Chapter 4

The Periodic Table

4 – 1 Introduction to the Periodic Table

Development of the Periodic Table

- Early man was familiar with a few elements.
  - Gold and Silver were used for coins.
  - Copper, Tin and Iron were used for weapons.

Dmitri Mendeleev

- Russian Chemist.
- Published the first version of the Periodic Table in 1896.

- Arranged the elements in order of increasing atomic mass.
- He noticed that the properties of the elements seemed to repeat in a pattern.

- He placed the elements onto a table.
- He kept the same properties in vertical columns called "Groups".

Mendeleev's Periodic Table of 1871[1]

	I --- R_2O	II --- RO	III --- R_2O_3	IV RH_4 RO_2	V RH_3 R_2O_3	VI RH_2 RO_3	VII RH R_2O_7	VIII --- RO_4
1	H 1							
2	Li 7	Be 9.4	B 11	C 12	N 14	O 16	F 19	
3	Na 23	Mg 24	Al 27.3	Si 28	P 31	S 32	Cl 35.5	
4	K 39	Ca 40	? 44	Ti 48	V 51	Cr 52	Mn 55	Fe, Co, Ni, Cu 56, 59, 59, 63
5	Cu 63	Zn 65	? 68	? 72	As 75	Se 78	Br 80	
6	Rb 85	Sr 87	? Yt 88	Zr 90	Nb 94	Mo 96	? 100	Ru, Rh. Pd, Ag 104, 104, 106, 108
7	Ag 108	Cd 112	In 113	Sn 118	Sb 122	Te 125	I 127	
8	Cs 133	Ba 137	? Di 138	? Ce 140	?	?	?	?, ?, ?, ?
9	?	?	?	?	?	?	?	
10	?	?	? Er 178	?? La 180	Ta 182	W 184	?	Os, Ir, Pt, Au 195, 197, 198, 199
11	Au 199	Hg 200	Tl 204	Pb 207	Bi 208	?	?	
12	?	?	?	Th 231	?	U 240	?	

- He left blanks for elements that had yet to be discovered.
- He predicted the properties of those elements.
- This led to their discovery.

Henry Moseley

- English Physicist
- Improved upon Mendeleev's work in 1913.
- Ordered the Periodic Table by Atomic Number.

Periodic Table of Elements

Representative elements

Halogens Noble gases

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Alkali metals
Alkaline earth metals

1
Group 1A

18
Group 8A

Period number

Period	1A	2A	3B	4B	5B	6B	7B	8B			1B	2B	3A	4A	5A	6A	7A	8A
1	1 H 1.008	Group 2A																2 He 4.003
2	3 Li 6.941	4 Be 9.012			Transition elements								5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 132.9	56 Ba 137.3	57* La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po 209	85 At 210	86 Rn 222
7	87 Fr 223	88 Ra 226	89† Ac 227	104 Rf 261	105 Db 262	106 Sg 263	107 Bh 262	108 Hs 265	109 Mt 266	110 — 269	111 — 272	112 — 277		114 — 289				

	*Lanthanides		58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm 145	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
	†Actinides		90 Th 232.0	91 Pa 231	92 U 238.0	93 Np 237	94 Pu 244	95 Am 243	96 Cm 247	97 Bk 247	98 Cf 251	99 Es 252	100 Fm 257	101 Md 258	102 No 259	103 Lr 260

Metals   Metalloids   Nonmetals

Today's Periodic Table

- **Periodic** – Repeating in a pattern.

Groups

- <u>Groups</u> – the vertical columns in the table.
  - Numbered 1 – 18.

Periods

- <u>Periods</u> – The horizontal rows in the table.
  - Numbered 1 – 7.

Periodic Table of Elements

Representative elements

Alkali metals | Alkaline earth metals | Halogens | Noble gases

Period number

Period	Group 1A (1)	Group 2A (2)	3B (3)	4B (4)	5B (5)	6B (6)	7B (7)	8B (8)	8B (9)	8B (10)	1B (11)	2B (12)	Group 3A (13)	Group 4A (14)	Group 5A (15)	Group 6A (16)	Group 7A (17)	Group 8A (18)
1	1 H 1.008																	2 He 4.003
2	3 Li 6.941	4 Be 9.012				Transition elements							5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 132.9	56 Ba 137.3	57* La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po 209	85 At 210	86 Rn 222
7	87 Fr 223	88 Ra 226	89† Ac 227	104 Rf 261	105 Db 262	106 Sg 263	107 Bh 262	108 Hs 265	109 Mt 266	110 — 269	111 — 272	112 — 277		114 — 289				

*Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm 145	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
†Actinides	90 Th 232.0	91 Pa 231	92 U 238.0	93 Np 237	94 Pu 244	95 Am 243	96 Cm 247	97 Bk 247	98 Cf 251	99 Es 252	100 Fm 257	101 Md 258	102 No 259	103 Lr 260

Metals | Metalloids | Nonmetals

Atomic Number

- <u>Atomic Number</u> – the number of protons in the nucleus.
- The largest (font size) whole number in the square on the Periodic Table of Elements.

Be

4

BERYLLIUM

9.01   1.85

1278   2970

Chemical Symbol

- <u>Chemical Symbol</u> – The shorthand way to write the name of an element.
- The first letter is always capitalized, the following letter(s) is lower case.

- Used the first letter if it was available.
- Used the second letter if the first was already taken.
- If the first two letters were taken, then a different second letter is taken out of the name.

- Some elements were discovered when Latin or Greek was the official language of science.
  - They use the letters from the Latin version.
  - Sodium – Na

- Some were named after famous people, or places.

Mass Number

- Mass Number – the sum of the number of Protons and Neutrons in the nucleus of an atom.

