

Warm Up

1. Which group of elements has electron configurations ending in s^2 ? **Group 2A Alkaline Earth Metals**

2. Which group of elements has electron configurations ending in s^2p^5 ? **Group 7A Halogens**

Objectives

TSWBAT:

Identify trends in the periodic table involving atomic radius, ionization energy.

Trends in the Periodic Table

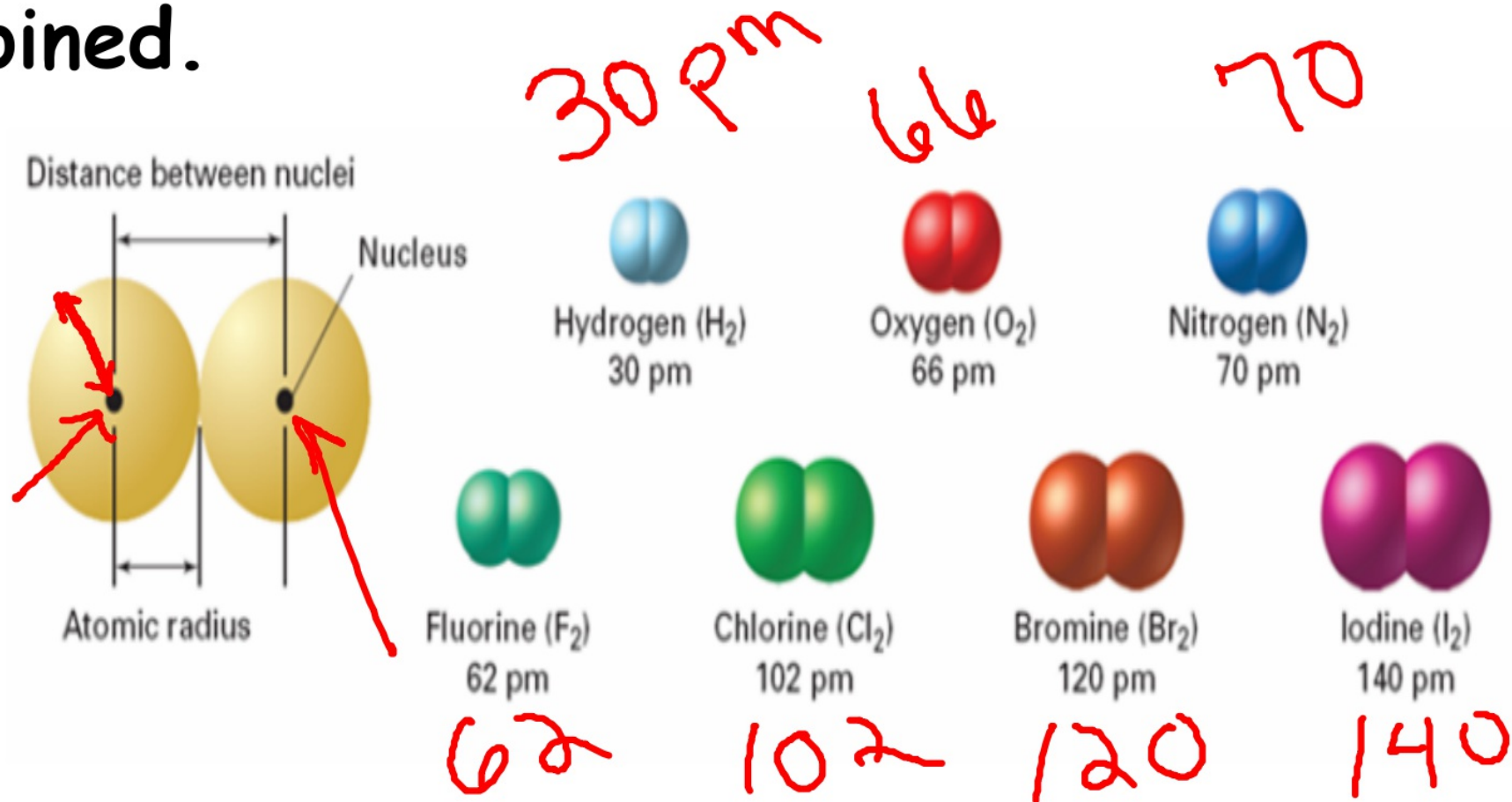
Trend #1: Electron configurations occur in blocks.

Trend #2:


Trends in Atomic Size

What are the trends among the elements for atomic size?

The **atomic radius** is one half of the distance between the nuclei of two atoms of the same element when the atoms are joined.



In general, **atomic size increases** from top to bottom within a group and **decreases** from left to right across a period.



