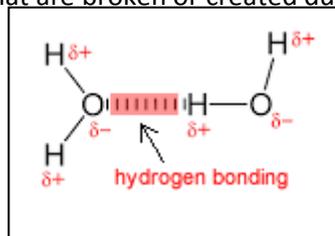


Revision Unit 1

You may wish to revisit [inter-molecular](#) bonding and [intra-molecular](#) bonding.

- 1) Water is boiled in a kettle. Describe the bonds that are broken or created during this activity. Draw a diagram to assist in your explanation.

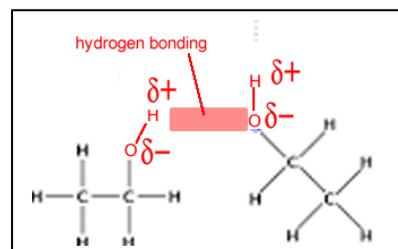
Hydrogen bonds between the water molecules are broken as the liquid water turns to steam.



- 2) Carbon dioxide has a molar mass of 44 g/mol while ethanol has a molar mass of 46 g/mol. Although the two molecules are very similar in size they differ greatly in their physical properties. Ethanol is a liquid at room temperature and has a boiling temperature of around 80 °C while carbon dioxide is a gas at room temperature and boils at around -80 °C. Explain why.

Carbon dioxide is a symmetrical molecule and as such has intermolecular forces made up of only, relatively weak, dispersion forces. These forces are easily broken with heat and so CO₂ boils at a very low temperature.

Ethanol on the, on the other hand, has hydrogen bonding as well as dispersion forces. Hydrogen bonding is a strong form of intermolecular bonding and takes more energy to break. This is why ethanol boils at 80 °C.



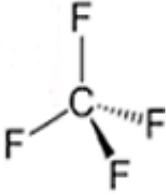
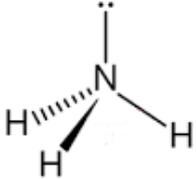
- 3) The following table provides information about the physical properties of 5 substances.

Substance	Melting Point (°C)	Boiling Point (°C)	Conduct electricity in solid form?	Conduct electricity in liquid form?
A	12	120	No	No
B	800	1200	No	Yes
C	700	1500	yes	Yes
D	145	200	No	No
E	-95	-12	No	No

- i. Which substance is most likely a metal?
C. Metals have relatively high melting temperatures and conduct electricity in both the solid and molten state.

- ii. Which substance is very brittle?
B Ionic substances are brittle and have relatively high melting temperatures. Ionic compounds conduct electricity in the molten but not the solid states.
 - iii. Which substances are likely to be molecular substances?
A, D and E are likely candidates. They have relatively low boiling temperatures and do not conduct electricity in both the solid and liquid states.
 - iv. One of the substances is known to be composed of non-polar molecules. Which is the likely substance?
E is the likely substance. Non-polar molecules tend to have weak intermolecular forces of attraction (dispersion). This means they have very low boiling and melting temperatures.
- 4) Consider the following substances. CH_3F , CH_3OH , CO_2 , CH_3COOH .
- i. What is the intra-molecular bonding in all of these molecules?
 CH_3F =Dispersion forces and dipole-dipole bonding
 CH_3OH =dispersion forces and hydrogen bonding
 CO_2 =dispersion forces
 CH_3COOH = dispersion forces and hydrogen bonding
 - ii. Which molecules have inter molecular forces composed of dispersion forces only?
 CO_2
 - iii. Which molecules have a high degree of solubility in water?
Like dissolves like. Since water has hydrogen bonding it will dissolve substances which also show hydrogen bonding.

5) Revise [Lewis dot diagrams](#) You may also wish to revise [polar molecules](#)

Molecule	Electron dot diagram	Molecular shape
CO ₂	$\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{O} = \text{C} = \text{O} \\ \cdot\cdot \\ \cdot\cdot \end{array}$	$\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{O} = \text{C} = \text{O} \\ \cdot\cdot \\ \cdot\cdot \end{array}$ Linear
CF ₄	$\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{F} \\ \cdot\cdot \\ \cdot\cdot \\ \text{F} - \text{C} - \text{F} \\ \cdot\cdot \\ \cdot\cdot \\ \text{F} \\ \cdot\cdot \\ \cdot\cdot \end{array}$	 Tetrahedral
NH ₃	$\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{H} : \text{N} : \text{H} \\ \cdot\cdot \\ \cdot\cdot \\ \text{H} \end{array}$	 Triangular pyramid
H ₂ S	$\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{H} : \text{S} : \\ \cdot\cdot \\ \cdot\cdot \\ \text{H} \end{array}$	 V-shape

ii. Explain how the octet rule is used to draw electron dot diagrams?

The **octet rule** states that atoms prefer to have an outer shell with eight electrons.

The octet rule is used in Lewis dot diagrams to arrange bonding electrons so that each atom, apart from hydrogen, obeys the Octet Rule.

3) A substance is composed of three isotopes listed below along with their percentage abundance. Calculate the relative atomic mass of the element. Revise isotopes at this [link](#).

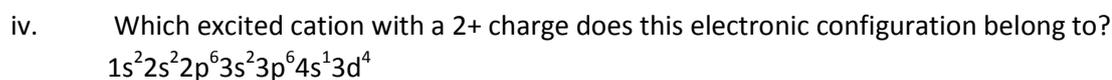
Isotope	Relative Isotopic Mass	Abundance (%)
35	34.98	45.0
32	31.96	15.0
31	31.01	40.0

$$\text{relative atomic mass} = \frac{34.98 \times 45.0 + 31.96 \times 15.0 + 31.01 \times 40.0}{100} = 32.94 \text{ amu}$$

4) Write the electronic configuration of the following species.



The neutral iron atom has the following configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$
Now take 2 electrons from the furthest (4s) orbital to make the Fe^{2+} . Electrons are removed from the 4s first as they are further from the nucleus than the 3d.



The original neutral atom has 25 electrons. Since it is neutral it must also have 25 protons which makes it Mn.

[Read](#) more on electronic configuration.