

Ch05

# Flavors of the Atom

Not every atom is the same.

Differences between ions, elements, and isotopes.



version 1.5

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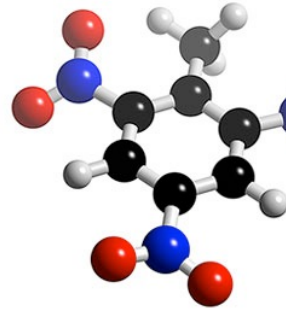


# Flavors of the Atom

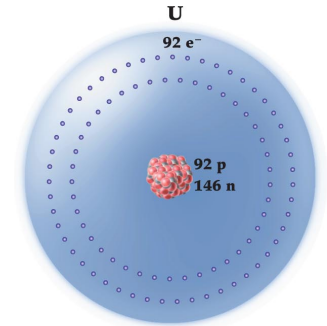
## → Organizing the Elements

- ▶ Chemical Symbols
- ▶ Periodicity
- ▶ The Periodic Table
  - ▶ The First Periodic Table
  - ▶ Metals & Non-metals
    - ▶ Metallic Properties
  - ▶ Common Ions, Predicting Charge
  - ▶ Representative Elements
  - ▶ Periods, Groups & Families
    - ▶ Group Numbers
    - ▶ Family Names
  - ▶ Official Class Periodic Table
- ▶ Parts of the atom – electrons, protons, neutrons
  - ▶ Ions differ in electron count
  - ▶ Proton count distinguishes between elements
  - ▶ Isotopes differ in total mass (because they differ in neutrons)
    - ▶ Isotopic Notation
      - ▶ Atomic Number
      - ▶ Mass Number
      - ▶ Electron Counts

1 H							2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca						



17  
80



# Organizing the Elements

- ▶ Finding new pure substances with useful and interesting properties made chemistry a valuable science.
- ▶ As chemists sought out more pure substances and documented their properties they explored how those substances could be made or decomposed.
- ▶ They quickly realized that every substance they discovered could be decomposed into one of a handful of unique substances that could not themselves be decomposed.
- ▶ They called those handful of cornerstone substances elements.
- ▶ Between the early 1700's and mid 1800's chemists sought out and found over 50 of those essential substances.
- ▶ As we found more and more elements we needed to organize them.
- ▶ So we started by making flash cards.
- ▶ We gave each element a symbol.

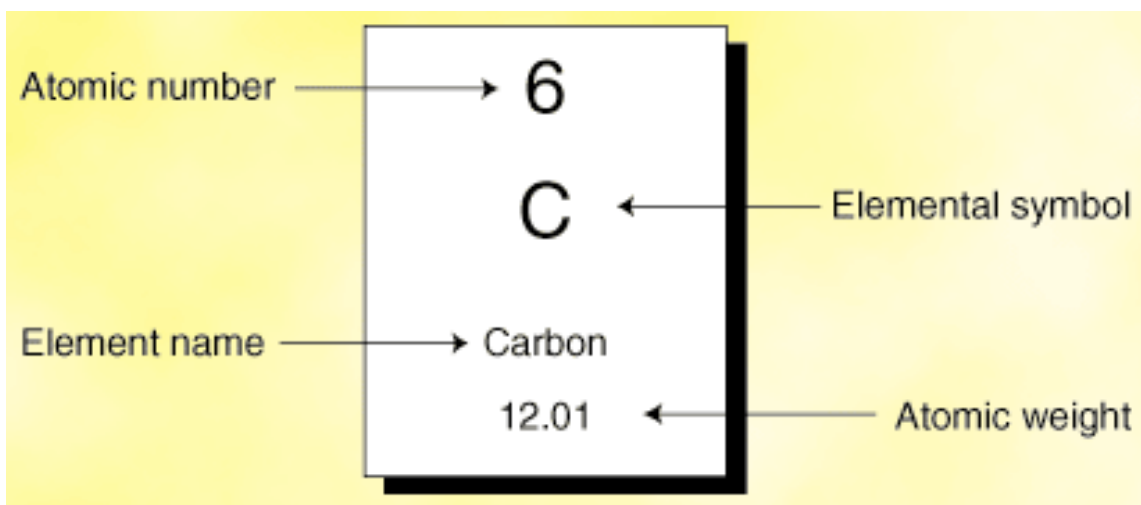


## Symbols for 18 Elements

Hydrogen (H)	Neon (Ne)
Helium (He)	Sodium (Na)
Lithium (Li)	(latin: <b>Natrium</b> )
Beryllium (Be)	<b>Magnesium (Mg)</b>
Boron (B)	<b>Aluminum (Al)</b>
Carbon (C)	<b>Silicon (Si)</b>
Nitrogen (N)	<b>Phosphorus (P)</b>
Oxygen (O)	<b>Sulfur (S)</b>
Fluorine (F)	<b>Chlorine (Cl)</b>
	<b>Argon (Ar)</b>

For Exam #1  
know the name and symbol of the  
first 18 elements.

# Organizing the Elements



Symbols have 1, 2 or 3 letters. If 1 letter is used, it is capitalized. If 2 or 3 letters are used, only the first is capitalized.

- ▶ We started by making flash cards.
- ▶ We gave each element a symbol.
- ▶ Then we lined them up by increasing weight, just like you might organize a poker hand.
- ▶ We gave each element a serial number (atomic number), to indicate it's place in the sequence of increasing weight.

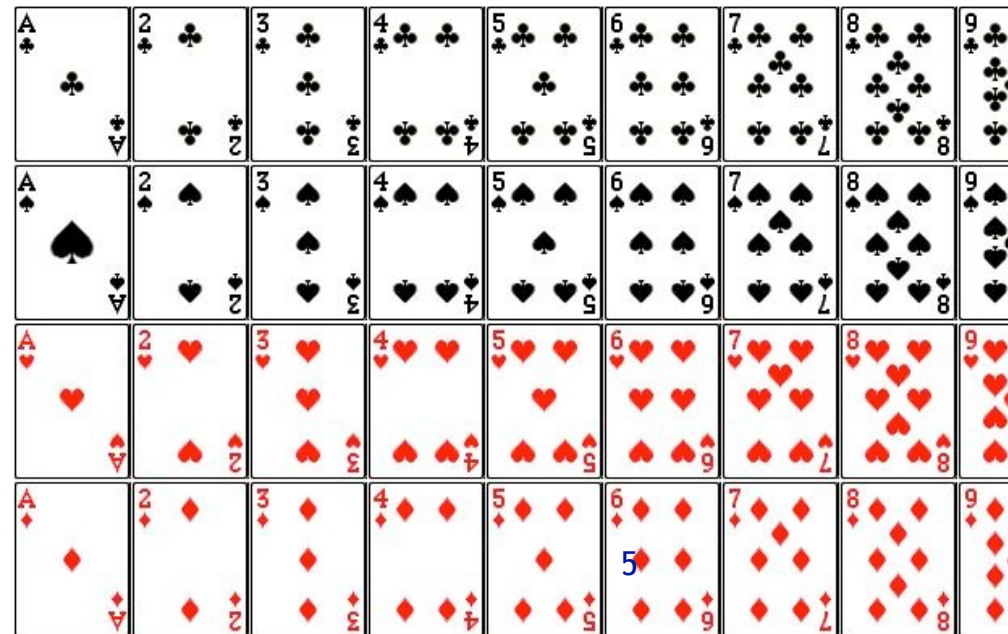




# Periodicity

Atomic number	1	2	3	4	—	9	10	11	12	—	17	18	19	20	—
Symbol	H	He	Li	Be	—	F	Ne	Na	Mg	—	Cl	Ar	K	Ca	—
	Nonreactive gas		Soft, reactive metal			Nonreactive gas		Soft, reactive metal			Nonreactive gas		Soft, reactive metal		

- ▶ We lined up all the cards by weight. From lightest to heaviest.
- ▶ Then we looked at their chemical and physical properties and saw a repeating pattern.
- ▶ Periodically, the same property shows up again and again and again.
- ▶ So instead of making it one really long line, we wrapped our set of cards so that those periodic trends lined up.