Decreases

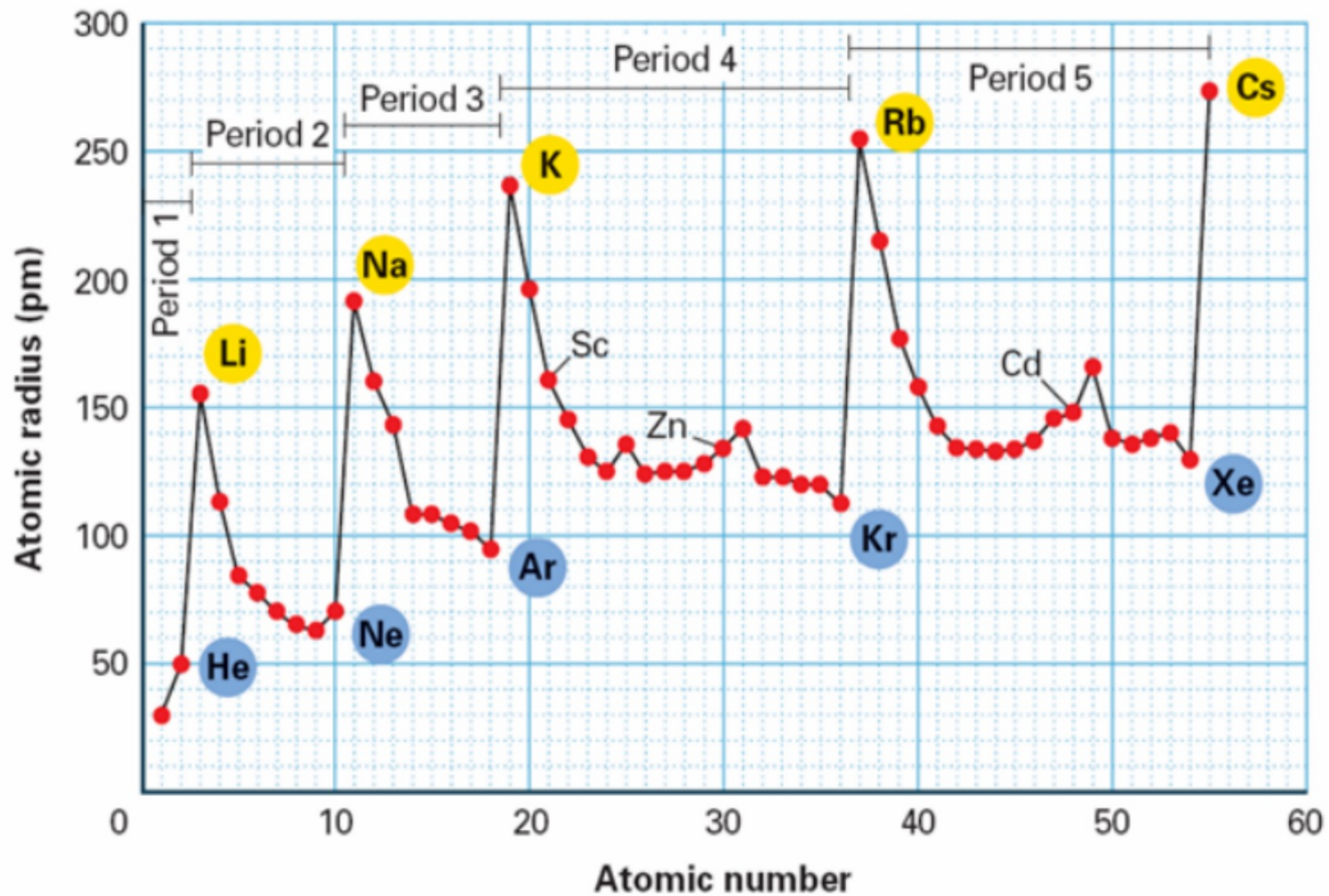
**I
n
c
r
e
a
s
e
s**

IA ¹												VIA ³				Zero ⁴	
H 1											B 5	C 6	N 7	O 8	F 9	He 2	
Li 3	Be 4											Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
Na 11	Mg 12	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
Cs 55	Ba 56	*La 57	Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80						
Fr 87	Ra 88	Ac 89	Unq 104	Unp 105	Umh 106												
*Lanthanide series		Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71		
*Actinide series		Th 90	Pu 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103		

¹Group IA (excluding hydrogen) comprises the alkali metals.

³Group VIIA (excluding hydrogen) comprises the halogens.

Atomic Radius Versus Atomic Number



Ions

Today we will address:

- 1. Names for 2 types of ions**
- 2. How ions form**

Some compounds are composed of particles called ions.

- **An ion** is an atom or group of atoms that has a **positive** or **negative** charge.
- **A cation** is an ion with a **positive** charge.
- **An anion** is an ion with a **negative** charge.

Warm Up:

What is a cation?

