MODERN PERIODIC TABLE

Lecture 2.

Q.1 – What were the classification basis of the following scientists:

i. J. W. Dobreiner.

ii. John Newlands.



Q.2 – Do all elements in the periodic table contain neutron?

Organizing the Elements

- Chemists used the properties of elements to sort them into groups.
- JW. Dobreiner grouped elements into triads.
- A triad is a set of three elements with similar properties.



Chlorine
35.453 amu

Bromine
79.904 amu

Iodine
126.90 amu

Newlands' Law of Octaves

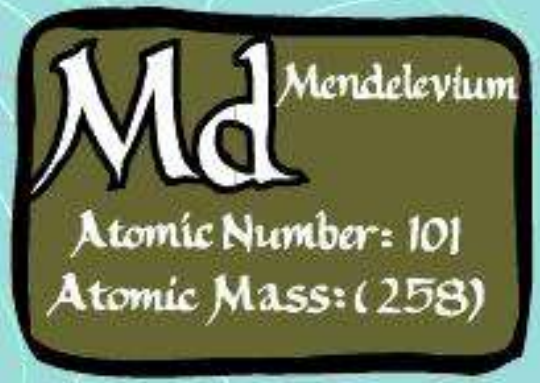
If the chemical elements are arranged according to increasing atomic weight, those with similar physical and chemical properties occur after each interval of seven elements. Newlands was one of the first to detect a periodic pattern in the properties of the elements and anticipated later developments of the periodic law.

sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	da (la)	ni (ti)
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co & Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce & La	Zr	–	–

Dmitri Mendeleev: Father of the Table

HOW HIS WORKED…

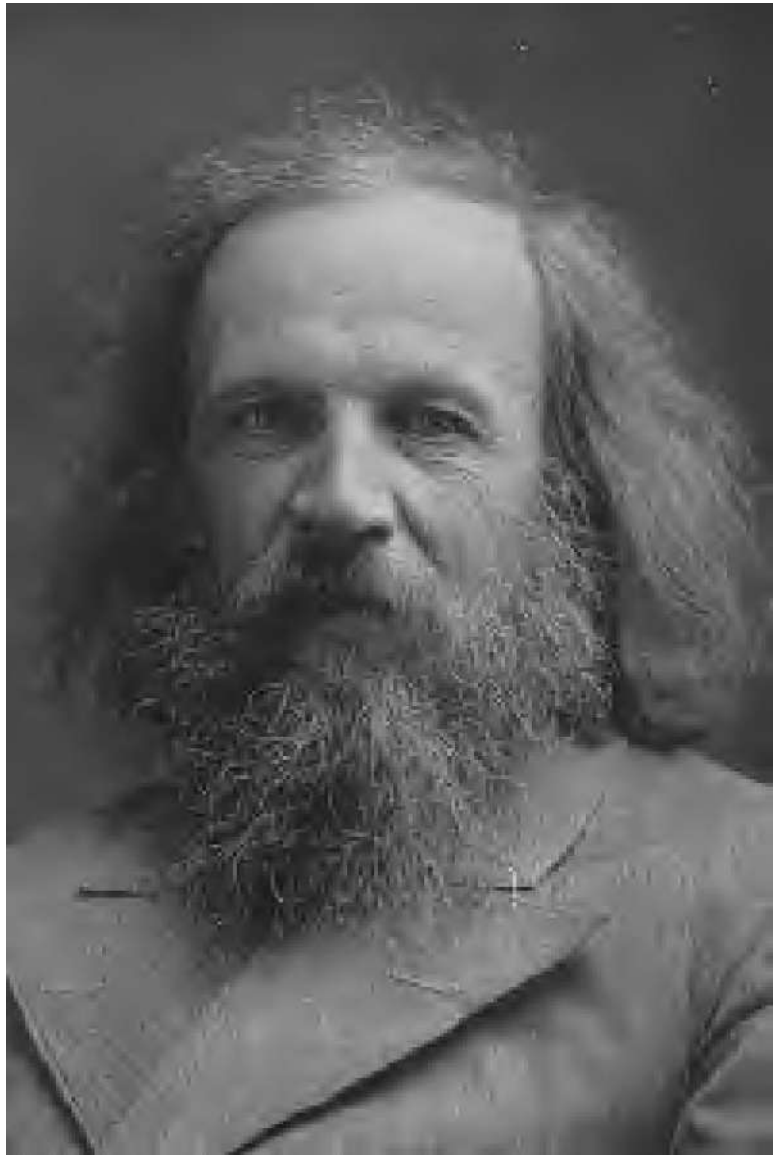
- Put elements in rows by increasing atomic weight.
- Put elements in columns by the way they reacted.



