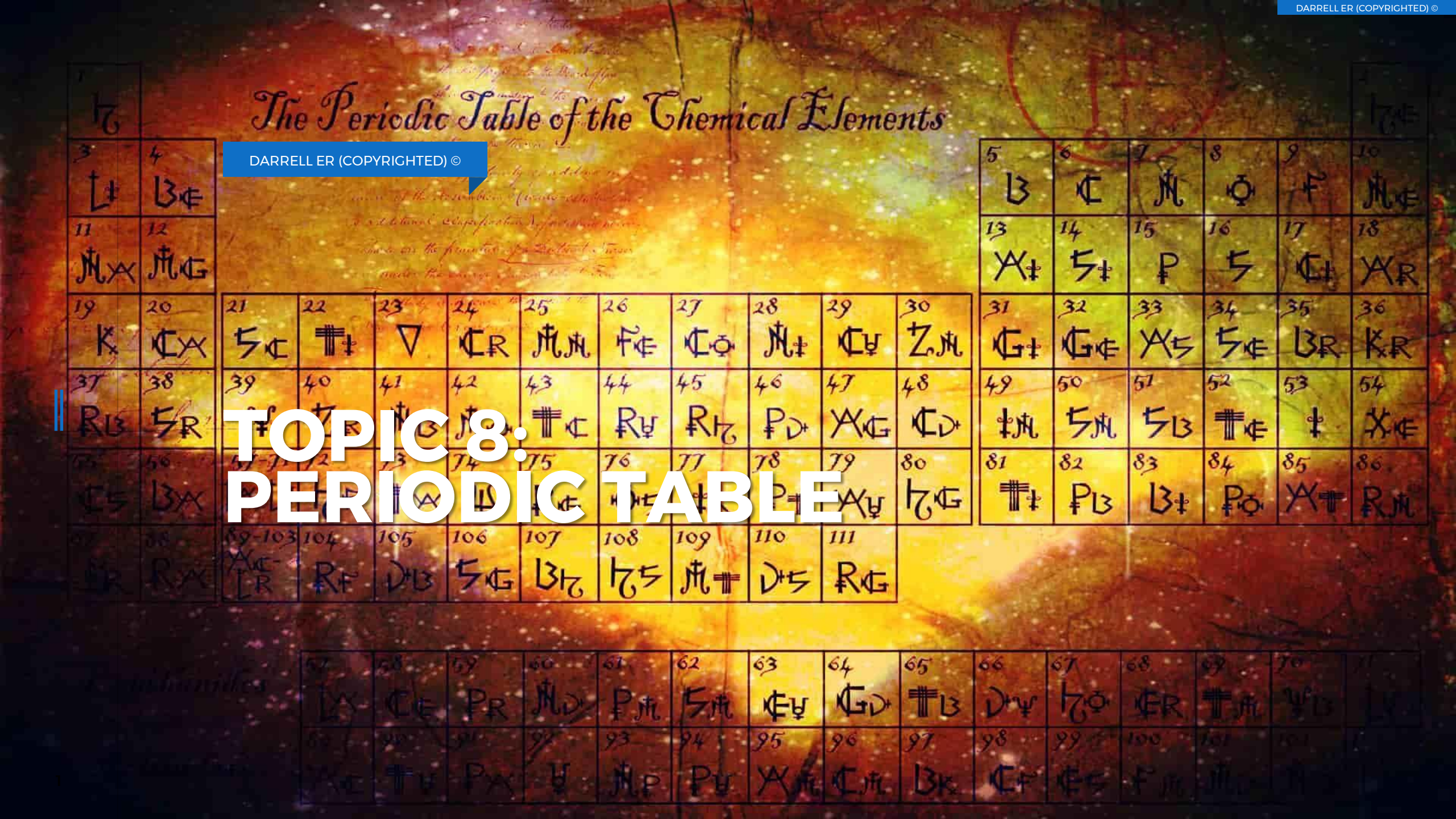

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TOPIC 8: PERIODIC TABLE

THE ABOUT

CHAPTER ANALYSIS

TIME

- Content heavy chapter
- 3 **key** concepts

EXAM

- Usually tested along with ‘Atomic Structure’ & ‘Chemical Bonding’
- Highly tested on specifically ‘alkali metals’, ‘halogens’ & ‘noble gases’.