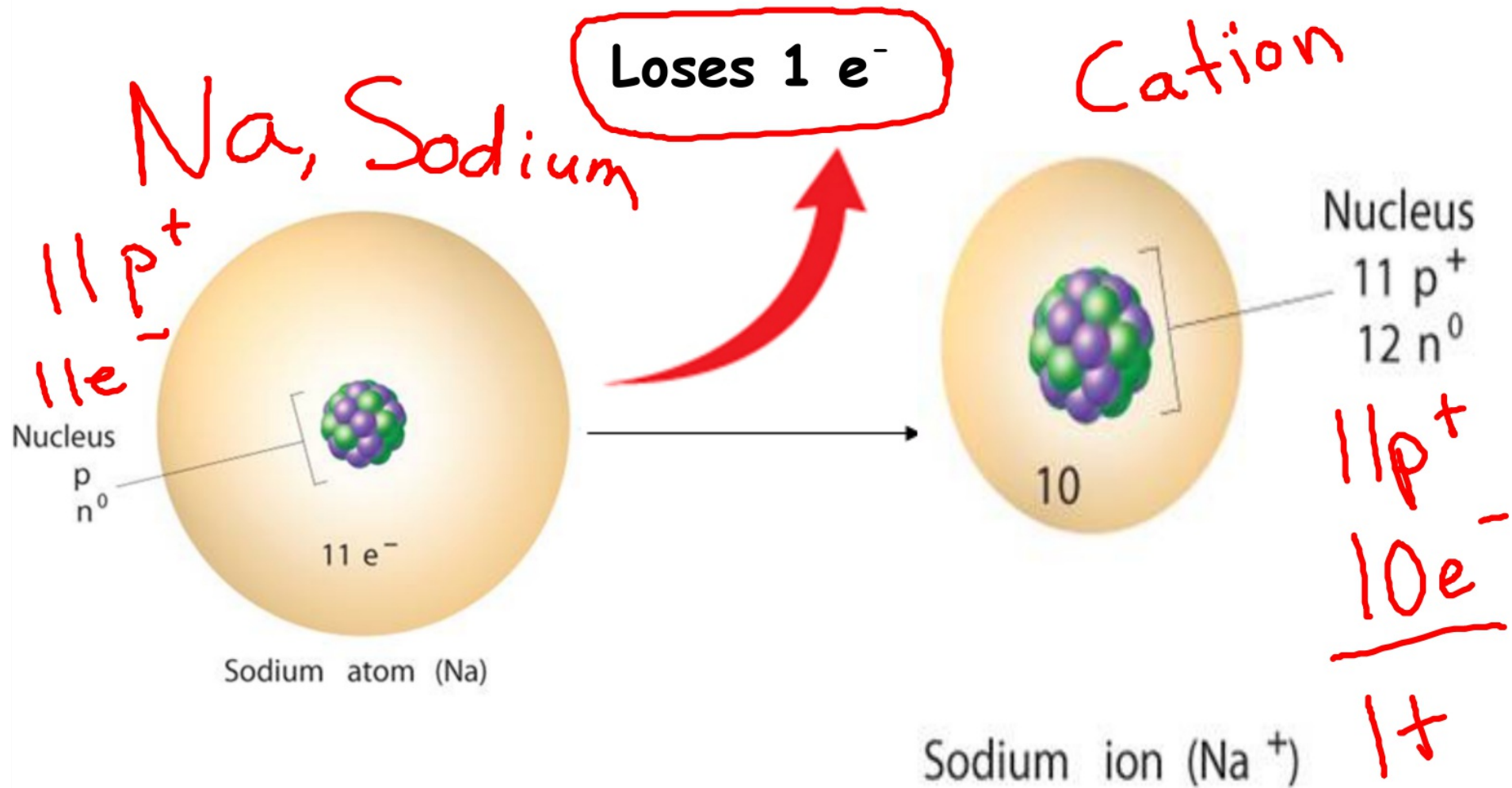
What is an anion?

Warm Up

What is the electron configuration of fluorine (F)? How many unpaired electrons are there?

Use the aufbau diagram on p. 133 of your textbook or the blank diagram I gave you a few days ago.

Positive and negative ions form when electrons are transferred between atoms.

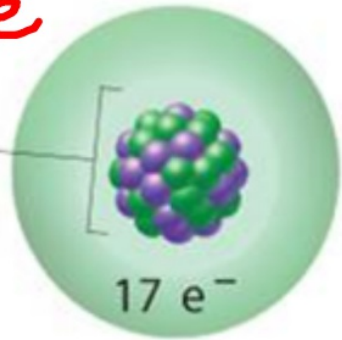


1, 2, or 3

Chlorine

17 p⁺
17 e⁻

Nucleus
17 p⁺
18 n⁰

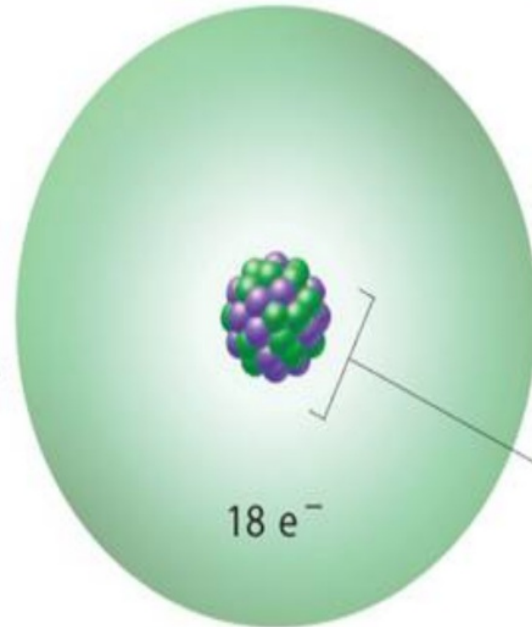


Chlorine atom (Cl)

Gains 1 e⁻

A nion

17 p⁺
18 e⁻
1-



Chloride ion (Cl⁻)

DEF: Ionization Energy

The energy required to remove an electron from an atom.