SOME PROBLEMS…

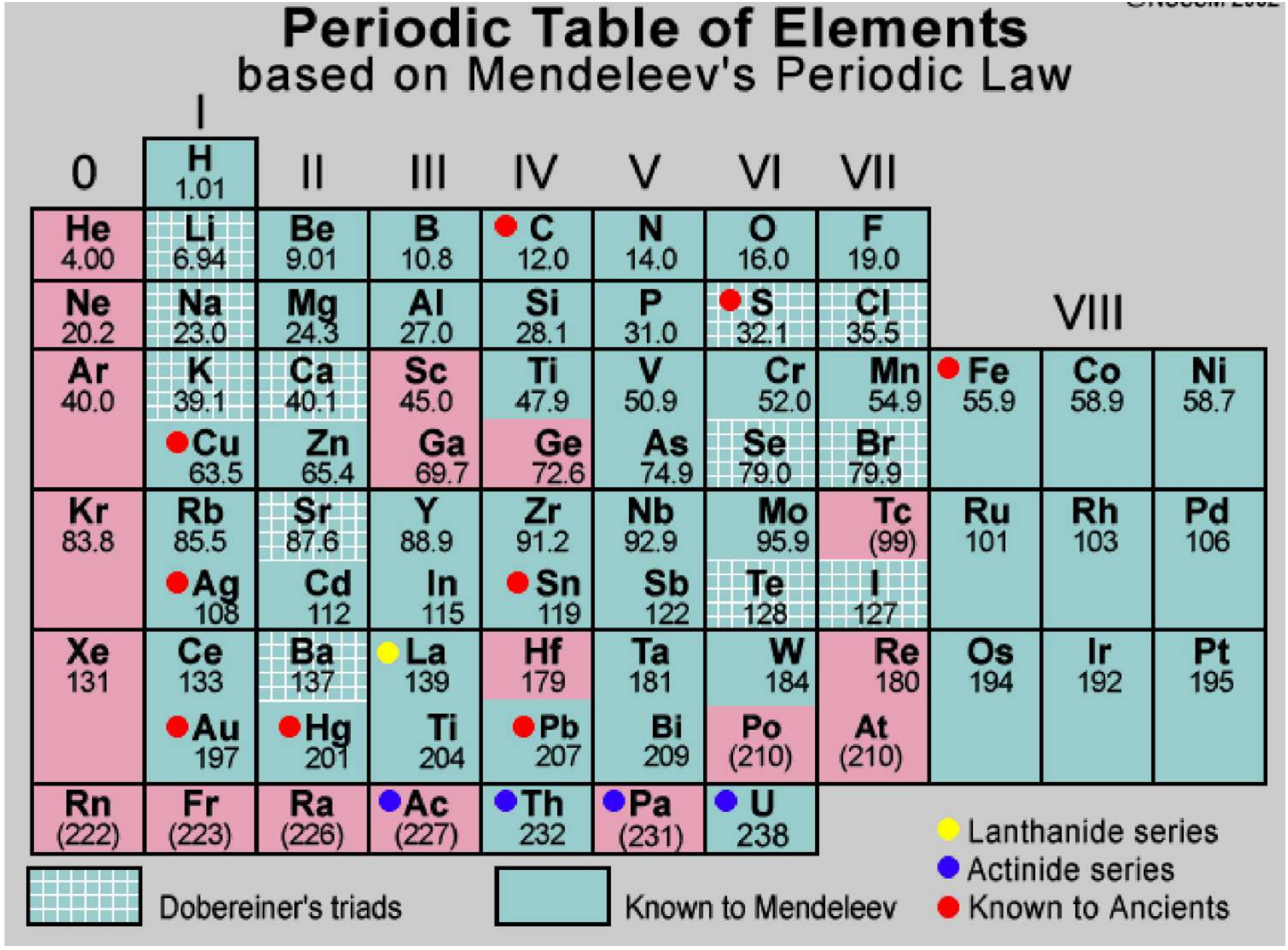
- He left blank spaces for what he said were undiscovered elements. (Turned out he was right!)
- He broke the pattern of increasing atomic weight to keep similar reacting elements together.

