Name:

Date:



**Chemistry** ~ Ms. Hart

Anions or Cations

## 4.8 Ions and Ionic Radius

Class:

**Directions:** As we watch the video, answer these questions.

- 1. What is it called when an atom gains or loses an electron?
- 2. Atoms with nearly empty valence shells give up electrons. They are called...
- 3. Negative valence elements are found on what side of the periodic table?

#### THINK ABOUT IT !!!

Potassium atom	Potassium Ion	
Potassium is the eighth most abundant element on	Potassium ions are necessary for the function of	
the earth, but it is never found free in nature.	all living cells.	
Draw the lewis dot diagram for potassium (K).	Draw the lewis dot diagram for potassium ion (K <sup>+</sup> ).	
Number of protons: Number of neutrons:	Number of protons: 19 Number of neutrons: 20 Number of electrons: 18	
Number of electrons:	Electron Configuration: 2-8-8	
Electron Configuration:	Real electron configuration:	
<b>COMPARE AND CONTRAST:</b> How are potassium atoms different from potassium ions:		

sium atoms different fro

# The Octet Rule:



Noble Gases (Group 18) are the most stable atoms. Why is this statement true based on the octet rule?

### GIVE IT A TRY! Determine the number of electrons needed to fulfill the octet rule.

Na	0	Ν
Valence Electrons:	Valence Electrons:	Valence Electrons:
Has to gain:	Has to gain:	Has to gain:
Has to lose:	Has to lose:	Has to lose:
Li	S	Н
Valence Electrons:	Valence Electrons:	Valence Electrons:
Has to gain:	Has to gain:	Has to gain:
Has to lose:	Has to lose:	Has to lose:

Vocabulary	Definition	Examples
Ion	An element with a charge.	
Anion	An atom with a negative charge.	
Cation	An atom with a positive charge.	

## The Next Big Dilemma: Anion or Cation?

- Determine the number of electrons required to get a full 8 in the outermost electron shell by adding
- Determine the number of electrons required to get a full o in the outermost electron shell by subtracting
- The number that is lower will be the action that element will take to become an ion
- If addition and subtraction numbers are the same, then element has the ability to do BOTH THINGS

## Example: What ion will the following atom form?



- 1. How many protons does this atom have?
- 2. How many electrons does this atom have?
- 3. How many electrons does this atom need to gain or lose in order to fulfill a full octet?
- 4. What is the electron configuration of the Li ion?
- 5. Protons + Electrons = what charge?

### Quick Check (1 min):

How many electrons does a Mg+2 have?

How is this different from a Mg atom?

What is the electron configuration for a Ca<sup>+2</sup> ion?

Calcium	Berylium	Bromine	Sulfur
valence electrons:	valence electrons:	valence electrons:	valence electrons:
gain or lose how many			
electrons?	electrons?	electrons?	electrons?
charge of ion:	charge of ion:	charge of ion:	charge of ion:
Ion electron	Ion electron	Ion electron	Ion electron
configuration:	configuration:	configuration:	configuration:
Strontium	Boron	Carbon	Potassium
valence electrons:	valence electrons:	valence electrons:	valence electrons:
gain or lose how many			
electrons?	electrons?	electrons?	electrons?
charge of ion:	charge of ion:	charge of ion:	charge of ion:
Ion electron	Ion electron	Ion electron	Ion electron
configuration:	configuration:	configuration:	configuration:

### Try a few on your own! Quick Practice (5 mins)

What kind of ion will sodium become?

Positive Ions are

- 1) Cation
- 2) Anion

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- 3) Bohr Ion
- 4) Negative Ion

#### **Ionic Radius**

\_\_\_\_\_ than the atoms from which they are formed Negative Ions are \_\_\_\_\_\_ than the atoms from which they are formed

In your own words, explain why this might be. ٠

Check for L	Inderstanding
<ul> <li>Compared to the radius of a neutral chlorine atom, the radius of its ion will be</li> <li>1. larger because chlorine loses an electron</li> <li>2. larger because chlorine gains an electron</li> <li>3. smaller because chlorine loses an electron</li> <li>4. smaller because chlorine gains an electron</li> </ul>	<ul> <li>Compared to the radius of a neutral sodium atom, the radius of its ion will be</li> <li>1. larger because chlorine loses an electron</li> <li>2. larger because chlorine gains an electron</li> <li>3. smaller because chlorine loses an electron</li> <li>4. smaller because chlorine gains an electron</li> </ul>
<ul> <li>Which atom has an ion with the largest radius?</li> <li>1. Cl</li> <li>2. Ca</li> <li>3. S</li> <li>4. Se</li> </ul>	
Ionization Energy	
Across a Period	
Down a Group	

#### 4.8 Classwork/Homework

1. Which statement is true about the charges assigned to an electron and a proton?

- 1. Both an electron and a proton are positive.
- 2. An electron is positive and a proton is negative.
- 3. An electron is negative and a proton is positive.
- 4. Both an electron and a proton are negative.