# Periodicity

1 H	2 He	3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne	11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	19 K	20 Ca
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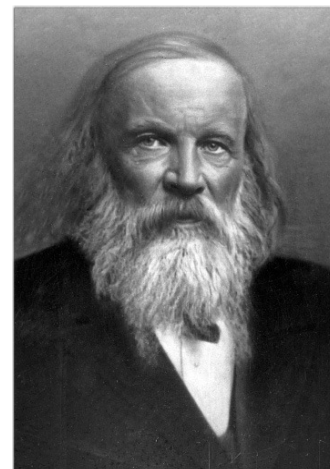
Elements with similar properties recur in a regular pattern.

- ▶ We lined up all the cards by weight. From lightest to heaviest.
- ▶ Then we looked at their chemical and physical properties and saw a repeating pattern.
- ▶ Periodically, the same property shows up again and again and again.
- ▶ So instead of making it one really long line, we wrapped our set of cards so that those periodic trends lined up.

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Elements with similar properties fall into columns.

# Periodic Table



- ▶ Dmitri Ivanovich Mendeleev, a Russian chemistry teacher, is credited for producing the first periodic table in 1871.
- ▶ There was about 50 elements in his first table.
- ▶ Periodic law predicted elements that weren't yet known, so Mendeleev left holes in his periodic table – to leave room for when they were discovered.

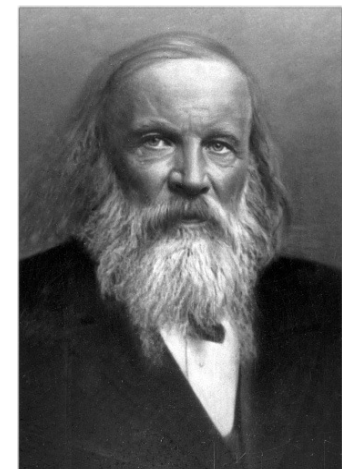


I	II	III	IV	V	VI	VII	VIII		
H 1.01									
Li 6.94	Be 9.01	B 10.8	C 12.0	N 14.0	O 16.0	F 19.0			
Na 23.0	Mg 24.3	Al 27.0	Si 28.1	P 31.0	S 32.1	Cl 35.5			
K 39.1	Ca 40.1		Ti 47.9	V 50.9	Cr 52.0	Mn 54.9	Fe 55.9	Co 58.9	Ni 58.7
Cu 63.5	Zn 65.4			As 74.9	Se 79.0	Br 79.9			
Rb 85.5	Sr 87.6	Y 88.9	Zr 91.2	Nb 92.9	Mo 95.9		Ru 101	Rh 103	Pd 106
Ag 108	Cd 112		In 115	Sn 119	Sb 122	Te 128	I 127		
Ce 133	Ba 137	La 139		Ta 181	W 184		Os 194	Ir 192	Pt 195
Au 197	Hg 201	Tl 204	Pb 207	Bi 209					
			Th 232		U 238				

1							2
H							He
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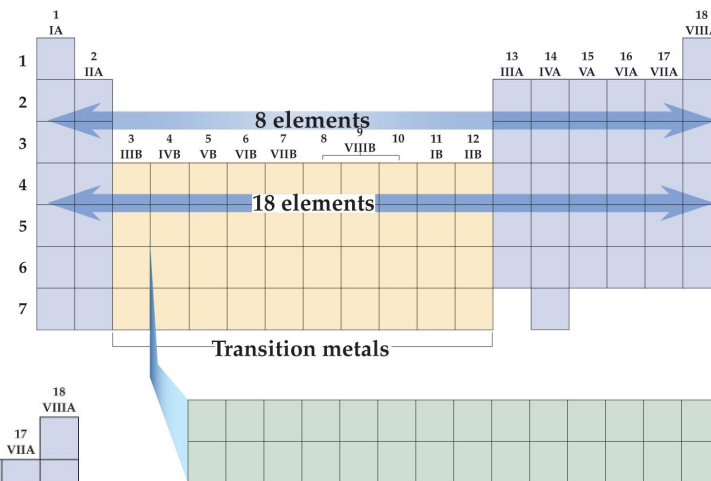
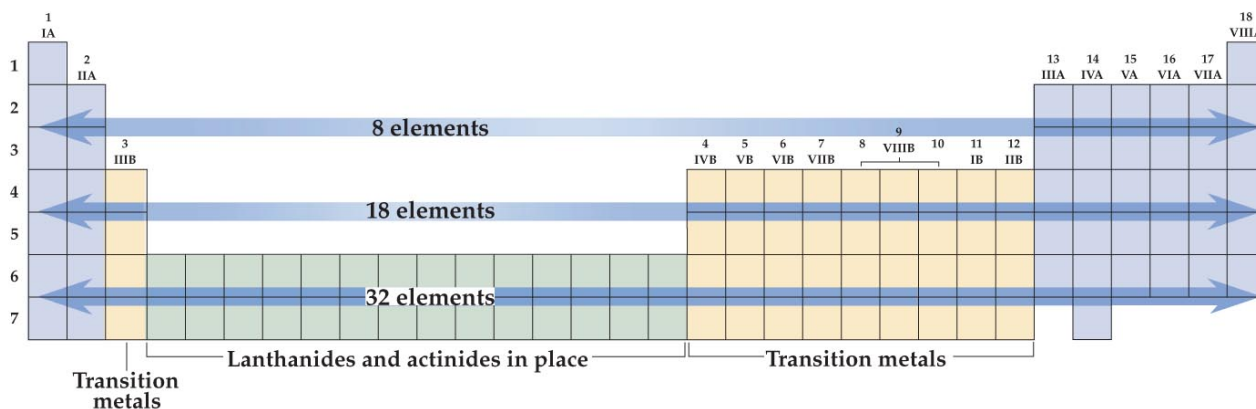
## ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ.

ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

	Ti = 50	Zr = 90	? = 180.
	V = 51	Nb = 94	Ta = 182.
	Cr = 52	Mo = 96	W = 186.
	Mn = 55	Rh = 104,4	Pt = 197,4
	Fe = 56	Ru = 104,4	Ir = 198.
	Ni = 59	Pd = 106,8	Os = 199.
	Cu = 63,4	Ag = 108	Hg = 200.
H = 1	Be = 9,4	Mg = 24	Zn = 65,2
	B = 11	Al = 27,1	? = 68
	C = 12	Si = 28	? = 70
	N = 14	P = 31	As = 75
	O = 16	S = 32	Se = 79,4
	F = 19	Cl = 35,5	Br = 80
Li = 7	Na = 23	K = 39	Rb = 85,4
		Ca = 40	Sr = 87,6
		? = 45	Ce = 92
		?Er = 56	La = 94
		?Yt = 60	Di = 95
		?In = 75,6	Th = 118?

Д. Менделѣевъ

- ▶ As we added more elements the table grew.
- ▶ To make it more manageable, we cut out the lanthanide and actinide cards and set them in a separate table.