- In 1869, Dmitri Ivanovitch Mendeléev created the first accepted version of the periodic table.
- He grouped elements according to their atomic mass, and as he did, he found that the families had similar chemical properties.
- <u>THE PHYSICAL AND CHEMICAL PROPERTIES OF ELEMENTS ARE PERIODIC FUNCTION OF THEIR ATOMIC MASSES.</u>
- Blank spaces were left open to add the new elements he predicted would occur (& to maintain periodicity).
- As a result, he was able to classify 63 elements known at that time.



Mendeleev: Developing a Periodic Table

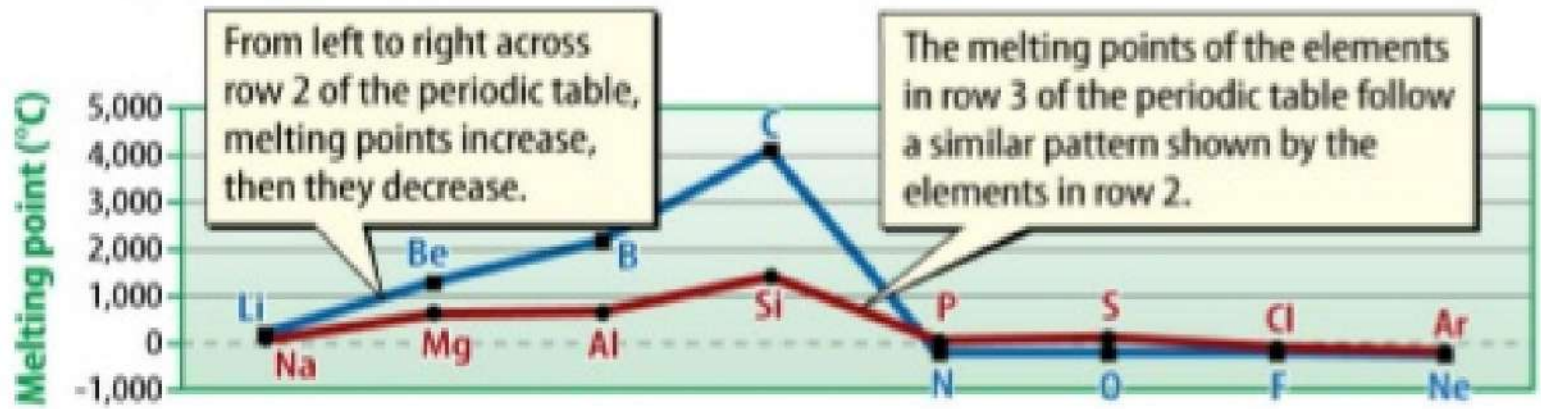
- Mendeleev studied the physical properties such as density, colour, melting point and atomic mass of each element.
- Mendeleev also studied chemical properties such as how each element reacted with other elements.
- He arranged the elements in a list using their atomic masses.
- He noticed that the properties of the elements seemed to repeat in a pattern.
- When Mendeleev placed his list of elements into a table, he arranged them in rows of increasing atomic mass. Elements with similar properties were grouped in the same columns


