Periodic Trends Tutorial 1 - 2026 (Unit 1- Tutorial 12)

A. Atomic Radius: the distance from the center of the nucleus to the outer most electrons in an atom

_____ as you move across a row (left to right) on the periodic table

_____ as you move down a family (top to bottom) on the periodic table

Ionic Radius: the distance from the center of the nucleus to the outer most electrons in an ion

Cations: _____ outer electrons, so are _____ than the atom it forms from

Anions: _____ electrons, so are _____ than the atom it forms from

1. Which atom in each pair has the larger atomic radius?

_____ a. Li or K
_____ b. Ca or Ni
_____ c. Ga or B
_____ d. O or C
_____ e. Cl or Br
_____ f. Be or Ba
_____ g. Si or S
_____ h. Fe or Au

2. Rank each of the following in order of INCREASING atomic radius

a. F, K, Br _____

b. Os, Ni, Fe _____

3. Rank each of the following in order of DECREASING atomic radius

a. Cl, Br, Ga _____

b. Ca, Rb, C _____

4. Which ion in each pair has the smaller atomic radius?

_____ a. K^+ or O^{2-}
_____ b. Ba^{2+} or I^-
_____ c. Al^{3+} or P^{3-}
_____ d. K^+ or Cs^+
_____ e. F^- or S^{2-}
_____ g. Fe^{2+} or Fe^{3+}

5. **Place in order from smallest to largest atomic/ ion radius:**

a. Fe Fe^{+2} Fe^{+1} _____
b. O O^{-2} O^{-1} _____
c. Na Na^{+1} Cl _____
d. K Cl^{-1} Ar S^{-2} _____

B. Ionization Energy: energy needed to remove an electron from an atom

First Ionization Energy: energy needed to remove the first electron from an atom(is always the lowest)

1. As you go from lithium across a row, what happens to the ionization energies?
   Increases/decreases

2. Which family of elements has the highest ionization energy? _____

3. Which atom or ion in each pair has the larger ionization energy?

_____ a. Na or O
_____ b. Ar or F
_____ c. I or Ne
_____ e. Be or Ba
_____ f. Cu or Ra
_____ g. K or V

_____ d. Ca or Fr _____ h. W or Se

4. Rank each of the following in order of INCREASING ionization energy
a. O, S, Ge _____
b. Be, Ba, B _____

5. Rank each of the following in order of DECREASING ionization energy
a. Cl, Cu, Au _____
b. Te, Sb, Xe _____

C. **Electronegativity:** the ability to attract an electron in a chemical bond
-most commonly measuring with the Pauling Scale, where 0 represents the least ability and 4 is the greatest ability to attract electrons in chemical bonds

1. Which family of elements has the highest electronegativity values? _____

2. Which family of elements doesn't have electronegativity values listed? _____
Explain why this family wouldn't have electronegativity values:

1. Rank each of the following in order of INCREASING electronegativity
a. Na, K, Ne _____
b. Fr, Ca, Co _____

2. Rank each of the following in order of DECREASING electronegativity
a. As, Se, Sn _____
b. Xe, Ru, Hf _____

3. Table below gives the ionization energies for **potassium, bromine** and **calcium**. Identify which element is which from the data given. Explain your answer in the space provided.

ELEMENT 1			ELEMENT 2			ELEMENT 3	
Ionization energy number	**Enthalpy kJ/mol**		**Ionization energy number**	**Enthalpy kJ/ mol**		**Ionization energy number**	**Enthalpy kJ/mol**
1st	418.8		**1st**	1139.9		**1st**	589.8
2nd	3052		**2nd**	2103		**2nd**	1145.4
3rd	4420		**3rd**	3470		**3rd**	4912.4
4th	5877		**4th**	4560		**4th**	6491

ELEMENT 1 is _____. ELEMENT 2 is _____. ELEMENT 3 is _____.

Explanation:

Periodic Trends Tutorial 2

1. Compare the effects of atomic radius on the first ionization energy of an atom.

2. Compare the effect of atomic radius on the electronegativity of a neutral atom.

3. The first four ionization energies for two unknown elements X and Y are listed below. Identify the elements. There may be more than one correct answer, so explain completely to justify your choices. All values are given in kJ/mol.

	X	Y
1st Ionization energy	170	200
2nd Ionization energy	350	400
3rd Ionization energy	1800	3500
4th Ionization energy	2500	5000

4. Explain why a graph of ionization energy versus atomic number (across a period) is not linear. Where are the exceptions? Why are there exceptions?