# Flavors of the Atom

## ▶ Organizing the Elements

- ▶ Chemical Symbols
- ▶ Periodicity

## ▶ The Periodic Table

### ▶ The First Periodic Table

#### ▶ Metals & Non-metals

##### ▶ Metallic Properties

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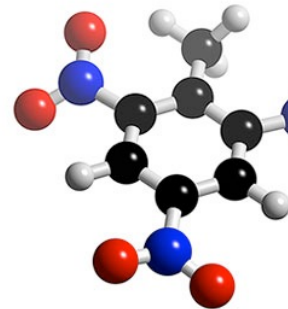
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- ▶ Isotopes differ in total mass (because they differ in neutrons)

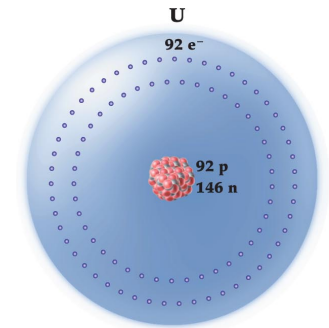
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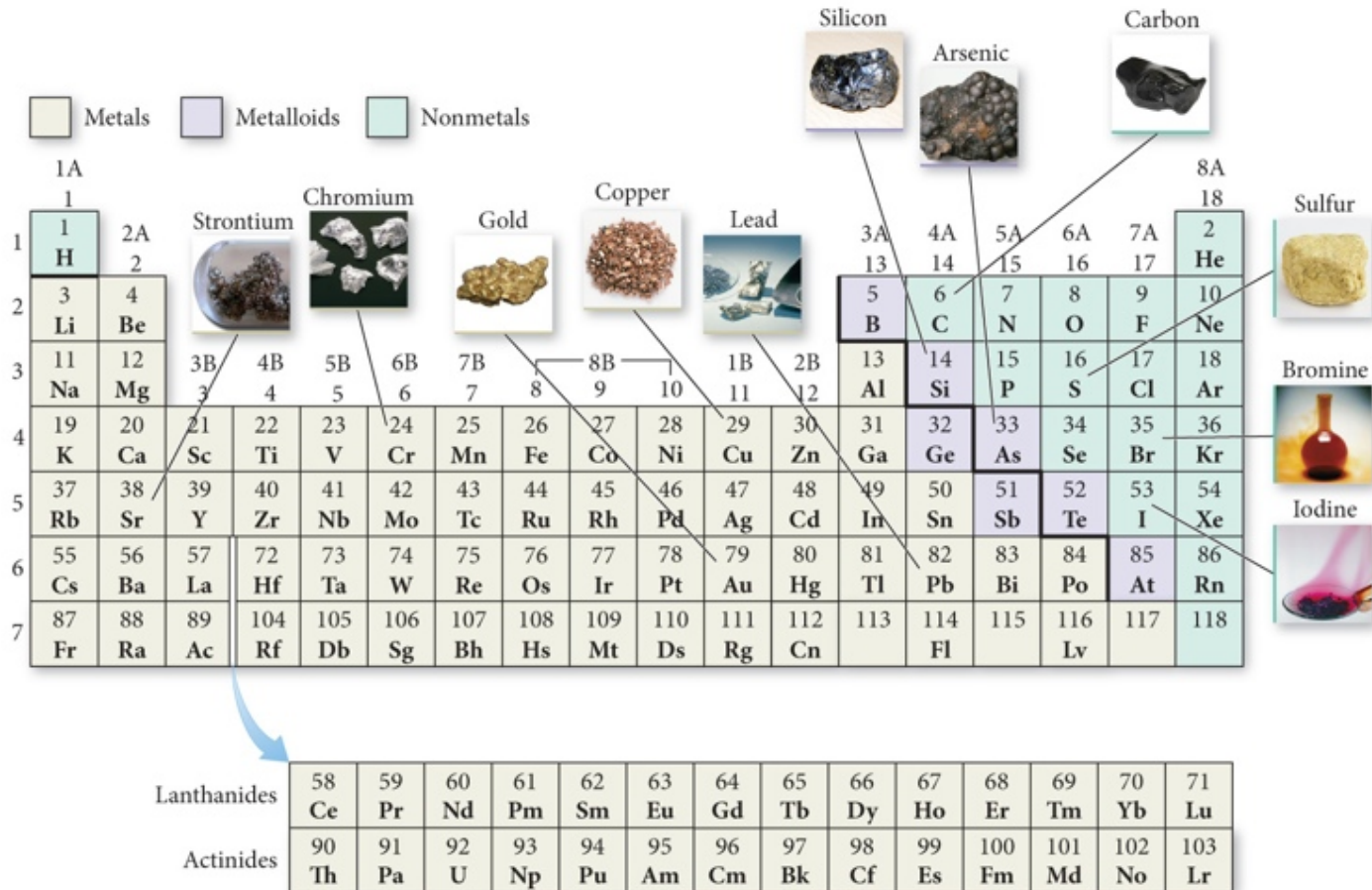


17  
80



# Metallic Character

- ▶ Most elements are metals (shiny, malleable, ductile, good conductors)
- ▶ Some are non-metals (dull, brittle, not-ductile, poor conductors)
- ▶ Seven are metalloids (kinda shiny, somewhat malleable, sorta ductile, semi-conductors)





# Periodic Table

- ▶ We call each horizontal row a **period**.
- ▶ We call each vertical column a **family** or **group**.
- ▶ We divide sections of the table into the **representative elements**, the **transition metals** and the **inner transition metals**.

**Periodic Table of the Elements**

**Element symbol coloring**  
 ● **H** Gas  
 ● **Li** Solid  
 ● **Br** Liquid  
 ● **Tc** Not found in nature  
 } at 25°C and 1 atm pressure