Periodic Table of Elements
based on Mendeleev's Periodic Law
0
I
H 1.01
II
III
IV
V
VI
VII
VIII
He 4.00
Li 6.94
Be 9.01
B 10.8
C 12.0
N 14.0
O 16.0
F 19.0
Ne 20.2
Na 23.0
Mg 24.3
Al 27.0
Si 28.1
P 31.0
S 32.1
Cl 35.5
Ar 40.0
K 39.1
Ca 40.1
Sc 45.0
Ti 47.9
V 50.9
Cr 52.0
Mn 54.9
Fe 55.9
Co 58.9
Ni 58.7
Cu 63.5
Zn 65.4
Ga 69.7
Ge 72.6
As 74.9
Se 79.0
Br 79.9
Kr 83.8
Rb 85.5
Sr 87.6
Y 88.9
Zr 91.2
Nb 92.9
Mo 95.9
Tc (99)
Ru 101
Rh 103
Pd 106
Ag 108
Cd 112
In 115
Sn 119
Sb 122
Te 128
I 127
Xe 131
Ce 133
Ba 137
La 139
Hf 179
Ta 181
W 184
Re 180
Os 194
Ir 192
Pt 195
Au 197
Hg 201
Ti 204
Pb 207
Bi 209
Po (210)
At (210)
Rn (222)
Fr (223)
Ra (226)
Ac (227)
Th 232
Pa (231)
U 238
Dobereiner's triads
Known to Mendeleev
Lanthanide series
Actinide series
Known to Ancients

Periodic Table: Patterns in Properties

- Mendeleev noticed that melting point is one property that shows a repeating pattern.

Row 2	Lithium 3 Li	Beryllium 4 Be	Boron 5 B	Carbon 6 C	Nitrogen 7 N	Oxygen 8 O	Fluorine 9 F	Neon 10 Ne
Row 3	Sodium 11 Na	Magnesium 12 Mg	Aluminum 13 Al	Silicon 14 Si	Phosphorus 15 P	Sulfur 16 S	Chlorine 17 Cl	Argon 18 Ar



- Boiling point and reactivity also follow a periodic pattern.

The Current Periodic Table

- Mendeleev wasn't too far off.
- Now the elements are put in rows by increasing **ATOMIC NUMBER!!**
- The horizontal rows are called periods and are labeled from 1 to 7.
- The vertical columns are called groups are labeled from 1 to 18.

Groups…Here's Where the Periodic Table Gets Useful!!

- **Elements in the same group have similar chemical and physical properties!!**
- **(Mendeleev did that on purpose.)**

Why??

- They have the same number of valence electrons.
- They will form the same kinds of ions.

