Name: ______________________________

Homework was checked against the key with wrong answers corrected.

Parent Signature: ________________________________

Chapter 14: Chemical Periodicity

Each numbered question is worth 1 point except as noted. Total possible = 24 points

Watch the **Professor Dave Explains** video, *The Periodic Table: Atomic Radius, Ionization Energy, and Electronegativity* at https://www.youtube.com/watch?v=hePb00CqvP0 in order to answer questions 1-22. These topics are also explained in the textbook, with Section 14.1 covering #1-3, and Section 14.2 covering #4-22.

Arrangement of the Periodic Table

1. In the periodic table, columns are called ______________, and rows are called _____________. (0.5)

2. How was Dimitri Mendeleev able to predict the properties of elements not yet discovered?

3. Why do elements in the same group (such as Li, Na, K) all behave similarly?

4. Every element in Group 2A has _____ valence electrons (electrons in its outermost energy level). Name three of these elements. ____

Every element in Group 3A has _____ valence electrons (electrons in its outermost energy level). Name three of these elements. ____

Every element in Group 7A has _____ valence electrons (electrons in its outermost energy level). Name three of these elements. ____

You may want to skip to the last homework question here.

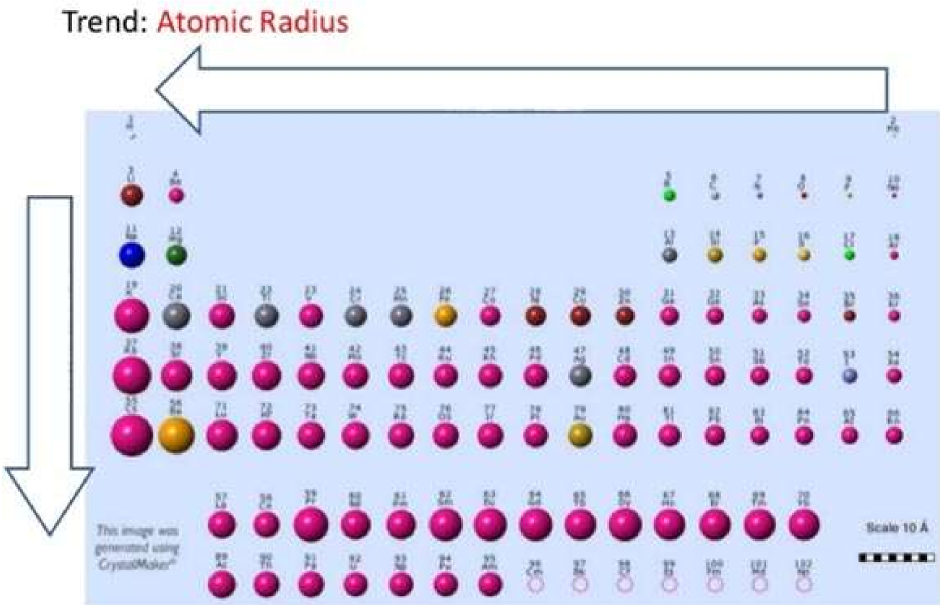
Periodic Trends in Atomic Radius

The atomic radius is one-half the distance between the nuclei of two like atoms in a real or theoretical diatomic molecule (Wilbraham, Staley, Matta, & Waterman, 2002, p. 398).

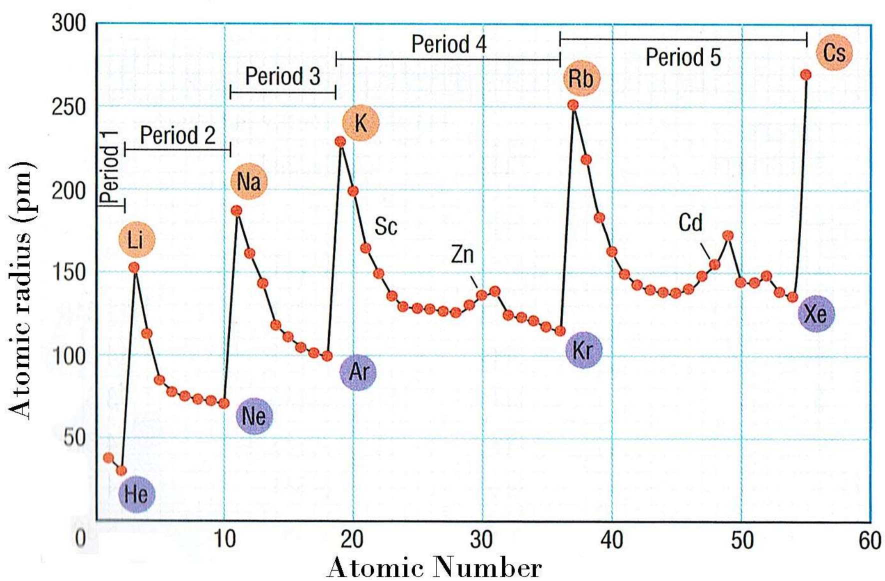
5. Describe the trend in atomic radius as you move down a group. Why does this trend exist?

