

Worksheet: Periodic Trends

1. What general statement can be made regarding the ionic radii of cations having the same number of electrons, but a different number of protons (for example, Al^{3+} versus Na^+)?
2. a) How may the relative sizes of the ionic radius of an anion and its parent neutral atom be summarized?
b) Summarize the relative ionic radii of anions having the same number of electrons, but different number of protons (for example N^{3-} versus F^-).
3. Identify the atom or ion with the larger radius in each of the following pairs: (a) Cl or S; (b) Cl^- or S^{2-} ;
(c) Na or Mg; (d) Mg^{2+} or Al^{3+}
4. Which atom or ion has the smaller radius: (a) Li^+ or Na^+ ;
(b) Cl or Cl^- ; (c) Al or Al^{3+} ; (d) N^{3-} or O^{2-}
5. Predict which atom of each pair has the greater first ionization energy (be alert for any exceptions to the general trend):
(a) Na or Mg; (b) C or N; (c) P or S.
6. Predict which atom of each pair has the greater first ionization energy (be alert for any exceptions to the general trend):
(a) Ba or Ca; (b) Be or B; (c) Ar or Xe.
7. In terms of electron configurations obtained from the building-up principle, explain why the ionization energies of Group 16 elements are smaller than those of Group 15 elements.
8. In terms of electron configurations obtained from the building-up principle, explain why the ionization energies of Group 3 elements are smaller than those of Group 2 elements.
9. Explain why the second ionization energy of sodium is significantly higher than the second ionization energy of magnesium, even though the first ionization energy of sodium is less than that of magnesium.
10. Explain why the second ionization energy of sodium is even larger than the third ionization energy of aluminum, even though the first ionization energy of sodium is low.
11. (a) Which group of elements has the highest ionization energies? (b) Which group of elements has the lowest ionization energies?
12. (a) Which group of elements tends to have high electron affinities? (b) What is the general trend in electron affinities across a period?
13. Explain why the electron affinity of chlorine is greater than that of bromine.
14. Arrange the elements N, Al, C, and B in order of increasing electronegativity. (lowest to highest)
15. Select the element that has the greatest electronegativity in each set: (a) Cl, P, or S; (b) F, O, or S; (c) Sr, In or Ge
16. Identify the element in each of the following pairs that tends to acquire electrons from the other when forming a bond:
(a) H and C; (b) O and F; (c) S and P.
17. Identify the element in each of the following pairs that tends to acquire electrons from the other when forming a bond:
(a) Si and Al; (b) S and As; (c) Cl and Br.
18. Circle the best choice in the list:

(a) highest first ionization energy	Se, S, Te
(b) smallest radius	Cl^- , Br^- , F^-
(c) lowest electron affinity	Ba, Sr, Cs
(d) largest ionization energy	O, S, F
(e) lowest second ionization energy	Ar, K, Ca
(f) most paramagnetic	Fe, Co, Ni
(g) largest ionic radius	Ca^{2+} , Mg^{2+} , Ba^{2+}
(h) largest radius	S^{2-} , Cl^- , Cl
(i) highest first ionization energy	C, N, O
(j) highest electron affinity	P, S, Cl
(k) highest electronegativity	As, Sn, S
(l) smallest atom	Sn, I, Bi
(m) lowest ionization energy	K, Na, Ca
(n) impossible subshell designation	4g, 5d, 4p
(o) number of orbitals for $n = 2$	2, 4, 8
(p) number of 5f orbitals	14, 7, 9