Chapter 4 : Periodic Table of Elements

Arrangement in the Periodic Table of Elements

Groups in the Periodic Table of Elements

- Groups are known as the vertical bars down the periodic table.
- Groups are based on the valence electron of the element.
- There are 18 groups which the groups are based on the valence electron such that
  - if it is 2 or lesser than 2, the group of electron = valence electron and
  - if it is more than 2 and smaller than 8, the group of electron = valence electron + 10

GROUP	NAME
1	AKALI METALS
2	ALKALINE EARTH METALS
3-12	TRANSITION METALS
17	HALOGENS
18	NOBLE GASES

Periods in the Periodic Table of Elements

- Periods are known as the horizontal bars across the periodic table.
- Periods are based on the number of shells of the element.
- There are 7 periods.

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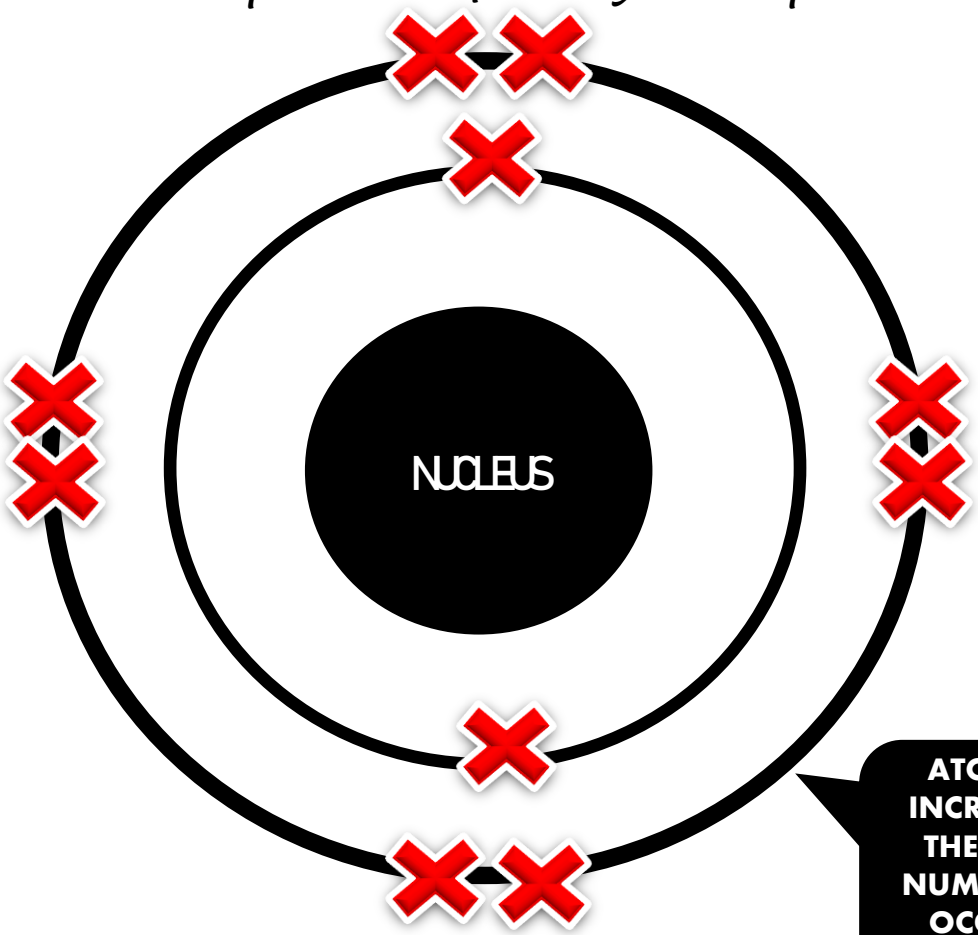
Physical Properties of Every Group



ATOMIC RADIUS INCREASES DUE TO THE INCREASE IN NUMBER OF SHELLS OCCUPIED WITH ELECTRON

FOR GROUP 1 :
THE METALIC BONDING BETWEEN THE ATOMS BECOMES WEAKER, THUS THE MELTING AND BOILING POINT DECREASES

FOR GROUP 17 :
THE MOLECULAR SIZE INCREASES, THUS THE FORCE OF ATTRACTION INCREASES, THUS REQUIRING MORE HEAT TO BREAK THE BOND.

