry

Addition polymerisation

PVC or poly(vinyl chloride) is a polymer made from the monomer unit chloroethene (vinyl chloride).



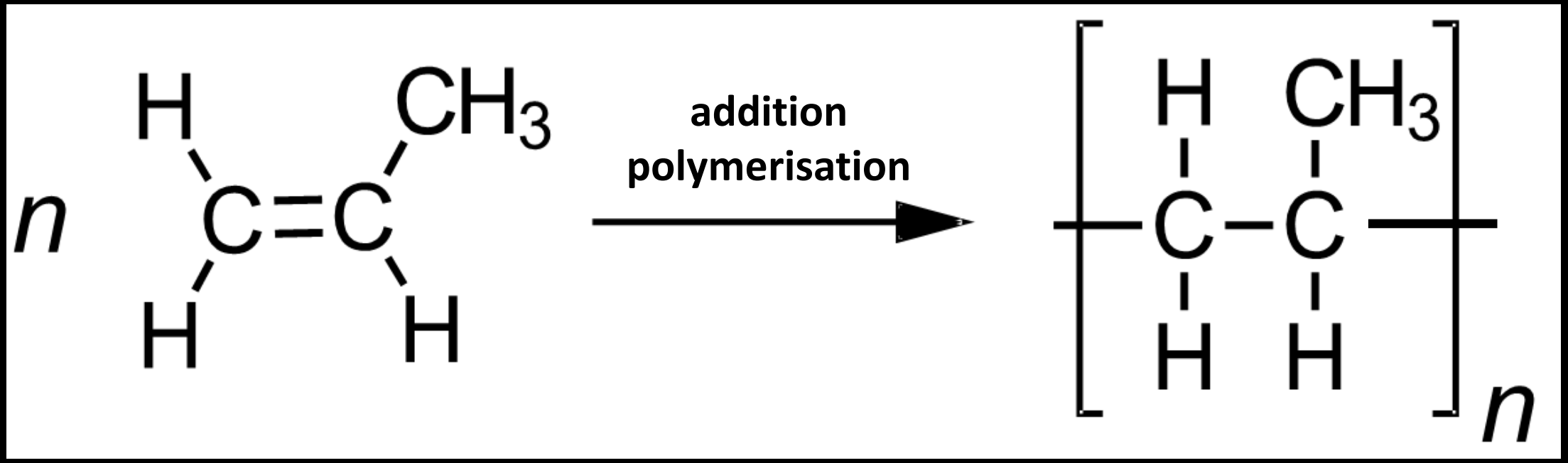
repeating unit



MSJChem
Tutorials for IB Chemistry

Addition polymerisation

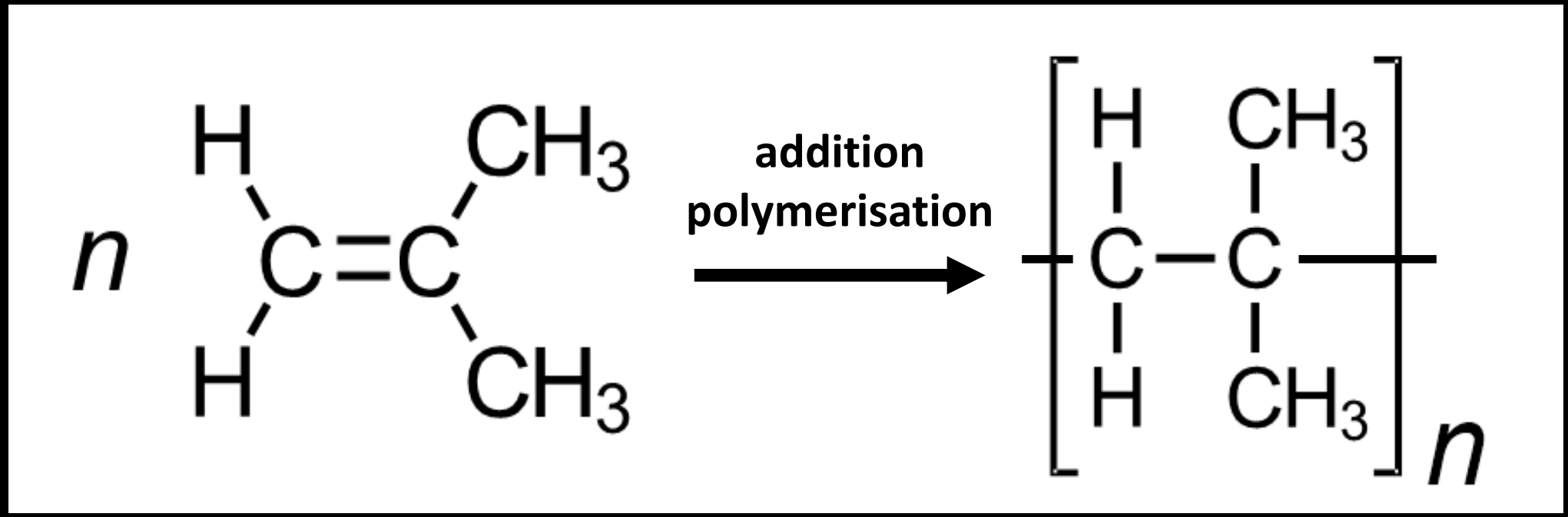
Poly(propene) is an addition polymer made from the monomer unit propene.



