

# The Periodic Table of the Elements

by Robert Compton version 1.4

group 1																	18	
period 1	1.00794 1312.0 2.20 H Hydrogen 1s <sup>1</sup>																	4.002602 2372.3 He Helium 1s <sup>2</sup>
2	6.941 520.2 0.98 +1 Li Lithium 1s <sup>2</sup> 2s <sup>1</sup>	9.012182 899.5 1.57 +2 Be Beryllium 1s <sup>2</sup> 2s <sup>2</sup>											10.811 800.6 2.04 +3 -1 B Boron 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>1</sup>	12.0107 1086.5 2.55 +4 -4 C Carbon 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>2</sup>	14.0067 1402.3 3.04 +5 -3 N Nitrogen 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>3</sup>	15.9994 1313.9 3.44 +6 -2 O Oxygen 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>4</sup>	18.998403 1681.0 3.98 -1 F Fluorine 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>5</sup>	20.1797 2080.7 Ne Neon 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>6</sup>
3	22.98976 495.8 0.93 +1 Na Sodium [Ne] 3s <sup>1</sup>	24.3050 737.7 1.31 +2 Mg Magnesium [Ne] 3s <sup>2</sup>											26.98153 577.5 1.61 +3 -1 Al Aluminum [Ne] 3s <sup>2</sup> 3p <sup>1</sup>	28.0855 786.5 1.90 +4 -2 Si Silicon [Ne] 3s <sup>2</sup> 3p <sup>2</sup>	30.97696 1011.8 2.19 +5 -3 P Phosphorus [Ne] 3s <sup>2</sup> 3p <sup>3</sup>	32.065 999.6 2.58 +6 -2 S Sulfur [Ne] 3s <sup>2</sup> 3p <sup>4</sup>	35.453 1251.2 3.16 -1 Cl Chlorine [Ne] 3s <sup>2</sup> 3p <sup>5</sup>	39.948 1520.6 Ar Argon [Ne] 3s <sup>2</sup> 3p <sup>6</sup>
4	39.0983 418.8 0.82 +1 K Potassium [Ar] 4s <sup>1</sup>	40.078 589.8 1.00 +2 Ca Calcium [Ar] 4s <sup>2</sup>	44.9559 600.9 0.88 +3 Sc Scandium [Ar] 3d <sup>1</sup> 4s <sup>2</sup>	47.867 50.9 0.8 +4 Ti Titanium [Ar] 3d <sup>2</sup> 4s <sup>2</sup>	50.9415 50.9 0.8 +3 V Vanadium [Ar] 3d <sup>3</sup> 4s <sup>2</sup>	51.9962 50.9 0.8 +4 Cr Chromium [Ar] 3d <sup>5</sup> 4s <sup>1</sup>	54.93804 54.9 0.8 +3 Mn Manganese [Ar] 3d <sup>5</sup> 4s <sup>2</sup>	55.845 54.9 0.8 +4 Fe Iron [Ar] 3d <sup>6</sup> 4s <sup>2</sup>	58.93319 58.9 0.8 +3 Co Cobalt [Ar] 3d <sup>7</sup> 4s <sup>2</sup>	58.9334 58.9 0.8 +4 Ni Nickel [Ar] 3d <sup>8</sup> 4s <sup>2</sup>	63.546 63.5 0.8 +3 Cu Copper [Ar] 3d <sup>10</sup> 4s <sup>1</sup>	65.38 65.4 0.8 +2 Zn Zinc [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	69.723 69.7 0.8 +3 Ga Gallium [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>1</sup>	72.64 72.6 0.8 +4 Ge Germanium [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>2</sup>	74.92160 74.9 0.8 +3 As Arsenic [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>3</sup>	78.9718 78.9 0.8 +4 Se Selenium [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>4</sup>	79.904 1139.9 2.96 +7 -5 Br Bromine [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>5</sup>	83.798 1350.8 3.00 +6 -2 Kr Krypton [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>6</sup>
5	85.4678 403.0 0.82 +1 Rb Rubidium [Kr] 5s <sup>1</sup>	87.62 549.5 0.95 +2 Sr Strontium [Kr] 5s <sup>2</sup>	88.9058 600.9 0.8 +3 Y Yttrium [Kr] 4d <sup>1</sup> 5s <sup>2</sup>	91.224 91.2 0.8 +4 Zr Zirconium [Kr] 4d <sup>2</sup> 5s <sup>2</sup>	92.90638 92.9 0.8 +3 Nb Niobium [Kr] 4d <sup>4</sup> 5s <sup>1</sup>	95.96 95.9 0.8 +4 Mo Molybdenum [Kr] 4d <sup>5</sup> 5s <sup>1</sup>	98 98 0.8 +3 Tc Technetium [Kr] 4d <sup>5</sup> 5s <sup>2</sup>	101.07 101.1 0.8 +4 Ru Ruthenium [Kr] 4d <sup>7</sup> 5s <sup>1</sup>	106.42 106.4 0.8 +3 Rh Rhodium [Kr] 4d <sup>8</sup> 5s <sup>1</sup>	107.8682 107.9 0.8 +4 Pd Palladium [Kr] 4d <sup>10</sup> 5s <sup>0</sup>	112.41 112.4 0.8 +3 Ag Silver [Kr] 4d <sup>10</sup> 5s <sup>1</sup>	