

UNIT 4: The Periodic Table

Aristotle	Circa 300 BC
Antoine Lavoisier	1770–1789
Jöns Jakob Berzelius	1828
Johann Döbereiner	1829
John Newlands	1864
Julius Lothar Meyer	1869-1870
Dmitri Mendeleev	1869-1870
William Ramsay	1894
Henry Moseley	1913
Glenn T. Seaborg	1914 1940s

Periodic Law:

MODERN PERIODIC TABLE

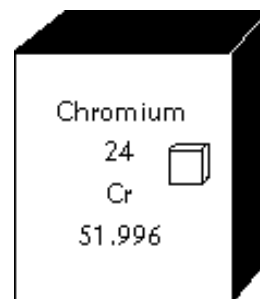
The modern table maintains Moseley's arrangement and clearly shows periodicity, which refers to _____

_____. The

periodic table consists of boxes for elements arranged in order of _____.

Each box contains the element's _____ and _____, _____, and _____.

The _____ element boxes are arranged in rows called _____ and columns called _____ or _____.



- Total of seven (7) periods, numbered _____ through _____
 - ☞ Correspond to the _____
 - ☞ Referred to as _____
 - ☞ _____ in an atom determines period placement
- Two numbering systems (left to right) are in effect for the _____:
 1. Numbered _____ through _____.
 2. Numbered _____ through _____ followed by the letter _____ or _____.
 - ☞ Groups designated with the letter A are known as _____ elements. They display a _____.
 - ☞ Groups designated with the letter B are _____.

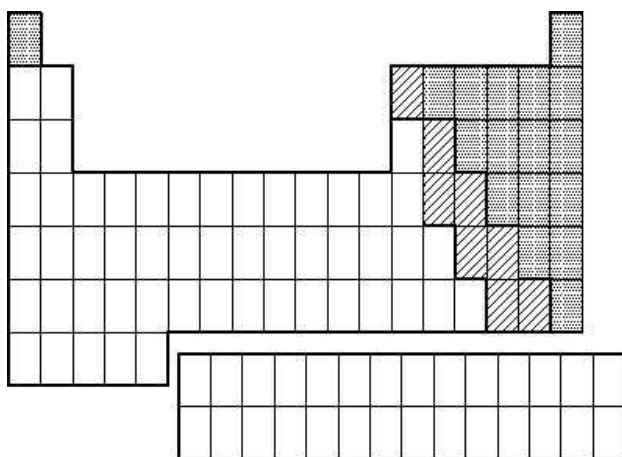
THE s-, p-, d-, AND f-BLOCKS

The periodic table is divided into four blocks representing the _____

1 H Hydrogen 1.00794																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.006434	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
11 Na Sodium 22.989770	12 Mg Magnesium 24.3050											13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955910	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.845	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.29
55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	58 Ce Cerium 140.12	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93032	68 Er Erbium 167.26	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967	
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 Ds Darmstadtium (269)	111 Rg Roentgenium (272)	112 Cn Copernicium (277)						
88 Ce Cerium 140.116	89 Pr Praseodymium 140.90765	90 Nd Neodymium 144.24	91 Pm Promethium (145)	92 Sm Samarium 150.36	93 Eu Europium 151.964	94 Gd Gadolinium 157.25	95 Tb Terbium 158.92534	96 Dy Dysprosium 162.50	97 Ho Holmium 164.93032	98 Er Erbium 167.26	99 Tm Thulium 168.93421	100 Yb Ytterbium 173.04	101 Lu Lutetium 174.967	102 No Nobelium (259)	103 Lr Lawrencium (262)		
90 Th Thorium 232.0381	91 Pa Protactinium 231.03588	92 U Uranium 238.0289	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)				

CLASSIFICATION OF ELEMENTS

	Metals	Nonmetals	Metalloids
Characteristics	<p>◆<i>Exception:</i></p>	<p>◆<i>Exception:</i></p>	
Location on PT	<p>_____ of the stair step line Most _____ elements ◆<i>Exception:</i></p> <p>All _____ elements ◆Transition metals in ◆Inner transition metals:</p>	<p>_____ of the stair step line</p>	<p>_____ the stair step line ◆<i>Exception:</i></p>



GROUPS OF ELEMENTS

Group	Group Name	Group Properties	Valence e ⁻	Oxidation Number	Block	e- Conf End
Hydrogen						
1 or 1A						
2 or 2A						
13 or 3A						
14 or 4A						
15 or 5A						
16 or 6A						
17 or 7A						
18 or 8A						
3 – 12 or B Groups	Transition Metals					
	Inner Transition Metals	◆				
	◆	◆				
		◆				

Valence electrons: electrons in an atom's _____
 that determine the _____ of an element


- Atoms in the _____ have similar properties because they have _____
- _____ is indicated by the period in which element is found
- For representative elements, the last digit of the group number indicates the _____.




Element	# Valence Electrons	Energy Level of Valence Electrons	Configuration of Valence Electrons
1. Hydrogen			
2. Nitrogen			
3. Magnesium			
4. Silicon			
5. Sulfur			
6. Krypton			

Ions

- Neutral atoms have no overall electrical charge because _____
- Noble gases have stable configurations because _____
 - Exception: _____
- Atoms gain or lose electrons to _____ by _____
- Such an atom is no longer neutral but _____
 - Metals: _____
 - Nonmetals: _____

 Write the electron configuration for a neutral potassium atom. Circle valence e⁻.

 Write the electron configuration for a potassium ion.

 Write the electron configuration for a neutral argon atom.