FOR GROUP 18 :
THE VAN DEER WAALS FORCE INCREASES, THUS IT NEEDS MORE HEAT TO BREAK THE BOND.

MELTING AND BOILING POINT INCREASES

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Physical Properties of Every Group

ATOMIC MASS INCREASES RESULTED IN BIGGER MASS THAN VOLUME.

$$DENSITY = \frac{MASS}{VOLUME}$$

Chapter 4 : Periodic Table of Elements

Physical Properties of Every Group

GROUP	GROUP 1
ATOMIC RADIUS	INCREASES WHEN GOING DOWN
MELTING POINT AND BOILING POINT	DECREASES WHEN GOING DOWN
DENSITY	INCREASES WHEN GOING DOWN
SOLUBILITY	-
ELECTRICAL CONDUCTIVITY AND HEAT CONDUCTIVITY	GOOD ELECTRIC AND HEAT CONDUCTORS

Chapter 4 : Periodic Table of Elements

CHARACTERISTICS OF ELEMENTS IN GROUP 1

- Group 1 elements are known as Alkali metals.
- Group 1 elements are grey solids with shiny silvery surfaces.
- Group 1 elements are soft solids and can be easily cut.
- The shiny surfaces of group 1 elements turn dull very quickly when it is exposed to air because the alkali metals are very reactive and they react rapidly with oxygen and water vapour in the air when exposed.
- Group 1 elements are kept in paraffin oil to prevent them from reacting with air or water vapour in the atmosphere.

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REACTIVITY OF ELEMENTS IN GROUP 1

- Alkali metals have 1 valence electron. In order to achieve octet configuration, its atom will donate 1 electron to achieve octet configuration
- Thus, the reactivity of Group 1 elements is measured by the ease of its atom to donate 1 valence electron to achieve octet configuration.
- The nearer the valence electron to the nucleus, the harder it will be donated.

Shiny, silvery and soft appearance of group 1 elements.

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REACTIVITY OF ELEMENTS IN GROUP 1

When going down group 1 elements, extra shell is added.

Thus, the atomic size increases from lithium to francium.

Valence electron becomes further away from the nucleus.

Attraction between nucleus and valence electron become weaker.

Thus, the outermost electron is easier to be donated from its electron.

Reactivity increases when going down Group 1.

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CHEMICAL REACTION OF ELEMENTS IN GROUP 1

ALKALI METALS + WATER

LITHIUM	SODIUM	POTASSIUM
• Lithium move slowly on the water surface with a soft "hiss" sound. • A colourless solution that turns red litmus paper blue is formed.	• Sodium melts to become small sphere, moves rapidly and randomly on the water surface with a "hiss" sound. • A colourless solution that turns red litmus paper blue is formed.	• Potassium melts to become small sphere, burns with a lilac flames, moves very rapidly and randomly on the water surface with "hiss" and "pop" sounds. • A colourless solution that turns red litmus paper blue is formed.

EQUATION :

2(Alkali Metal) + 2(Water) → 2(Alkali Metal Hydroxide) + Hydrogen Gas

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CHEMICAL REACTION OF ELEMENTS IN GROUP 1

ALKALI METALS + OXYGEN

LITHIUM	SODIUM	POTASSIUM
• Lithium burns slowly with a red flame and liberates white fumes which become a white solid on cooling to room temperature. • The white solid dissolves in water to produce a colourless solution. • A colourless solution that turns red litmus paper blue is formed.	• Sodium burns rapidly and brightly with a yellow flame and liberates white fumes which become a white solid on cooling to room temperature. • The white solid dissolves in water to produce a colourless solution. • A colourless solution that turns red litmus paper blue is formed.	• Potassium burns very rapidly and brightly with a lilac flame and liberates white fumes which become a white solid on cooling to room temperature. • The white solid dissolves in water to produce a colourless solution. • A colourless solution that turns red litmus paper blue is formed.

EQUATION :

4(Alkali Metal) + Oxygen Gas → 2(Alkali Metal Oxide)

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CHEMICAL REACTION OF ELEMENTS IN GROUP 1

ALKALI METALS + CHLORINE

LITHIUM	SODIUM	POTASSIUM
Lithium burns slowly with a red flame and liberates white fumes which become a white solid at the end of the reaction.	Sodium burns rapidly and brightly with a yellow flame and liberates white fumes which become a white solid at the end of the reaction.	Potassium burns very rapidly and brightly with a lilac flame and liberates white fumes which become a white solid at the end of the reaction.