WEIGHTAGE

- Medium overall weightage
- Constitute to **4%** of marks for past 5 year papers

KEY CONCEPT

PERIODIC TABLE & TRANSITION METALS
ALKALI METALS
HALOGENS
NOBLE GASES

PERIODIC TABLE

	Group 1	Group 2											Group 3	Group 4	Group 5	Group 6	Group 7	Group 0
Period 1								H										He
Period 2	Li	Be											B	C	N	O	F	Ne
Period 3	Na	Mg											Al	Si	P	S	Cl	Ar
Period 4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Period 5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Period 6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Period 7	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg							

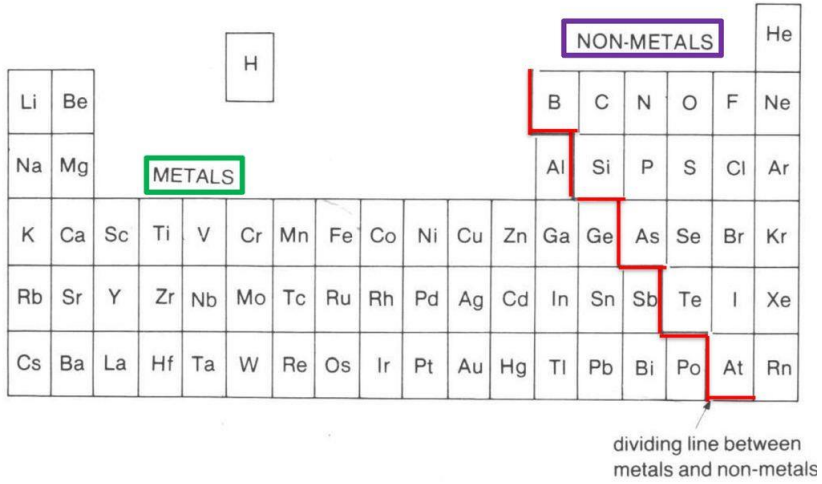
Horizontal rows are known as **periods**. (Represent **number of electron shells**.)

V**ertical rows** are known as **groups**. (Represent **number of valence electrons**.)

The block of elements between Group II and Group III are called **transition metals** and they tend to have variable oxidation states.

One way of organizing the periodic table....

- The zigzag line or the staircase separates
- Metals vs Nonmetals



<u>Trend across a period (left to right)</u>

- Number of protons increases
- Atomic radius decreases
- Metallic properties decreases

<u>Trends down a group (top to bottom)</u>

- Number of protons increases
- Number of electron shells increases
- Atomic radius increases
- Metallic properties remain constant

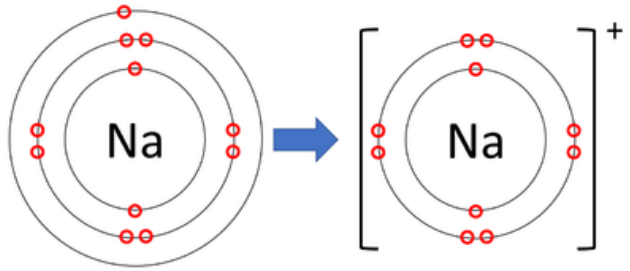
PERIODIC TABLE

Group	I	II	III	IV	V	VI	VII	VIII
Valence electrons	1	2	3	4	5	6	7	8
Period II	Li	Be	B	C	N	O	F	Ne
Ion	Li^{+}	Be^{2+}	B^{3+}	-	N^{3-}	O^{2-}	F^{-}	-
Period III	Na	Mg	Al	Si	P	S	Cl	Ar
Ion	Na^{+}	Mg^{2+}	Al^{3+}	-	P^{3-}	S^{2-}	Cl^{-}	-

ION FORMATION

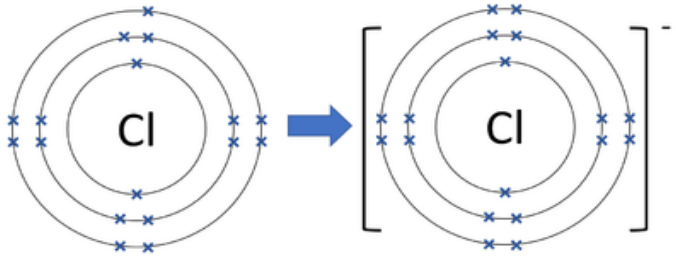
Metallic elements will form **cations** as **they lose their valence electrons** to form **positively charged ions**.

For example, Group I elements like Sodium (Na) will form Na^{+} with charge +1.

