CHAPTER 2 Review

Reflecting on Chapter 2

Summarize this chapter in the format of your choice. Here are a few ideas to use as guidelines:

- Identify the subatomic particles that make up atoms, as well as the theory that chemists use to explain the composition and behaviour of atoms.
- Use the periodic law to examine the structure and organization of the periodic table of the elements.
- Draw Lewis structures to model the arrangements of electrons in the outer energy levels of atoms.
- Identify periodic trends involving atomic size, ionization energy, and electron affinity.

Reviewing Key Terms

For each of the following terms, write a sentence that shows your understanding of its meaning.

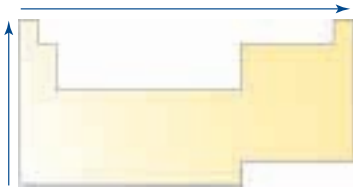
element
atom
atomic number (Z)
isotope
periodic law
periodic trend
Lewis structure
octet
ionization energy
atomic mass unit (u)
mass number (A)
radioisotope
energy level
valence electrons
stable octet
atomic radius
electron affinity

Knowledge/Understanding

1. Explain the difference between an atom and an element.
2. Compare protons, neutrons, and electrons in terms of their charge, their mass, and their size.
3. What information does the following notation express: $^{16}_{8}O$?
4. Write an equation that shows how to calculate the number of neutrons in a neutral atom if you know its mass number and its atomic number.
5. Use an example and the appropriate terminology to explain the difference between an isotope and a radioisotope.
6. In your notebook, copy the table below and fill in the missing information.

Symbol	Protons	Neutrons	Electrons	Charge
$^{14}_{7}N^{-3}$	(a)	(b)	(c)	(d)
(e)	34	45	36	(f)
$^{52}_{24}(g)^{3+}$	(h)	(i)	(j)	(k)
$^{(l)}_{(m)}(F)$	(n)	10	(o)	(p)

7. A cobalt atom has an atomic mass of 59 and an atomic number of 27. How many neutrons does it have? How many electrons does it have?
8. **(a)** Hydrogen atoms are lying side-by-side along a line that is 1 mm long. How many hydrogen atoms are there?
   (b) How many potassium atoms would lie side-by-side along the same 1 mm line?
9. Use a Venn diagram or a graphic organizer of your choice to compare Dalton's atomic theory with the more modern atomic theory that you learned about in this chapter.
10. Invent an entirely different name for the periodic table. Give reasons to support your choice.
11. Consider the following elements: H, Li, N, F, Co, Ag, Kr, I, Hg.
    (a) Sketch an outline of the periodic table, with these elements properly placed.
    (b) State the group number and period number each element belongs to.
    (c) Identify each element as a metal, metalloid, or non-metal.
    (d) Identify the state of each element at room temperature.
    (e) Draw the Lewis structure for each of these elements.
12. **(a)** Which of the following trends is best represented by this diagram: atomic size, ionization energy, or electron affinity? Justify your decision.



(b) Sketch outlines of the periodic table to show the trends for the remaining two choices from part (a). Explain how these trends are related to the one in part (a).

13. Arrange the following elements into groups that share similar properties: Ca, K, Ga, P, Si, Rb, B, Sr, Sn, Cl, Bi, Br. How much confidence do you have in your groupings, and why?

14. Use a drawing of your choice to show clearly the relationship among the following terms: valence, stable octet, electron, energy level.

15. In what ways are periodic trends related to the arrangement of electrons in atoms?

Inquiry

16. Imagine hearing on the news that somebody has discovered a new element. The scientist who discovered this element claims that it fits between tin and antimony on the periodic table.
    (a) How likely is it for this claim to be true? Justify your answer.
    (b) Write at least three questions that you could ask this scientist. What is your reasoning for asking these questions? (In other words, what do you expect to hear that could help convince you that the scientist is right or that you are?)