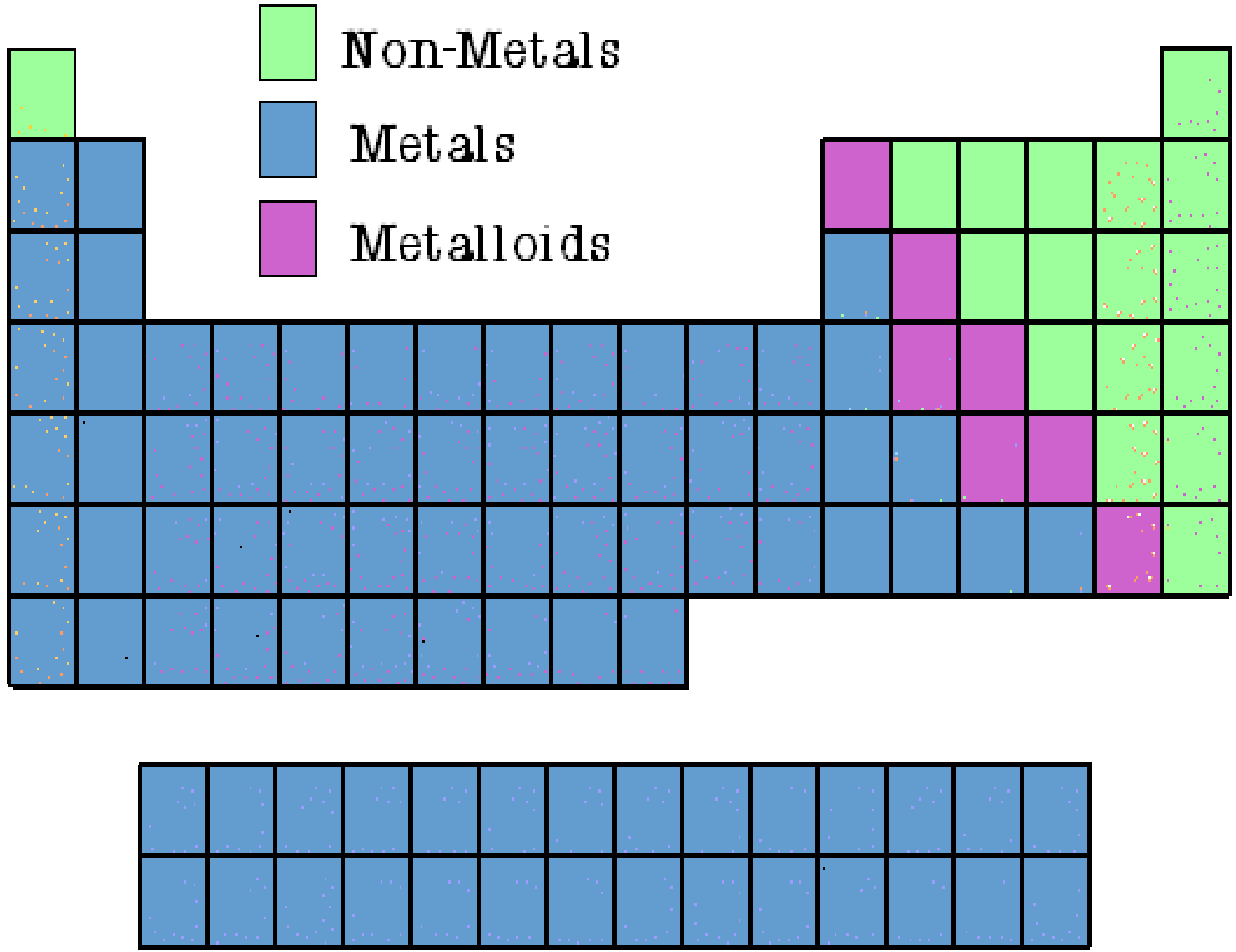
- Henry Moseley, in 1913, showed that the frequency of X-Ray emitted by an element is related to its Atomic Number (Z).
- Thus, he modified the periodic law given by Mendeléev.
- THE PHYSICAL AND CHEMICAL PROPERTIES OF ELEMENTS ARE A PERIODIC FUNCTION OF THEIR ATOMIC NUMBERS.





- Long form or the modern period table consists of 118 elements spread across:
    - i. 7 horizontal rows called as PERIODS (numbered 1 to 7).
    - ii. 18 vertical columns called as GROUPS (numbered 1 to 18).
- Below the main table are placed two series (Lanthanides & Actinides) containing fourteen elements each.
- Furthermore, it is divided into 4 blocks.
- Group 1 & 2 -> S block.
- Group 3 to 12 -> D block.
- Group 13 to 18 -> P block.
- Two series placed @ bottom -> F block.

The elements of the periodic table can be divided into three main categories: Metals, Non-Metals, and Metalloids.





PROPERTIES OF METALS

- Metals are good conductors of heat and electricity.
- Metals are shiny.
- Metals are ductile (can be stretched into thin wires).
- Metals are malleable (can be pounded into thin sheets).
- A chemical property of metal is its reaction with water which results in corrosion.