EQUATION :

2(Alkali Metal) + Chlorine Gas → 2(Alkali Metal Chloride)

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CHEMICAL REACTION OF ELEMENTS IN GROUP 1

- Lithium burns slowly with a red flame and liberates white fumes which become a white solid at the end of the reaction.
- Brown bromine vapour is decolourised .

- Sodium burns rapidly and brightly with a yellow flame and liberates white fumes which become a white solid at the end of the reaction.
- Brown bromine vapour is decolourised.

- Potassium burns very rapidly and brightly with a lilac flame and liberates white fumes which become a white solid at the end of the reaction.
- Brown bromine vapour is decolourised.

EQUATION :

2(Alkali Metal) + Bromine Gas → 2(Alkali Metal Bromide)

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Physical Properties of Every Group

GROUP	GROUP 17
ATOMIC RADIUS	INCREASES WHEN GOING DOWN
MELTING POINT AND BOILING POINT	INCREASES WHEN GOING DOWN
DENSITY	INCREASES WHEN GOING DOWN
SOLUBILITY	-
ELECTRICAL CONDUCTIVITY AND HEAT CONDUCTIVITY	• CANNOT CONDUCT ELECTRICITY • WEAK CONDUCTOR OF HEAT

Chapter 4 : Periodic Table of Elements

CHARACTERISTICS OF ELEMENTS IN GROUP 17

- Group 17 elements are known as Halogens, which are reactive non-metals.
- Group 17 elements are diatomic covalent molecules with molecular formula of F_2, C_2, Br_2, I_2, At_2.
- Group 17 elements become darker when going down the group.

Halogen	Physical State and Colour
Fluorine	Pale yellow gas
Chlorine	Greenish-yellow gas
Bromine	Reddish-brown liquid
Iodine	Purplish-black solid

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ELECTRONEGATIVITY OF ELEMENTS IN GROUP 17

- Electronegativity is the strength of an atom of halogen to pull electron towards its nucleus.
- Elements in Group 17 have a high electronegativity This is because they have 7 valence electrons. Thus, they will attract or pull another electron to its atom so that it achieve stable octet configuration.
- When going down group 17, the electronegativity decreases.

Diatomic and covalent molecules of group 17 elements.

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ELECTRONEGATIVITY OF ELEMENTS IN GROUP 17

When going down group 17 elements, extra shell is added.

Thus, the atomic size increases.

This causes the outermost shell to become further away from the nucleus.

The strength of nucleus to attract electron become weaker.

Thus, the electron is more difficult to be attracted to the atom.