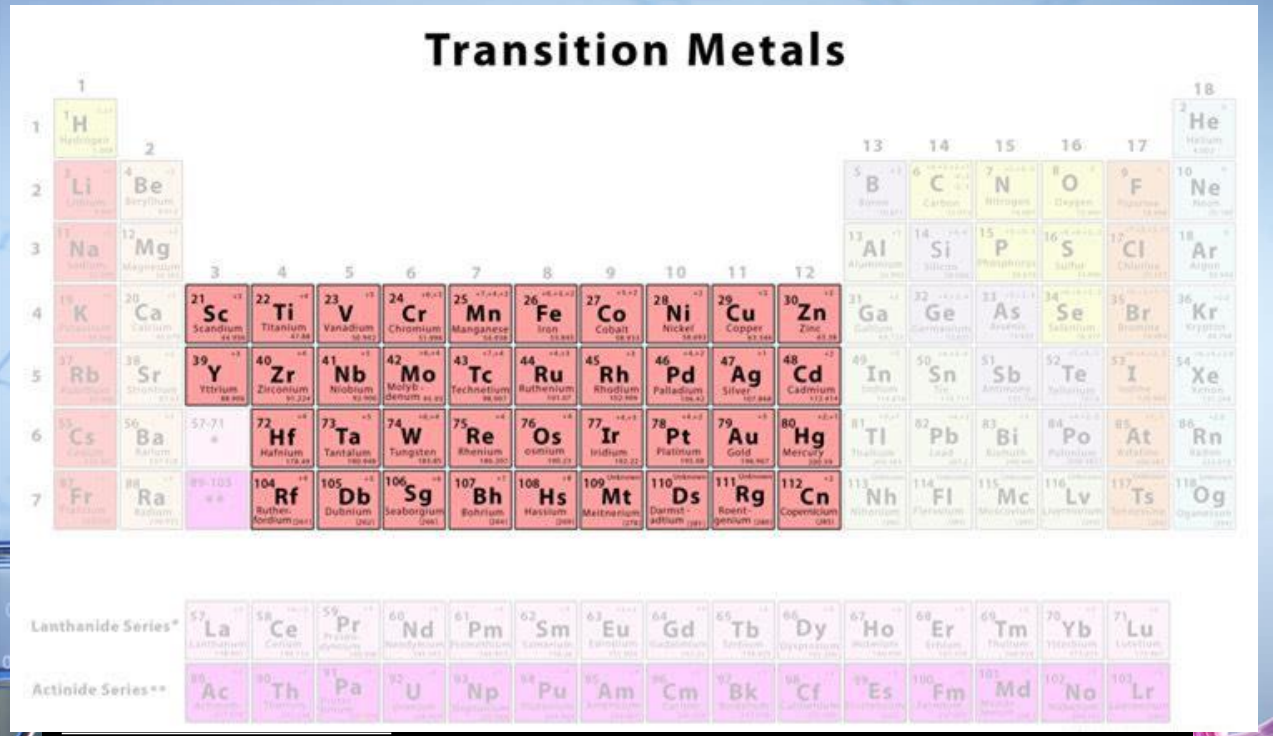


Non-metallic elements will **form anions** as they gain electrons to form negatively charged ions.

For example, Group VII elements like chlorine (Cl) will form Cl^{-} with charge of –1.



TRANSITION METALS



Transition metals are found in between the Group II and Group III elements in the periodic table.

PHYSICAL PROPERTIES OF TRANSITION METALS

Transition metals has high melting points and high densities due to the strong metallic bonds.

They are good electrical and thermal conductors.

Transition metals also form **coloured compounds.**

CHEMICAL PROPERTIES OF TRANSITION METALS

Transition metals has the ability to exhibit **multiple oxidation states.**

Hence, they are frequently used as **catalysts.**

For example, **iron** is used in the Haber process to produce ammonia, and **nickel** is used in making margarine through the process of adding hydrogen to vegetable oil (hydrogenation).

ALKALI METALS

Name of element	Melting points / °C	Density / gcm^{-3}
Lithium (Li)	180	0.534
Sodium (Na)	98	0.971
Potassium (K)	63	0.862
Rubidium (Rb)	39	1.532
Caesium (Cs)	28	1.873
Francium (Fr)	27	-
	(decreases down the group)	(increases down the group)

GROUP I: ALKALI METALS

Group I elements are called alkali metals as they react with water to give alkaline solutions.

Metal	Chloride	Nitrate	Carbonate	Sulfate	Oxide	Hydroxide
Lithium	LiCl	$LiNO_3$	Li_2CO_3	Li_2SO_4	Li_2O	LiOH
Sodium	NaCl	$NaNO_3$	Na_2CO_3	Na_2SO_4	Na_2O	NaOH
Potassium	KCl	KNO_3	K_2CO_3	K_2SO_4	K_2O	KOH

PHYSICAL PROPERTIES OF ALKALI METALS

- **Low melting points**
- **Low densities**, lithium, sodium and potassium can float on water
- Good conductor of electricity & heat

Densities of alkali metals generally increase down the group while **melting points decrease down the group.**

This is due to the increase in atomic radius down the group.

Chemical properties of alkali metals

As they have only one valence electron in their outermost shell, they form ionic compounds, with their resulting ions of +1 charge.