- The energy required to remove the **first electron from an atom is called the first ionization energy.**
- The energy required to remove an electron from an ion with a $1+$ charge is called the **second ionization energy.**

Warm Up (review of trend #2)

Get a set of blue circles and cut them out. **In pencil** write on each circle which atom is largest to smallest atomic radius for this set:

Ca, Sr, Be, Mg

Warm Up

Which atom has the largest atomic radius?

K or Se or Br?

Objectives:

TSWBAT

Predict trends in several properties using the periodic table.

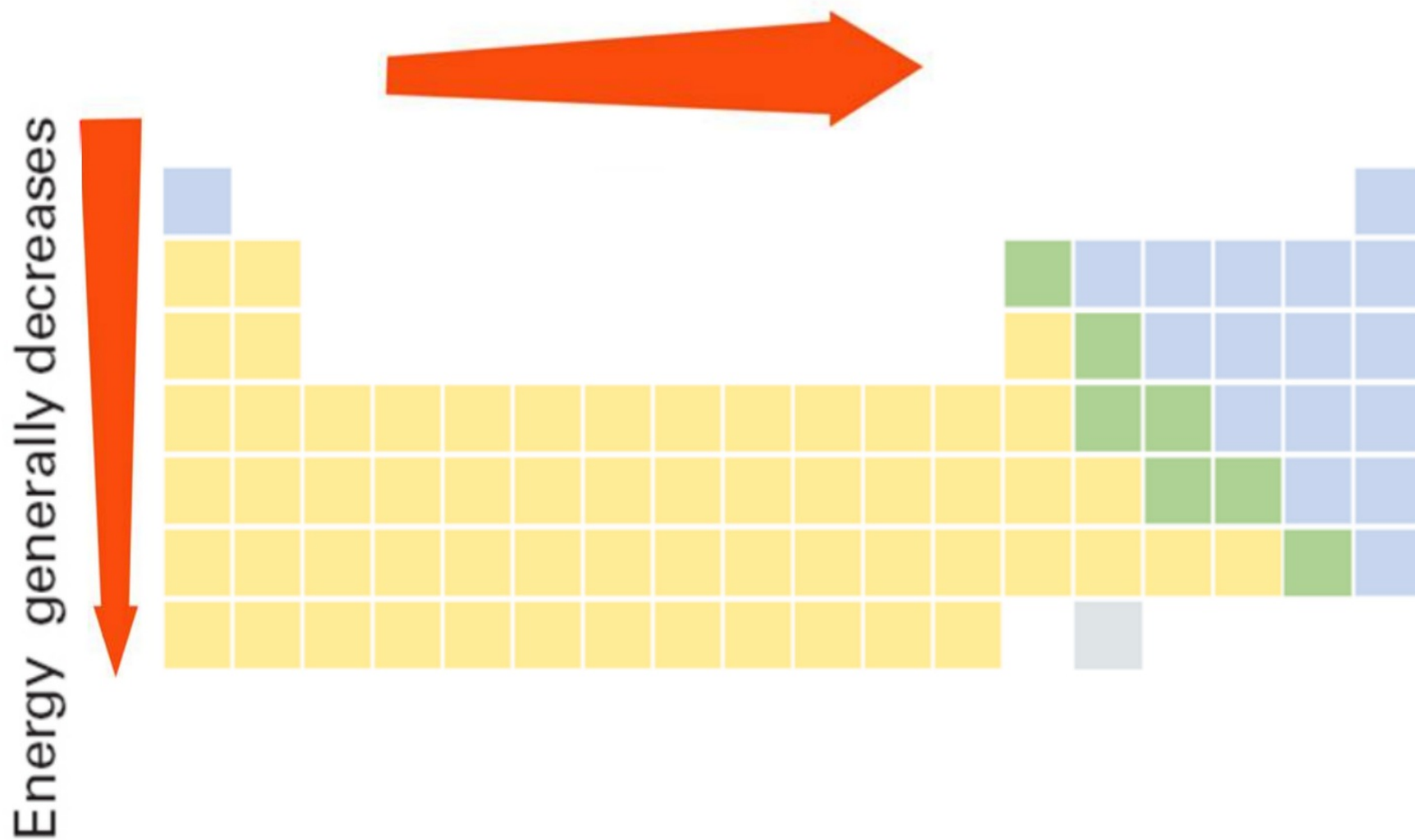
Trend #3

First ionization energy tends to **decrease** from top to bottom within a group and **increase** from left to right across a period.