Electronega tivity decreases

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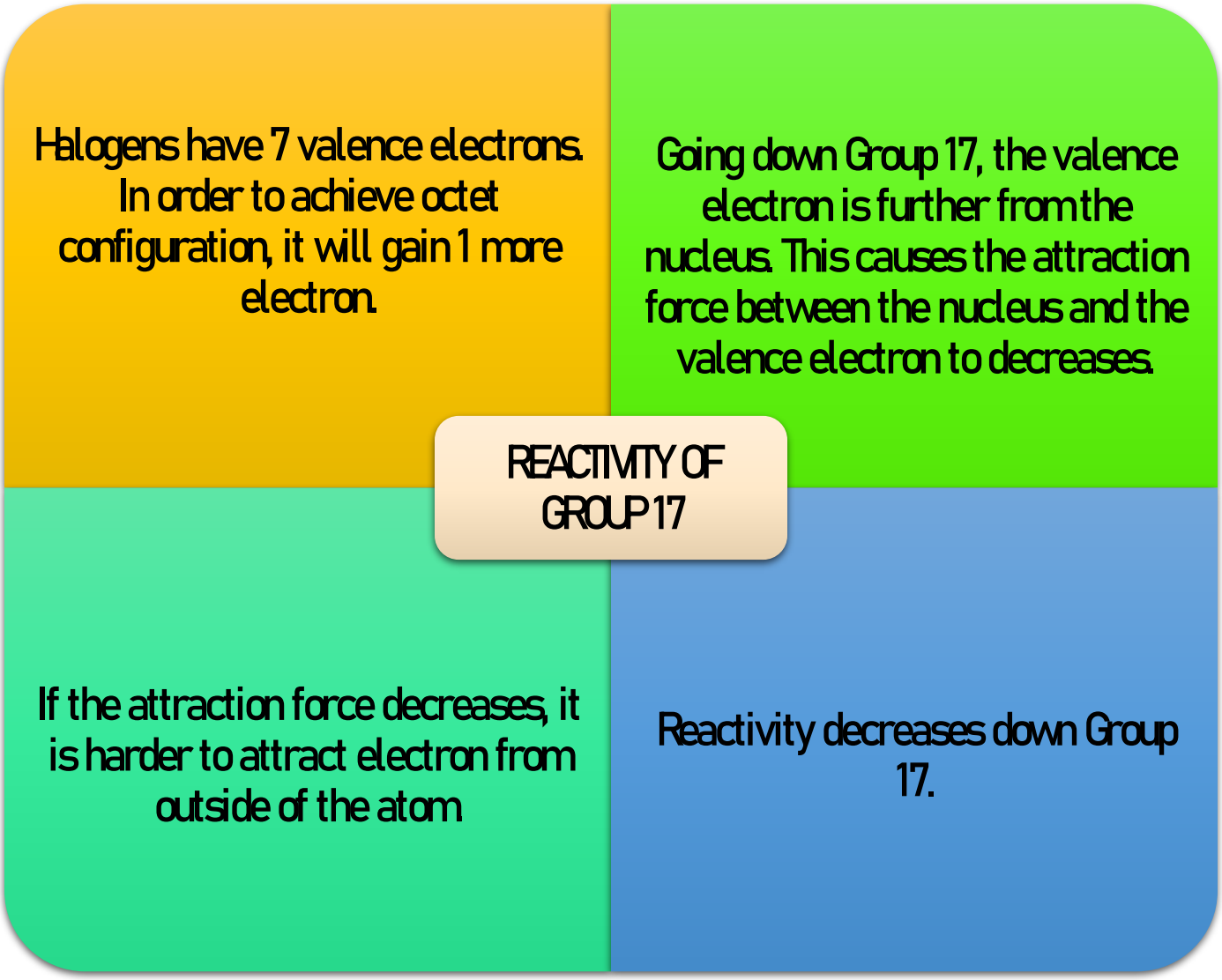
REACTIVITY OF ELEMENTS IN GROUP 17



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CHEMICAL REACTION OF ELEMENTS IN GROUP 1

ALKALI METALS + WATER

CHLORINE	BROMINE	IODINE
▪ Greenish-yellow gas dissolves rapidly in water to produce pale yellow solution. ▪ The pale-yellow solution turns blue litmus paper into red and then white	▪ Reddish-brown liquid dissolves slowly in water to produce a yellowish-brown solution. ▪ The yellowish-brown solution turns blue litmus paper into red and then white.	▪ Only a small amount of the purplish-black crystal dissolves slowly in water to produce a pale-yellow solution. ▪ This solution has no effect on blue litmus paper.

EQUATION :

$X_2 + H_2 \rightarrow HX + HOX$

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CHEMICAL REACTION OF ELEMENTS IN GROUP 1

- The hot iron wool ignites rapidly with a bright flame.
- A brown solid is formed.

- The hot iron wool glows moderately bright, moderately fast and less vigorously.
- A brown solid is formed.

- The hot iron wool glows dimly and slowly.
- A brown solid is formed.

EQUATION :

$3X_2 + 2Fe \rightarrow 2FeX_3$

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CHEMICAL REACTION OF ELEMENTS IN GROUP 1

- The greenish-yellow gas dissolves rapidly in Sodium Hydroxide solution to form a colourless solution.

- The reddish-brown liquid dissolves moderately fast in Sodium Hydroxide solution to form a colourless solution.

- The purplish-black solid dissolves slowly in Sodium Hydroxide solution to form a colourless solution.

