

SEVERAL QUESTIONS ABOUT PERIODICITY

1. Where do you find exceptions to the atomic radius trend within periods? Why do they occur?
Exceptions to the atomic radius trends occur at the beginning of the p sublevel. This occurs because the slight increase in shielding effect when an electron moves to a higher sublevel. The nucleus' attraction for the electron is slightly diminished.
2. Which family would you expect to have an extremely high 3rd ionization energy? Why?
Group 2. There are two electrons in the valence shell which can be removed relatively easily. The third electron will need to be removed from a lower energy level and will be very difficult to remove.
3. Why is there a decrease in ionization energy between phosphorous and sulfur? *Phosphorous has a half full p sublevel. Sulfur has four electrons in the p sublevel. The 4th electron is repelled by the third electron and is therefore easier to remove.*
4. Why is there a discrepancy between the atomic size of zinc and gallium? *There is a slight increase in shielding effect when an electron moves to a higher sublevel. The nucleus' attraction for the electron is slightly diminished. This is even more significant due to the full d sublevel as the 4p sublevel begins to fill.*
5. Where do you find exceptions to the electron affinity trends within periods? Why do they occur?
Full and half full sublevels. Adding an electron to a full sublevel requires that a new sublevel begin, and this requires energy. When adding to half full sublevel the new electron will be repelled by the electron that is already in the orbital.
6. Why is there a discrepancy between the electronegativity of chromium and manganese? *Mn has a full 4s sublevel and a half full 3d sublevel. Full and half full sublevels do not strongly attract additional electrons.*
7. Discuss how shielding effect and effective nuclear charge affect periodic trends. *Shielding effect minimizes effective nuclear charge in that the inner shell electrons repel the outer shell. Within a family this causes size to get larger as atomic number increases while ionization energy, electronegativity and electron affinity decrease. Effective nuclear charge increases within a series as atomic number increases. This causes atomic radius to decrease while the other trends increase. Within a series shielding effect is relatively constant.*
8. Why does manganese not have an electron affinity?
Mn has an electron affinity of near 0 because it has a half full d sublevel, so an additional electron would be significantly repelled
9. List the following in order of increasing atomic radius:
 S^{-2} , Cl^{-1} , K^{+1} , Na^{+1} Na^{+1} , K^{+1} , Cl^{-1} , S^{-2}
10. List the following in order of increasing ionization energy: Cl , Ar , Cl^{-1} , K , K^{+1}
 K , Cl^{-1} , Cl , Ar , K^{+1}
11. Explain the electron affinity discrepancy between F & Cl. *Both F and Cl gain electrons easily and release great deal of energy in the process. However, the outer shell of F is more crowded than that of Cl, so the 8th electron is slightly repelled. There is more room in the outer shell of Cl for the addition of an electron because the outer shell is further from the nucleus.*
12. Ionization energy should increase as we progress through the periodic table, but it actually fluctuates throughout the transition metals – why might this be? *The d sublevel has 5 complicated orbitals. Electrons in these orbitals interact with each other to some extent and this causes many exceptions to the trends in the d (and f) sublevels.*
13. List the following in order of increasing electron affinity - Mg , Na , I , I^{-1} ! I^{-1} , Mg , Na , I
14. Sulfur has a negative first electron affinity, but a positive second electron affinity, even though it wants two electrons total. Why might this be! *There is plenty of room for the first electron to fit into the outer shell, but the next electron to be added would be repelled by the electrons that were already present.*
15. An atom releases energy during a process. Is it now more or less thermodynamically stable? *A release of energy creates a more stable thermodynamic state.*
16. Why is the second ionization energy for magnesium higher than the first, if it wants to give away two electrons total? *Ionization energy increases with each successive electron that is removed. Since there are two electrons in the outer shell of Mg, they have relatively low ionization energies and this is why Mg loses two electrons in chemical reactions.*
17. Which energy change associated with electron transition is ALWAYS positive? *Ionization energy*
18. What element is isoelectronic with S^{-2} ?
With Ca^{+2} ? With Ti^{+4} ? *Argon (in all of these)*