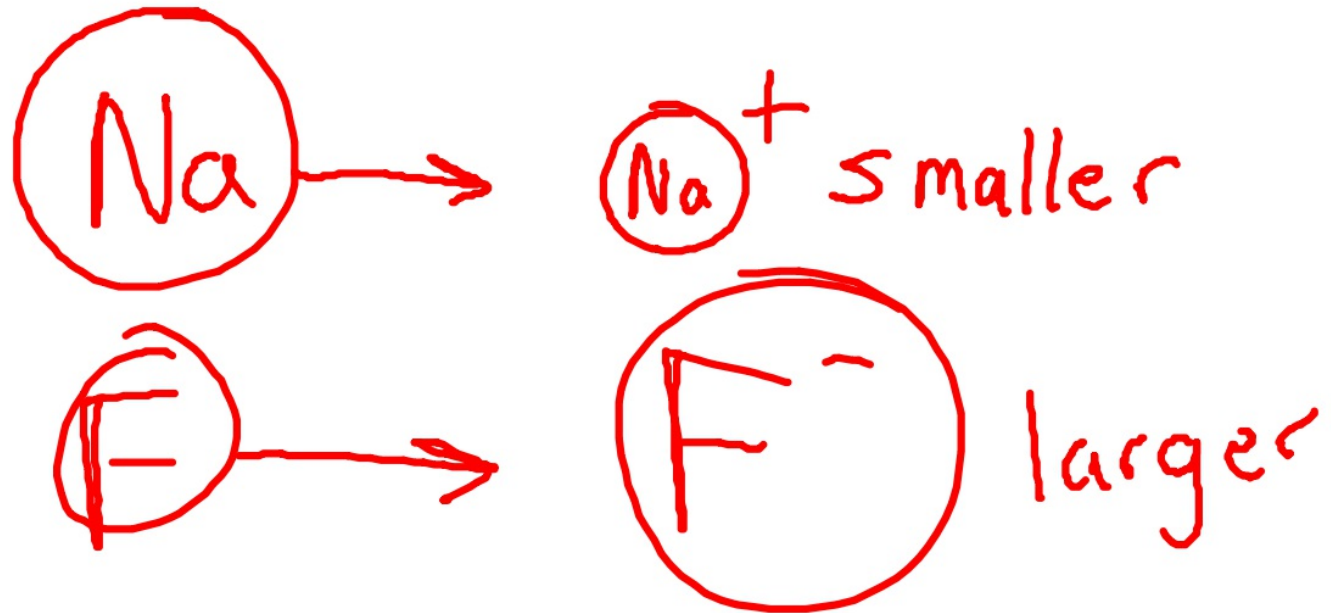
Trends in First Ionization Energy

Energy generally increases



Trend # 4: Ionic Size

Cations are always smaller than the atoms from which they form. **Anions** are always larger than the atoms from which they form.