EQUATION :

$X_2 + 2NaOH \rightarrow NaX + NaOX + 2H_2O$

Chapter 4 : Periodic Table of Elements

Physical Properties of Every Group

GROUP	GROUP 18
ATOMIC RADIUS	INCREASES WHEN GOING DOWN
MELTING POINT AND BOILING POINT	INCREASES WHEN GOING DOWN
DENSITY	INCREASES WHEN GOING DOWN
SOLUBILITY	INSOLUBLE IN WATER
ELECTRICAL CONDUCTIVITY AND HEAT CONDUCTIVITY	CANNOT CONDUCT ELECTRICITY

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USES OF ELEMENTS IN GROUP 18

- To fill weather balloons and airships because it is very light and non-flammable.
- Mixture of 80% Helium and 20% Oxygen in the oxygen tans is used as an artificial atmosphere by divers.
- Used as a protective atmosphere for growing crystals of silicon and germanium in the microelectronic industry to make microchips.

- Used to fill advertising light bulbs in which that when an electric current is passed through these bulbs, the neon gas glows with a reddish-orange colour.
- Used as an indicator light to show that a circuit is on.

- Used to fill electric bulbs because argon is chemically inert, thus the hot tungsten filament in the bulb does not react with it. As a result, argon gas prevents the tungsten filament from being oxidized.
- Used to supply an inert atmosphere for welding because it prevents the hot metals from reacting with oxygen in the air.

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USES OF ELEMENTS IN GROUP 18

- Fill high speed photographic flash lamps.
- Used in lasers to repair the retina of the eye.

- Used in electron tubes and stroboscopic lamps.
- Used in bubble chambers in the atomic energy reactors.

- Used to treat cancer because it is radioactive.

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Physical Properties of Period

PERIOD	PERIOD 3
ATOMIC RADIUS	DECREASES WHEN GOING DOWN
METALLIC PROPERTIES	CHANGES FROM METALLIC PROPERTIES TO NON-METALLIC PROPERTIES WHEN GOING ACROSS PERIOD 3
PHYSICAL STATE	CHANGES FROM SOLID TO GAS
ELECTRO NEGATIVITY	INCREASES GOING ACROSS PERIOD 3
ELECTRICAL CONDUCTIVITY AND HEAT CONDUCTIVITY	CHANGES FROM GOOD CONDUCTOR OF ELECTRICITY TO SEMI-CONDUCTOR AND TO POOR CONDUCTOR OF ELECTRICITY WHEN GOING ACROSS PERIOD 3