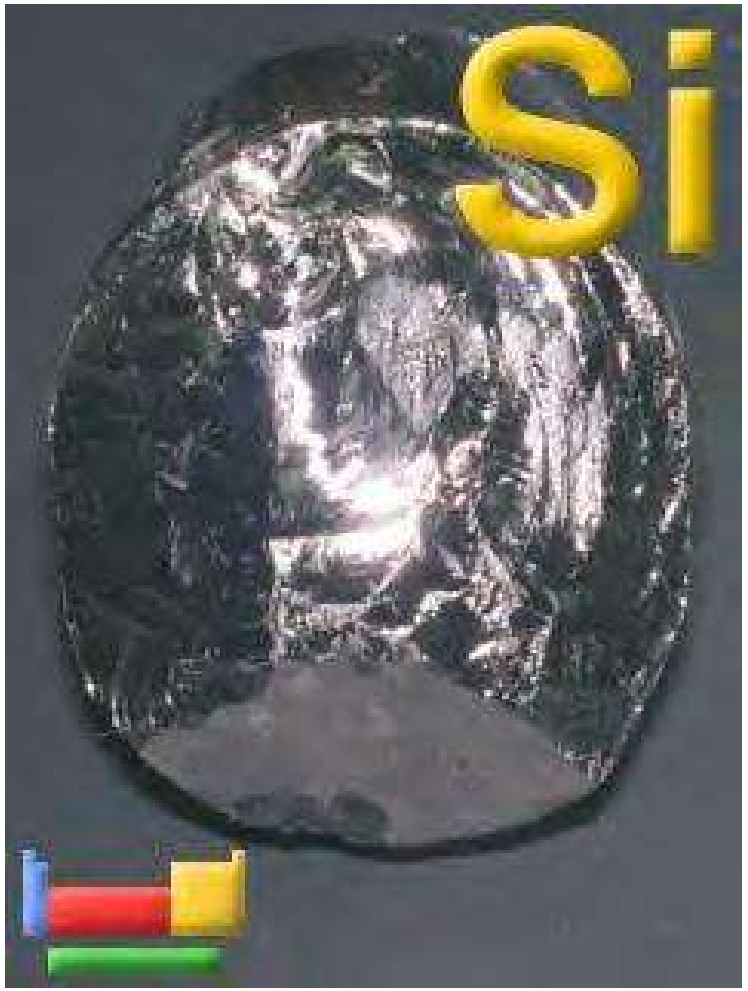
PROPERTIES OF NON-METALS



SULFUR

- Non-metals are poor conductors of heat and electricity.
- Non-metals are not ductile or malleable.
- Solid non-metals are brittle and break easily.
- They are dull.
- Many non-metals are gases.

PROPERTIES OF METALLOIDS



SILICON

- Metalloids (metal-like) have properties of both metals and non-metals.
- They are solids that can be shiny or dull.
- They conduct heat and electricity better than non-metals but not as well as metals.
- They are ductile and malleable.

Periodic Table of the Elements

1 IA 11A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.933	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.732	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.09	35 Br Bromine 79.904	36 Kr Krypton 84.80
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 168.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Fl Flerovium [289]	115 Uup Ununpentium unknown	116 Lv Livermorium [298]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown

Lanthanide Series	57 La Lanthanum 138.906	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.966	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
Actinide Series	89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]