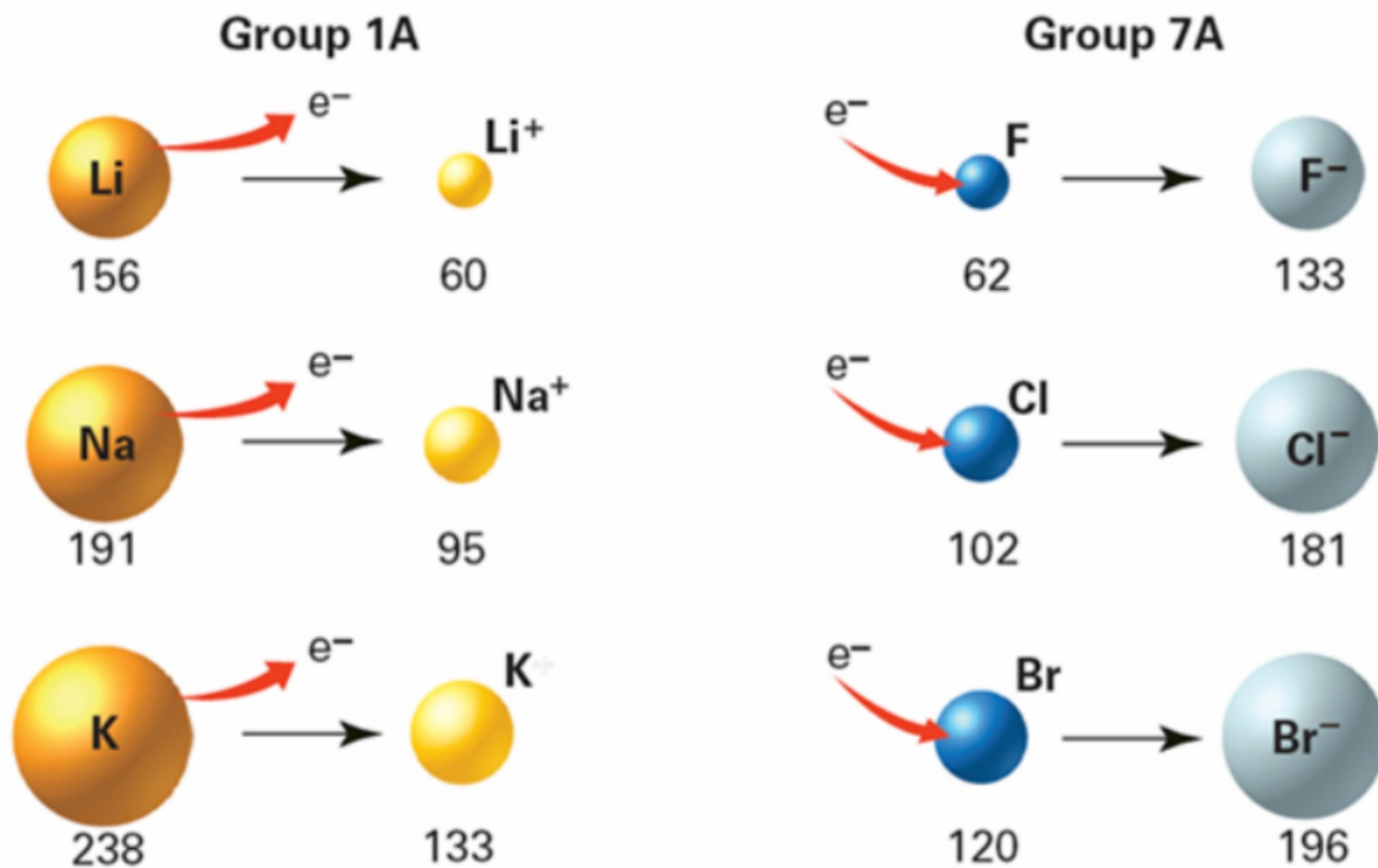


How can we tell which atoms form cations (positive) and which form anions (negative)?

Metals tend to form **cations** (they lose electrons)

Nonmetals tend to form **anions** (they gain electrons.)

