Subatomic Particles

Octet Rule

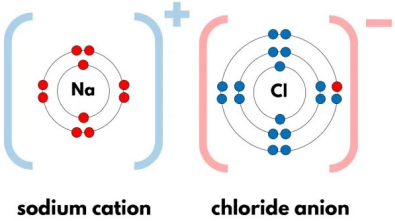
Atoms are the most stable when they have 0 or 8 valence electrons.

Ion – Atom that has lost or gained e^- to fulfil the octet rule

Sodium (Na) loses $1e^-$ to form a **cation**

1 val e^- → 0 val e^-

Cation = + Ion



Chlorine (Ca) gains $1e^-$ to form an **anion**

7 val e^- → 8 val e^-

Anion = - Ion

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Subatomic Particles

Ion Charge

Charge of an ion is based on the group on the periodic table

Cation (+ ion): Ions formed due to losing electrons (*metals*)
Anion (- ion): Ions formed due to gaining electrons (*non-metals*)

Group	Val e^-	Charge	Group	Val e^-	Charge	Group	Val e^-	Charge
1A (1)	1	1+	**3A (13)**	3	3+	**6A (16)**	6	2-
2A (2)	2	2+	**4A (14)**	4	4+ / 4-	**7A (17)**	7	1-
1B – 10B (3 – 12)	2 (Varies)	Varies	**5A (15)**	5	3-	**8A (18)**	8	No Charge

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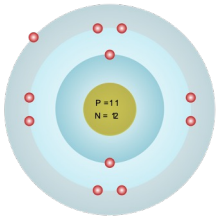
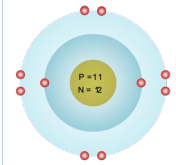
Subatomic Particles

Charges of Ions– Cations (Lose e^-)



Na Atom



Na^+ Ion

Neutral Atom

Sodium (*Metal*)

$11p^+ + 11e^- = 0$

No Charge - Neutral

Cation (*Lose 1e⁻*)

Sodium Ion (*Cation*)

$11p^+ + 10e^- = +1$

+1 Charge - Cation

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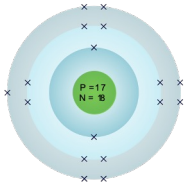
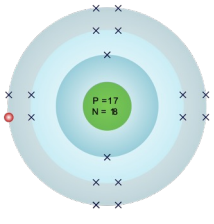
Subatomic Particles

Charges of Ions– Anions (Gain e^-)



Cl Atom



Cl^- Ion

Neutral Atom

Chlorine (*non-metal*)

$17p^+ + 17e^- = 0$

No Charge - Neutral

Cation (*gain 1e⁻*)

Chlorine Ion (*anion*)

$17p^+ + 18e^- = -1$

-1 Charge - Anion

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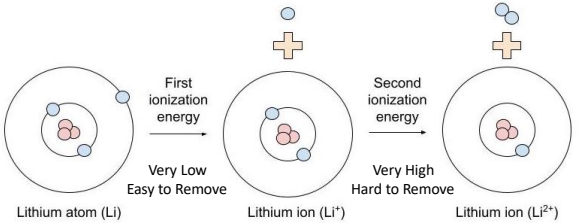
Formation of Ions

Ionization Energy

Energy required to remove an electron from atom to form an ion



Neutral Atom Li^{1+} (0 val e^-) Li^{2+} (-1 val e^-)

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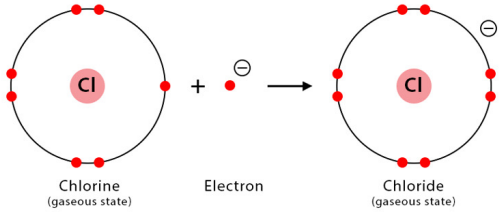
Formation of Ions

Electron Affinity

Energy lost (*ideal*) or gained when an atom gains an electron



Energy released: EA = -349 kJ/mol

Chloride Anion (-1 anion) Chlorine Atom (Neutral)

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Formation of Ions

Comparing Ionization Energy and Electron Affinity

Energy required to remove an electron from atom to form an ion

Element Type	Ionization Energy	Electron Affinity
Metals (0 – 4 Valence Electrons)	Low IE (*easy to lose* e^-) Atoms want to lose e^-	Low EA (*Low desire to gain* e^-) Atoms don't want e^-
Non-Metals (5 – 8 Valence Electrons)	High IE (*hard to lose* e^-) Atoms don't want to lose e^-	High EA (*High desire to gain* e^-) Atoms want to gain e^-

In general: Atoms always want to lose heat (*q*), - to become more stable

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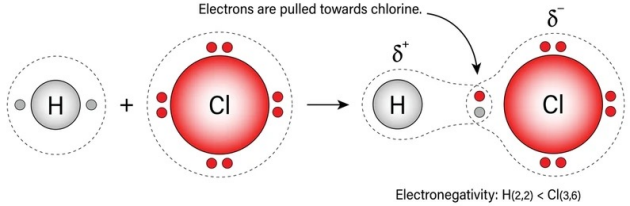
Formation of Ions

Electronegativity

Atoms ability to attract electrons towards itself



Metals/Hydrogen – Low Electroneg. Non-Metals – High Electroneg.

Higher Electronegativity = More pull on electrons towards itself in bond

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