Representative (main-group) elements		Transition metals										Representative (main-group) elements						
1 IA												13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA	
1	<b>H</b> 1.0079																<b>He</b> 4.003	
2	<b>Li</b> 6.941	<b>Be</b> 9.012											<b>B</b> 10.811	<b>C</b> 12.011	<b>N</b> 14.007	<b>O</b> 15.999	<b>F</b> 18.998	<b>Ne</b> 20.180
3	<b>Na</b> 22.990	<b>Mg</b> 24.305	<b>Sc</b> 44.956	<b>Ti</b> 47.88	<b>V</b> 50.942	<b>Cr</b> 51.996	<b>Mn</b> 54.938	<b>Fe</b> 55.845	<b>Co</b> 58.933	<b>Ni</b> 58.69	<b>Cu</b> 63.546	<b>Zn</b> 65.39	<b>Ga</b> 69.723	<b>Ge</b> 72.61	<b>As</b> 74.922	<b>Se</b> 78.96	<b>Br</b> 79.904	<b>Kr</b> 83.8
4	<b>K</b> 39.098	<b>Ca</b> 40.078	<b>Sc</b> 44.956	<b>Ti</b> 47.88	<b>V</b> 50.942	<b>Cr</b> 51.996	<b>Mn</b> 54.938	<b>Fe</b> 55.845	<b>Co</b> 58.933	<b>Ni</b> 58.69	<b>Cu</b> 63.546	<b>Zn</b> 65.39	<b>Ga</b> 69.723	<b>Ge</b> 72.61	<b>As</b> 74.922	<b>Se</b> 78.96	<b>Br</b> 79.904	<b>Kr</b> 83.8
5	<b>Rb</b> 85.468	<b>Sr</b> 87.62	<b>Y</b> 88.906	<b>Zr</b> 91.224	<b>Nb</b> 92.906	<b>Mo</b> 95.94	<b>Tc</b> 98	<b>Ru</b> 101.07	<b>Rh</b> 102.906	<b>Pd</b> 106.42	<b>Ag</b> 107.868	<b>Cd</b> 112.411	<b>In</b> 114.82	<b>Sn</b> 118.71	<b>Sb</b> 121.76	<b>Te</b> 127.60	<b>I</b> 126.905	<b>Xe</b> 131.29
6	<b>Cs</b> 132.905	<b>Ba</b> 137.327	<b>La</b> 138.906	<b>Hf</b> 178.49	<b>Ta</b> 180.948	<b>W</b> 183.84	<b>Re</b> 186.207	<b>Os</b> 190.23	<b>Ir</b> 192.22	<b>Pt</b> 195.08	<b>Au</b> 196.967	<b>Hg</b> 200.59	<b>Tl</b> 204.383	<b>Pb</b> 207.2	<b>Bi</b> 208.980	<b>Po</b> 209	<b>At</b> 210	<b>Rn</b> 222
7	<b>Fr</b> 223	<b>Ra</b> 226.025	<b>Ac</b> 227.028	<b>Rf</b> 261	<b>Db</b> 262	<b>Sg</b> 263	<b>Bh</b> 262	<b>Hs</b> 265	<b>Mt</b> 266	<b>Uun</b> 269	<b>Uuu</b> 272	<b>Uub</b> 277						
			Lanthanides (rare earths)															
			<b>Ce</b> 140.115	<b>Pr</b> 140.908	<b>Nd</b> 144.24	<b>Pm</b> 145	<b>Sm</b> 150.36	<b>Eu</b> 151.964	<b>Gd</b> 157.25	<b>Tb</b> 158.925	<b>Dy</b> 162.5	<b>Ho</b> 164.93	<b>Er</b> 167.26	<b>Tm</b> 168.934	<b>Yb</b> 173.04	<b>Lu</b> 174.967		
			Actinides															
			<b>Th</b> 232.038	<b>Pa</b> 231.036	<b>U</b> 238.029	<b>Np</b> 237.048	<b>Pu</b> 244	<b>Am</b> 243	<b>Cm</b> 247	<b>Bk</b> 247	<b>Cf</b> 251	<b>Es</b> 252	<b>Fm</b> 257	<b>Md</b> 258	<b>No</b> 259	<b>Lr</b> 262		

# Periodic Table

- Some families (groups) are important enough to have unique names.

Group	Name
1A	Alkali metals
2A	Alkaline earth metals
6A	Chalcogens
7A	Halogens
8A	Noble gases (or rare gases)

**Periodic Table of the Elements**

Representative (main-group) elements

1 IA

2 IIA

**Element symbol coloring**

● **H** Gas

● **Li** Solid

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Representative (main-group) elements

13 IIIA

14 IVA

15 VA

16 VIA

17 VIIA

18 VIIIA

		Transition metals																																														
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																															
		IIIB	IVB	VB	VIB	VII B	VIII B			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA																															
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11 <b>Na</b> 22.990	12 <b>Mg</b> 24.305	21 <b>Sc</b>	22 <b>Ti</b>	23 <b>V</b>	24 <b>Cr</b>	25 <b>Mn</b>	26 <b>Fe</b>	27 <b>Co</b>	28 <b>Ni</b>	29 <b>Cu</b>	30 <b>Zn</b>	31 <b>Ga</b>	32 <b>Ge</b>	33 <b>As</b>	34 <b>Se</b>	35 <b>Br</b>	36 <b>Kr</b>			
19 <b>K</b> 39.098	20 <b>Ca</b> 40.078	39 <b>Y</b>	40 <b>Zr</b>	41 <b>Nb</b>	42 <b>Mo</b>	43 <b>Tc</b>	44 <b>Ru</b>	45 <b>Rh</b>	46 <b>Pd</b>	47 <b>Ag</b>	48 <b>Cd</b>	49 <b>In</b>	50 <b>Sn</b>	51 <b>Sb</b>	52 <b>Te</b>	53 <b>I</b>	54 <b>Xe</b>			
37 <b>Rb</b> 85.468	38 <b>Sr</b> 87.62	72 <b>Hf</b>	73 <b>Ta</b>	74 <b>W</b>	75 <b>Re</b>	76 <b>Os</b>	77 <b>Ir</b>	78 <b>Pt</b>	79 <b>Au</b>	80 <b>Hg</b>	81 <b>Tl</b>	82 <b>Pb</b>	83 <b>Bi</b>	84 <b>Po</b>	85 <b>At</b>	86 <b>Rn</b>				
55 <b>Cs</b> 132.905	56 <b>Ba</b> 137.327	89 <b>Ac</b>	104 <b>Rf</b>	105 <b>Db</b>	106 <b>Sg</b>	107 <b>Bh</b>	108 <b>Hs</b>	109 <b>Mt</b>	110 <b>Uun</b>	111 <b>Uuu</b>	112 <b>Uub</b>									
87 <b>Fr</b> 223	88 <b>Ra</b> 226.025	114																		

# Many Ionic Charges are Predictable

1A	2A	Transition metals								3A	4A	5A	6A	7A	8A
H <sup>+</sup>												N <sup>3-</sup>	O <sup>2-</sup>	H <sup>-</sup>	N o b l e  G a s e s
Li <sup>+</sup>														F <sup>-</sup>	
Na <sup>+</sup>	Mg <sup>2+</sup>									Al <sup>3+</sup>			S <sup>2-</sup>	Cl <sup>-</sup>	
K <sup>+</sup>	Ca <sup>2+</sup>												Se <sup>2-</sup>	Br <sup>-</sup>	
Rb <sup>+</sup>	Sr <sup>2+</sup>												Te <sup>2-</sup>	I <sup>-</sup>	
Cs <sup>+</sup>	Ba <sup>2+</sup>														

# Flavors of the Atom

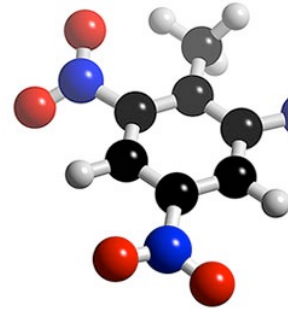
## ▶ Organizing the Elements

- ▶ Chemical Symbols
- ▶ Periodicity

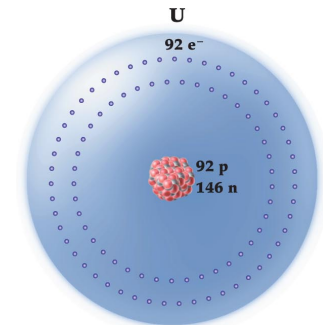
## ▶ The Periodic Table

- ▶ The First Periodic Table
- ▶ Metals & Non-metals
  - ▶ Metallic Properties
- ▶ Common Ions, Predicting Charge
- ▶ Representative Elements
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## ▶ Official Class Periodic Table

## ▶ Parts of the atom – electrons, protons, neutrons

- ▶ Ions differ in electron count
- ▶ Proton count distinguishes between elements
- ▶ Isotopes differ in total mass (because they differ in neutrons)
  - ▶ Isotopic Notation
    - ▶ Atomic Number
    - ▶ Mass Number
    - ▶ Electron Counts





# Official Class Periodic Table

Unless directed otherwise, use only this table for all classwork.

This table will be provided with all exams.