6. Describe the trend in atomic radius as you move across a period from left to right. What explains this trend?

7. Write *increasing* or *decreasing* in the arrows below, to indicate the trend of atomic size along a period and a group. Then, draw a single large arrow on the table to summarize.



8. Explain the spikes in the graph below, which plots atomic radius as a function of atomic number.



Periodic Trends in Ionic Radius

9. When an electron is removed from an atom, the radius gets ________________; when an electron is added to an atom, the radius gets ______________.

10. What is the electron configuration of these ions (and the neon atom)? O^{2-}, F^-, Ne, Na^+, Mg^{2+}
Hint: The electron configuration is the same for all these. _______________
Rank them from largest to smallest.

11. What accounts for the trend in ionic radius among the ions and atom of question #10?

Periodic Trends in Ionization Energy

The energy required to overcome the attraction of the nuclear charge and remove an electron from a gaseous atom is called the *ionization energy*. Removing one electron results in the formation of a positive ion with a 1+ charge (Wilbraham et al., 2002, p. 401).

$$Na(g) \rightarrow Na^+ (g) + e^-$$

The energy required to remove the first outermost electron is called the *first ionization energy*.

12. What happens to the electromagnetic force attracting electrons to protons as the distance between outer electrons and the nucleus increases? (0.5)

13. As you move down a group, from lithium to cesium, first ionization energy ____________, and as you move across a row, from sodium to argon, the first ionization energy ____________. How do these trends compare to the trends for atomic radius?

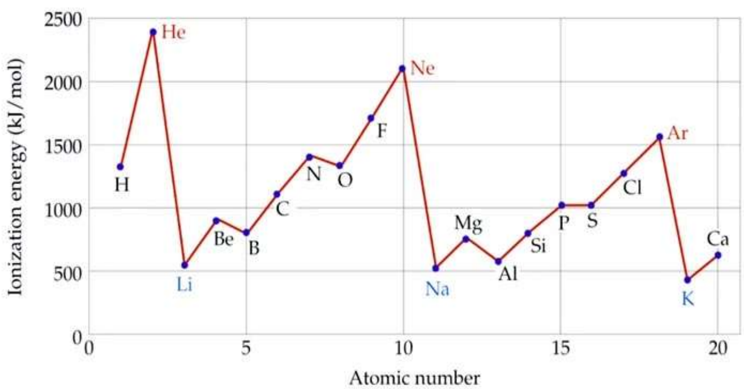
14. Give two reasons why a francium outermost electron is so much easier to pull off than an outermost electron from helium.

15. What is *second ionization energy*? Why is the second ionization energy higher than the first?

successive ionization energies (kJ/mol)

	Na	Mg	Al	Si	P	S	Cl	Ar
1st IE	496	738	578	787	1,012	1,000	1,251	1,520
2nd IE	4,562	1,451	1,817	1,577	1,903	2,251	2,297	2,665
3rd IE	6,912	7,733	2,745	3,231	2,912	3,361	3,822	3,931
4th IE	9,543	10,540	11,575	4,356	4,956	4,564	5,158	5,770
5th IE	13,353	13,630	14,830	16,091	6,273	7,013	6,540	7,238
6th IE	16,610	17,995	18,376	19,784	22,233	8,495	9,458	8,781
7th IE	20,114	21,703	23,293	23,783	25,397	27,106	11,020	11,995

16. Once the two outer electrons from Mg are removed, ionization energy makes a big jump from 1,451 kJ/ mol to 7,733 kJ/ mol. Why?



17. Consider the graph at left. First ionization energy increases going across a period from left to right, with a few exceptions. Explain why the first ionization energy of oxygen is lower than that of nitrogen.

Trends in Electron Affinity (not in the text)

18. Define *electron affinity*.

19. Which element has the greatest affinity for electrons? _________________

Trends in Electronegativity

20. Disregarding the noble gases, electronegativity _____________ as you move left to right across a period, and ______________ as you move down a group. Which element has the greatest electronegativity?________________

Comprehension Check (from video)

21. List the following atoms in order of increasing atomic radius: Si, Kr, Cl, K, Ca

22. Choose the larger atom in each pair:

Br and Br^- $\quad$ Cl^- and Ar $\quad$ K and K^+

Chapter Review (from text)

13. Write the electron configuration of these elements, using a periodic table only.

a. the inert gas in period 3

b. the element in Group 4A, period 4

c. the element in Group 2A, period 6

20. Indicate which element in each pair has the greater first ionization energy, by circling it.

a. lithium, boron $\quad$ b. magnesium, strontium $\quad$ c. cesium, aluminum

45. Indicate which outermost sublevels are filled or partially filled for each (p. 394, 395 in text).

a. Noble gases

b. Representative elements

c. Transition metals

d. Inner transition metals