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19. How many valence electrons does V have? How about Co? How about Ag? What do these elements have in common with each other? *2,2,1. They are all transition elements.*
20. What is so unique about the transition elements and their valence states? *Transition elements sometimes lose some of their d electrons when forming chemical bonds. Valence states (oxidation states) for transition metals according to the aufbau principle (filling order) should be +2 but when the d electrons become involved several different oxidation states become possible.*
21. If Br^{-1} , Kr, and Rb^{+1} all have the same number of electrons, then why is Rb^{+1} the smallest of the three? *Rubidium has the most protons.*
22. Why is I^{-1} bigger than Kr if they both have the same number of electrons? *This question should have compared I^{-1} to Xe—not Kr. I^{-1} would be bigger than Xe because I^{-1} has less protons.*
23. Why are Bi, Po, Pb, and Sb metals if they are in the p block of elements? *These are the largest elements in their families. Large elements can lose electrons more easily and are therefore more metallic.*
24. Sn is in group IV, but it is a metal - why is this? *Sn is one of the largest elements in its family. Large elements have more shielding effect and can lose electrons more easily—characteristic of metals.*
25. Does K or As have a greater effective nuclear charge? What effects in trends do we witness because of this? *As. This causes As to have a smaller radius and higher ionization energy, electronegativity, and electron affinity.*
26. Sr has more electrons and protons than Ca, and electrons attract protons, but it is a larger atom - explain! *Sr has an extra energy level, so the effective nuclear charge is less due to the increased shielding effect.*
27. Carbon, Nitrogen, and Oxygen - which has the highest effective nuclear charge? *Oxygen --- because it has the most protons while they all have similar shielding effect.*
28. Cr and Cu have different electron configurations listed on the periodic table than what we would expect - why? *In order to increase thermodynamic stability, an electron is promoted from the 4s to the 3d. For Cr this creates a half full d level and for Cu this creates a full d sublevel.*
29. Why do transition metals have multiple oxidation states? *Electrons in d sublevel orbitals interfere with each other and create some shielding effect. This allows d electrons to sometimes become involved in bonding.*
30. Explain what happens when Titanium forms a +2 or +4 ion? Explain what happens when Fe forms a +2, +3, or +6 ion? *In both cases, where the oxidation state is not +2, d electrons are involved in ion formation.*
31. Why does electron affinity actually decrease between groups I and II? Don't more protons mean more attractions to electrons? *Electron affinity for group II is actually a positive number. Even though there are more protons for elements in group II, they have a full S sublevel. This means that energy will be required to add a new electron as it will have to enter a higher energy sublevel.*
32. If Al has more protons than F, then why does it have a lower electron affinity? *Al has an extra energy level and thus more shielding effect which diminishes the effect of the nuclear charge—so electrons are attracted to a lesser extent.*
33. What does the oxidation state of an element tell us? *The number of electrons lost, gained, or shared in a chemical bond.*
34. An atom loses an electron. Does this process always require energy, always give off energy, sometimes require energy, sometimes give off energy, or do we not know unless we know what atom we are talking about? *This is ionization energy. Losing electrons always requires energy.*
35. An atom gains an electron. Does this process always require energy, always give off energy, sometimes require energy, sometimes give off energy, or do we not know unless we know what atom we are talking about? *In this case we need to know what atom we are talking about. Electron affinity is positive for elements with full sublevels and negative for almost all other elements.*
36. What does it mean to have an exothermic process, or a negative energy, during an atomic process? *Energy is released to the environment.*
37. Why are there no electronegativities listed for most of the noble gases? *Noble gases have full outer shells and rarely form compounds, so it would not make sense to talk about their attraction for shared electrons.*