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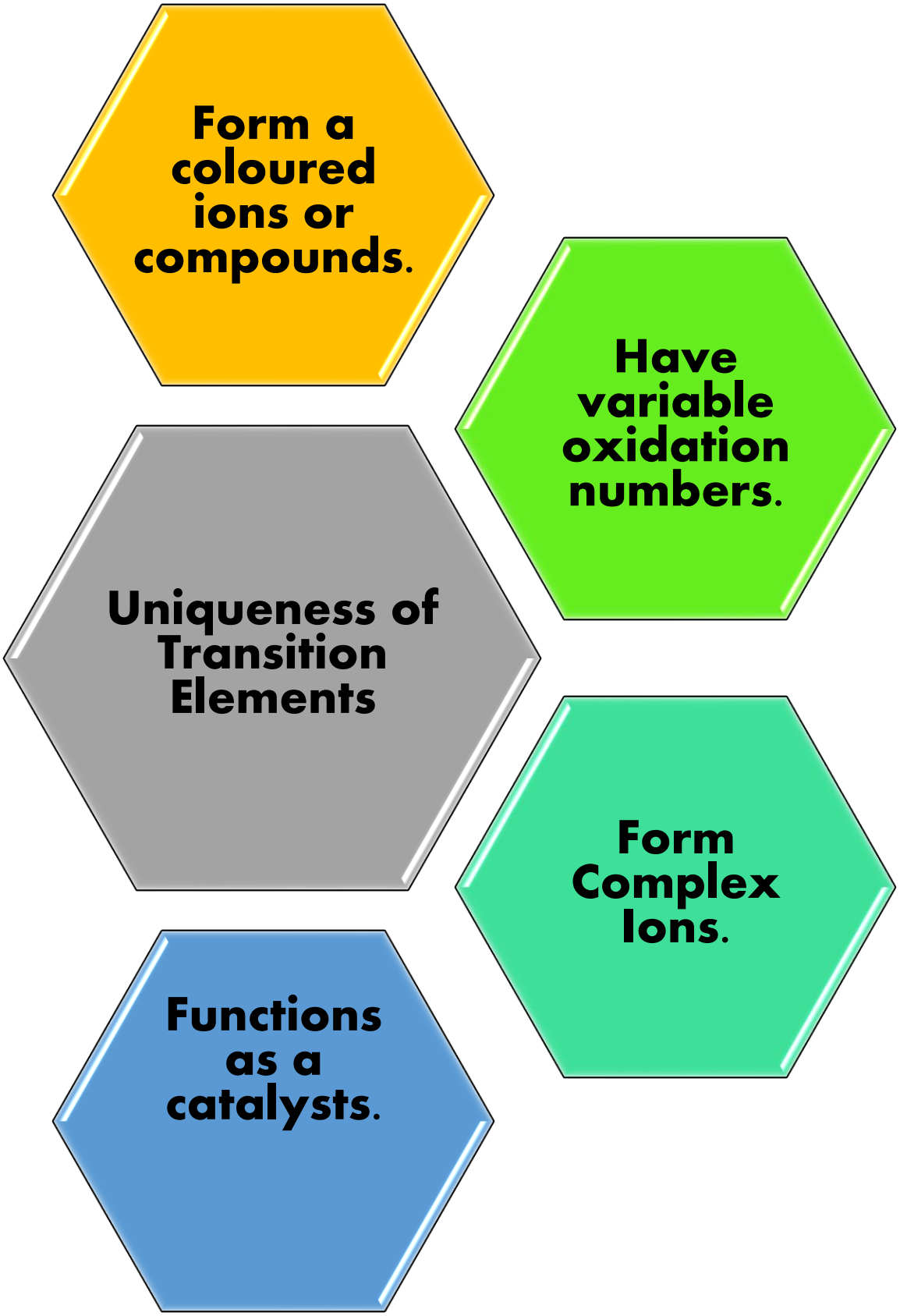
Transition Elements and its Uniqueness



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Colours of Transition Element Ions

TRANSITION ELEMENT IONS	COLOUR OF SOLUTION
Chromium (III) ion	Green
Dichromate (VI) ion	Orange
Manganese (II) ion	Pink
Manganate (VII) ion	Purple
Iron (II) ion	Green
Iron (III) ion	Brown
Copper (II) ion	Blue

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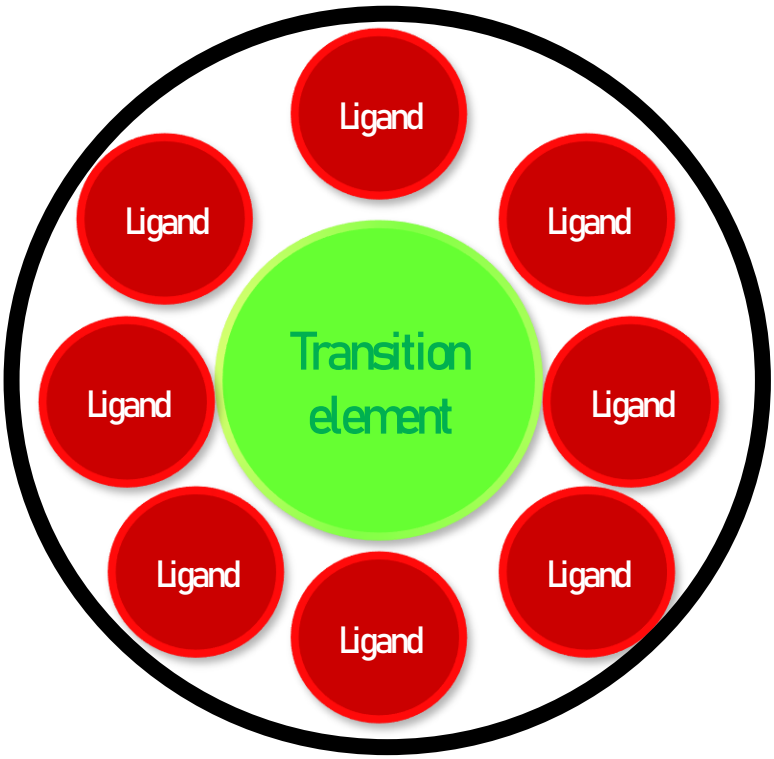
Formation of Complex Ions of Transition Element

Complex ions are bigger polyatomic ion formed when a fixed number of molecules(known as ligands) are bonded to the central transition element ion.