OCTET RULE

Oxidation number (or **state**): _____

_____. It equals the _____ when an atom forms its ion.

- Predicted by _____
- Positive when _____; negative when _____
- Written _____
- Noble gases have oxidation number of ____; _____
_____.
- Elements in the carbon group have _____
_____.



Element Name	Element Symbol	Oxidation Number	Symbol for Ion	Configuration of Ion (noble gas configuration)
1. Hydrogen				
2. Magnesium				
3. Oxygen				
4. Aluminum				
5. Nitrogen				
6. Sodium				
7. Sulfur				
8. Calcium				
9. Chlorine				
10. Bromine				

 Practice

1. Elements #110 through #118 are the most recently discovered elements. For these elements, complete the table below.

Atomic #	Element Name	Element Symbol	Discovered in	Group	# ve ⁻	Most closely resembles
110	Darmstadtium	Ds	1994			
111	Roentgenium	Rg	1994			
112	Copernicium	Cn	1996			
113	Ununtrium	Uut	2003			
114	Flerovium	Fl	1998			
115	Ununpentium	Uup	2004			
116	Livermorium	Lv	2000			
117	Ununseptium	Uus	2009			
118	Ununoctium	Uuo	2002			

2. Explain the term *representative elements*.

What is the primary difference between the representative elements and the transition elements? (*Think: electron configuration.*)

3. The numbers and locations of valence electrons determine the _____ of elements.
4. Oxygen is a gas. Sulfur is a solid. What is it about their electron structures that cause them to be grouped in the same chemical family?
5. Identify the element fitting each of the following descriptions:
- The metalloid in group 3A: _____
 - The halogen in period 5: _____
 - The alkali metal in period 4: _____
 - The nonmetal that is a liquid at room temperature: _____
6. Why about zinc, cadmium, and mercury cause them to be in the same chemical family?

CP/Honors Chemistry
PERIODIC TRENDS: ATOMIC RADIUS

Atomic radius:

Trends within periods (L to R)
 Why?

Trends within groups (bottom to top)
 Why?

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Atoms with largest atomic radii: _____

 **Practice**

- Which has the largest atomic radius: lithium (Li), beryllium (Be), nitrogen (N), or neon (Ne)? _____ The smallest? _____
- Which has the largest atomic radius: sodium (Na), potassium (K), rubidium (Rb) or cesium (Cs)? _____ The smallest? _____
- Circle the element in each pair with the largest atomic radius.
 Na or K Na or Mg O or F Br or I Ti or Zr
- Rank the following elements from smallest to largest atomic radius: Na, Mg, Cl, K, Rb. _____
- Which has the largest atomic radius: potassium (K) or magnesium (Mg)?
- Which has the smallest atomic radius: aluminum (Al) or barium (Ba)?

PERIODIC TRENDS: IONIZATION ENERGY (IE)

Ionization energy:

First ionization energy:

Second ionization energy:

Third ionization energy:

, etc.

Trends within periods (L to R)

Why?

Trends within groups (bottom to top)

Why?

1 H Hydrogen 1.00794																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
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55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.078	79 Au Gold 196.96655	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98038	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110	111	112	113	114				
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Practice

- Does sodium (Na) or potassium (K) have a higher first ionization energy?
- Does magnesium (Mg) or argon (Ar) have a higher first ionization energy?
- Explain why much more ionization energy is required to remove the first electron from neon than from sodium.
- Why does barium (Ba) have a lower ionization energy than beryllium (Be)?

PERIODIC TRENDS: ELECTRONEGATIVITY

Electronegativity:


- Differences in electronegativity determine _____
- Electronegativity of _____ is not usually included

Trends within periods (L to R)

Trends within groups (bottom to top)

1 H Hydrogen 1.00794																	2 He Helium 4.003	
3 Li Lithium 6.941	4 Be Beryllium 9.012182																	10 Ne Neon 20.1797
11 Na Sodium 22.989770	12 Mg Magnesium 24.3050																	18 Ar Argon 39.948
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 Shade the box of the element with the *highest* electronegativity.

 Outline the box of the element with the *lowest* electronegativity.

Practice

1. Does magnesium or aluminum have a higher electronegativity value?
2. Does nitrogen or phosphorous have a higher electronegativity value?
3. Does calcium (Ca) or bromine (Br) have a higher electronegativity value?
4. Does sodium (Na) or potassium (K) have a higher electronegativity value?
5. Which atom is more electronegative: hydrogen (H) or oxygen (O)?
6. Which atom is more electronegative: carbon (C) or chlorine (Cl)?
7. Which atom is more electronegative: magnesium (Mg) or oxygen (O)?
8. Which atom is more electronegative: sodium (Na) or chlorine (Cl)?

PERIODIC TRENDS: REACTIVITY

Reactivity: _____

related to several factors, including _____

- Metals: more reactive if have _____

- Nonmetals: more reactive if have _____

Trends within periods (L to R)
Metals:
Nonmetals:

Trends within groups (bottom to top)
Metals:
Nonmetals:

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55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	58 Ce Cerium 140.12	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93032	68 Er Erbium 167.26	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967		
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (264)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 Ds Darmstadtium (269)	111 Rg Roentgenium (271)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (290)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Oganesson (294)	
90 Th Thorium 232.0381	91 Pa Protactinium 231.03688	92 U Uranium 238.0289	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)					

✍️ Shade the element box of the most reactive metal:

✍️ Outline the box of the most reactive nonmetal:

✍️ Practice

1. Which metal is more reactive: sodium (Na) or rubidium (Rb)?
2. Which nonmetal is more reactive: oxygen (O) or sulfur (S)?
3. Which element is more reactive: magnesium (Mg) or aluminum (Al)?
4. Which element is more reactive: phosphorous (P) or chlorine (Cl)?