Reactivity of alkali metals increases down the group due to the extra electron shells and the nucleus is further away, which increases the **ease of losing the valence electron**.

HALOGENS

Name of element	State	Colour
Fluorine (F_2)	Gas	Pale Yellow
Chlorine (Cl_2)	Gas	Green Yellow
Bromine (Br_2)	Liquid	Reddish brown
Iodine (I_2)	Solid	Black
Astatine (At_2)	Solid	Black
	(increases down the group)	(increasing colour intensity)

GROUP VII: THE HALOGENS

Halogens usually exist as diatomic molecules.

PHYSICAL PROPERTIES OF HALOGENS

- **Low melting and boiling points that has an increasing trend down the group**
- **Densities of the halogens increase down the group**
- Dissolve sparingly in water (chlorine, bromine and iodine) generally, but soluble in organic solvents.
- Does not conduct electricity due to a lack of mobile charge carriers

CHEMICAL PROPERTIES OF HALOGENS

Reactivity decreases down the group. The **ease of gaining a valence electron decreases** as the valence shell is further away from the nucleus, making it **more difficult to attract an electron.**

DISPLACEMENT REACTION

A **more reactive halogen** is able to **displace a less reactive halogen** from an aqueous solution of its ions.

$$Cl_2\,(aq) + 2KBr\,(aq) \rightarrow 2KCl\,(aq) + Br_2\,(aq)$$

The solution will turn reddish brown due to the aqueous bromine produced.

NOBLE GAS

Name of element	Melting points / °C	Boiling points / °C	State
Helium (He)	-	-269	Gas
Neon (Ne)	-248	-246	Gas
Argon (Ar)	-189	-186	Gas
Krypton (Kr)	-157	-153	Gas
Xenon (Xe)	-111	-108	Gas
Radon (Rn)	-71	-62	Gas
	(increases down the group)	(increases down the group)	

GROUP 0: THE NOBLE GASES

All noble gases have a **fully filled valence shell**.

Noble gases are **unreactive** and **inert** since they have a **stable electronic configuration**.

They exist as mono-atomic particles (single atoms).

PHYSICAL PROPERTIES OF NOBLE GASES

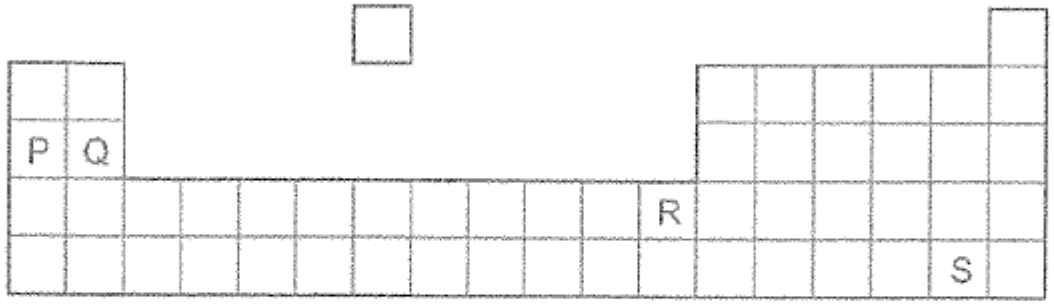
- Do not conduct electricity (lack of charge carriers)
- Very low melting and boiling points
- Increasing melting and boiling points going down the group
- Increasing densities of noble gases going down the group

USE OF NOBLE GASES

Element	Application	Reason
Helium (He)	Fill airships & hot air balloons	Low density comparative to air
Neon (Ne)	Fill interior of neon light tubes	Unreactive gas
Argon (Ar)	Fill light bulbs	Unreactive gas

Try it yourself! (TYS Question)

19. The diagram shows part of the Periodic Table.



Which two elements would react together most vigorously? (N2020/P1/Q23)

A P and R
B P and S
C Q and S
D R and S

( )

Answer:

19. **B**
Elements P, Q and R will react with S to form an ionic compound. However, P is the most reactive element and gives the most vigorous reaction.

Try it yourself! (TYS Question)

20. In the equation shown, X and Y represent elements in Group VII of the Periodic Table.

$$X_2 + 2KY \rightarrow Y_2 + 2KX$$

Which pair of elements could be X and Y? (N2020/P1/Q24)

	X	Y
1	chlorine	iodine
2	bromine	chlorine
3	bromine	iodine
4	iodine	fluorine

A 1 and 3
B 1 and 4
C 2 and 3
D 2 and 4

( )

Answer:

20. **A**
In Group VII, a more reactive element is higher in position in the group. X must be more reactive than Y since a reaction happens between X_2 and KY.

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