Relative Sizes of Some Atoms and Ions



Trends in Ionic Size

decreases

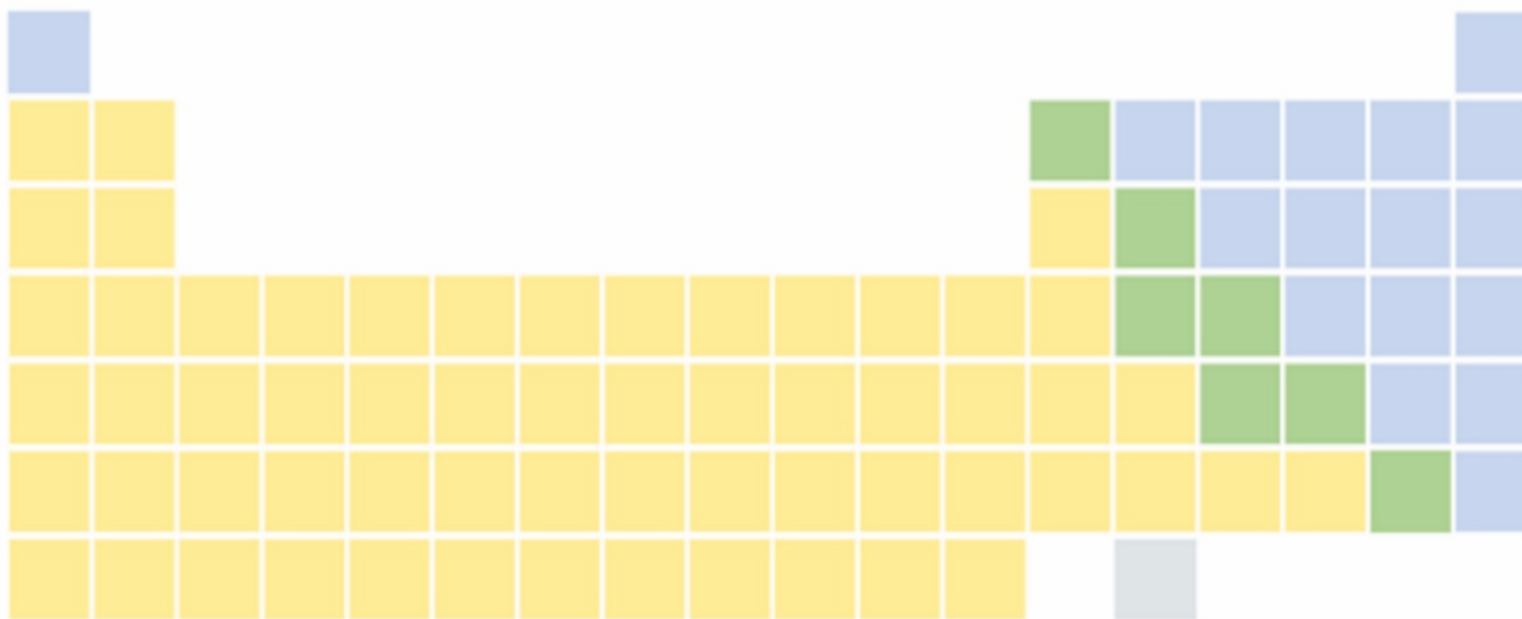


Size of cations decreases



Size of anions decreases

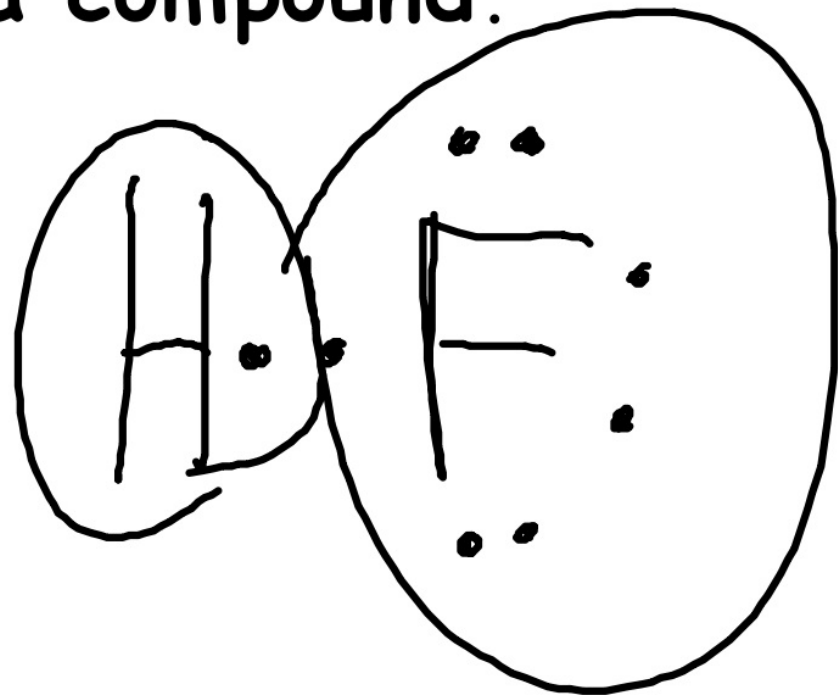
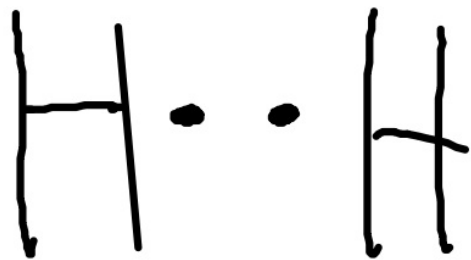
Size generally increases



Trend # 5: Electronegativity

aka Electron affinity

Def: Electronegativity is the ability of an atom of an element to attract electrons when the atom is in a compound.



Warm Up:

Which is larger?

- 1. Atomic radius of Na or Cl?**
- 2. Ionization energy of Be or Mg?**

In general, electronegativity values **decrease** from top to bottom within a group. For representative elements, the values tend to **increase** from left to right across a period.