114.818 114.8 0.8 +2 Cd Cadmium [Kr] 4d <sup>10</sup> 5s <sup>2</sup>	118.710 118.7 0.8 +3 In Indium [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>1</sup>	118.710 118.7 0.8 +4 Sn Tin [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>2</sup>	121.760 121.8 0.8 +3 Sb Antimony [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>3</sup>	127.3 127.3 0.8 +4 Te Tellurium [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>4</sup>	126.9044 1008.4 2.66 +7 -5 I Iodine [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>5</sup>	131.293 1170.4 2.60 +6 -2 Xe Xenon [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>6</sup>
6	132.9054 375.7 0.79 +1 Cs Caesium [Xe] 6s <sup>1</sup>	137.327 502.9 0.89 +2 Ba Barium [Xe] 6s <sup>2</sup>	174.967 175.0 0.8 +3 La Lanthanum [Xe] 4f <sup>1</sup> 5d <sup>1</sup> 6s <sup>2</sup>	175.073 175.1 0.8 +4 Ce Cerium [Xe] 4f <sup>1</sup> 5d <sup>1</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +3 Pr Praseodymium [Xe] 4f <sup>3</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +4 Nd Neodymium [Xe] 4f <sup>4</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +3 Pm Promethium [Xe] 4f <sup>5</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +4 Sm Samarium [Xe] 4f <sup>6</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +3 Eu Europium [Xe] 4f <sup>7</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +4 Gd Gadolinium [Xe] 4f <sup>7</sup> 5d <sup>1</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +3 Tb Terbium [Xe] 4f <sup>9</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +4 Dy Dysprosium [Xe] 4f <sup>10</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +3 Ho Holmium [Xe] 4f <sup>11</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +4 Er Erbium [Xe] 4f <sup>12</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +3 Tm Thulium [Xe] 4f <sup>13</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +4 Yb Ytterbium [Xe] 4f <sup>14</sup> 6s <sup>2</sup>	176.427 176.4 0.8 +7 -5 At Astatine [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>5</sup>	176.427 176.4 0.8 +6 -2 Rn Radon [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>6</sup>
7	(223) 380.0 0.70 +1 Fr Francium [Rn] 7s <sup>1</sup>	(226) 509.3 0.90 +2 Ra Radium [Rn] 7s <sup>2</sup>	(261) 261 0.8 +3 Ac Actinium [Rn] 6d <sup>1</sup> 7s <sup>2</sup>	(261) 261 0.8 +4 Th Thorium [Rn] 6d <sup>2</sup> 7s <sup>2</sup>	(262) 262 0.8 +3 Pa Protactinium [Rn] 5f <sup>2</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(264) 264 0.8 +4 U Uranium [Rn] 5f <sup>3</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(268) 268 0.8 +3 Np Neptunium [Rn] 5f <sup>4</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(271) 271 0.8 +4 Pu Plutonium [Rn] 5f <sup>6</sup> 7s <sup>2</sup>	(272) 272 0.8 +3 Am Americium [Rn] 5f <sup>7</sup> 7s <sup>2</sup>	(273) 273 0.8 +4 Cm Curium [Rn] 5f <sup>7</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(285) 285 0.8 +3 Bk Berkelium [Rn] 5f <sup>9</sup> 7s <sup>2</sup>	(289) 289 0.8 +4 Cf Californium [Rn] 5f <sup>10</sup> 7s <sup>2</sup>	(289) 289 0.8 +3 Es Einsteinium [Rn] 5f <sup>11</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(289) 289 0.8 +4 Fm Fermium [Rn] 5f <sup>12</sup> 7s <sup>2</sup>	(289) 289 0.8 +3 Md Mendelevium [Rn] 5f <sup>13</sup> 7s <sup>2</sup>	(294) 294 0.8 +4 No Nobelium [Rn] 5f <sup>14</sup> 7s <sup>2</sup>	(294) 294 0.8 +7 -5 Uus Ununseptium [Og] 5f <sup>14</sup> 6d <sup>1</sup> 7s <sup>2</sup> 8p <sup>5</sup>	(294) 294 0.8 +6 -2 Uuo Ununoctium [Og] 5f <sup>14</sup> 6d <sup>1</sup> 7s <sup>2</sup> 8p <sup>6</sup>