This table is printed in the front cover of your text book and is available as a pop-up in mastering chemistry.

1	1 <b>H</b> 1.01 hydrogen	2											13	14	15	16	17	18
	IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1	3 <b>Li</b> 6.94 lithium	4 <b>Be</b> 9.01 beryllium											5 <b>B</b> 10.81 boron	6 <b>C</b> 12.01 carbon	7 <b>N</b> 14.01 nitrogen	8 <b>O</b> 16.00 oxygen	9 <b>F</b> 19.00 fluorine	10 <b>Ne</b> 20.18 neon
2	11 <b>Na</b> 22.99 sodium	12 <b>Mg</b> 24.31 magnesium	3	4	5	6	7	8	9	10	11	12	13 <b>Al</b> 26.98 aluminum	14 <b>Si</b> 28.09 silicon	15 <b>P</b> 30.97 phosphorus	16 <b>S</b> 32.07 sulfur	17 <b>Cl</b> 35.45 chlorine	18 <b>Ar</b> 39.95 argon
3	19 <b>K</b> 39.10 potassium	20 <b>Ca</b> 40.08 calcium	21 <b>Sc</b> 44.96 scandium	22 <b>Ti</b> 47.88 titanium	23 <b>V</b> 50.94 vanadium	24 <b>Cr</b> 52.00 chromium	25 <b>Mn</b> 54.94 manganese	26 <b>Fe</b> 55.85 iron	27 <b>Co</b> 58.93 cobalt	28 <b>Ni</b> 58.69 nickel	29 <b>Cu</b> 63.55 copper	30 <b>Zn</b> 65.39 zinc	31 <b>Ga</b> 69.72 gallium	32 <b>Ge</b> 72.61 germanium	33 <b>As</b> 74.92 arsenic	34 <b>Se</b> 78.96 selenium	35 <b>Br</b> 79.90 bromine	36 <b>Kr</b> 83.80 krypton
4	37 <b>Rb</b> 85.47 rubidium	38 <b>Sr</b> 87.62 strontium	39 <b>Y</b> 88.91 yttrium	40 <b>Zr</b> 91.22 zirconium	41 <b>Nb</b> 92.91 niobium	42 <b>Mo</b> 95.94 molybdenum	43 <b>Tc</b> (99) technetium	44 <b>Ru</b> 101.07 ruthenium	45 <b>Rh</b> 102.91 rhodium	46 <b>Pd</b> 106.42 palladium	47 <b>Ag</b> 107.87 silver	48 <b>Cd</b> 112.41 cadmium	49 <b>In</b> 114.82 indium	50 <b>Sn</b> 118.71 tin	51 <b>Sb</b> 121.75 antimony	52 <b>Te</b> 127.60 tellurium	53 <b>I</b> 126.90 iodine	54 <b>Xe</b> 131.29 xenon
5	55 <b>Cs</b> 132.91 cesium	56 <b>Ba</b> 137.33 barium	57 <b>La</b> 138.91 lanthanum	72 <b>Hf</b> 178.49 hafnium	73 <b>Ta</b> 180.95 tantalum	74 <b>W</b> 183.85 tungsten	75 <b>Re</b> 186.21 rhenium	76 <b>Os</b> 190.2 osmium	77 <b>Ir</b> 192.22 iridium	78 <b>Pt</b> 195.08 platinum	79 <b>Au</b> 196.97 gold	80 <b>Hg</b> 200.59 mercury	81 <b>Tl</b> 204.38 thallium	82 <b>Pb</b> 207.2 lead	83 <b>Bi</b> 208.98 bismuth	84 <b>Po</b> (209) polonium	85 <b>At</b> (210) astatine	86 <b>Rn</b> (222) radon
6	87 <b>Fr</b> (223) francium	88 <b>Ra</b> (226) radium	89 <b>Ac</b> (227) actinium	104 <b>Rf</b> (261) rutherfordium	105 <b>Db</b> (262) dubnium	106 <b>Sg</b> (263) seaborgium	107 <b>Bh</b> (262) bohrium	108 <b>Hs</b> (265) hassium	109 <b>Mt</b> (266) meitnerium	110 <b>Ds</b> (281) darmstadtium	111 <b>Rg</b> (280) roentgenium	112 <b>Cn</b> (285) copernicium	113 — (284)	114 <b>Fl</b> (289) flerovium	115 — (288)	116 <b>Lv</b> (292) livermorium	117* — (294)	118 — (294)
7																		

58 <b>Ce</b> 140.12 cerium	59 <b>Pr</b> 140.91 praseodymium	60 <b>Nd</b> 144.24 neodymium	61 <b>Pm</b> (147) promethium	62 <b>Sm</b> 150.36 samarium	63 <b>Eu</b> 151.97 europium	64 <b>Gd</b> 157.25 gadolinium	65 <b>Tb</b> 158.93 terbium	66 <b>Dy</b> 162.50 dysprosium	67 <b>Ho</b> 164.93 holmium	68 <b>Er</b> 167.26 erbium	69 <b>Tm</b> 168.93 thulium	70 <b>Yb</b> 173.04 ytterbium	71 <b>Lu</b> 174.97 lutetium
90 <b>Th</b> (232) thorium	91 <b>Pa</b> (231) protactinium	92 <b>U</b> (238) uranium	93 <b>Np</b> (237) neptunium	94 <b>Pu</b> (244) plutonium	95 <b>Am</b> (243) americium	96 <b>Cm</b> (247) curium	97 <b>Bk</b> (247) berkelium	98 <b>Cf</b> (251) californium	99 <b>Es</b> (252) einsteinium	100 <b>Fm</b> (257) fermium	101 <b>Md</b> (258) mendelevium	102 <b>No</b> (259) nobelium	103 <b>Lr</b> (260) lawrencium