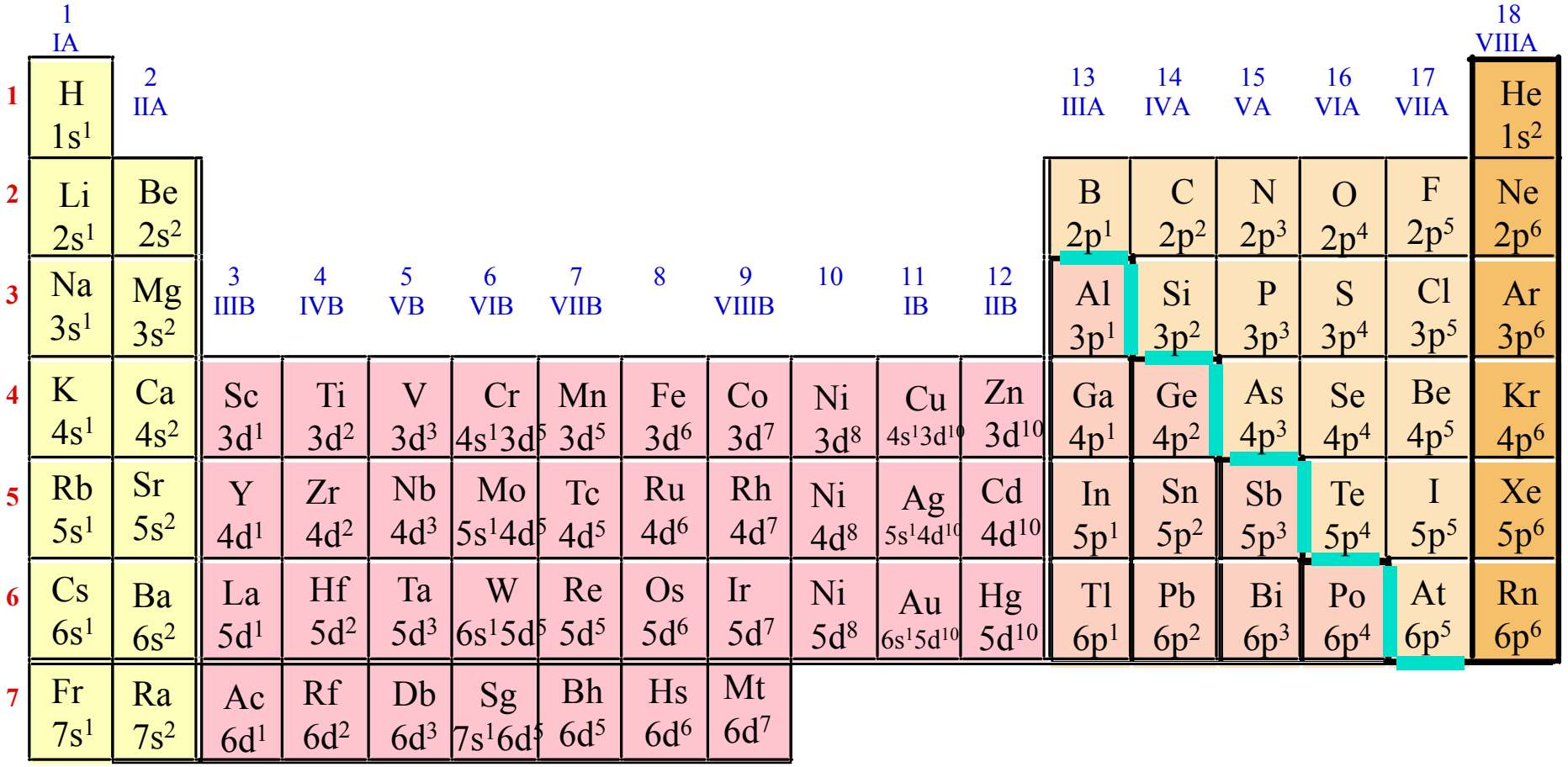
Alkali Metal | Alkaline Earth | Transition Metal | Semimetal | Nonmetal | Basic Metal | Halogen | Noble Gas | Lanthanide | Actinide

MNEMONIC TO MEMORIZE 1ST 20 ELEMENTS.