- It is found by rounding the Average Atomic Mass to a whole number.
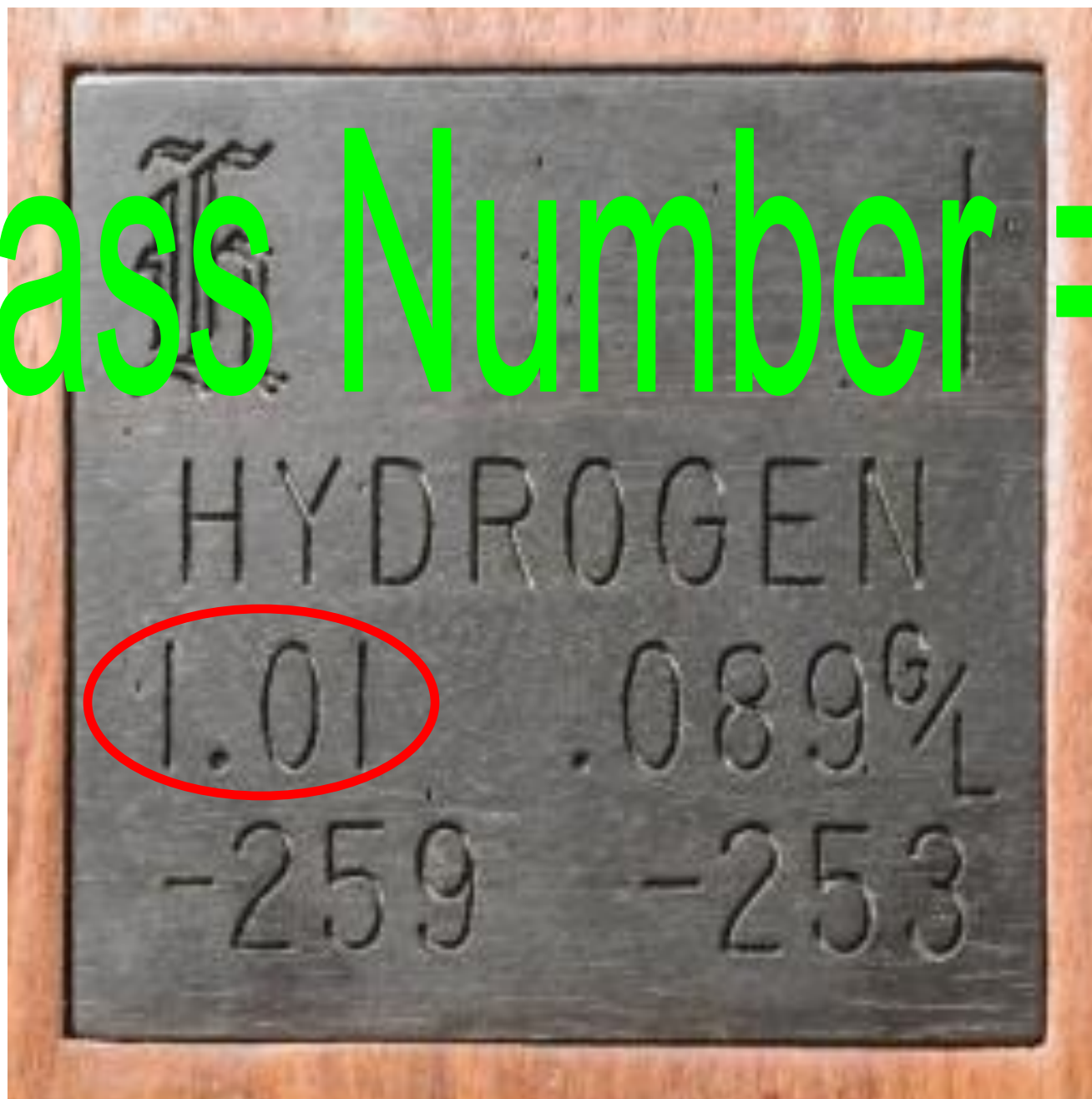
Zones on the Periodic Table

- <u>Representative Elements</u> – Groups 1, 2, 13 – 18.

- <u>Transition Elements</u> – Groups 3 – 12.

- <u>Inner Transition Elements</u> – Lanthanide and Actinide Series.

Periodic Table of Elements

Representative elements

Period number	Alkali metals ↓ 1 Group 1A	Alkaline earth metals ↓ 2 Group 2A	Transition elements 3 3B	4 4B	5 5B	6 6B	7 7B	8	8B 9	10	11 1B	12 2B	13 Group 3A	14 Group 4A	15 Group 5A	16 Group 6A	17 Group 7A	18 Group 8A
1	1 H 1.008																	2 He 4.003
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5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
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Halogens ↓ 17

Noble gases ↓ 18

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Metals   Metalloids   Nonmetals

Metals

- Most are solids at room temperature.
- Only one is a liquid at room temperature - Mercury

- Most are shiny (Luster), good conductors, can be pounded (Malleable), and can be drawn into wires (Ductile).
- Found to the left of the "Stair-Step Line".

Periodic Table of Elements

Periodic Table of Elements

Nonmetals

- Most are gases or brittle solids at room temperature.
- Most do not conduct heat nor electricity well.
- Found to the right of the "Stair-Step Line"

Periodic Table of Elements

Periodic Table of Elements

Metalloids

- They have properties of both metals and nonmetals
- Found along the "Stair-Step Line"

Periodic Table of Elements

Representative elements

Alkali metals

Alkaline earth metals

Halogens   Noble gases

Period number

Transition elements

Group 1A	Group 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 Group 3A	14 Group 4A	15 Group 5A	16 Group 6A	17 Group 7A	18 Group 8A
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Metals   Metalloids   Nonmetals