# Flavors of the Atom

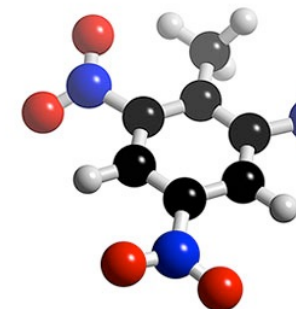
## ▶ Organizing the Elements

- ▶ Chemical Symbols
- ▶ Periodicity

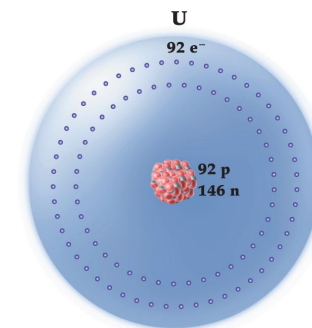
## ▶ The Periodic Table

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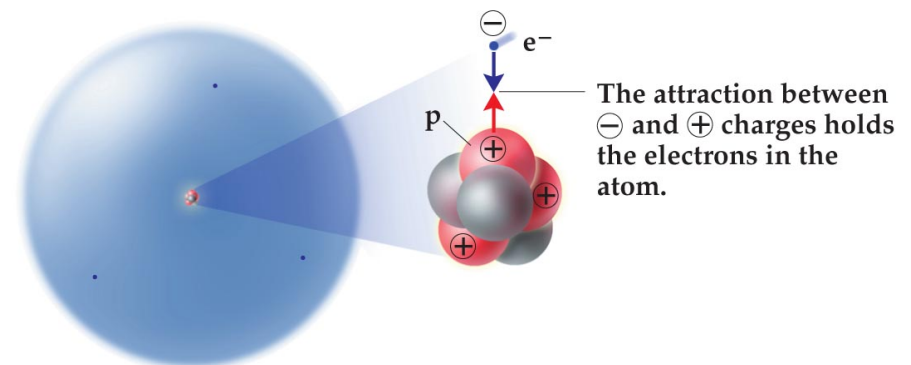
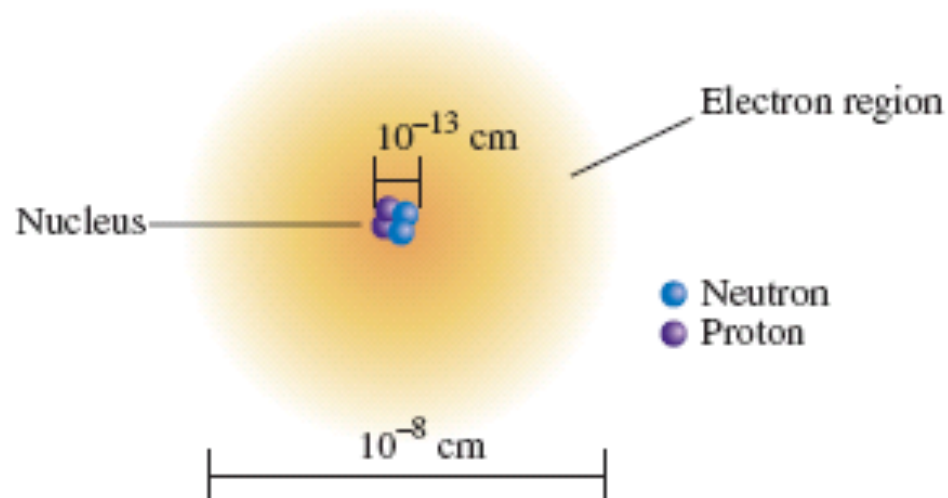
→ Parts of the atom – electrons, protons, neutrons

- ▶ Ions differ in electron count
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- ▶ Isotopes differ in total mass (because they differ in neutrons)
  - ▶ Isotopic Notation
    - ▶ Atomic Number
    - ▶ Mass Number
    - ▶ Electron Counts



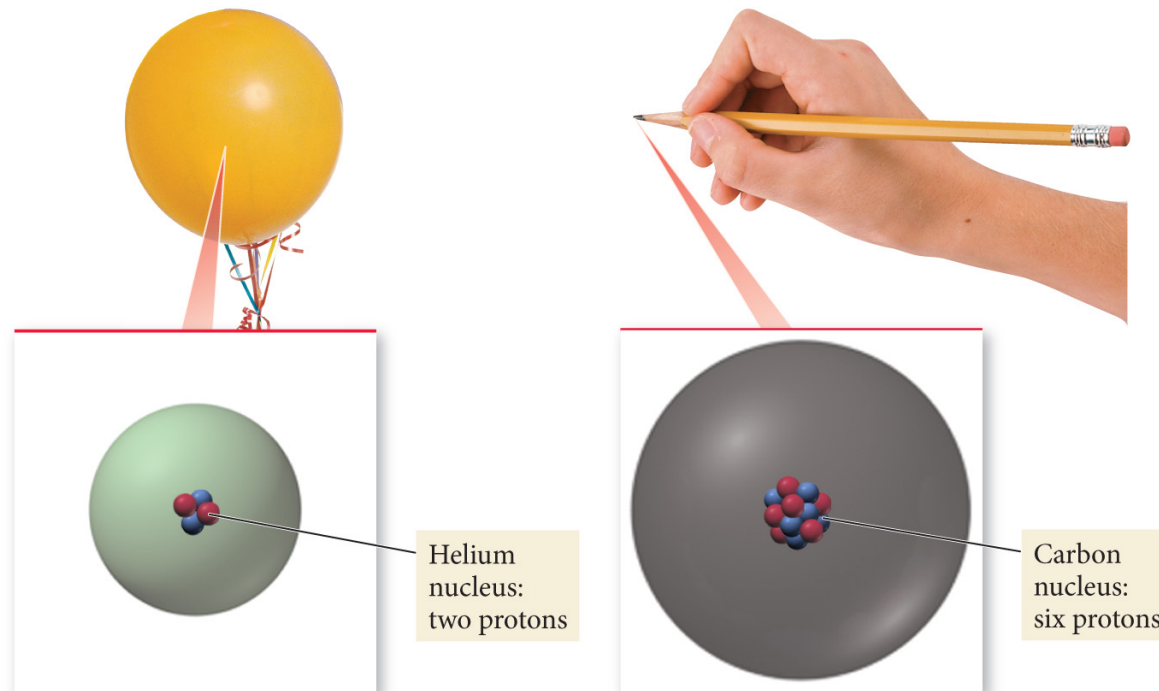
# Parts of the Atom

- ▶ Atoms are the smallest particle of an element that can enter into a chemical reaction.
- ▶ Protons and neutrons make up the dense, positive nucleus.
- ▶ Electrons occupy the empty space outside the nucleus.
- ▶ A neutral atom contains the same number of electrons and protons.



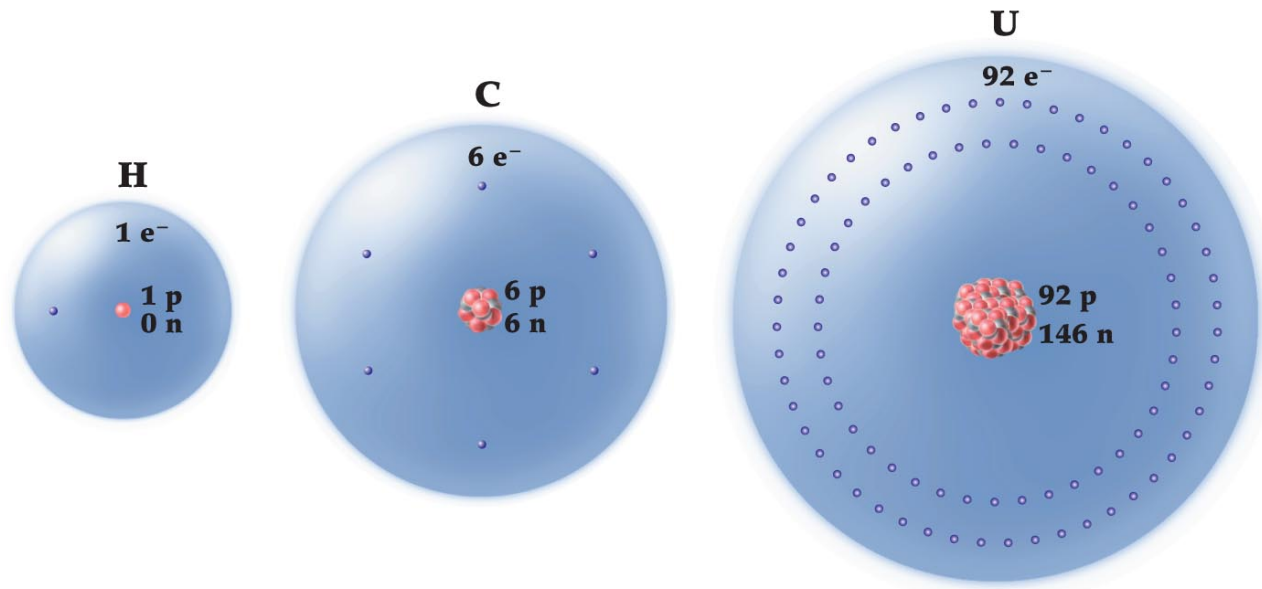
# Elements differ in Protons

- ▶ If all atoms are made up of protons, neutrons, and electrons – what makes one element different from another?
- ▶ Elements differ by the number of protons.
- ▶ Carbon atoms have six protons. Helium atoms have two protons. **Always.**



# Elements differ in Protons

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# Elements differ in Protons

- ▶ The “serial number” in the periodic table is the atomic number.
- ▶ The **atomic number** equals the number of protons for that element.