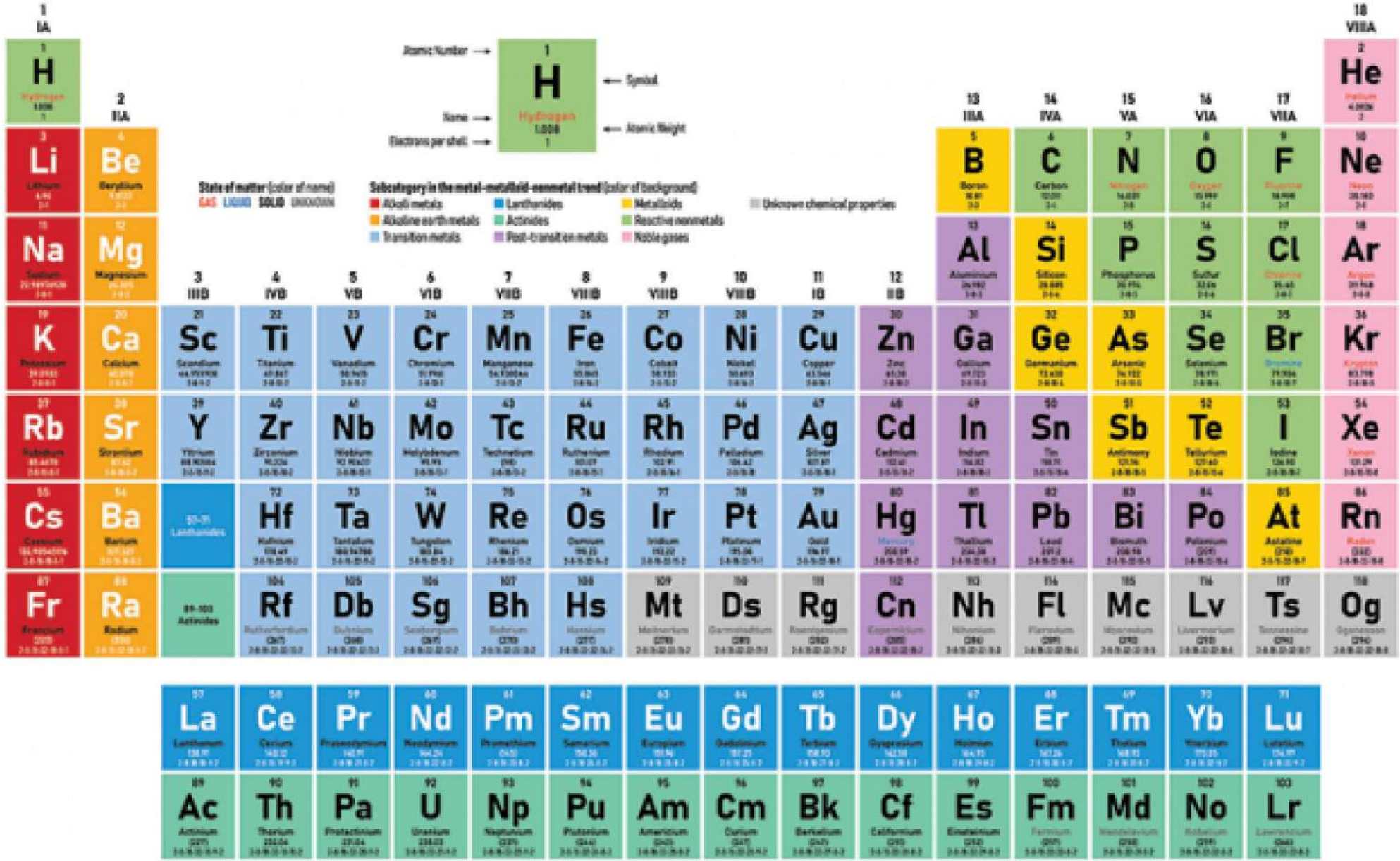
- Happy Heman Likes Beer But Could Not Obtain it for Free isiliye NeeNa se Maanga, AlSi Paise so She Called Arjun KaCa

- Elements covered = H, He, Li, Be, B, C, N, O, F, Ne, Na, Mg, Al, Si, P, S, Cl, Ar, K, Ca.

PER
ELECTRON



Periodic Table of the Elements



Next Lecture:

1. Trends in the MPT.

Any Question



“It is not the answer that enlightens, but the question.”

- Eugene Ionesco