atomic mass or most stable mass number  
1st ionization energy in kJ/mol

chemical symbol

name

electron configuration

atomic number

electronegativity

oxidation states most common are bold

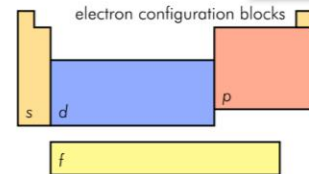
Iron

[Ar] 3d<sup>6</sup> 4s<sup>2</sup>

- alkali metals
- alkaline metals
- other metals
- transition metals
- lanthanoids
- actinoids
- metalloids
- nonmetals
- halogens
- noble gases
- unknown elements
- radioactive elements have

## Elements and Periodic Table

### Trends and patterns



- notes
- as of yet, elements 113-118 have no official name designated by the IUPAC.
  - 1 kJ/mol ≈ 96.485 eV.
  - all elements are implied to have an oxidation state of zero.

138.9054 538.1 1.10 +3 La Lanthanum [Xe] 5d <sup>1</sup> 6s <sup>2</sup>	140.116 534.4 1.12 +3 Ce Cerium [Xe] 4f <sup>1</sup> 5d <sup>1</sup> 6s <sup>2</sup>	140.9076 527.0 1.13 +3 Pr Praseodymium [Xe] 4f <sup>3</sup> 6s <sup>2</sup>	144.242 533.1 1.14 +3 Nd Neodymium [Xe] 4f <sup>4</sup> 6s <sup>2</sup>	(145) 540.0 +3 Pm Promethium [Xe] 4f <sup>5</sup> 6s <sup>2</sup>	150.36 544.5 1.17 +3 Sm Samarium [Xe] 4f <sup>6</sup> 6s <sup>2</sup>	151.964 547.1 +3 Eu Europium [Xe] 4f <sup>7</sup> 6s <sup>2</sup>	157.25 593.4 1.20 +3 Gd Gadolinium [Xe] 4f <sup>7</sup> 5d <sup>1</sup> 6s <sup>2</sup>	158.9253 565.8 +3 Tb Terbium [Xe] 4f <sup>9</sup> 6s <sup>2</sup>	162.500 573.0 1.22 +3 Dy Dysprosium [Xe] 4f <sup>10</sup> 6s <sup>2</sup>	164.9303 581.0 1.23 +3 Ho Holmium [Xe] 4f <sup>11</sup> 6s <sup>2</sup>	167.259 589.3 1.24 +3 Er Erbium [Xe] 4f <sup>12</sup> 6s <sup>2</sup>	168.9342 596.7 1.25 +3 Tm Thulium [Xe] 4f <sup>13</sup> 6s <sup>2</sup>	173.054 603.4 +3 Yb Ytterbium [Xe] 4f <sup>14</sup> 6s <sup>2</sup>
(227) 499.0 1.10 +3 Ac Actinium [Rn] 6d <sup>1</sup> 7s <sup>2</sup>	232.0380 587.0 1.30 +4 Th Thorium [Rn] 6d <sup>2</sup> 7s <sup>2</sup>	231.0358 568.0 1.50 +3 Pa Protactinium [Rn] 5f <sup>2</sup> 6d <sup>1</sup> 7s <sup>2</sup>	238.0289 597.6 1.38 +4 U Uranium [Rn] 5f <sup>3</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(237) 604.5 1.36 +3 Np Neptunium [Rn] 5f <sup>4</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(244) 584.7 1.28 +3 Pu Plutonium [Rn] 5f <sup>6</sup> 7s <sup>2</sup>	(243) 578.0 1.30 +3 Am Americium [Rn] 5f <sup>7</sup> 7s <sup>2</sup>	(247) 581.0 1.30 +3 Cm Curium [Rn] 5f <sup>7</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(247) 601.0 1.30 +3 Bk Berkelium [Rn] 5f <sup>9</sup> 7s <sup>2</sup>	(251) 608.0 1.30 +3 Cf Californium [Rn] 5f <sup>10</sup> 7s <sup>2</sup>	(252) 619.0 1.30 +3 Es Einsteinium [Rn] 5f <sup>11</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(257) 627.0 1.30 +3 Fm Fermium [Rn] 5f <sup>12</sup> 7s <sup>2</sup>	(258) 635.0 1.30 +3 Md Mendelevium [Rn] 5f <sup>13</sup> 7s <sup>2</sup>	(259) 642.0 1.30 +3 No Nobelium [Rn] 5f <sup>14</sup> 7s <sup>2</sup>