COMPLEX ION

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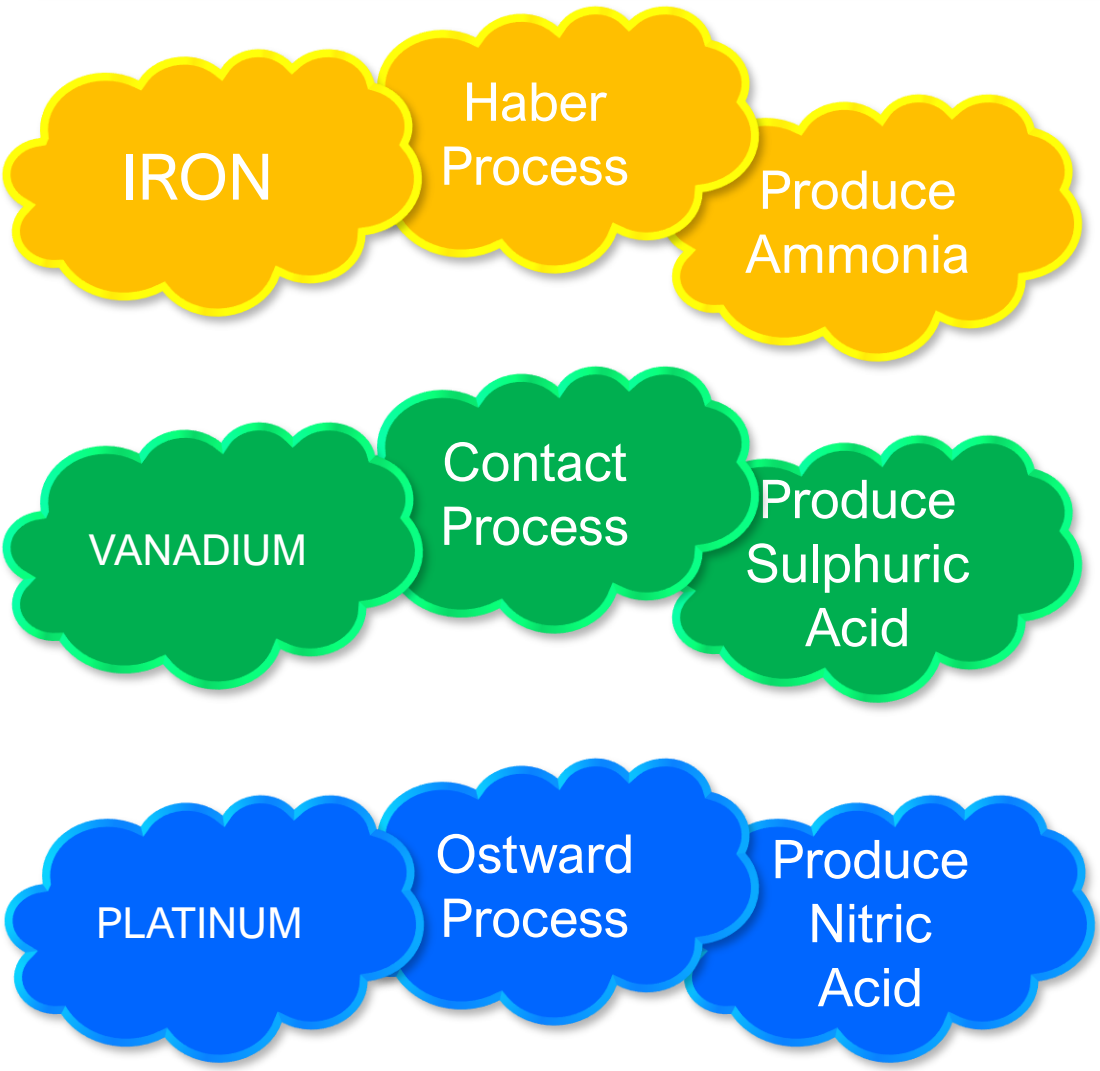
Formation of Complex Ions of Transition Element

Transition elements are used as catalysts in industry.



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