2. What is the total number of electrons found in an atom of sulfur?

- 1. 6
- 2. 8
- 3. 16
- 4. 32

3. An atom of an element has 28 innermost electrons and 7 valence electrons. In which period of the Periodic Table is this element located?

- 1. 5
- 2. 2
- 3. 3
- 4. 4

4. How many electrons are in an Fe<sup>2+</sup> ion?

- 1. 24
- 2. 26
- 3. 28
- 4. 56

5. Which electron configuration is correct for a sodium ion?

- 1. 2-7
- 2. 2-8
- 3. 2-8-1
- 4. 2-8-2

- 6. Compared to a calcium atom, the calcium ion Ca<sup>2+</sup> has
  - more protons 1.
  - fewer protons 2.
  - more electrons 3.
  - fewer electrons 4.

19 7. In comparison to an atom of  $9^{19}$  F in the ground state,

- an atom of  ${}^{12}_{6}$  C in the ground state has
  - 1. three fewer neutrons
  - three fewer valence electrons 2.
  - three more neutrons 3.
  - three more valence electrons 4.

8. An atom of argon rarely bonds to an atom of another element because an argon atom has

- 1. 8 valence electrons
- 2. 2 electrons in the first shell
- 3 electron shells 3.
- 22 neutrons 4.

9. Which ion has the same electron configuration as an atom of He?

- 1. H<sup>-</sup>
- 2. O2-
- Na+ 3.
- Ca+ 4.

10. Which set of symbols represents atoms with valence electrons in the same electron shell?

- 1. Ba, Br, Bi
- 2. Sr, Sn, I
- 3. O, S, Te
- 4. Mn, Hg, Cu

11. When metals form ions, they tend to do so by

- losing electrons and forming positive ions 1.
- losing electrons and forming negative ions 2.
- gaining electrons and forming positive ions 3.
- gaining electrons and forming negative ions 4.
- 12. Which ion has the largest atomic radius?
  - 1.  $I^{-}$
  - $Cl^{-}$ 2.
  - 3. Br
  - F 4.
- 13. Which element's ionic radius is smaller than its atomic radius?
  - Neon 1.
  - Nitrogen 2.
  - Sodium 3.
  - sulfur 4.
- 14. For which element is the radius of its ion larger than the radius of its atom?
  - Κ 1.
  - F 2.
  - Na 3.
  - Ca 4.
- 15. Compared to the radius of a neutral Rb atom, the radius of its ion
  - 1. larger because Rb loses an electron

- larger because Rb gains an electron 2.
- smaller because Rb loses an electron 3.
- smaller because Rb gains an electron 4.
- 16. Compared to the radius of a neutral Iodine atom, the radius of its ion
  - larger because Iodine loses an electron 1.
  - 2. larger because Iodine gains an electron
  - smaller because Iodine loses an electron 3.
  - smaller because Iodine gains an electrons 4.

17. Which element requires the least amount of energy to remove the most loosely held electron from a gaseous atom in the ground state?

- bromine sodium 1. 3.
- calcium Silver 2. 4.

18. Compared to a neon atom, a helium atom has a

- smaller atomic radius 1.
- 2. smaller first ionization energy
- 3. larger atomic number
- greater number of electrons 4.

19. Which element in Group 18 of the Periodic Table has the highest first ionization energy?

1.	Kr	3.	Ne
2.	Ar	4.	Не

20. Which element in Group 1 has the greatest tendency to lose an electron?

cesium potassium 1. 3. rubidium sodium 2. 4.

21. Which of the following Group 2 elements has the lowest first ionization energy?

1.	Be	3.	Ca
2.	Mg	4.	Ba

22. As the atoms in Period 3 of the Periodic Table are considered from left to right, the atoms generally show

1. an increase in radius and an increase in ionization energy

2. an increase in radius and a decrease in ionization energy

3. a decrease in radius and an increase in ionization energy

4. a decrease in radius and a decrease in ionization energy

24. As elements of Group 1 of the Periodic Table are considered in order from top to bottom, the ionization energy of each successive element decreases. This decrease is due to

- 1. decreasing radius and decreasing shielding effect
- decreasing radius and increasing shielding effect 2.
- increasing radius and decreasing shielding effect 3.
- increasing radius and increasing shielding effect 4.

25. From which of these atoms in the ground state can a valence electron be removed using the least amount of energy?

- 1. nitrogen oxygen 3.
- 2. carbon 4.
- chlorine