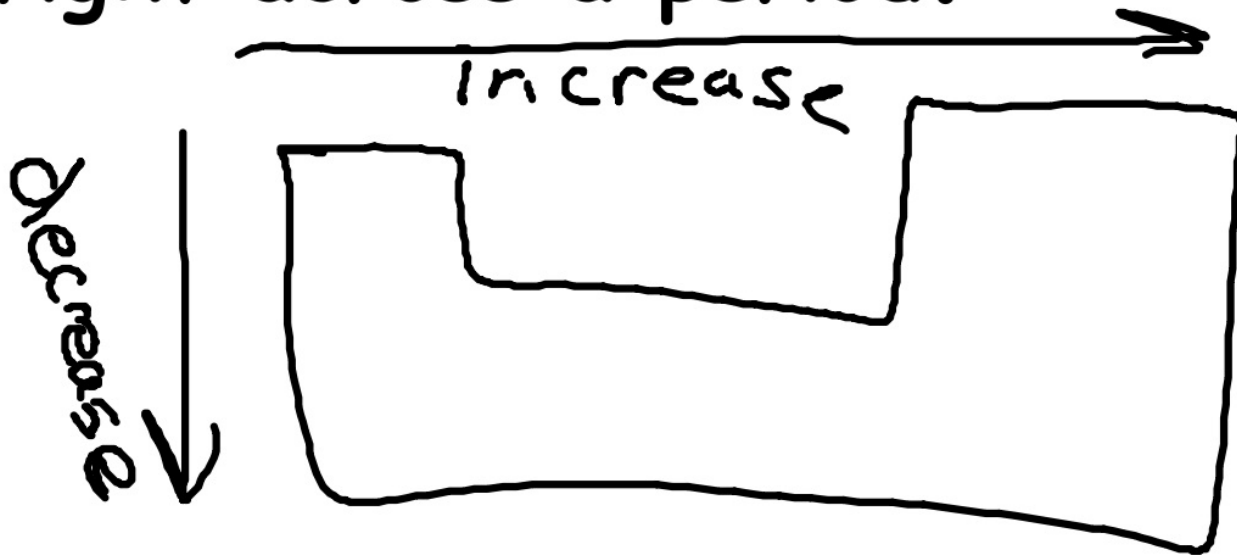


Table 6.2**Electronegativity Values for Selected Elements**

H 2.1						
Li 1.0	Be 1.5	B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2	Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8
Rb 0.8	Sr 1.0	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5
Cs 0.7	Ba 0.9	Tl 1.8	Pb 1.9	Bi 1.9		

Learning Check:

Which of the following sequences is correct for atomic size?

- a. Mg > Al > S
- b. Li > Na > K
- c. F > N > B
- d. F > Cl > Br

Learning Check:

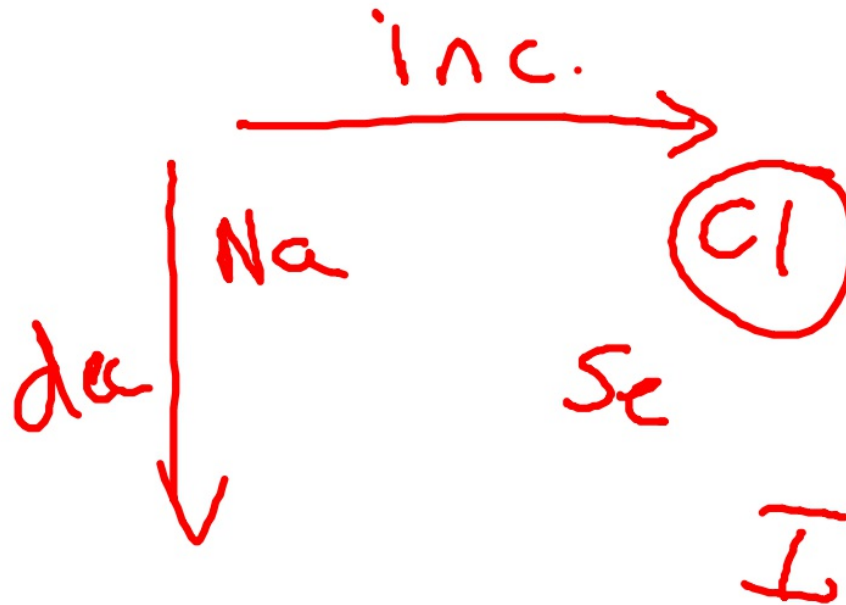
Metals tend to

- a. gain electrons to form cations.
- b. gain electrons to form anions.
- c. lose electrons to form anions.
- d. lose electrons to form cations.**

Learning Check:

Which of the following is the most electronegative?

- a. Cl
- b. Se
- c. Na
- d. I



Warm Up:

Which has a higher first ionization energy nitrogen or fluorine?

Warm Up

**Which has a larger atomic radius
Sodium or Chlorine?**

Warm Up:

1. Which has a higher first ionization energy:

Potassium or Calcium?

2. Which has a higher electronegativity:

Sodium or Cesium?

3. Which is larger: O or O²⁻?

Practice:

Try textbook

**p. 178 Section Assessment
(#16-23)**

p. 181 #28-32, 36, 42

#16

How does atomic size change within a group?



How does atomic size change across periods?



#17

When do ions form?



#18 What happens to first ionization energy within groups and across periods?



#19 Compare the size of the ion to the size of the atoms from which they form.

Anions:

Cations:

#20 How does electronegativity vary within groups and across periods?

.

#21 In general, how can the periodic trends displayed by the elements be explained?

.

#22 Arrange these elements in order of decreasing atomic size: sulfur, chlorine, aluminum, and sodium. Does this arrangement demonstrate a periodic trend or a group trend?

#23

Which element in each pair has the larger first ionization energy?

a. sodium, potassium

b. magnesium, phosphorus

p. 181 #28

Identify each property below as more characteristic of a metal or a nonmetal.

a. a gas at room temperature

b. brittle

c. malleable

d. poor conductor of electric current

e. shiny

#29

**In general, how are metalloids
different from metals and nonmetals?**

#30

Where are the

alkali metals

the alkaline earth metals

the halogens

the Noble gases

located on the periodic table?

#31

**Which of the following are symbols
for representative elements:**

Na, Mg, Fe, Ni, Cl?

#32

Which Noble Gas does not have 8 electrons in its highest occupied energy level?

#36

Which element in each pair has atoms with a larger atomic radius?

a. sodium or lithium

b. strontium or magnesium

c. carbon or germanium

d. selenium or oxygen

#42

Which particle has the larger radius in each atom/ion pair?

a. Na, Na⁺

b. S, S²⁻

c. I, I⁻

d. Al, Al³⁺