5. Fluorine is the most electronegative element and it has the highest ionization energy. How does the atomic radius of fluorine influence these trends?

6. Energy is released when an electron is added to an atom. Why is more energy released when an electron is added to a nonmetal, than when an electron is added to a metal?

7. An atom of sodium comes in close proximity to an atom of chlorine. Using what you know about electronegativity, explain what will happen between these two atoms.

8. The successive ionization energies for an unknown element are given below. To which family in the periodic table does the unknown element most likely belong?

IE 1 837 kJ/mol
IE 2 1691 kJ/mol
IE 3 16227 kJ/mol
IE 4 17948 kJ/mol

9. The electron affinities of the elements from aluminum to chlorine are -44, -120, -74, -200.4, and -384.7 kJ/mol, respectively. Rationalize the trend in these values.

10. Comparing an atom of magnesium and an atom of potassium, which atom has the more favorable (the more exothermic) electron affinity? Which has the higher ionization energy? Which has the larger atomic radius? When each atom forms a cation, which cation will be smaller in size?

13. Why do the successive ionization energies of an atom always increase? Note the successive ionization energies for silicon given in the table to the right?

14. Elements with very large ionization energies also tend to have highly exothermic electron affinities. Explain.

Table 7.5 Successive Ionization Energies in Kilojoules per Mole for the Elements in Period 3

Element	I_1	I_2	I_3	I_4	I_5	I_6	I_7
Na	495	4560					
Mg	735	1445	7730	Core electrons*			
Al	580	1815	2740	11,600			
Si	780	1575	3220	4350	16,100		
P	1060	1890	2905	4950	6270	21,200	
S	1005	2260	3375	4565	6950	8490	27,000
Cl	1255	2295	3850	5160	6560	9360	11,000
Ar	1527	2665	3945	5770	7230	8780	12,000

*Note the large jump in ionization energy in going from removal of valence electrons to removal of core electrons.

General decrease ↑

General increase →

Periodic Trends Tutorial 3

Atomic Radius

1. What trend in atomic radius do you see as you go down a group/family on the periodic table?

2. What causes this trend?

3. What trend in atomic radius do you see as you go across a period/row on the periodic table?

4. What causes this trend?

5. Circle the atom in each pair that has the largest atomic radius.

a) Al B b) S O c) Br Cl

d) Na Al e) O F f) Mg Ca

6. Put the following elements in order from smallest to largest atomic radius ***and*** explain why:

C, O, Sn, Sr.

Electronegativity

7. Define electronegativity

8. How does the ionic radius of a nonmetal compare with its atomic radius?

9. What trend in electronegativity do you see as you go down a group/family on the periodic table?

10. What causes this trend?

11. What trend in electronegativity do you see as you go across a period/row on the periodic table?

12. What causes this trend?

13. Circle the atom in each pair that has the greater electronegativity.

a) Ca Ga b) Li O c) Cl S d) Br As e) Ba Sr f) O S

General Questions

14. Which group tends to form +1 ions? _____

15. Which group tends to form +2 ions? _____

16. Which group tends to form -1 ions? _____

17. Which group tends not to form ions or react? _____

18. Based on the concept of periodic trends, answer the following questions for these atoms: ***Li, Be, Mg, Na***. Be able to defend your answers.

a. Which element has the lowest electronegativity? _____

b. Which element has the least metallic character? _____

c. Which element is the largest atom? _____

19. Based on the concept of periodic trends, answer the following questions for these atoms: ***P, S, Cl, F***. Be prepared to defend your answers.

d. Which element has the highest electronegativity? _____

e. Which element has the least metallic character? _____

f. Which element has the largest ion? _____

20. Based on the concept of periodic trends, answer the following questions for these atoms: ***Au, Zn, S, Si***. Be able to defend your answers.

a. Which element has the highest electronegativity? _____

b. Which element has the most metallic character? _____

c. Which element has the largest atom? _____

21. Complete the following chart:

	K	**Mg**	**Ne**	**N**	**Cl**	**Si**
Atomic #						
Period						
Group #						
Family name (if any)						
# of valence e^-						
# protons						
Metal, nonmetal, or metalloid?						
Conducts electricity? (yes/no)						
State at room temperature?						
Ion Formed? (positive, negative, none, varies)						

22. _____ metal

23. _____ chlorine

24. _____ metalloid

25. _____ transition elements

26. _____ group 1

27. _____ noble gases

28. _____ group 2

a. alkaline earth metals

b. metals with unpredictable properties

c. a halogen

d. make good semiconductors

e. alkali metals

f. has a full outer energy level (shell