MSJChem
Tutorials for IB Chemistry

Addition polymerisation

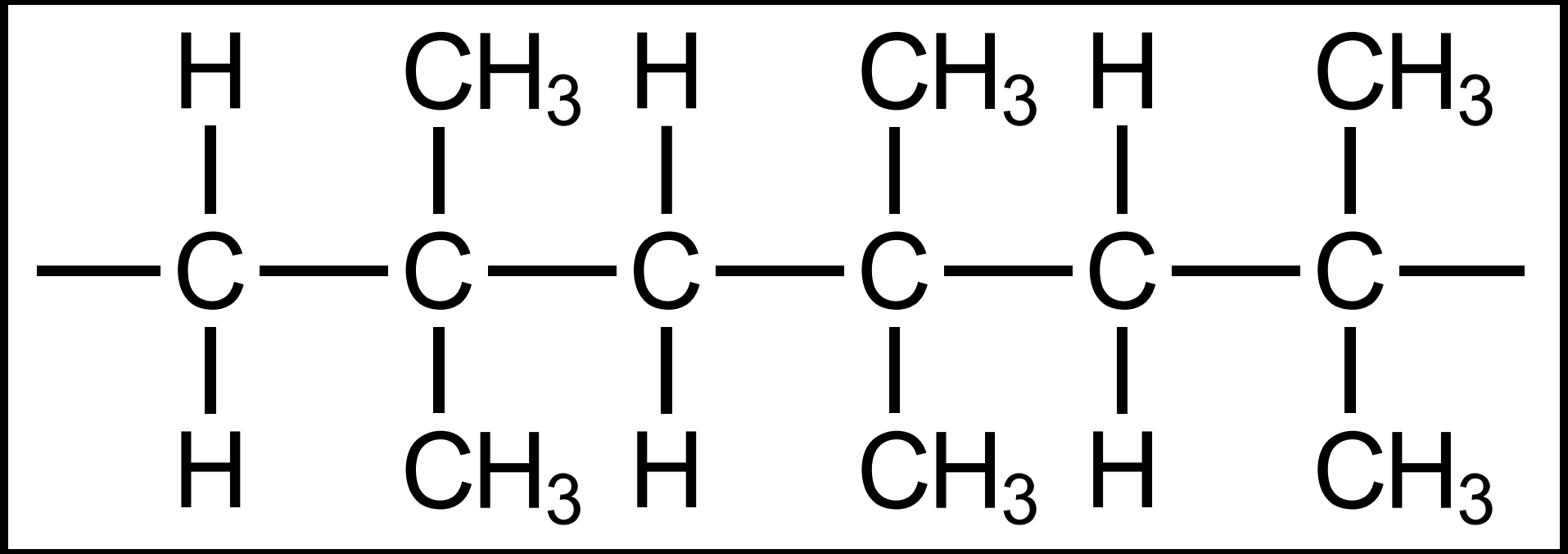
The polymerisation of 2-methylpropene forms the polymer poly(2-methylpropene) or butyl rubber.



MSJChem
Tutorials for IB Chemistry

Addition polymerisation

Draw the structure of the polymer made from three 2-methylpropene monomer units.



Every second carbon atom is bonded to two methyl (CH_3) groups.