Atomic number (Z)

Chemical symbol

Name

1 <b>H</b> hydrogen																	2 <b>He</b> helium
3 <b>Li</b> lithium	4 <b>Be</b> beryllium											5 <b>B</b> boron	6 <b>C</b> carbon	7 <b>N</b> nitrogen	8 <b>O</b> oxygen	9 <b>F</b> fluorine	10 <b>Ne</b> neon
11 <b>Na</b> sodium	12 <b>Mg</b> magnesium											13 <b>Al</b> aluminum	14 <b>Si</b> silicon	15 <b>P</b> phosphorus	16 <b>S</b> sulfur	17 <b>Cl</b> chlorine	18 <b>Ar</b> argon
19 <b>K</b> potassium	20 <b>Ca</b> calcium	21 <b>Sc</b> scandium	22 <b>Ti</b> titanium	23 <b>V</b> vanadium	24 <b>Cr</b> chromium	25 <b>Mn</b> manganese	26 <b>Fe</b> iron	27 <b>Co</b> cobalt	28 <b>Ni</b> nickel	29 <b>Cu</b> copper	30 <b>Zn</b> zinc	31 <b>Ga</b> gallium	32 <b>Ge</b> germanium	33 <b>As</b> arsenic	34 <b>Se</b> selenium	35 <b>Br</b> bromine	36 <b>Kr</b> krypton
37 <b>Rb</b> rubidium	38 <b>Sr</b> strontium	39 <b>Y</b> yttrium	40 <b>Zr</b> zirconium	41 <b>Nb</b> niobium	42 <b>Mo</b> molybdenum	43 <b>Tc</b> technetium	44 <b>Ru</b> ruthenium	45 <b>Rh</b> rhodium	46 <b>Pd</b> palladium	47 <b>Ag</b> silver	48 <b>Cd</b> cadmium	49 <b>In</b> indium	50 <b>Sn</b> tin	51 <b>Sb</b> antimony	52 <b>Te</b> tellurium	53 <b>I</b> iodine	54 <b>Xe</b> xenon
55 <b>Cs</b> cesium	56 <b>Ba</b> barium	57 <b>La</b> lanthanum	72 <b>Hf</b> hafnium	73 <b>Ta</b> tantalum	74 <b>W</b> tungsten	75 <b>Re</b> rhenium	76 <b>Os</b> osmium	77 <b>Ir</b> iridium	78 <b>Pt</b> platinum	79 <b>Au</b> gold	80 <b>Hg</b> mercury	81 <b>Tl</b> thallium	82 <b>Pb</b> lead	83 <b>Bi</b> bismuth	84 <b>Po</b> polonium	85 <b>At</b> astatine	86 <b>Rn</b> radon
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# Flavors of the Atom

## ▶ Organizing the Elements

- ▶ Chemical Symbols
- ▶ Periodicity

## ▶ The Periodic Table

- ▶ The First Periodic Table
- ▶ Metals & Non-metals
  - ▶ Metallic Properties
- ▶ Common Ions, Predicting Charge
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- ▶ Official Class Periodic Table

## ▶ Parts of the atom – electrons, protons, neutrons

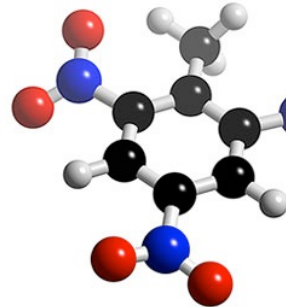
- ▶ Ions differ in electron count
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→ Isotopes differ in total mass (because they differ in neutrons)

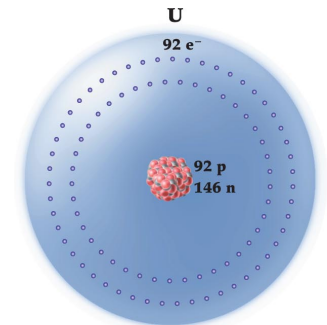
### ▶ Isotopic Notation

- ▶ Atomic Number
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11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca						



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# Isotopes differ in Mass

- ▶ All atoms of the same element, have the same number of protons.
- ▶ But may not have the same weight.
- ▶ Some hydrogen atoms weigh twice as much as other hydrogen atoms.
- ▶ The difference is in the **number of neutrons**.
- ▶ Atoms of the same element but different masses are called **isotopes**.
- ▶ Isotopes are defined by their number of neutrons.
- ▶ We use isotopic notation to describe different isotopes.

Mass number

(sum of protons and  
neutrons in the nucleus)



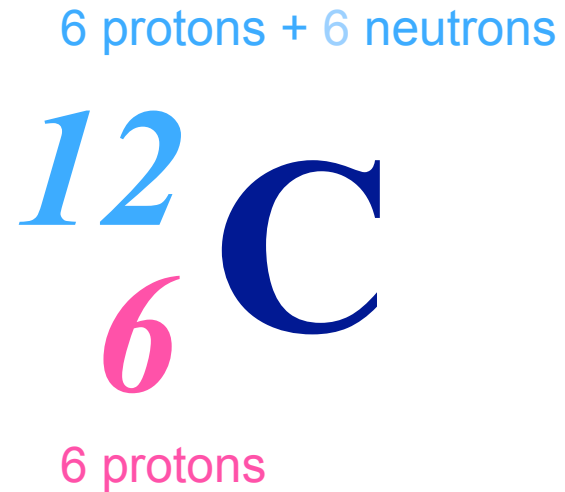
Atomic number  
(number of protons  
in the nucleus)

← Symbol of element

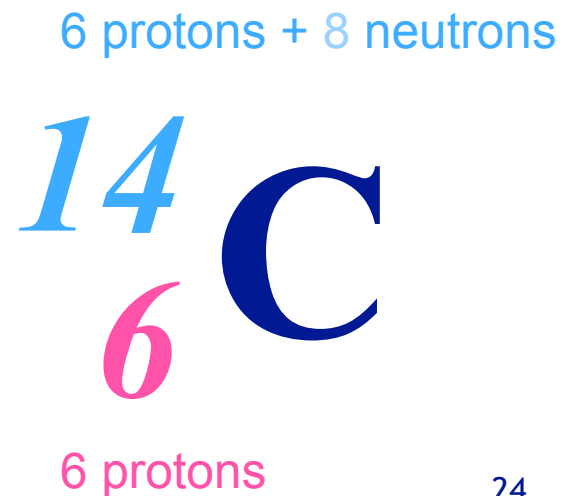
# Isotopes differ in Mass

$\begin{matrix} A \\ Z \end{matrix} E$

- ▶ What would the symbol be for the Carbon-12 isotope?



- ▶ What would the symbol be for the Carbon-14 isotope?



# Isotopes differ in Mass

$\frac{A}{Z}E$

- ▶ Oxygen has three isotopes...