## Review

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Elements have:

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Protons- Positive charge

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Electrons- Negative charge

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Neutrons- No charge

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Protons and neutrons give the element its mass

Protons,  
Neutrons,  
Electrons

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Oxygen- atomic number 8, mass 16

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Hydrogen- atomic number 1, mass 1

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Chlorine- atomic number 17, mass 35

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Xenon- atomic number 54, mass 131

# Patterns of Periodic Table

	group 1		
period 1	1.00794 1312.0 2.20 <b>H</b> Hydrogen $1s^1$		
		2	
2	6.941 520.2 0.98 <b>Li</b> Lithium $1s^2 2s^1$	9.012182 899.5 1.57 <b>Be</b> Beryllium $1s^2 2s^2$	
		3	4
3	22.98976 495.8 0.93 <b>Na</b> Sodium $[Ne] 3s^1$	24.3050 737.7 1.31 <b>Mg</b> Magnesium $[Ne] 3s^2$	
		11	12
4	39.0983 418.8 0.82 <b>K</b> Potassium $[Ar] 4s^1$	40.078 589.8 1.00 <b>Ca</b> Calcium $[Ar] 4s^2$	
		19	20
5	85.4678 403.0 0.82 <b>Rb</b> Rubidium $[Kr] 5s^1$	87.62 549.5 0.95 <b>Sr</b> Strontium $[Kr] 5s^2$	
		37	38
6	132.9054 375.7 0.79 <b>Cs</b> Caesium $[Xe] 6s^1$	137.327 502.9 0.89 <b>Ba</b> Barium $[Xe] 6s^2$	
		55	56
7	(223) 380.0 0.70 <b>Fr</b> Francium $[Rn] 7s^1$	(226) 509.3 0.90 <b>Ra</b> Radium $[Rn] 7s^2$	
		87	88

- Broken into groups and periods
  - Groups
    - Vertical
    - 18 columns, 8 groups
    - Based on valence electrons
  - Periods
    - horizontal
    - 7 total
    - Each period has 1 more outer shell of electrons

# How are elements formed?

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- The atom is formed with protons and neutrons
  - This gives the element its atomic number
  - Based on weight
- The electrons are in outer shells moving around the atom
  - The first shell can have 2
  - The rest can have up to 8 depending on number of electrons
- Number of protons and electrons is equal

## Group 1: Alkali Metals

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They each have 1 electron in their outer shell.

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This allows them to form bonds easily but also makes them highly reactive especially with the halogen group.

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They have a soft, metal appearance and low melting points.

Group 2:  
Alkaline  
Earth Metals

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They have 2 electrons in their outer shell.

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They also form bonds easily and generally exist as compounds.

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Their most common bonds are formed with the Oxygen group of elements.

## Group 7: Halogens

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They have 7 electrons in their outer shell.

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They like to form bonds with elements from the Alkali group.

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These elements can either be metal or non-metal.

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They exist in diatomic forms, Br<sub>2</sub> and O<sub>2</sub>.



## Group 8: Noble Gasses

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They have a full outer shell of electrons, so they are stable on their own.

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Helium is also considered part of this group because even though it only has 2 electrons its shell is full.

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Neon is a very popular element in this group it can be found in signs, under normal conditions they all exist as gases.

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Their melting points are lower than other groups, but because their shell is full their ionization energy is higher.

## Transition Metals

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They are found in the middle of periodic table.

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They are all metal and have different values of electrons in their outer shell.

## Orbitals

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Boron- atomic number 5

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Calcium- atomic number 20

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Phosphorus- atomic number 15

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Argon- atomic number 18

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Helium- atomic number 2



# Examples

Reorder the monsters from earlier now that we have learned the patterns of the periodic table.