Chapter 3 Exercises

1. Write valence electron configurations for each of the following:
a) carbon **b)** cobalt **c)** chlorine **d)** magnesium

2. Write valence electron configurations for each of the following:
a) copper **b)** calcium **c)** sulfur **d)** phosphorus

3. Which electron experiences the greater nuclear charge? Explain your reasoning in each case.
a) a 5p electron of In or a 5p electron of Sb?
b) a 5s electron of Sn or a 5p electron of Sn?

4. Which orbital is at *higher* energy? Explain your reasoning in each case.
a) a 4p orbital of Se or a 3d orbital of Se
b) a 3s orbital of S or a 3s orbital of Se
c) a 2p orbital of C or a 2p orbital of O

5. Use ionization energies to explain why +4 ions are very rare.

6. Use only the Periodic Table to order the elements in each of the following groups by increasing atomic radius.
a) N, F, B **b)** Ge, Pb, Sn **c)** K, Na, Li **d)** As, Sn, S

7. Use only the Periodic Table to order the elements in each of the following groups by decreasing atomic radius.
a) Na, K, Cl **b)** Al, C, B **c)** C, Ge, Sn **d)** Cs, Zn, O

8. Order the elements in each group of Exercise 6 by increasing first ionization energy.

9. Order the elements in each group of Exercise 7 by decreasing first ionization energy.

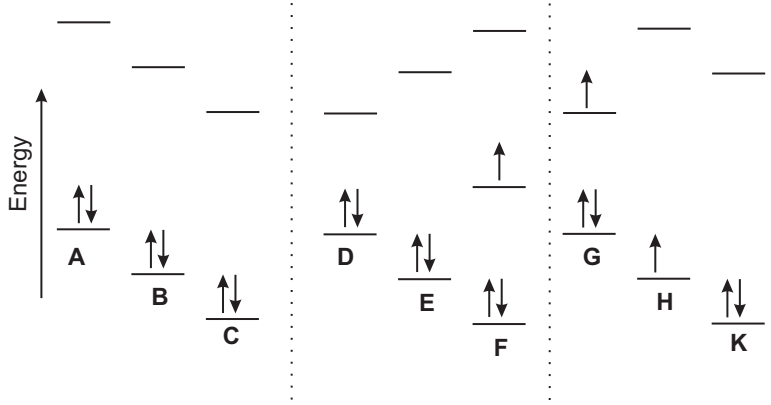
10. Order the elements in each group of Exercise 6 by increasing electronegativity.

11. Order the elements in each group of Exercise 7 by decreasing electronegativity.

12. Which is the *largest* atom in each of the following groups?
a) C, N, P, S **b)** N, O, F **c)** F, Cl, Br

13. Which is the *most electronegative* atom in each of the following groups?
a) N, O, P **b)** O, S, Se **c)** Si, P, S

Refer to the following diagrams showing the highest energy electrons and lowest energy empty orbitals of some atoms to answer Exercises 14-16



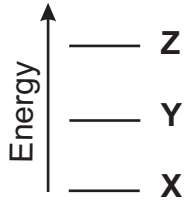
Exercise 14 **Exercise 15** **Exercise 16**

14. For atoms A, B, and C,
a) list the atoms in order of increasing ionization energy,
b) list the atoms in order of decreasing electronegativity, and
c) identify each atom as either paramagnetic or diamagnetic.

15. For atoms D,E and F,
a) list the atoms in order of increasing ionization energy,
b) list the atoms in order of decreasing electronegativity, and
d) identify each atom as either paramagnetic or diamagnetic.

16. For atoms G,H and K,
a) list the atoms in order of increasing ionization energy,
b) list the atoms in order of decreasing electronegativity, and
e) identify each atom as either paramagnetic or diamagnetic.

17. The relative energies of the highest occupied orbitals of H, Li, and F are given to the right.
a) Identify each atom as X, Y, or Z.
b) Where would the energies of the 3p orbital of Cl and the 4s orbital of K be placed? (Below X, between X and Y, between Y and Z, or above Z)



18. How many of the electrons in each of the following are core electrons and how many are valence electrons?

a) Na **b)** Xe **c)** S **d)** Ga

19. Use Equation 3.2 to explain why first ionization energies decrease going down a group and why electronegativities increase going from left to right in a period.

20. The first ionization energy of magnesium is 738 kJ/mol; its second ionization energy is 1451 kJ/mol; and its third ionization energy is 7733 kJ/mol.

a) Write the chemical equations for the processes to which these numbers apply.

b) Why is the second ionization energy so much greater than the first?

c) Suggest a reason why the third ionization energy is over five times greater than the second, but the second is less than twice the first.

21. Use the following effective nuclear charges experienced by the outermost electrons to order their outermost orbitals from lowest to highest energy:

Element	P	Al	Br	Pb
Z_{eff}	4.89	4.07	9.03	12.39

22. Given the following n quantum numbers of the valence shells, and the effective nuclear charges experienced by their valence electrons:

Element	A	B	C
n	2	4	5
Z_{eff}	3.1	3.5	11.6

Arrange the elements in increasing electronegativity and size. The elements belong to Groups 1A, 4A, and 7A. To which group does each element belong?

23. Use Equation 3.2 to determine where in Figure 3.4 the energy of the valence orbitals of nitrogen (Z_{eff} = 3.9) would be found? Is the location consistent with its electronegativity of 3.04? … with its ionization energy of 1402 kJ/mol? If not, explain why.

24. Use Equation 3.2 to determine where in Figure 3.4 the energy of the valence orbitals of boron (Z_{eff} = 2.6) would be found. Is the location consistent with its electronegativity of 2.04 and its ionization energy of 800 kJ/mol? If not, explain why.