8 protons + 8 neutrons

$^{16}_8\text{O}$

8 protons

8 protons + 9 neutrons

$^{17}_8\text{O}$

8 protons

8 protons + 10 neutrons

$^{18}_8\text{O}$

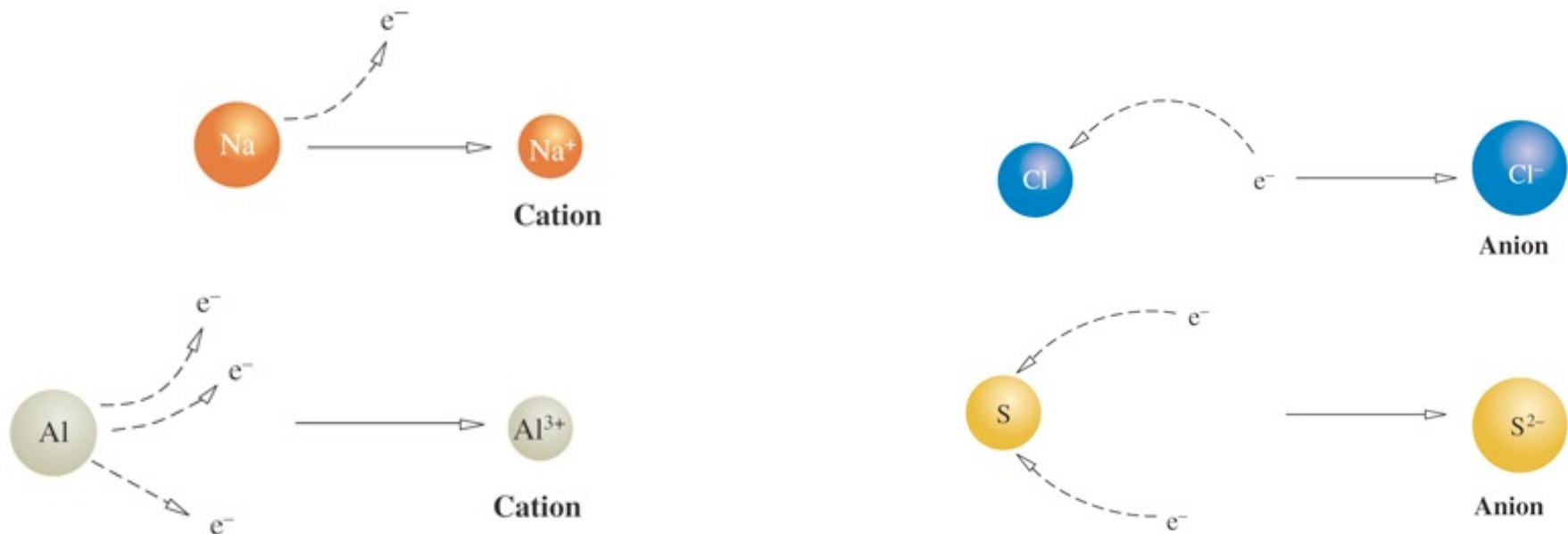
8 protons

# Examples of Isotopes

<u>Element</u>	<u>Protons</u>	<u>Electrons</u>	<u>Neutrons</u>	<u>Symbol</u>
Hydrogen	1	1	0	
Hydrogen	1	1	1	
Hydrogen	1	1	2	
Uranium	92	92	143	
Uranium	92	92	146	
Chlorine	17	17	18	
Chlorine	17	17	20	

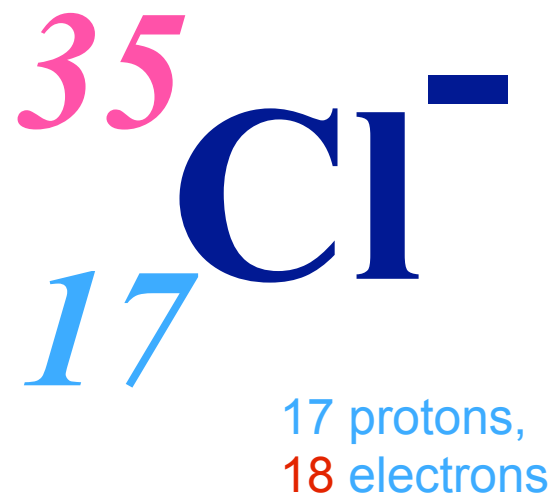
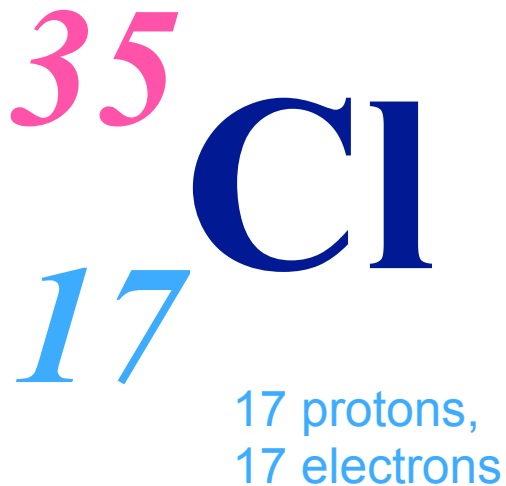
# Ions differ in Electrons

- ▶ For a neutral atom, the number of protons equals the number of electrons.
- ▶ For a cation, there are less electrons than protons.
- ▶ For an anion, there are more electrons than protons.



# Ions differ in Electrons

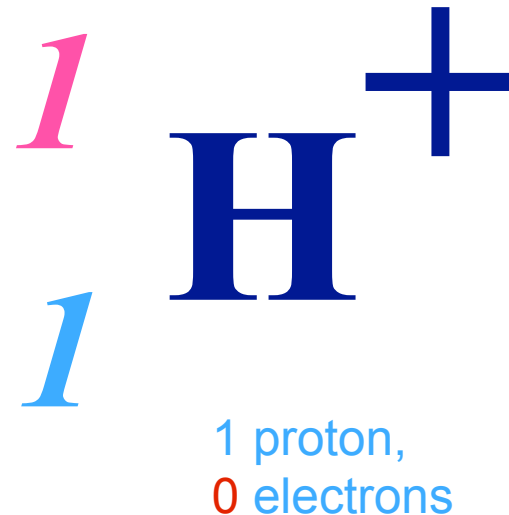
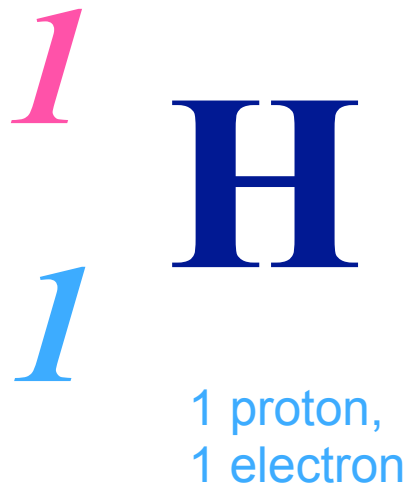
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# Flavors of the Atom

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- ▶ Periodicity

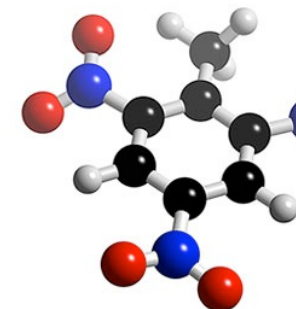
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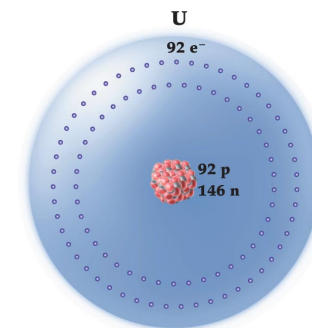
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# Questions?