17. Technetium, with an atomic number of 43, was discovered after Mendeleev's death. Nevertheless, he used the properties of manganese, rhenium, molybdenum, and ruthenium to predict technetium's properties.
    (a) Use a chemical database to find the following properties for the above-mentioned elemental "neighbours" of technetium:
    - atomic mass
    - appearance
    - melting point
    - density

    If you would like to truly follow in Mendeleev's footsteps, you could also look for the chemical formulas of the compounds that these elements form with oxygen and chlorine. (Such compounds are called oxides and chlorides.)
    (b) Use this data to predict the properties for technetium.
    (c) Consult a chemical data base to assess your predictions against the observed properties for technetium.

Communication

18. Explain how you would design a data base to display information about the atomic numbers, atomic masses, the number of subatomic particles, and the number of electrons in the outer energy levels of the main-group elements. If you have access to spreadsheet software, construct this table.

19. **(a)** Decide on a way to compare, in as much detail as you can, the elements sodium and helium. The following terms should appear in your answer. Use any other terms that you think are necessary to complete your answer fully.

atom	element
nucleus	proton
neutron	electron
energy level	valence
periodic table	periodic trend
group	period
atomic radius	electron affinity
ionization energy	

    (b) Modify your answer to part (a) so that a class of grade 4 students can understand it.

20. Element A, with three electrons in its outer energy level, is in Period 4 of the periodic table. How does the number of its valence electrons compare with that of Element B, which is in Group 13 (IIIA) and Period 6? Use Lewis structures to help you express your answer.

21. Which elements would be affected if the elements in Periods 1, 2, 3, and 4 were arranged based on their atomic mass, rather than their atomic number? Based on what you have learned in this chapter, how can you be reasonably sure that arranging elements by their atomic number is accurate?

Making Connections

22. "When she blew her nose, her handkerchief glowed in the dark." The woman who made this statement in the early 1900s was one of several factory workers who were hired to paint clock and watch dials with luminous paint. This paint glowed in the dark, because it contained radium (atomic number 88), which is

highly radioactive and toxic. Marie and Pierre Curie discovered radium in 1898. Chemists knew as early as 1906 that the element was dangerous. Nevertheless, it was used not only for its "glowing effects," but also as a medicine. In fact, several companies produced drinks, skin applications, and foods containing radium.

Choose either one of the topics below for research.

- the uses and health-related claims made for radium during the early 1900s
- the story of the so-called "radium girls"—the factory workers who painted clock and watch faces with radium paint

How does the early history of radium and its uses illustrate the need for people to understand the connections among science, technology, society, and the environment?

23. Have you ever heard someone refer to aluminum foil as "tin foil"? At one time, the foil was, in fact, made from elemental tin. Find out why manufacturers phased out tin in favour of aluminum. Compare their chemical and physical properties. Identify and classify the products made from or with aluminum. What are the technological costs and benefits of using aluminum? What health-related and environment-related issues have surfaced as a result of its widespread use in society? Write a brief report to assess the economic, social, and environment impact of our use of aluminum.

Answers to Practice Problems and Short Answers to Section Review Questions:

Practice Problems: 1. (a) boron **(b)** 5 **(c)** 6 **(d)** lead **(e)** 82 **(f)** 126 **(g)** $^{184}_{74}W$ **(h)** 74 **(i)** $^{4}_{2}He$ **(j)** 2 **(k)** plutonium **(l)** 94 **(m)** 145 **(n)** Fe **(o)** iron **(p)** 30 **(q)** $^{209}_{83}Bi$ **(r)** 83 **(s)** $^{154}_{47}Ag$ **(t)** silver **(u)** Ne **(v)** neon **(w)** 10 **(x)** 10 **2. (a)** carbon **(b)** copper **(c)** radon **(d)** hydrogen **(e)** cadmium **(f)** calcium **(g)** iodine **(h)** aluminum **3.** H and He have one occupied energy level; H has 1 electron, He has 2. Li, Be, B, C, N, O, F, and Ne have two energy levels. First energy level is filled with two electrons. Second energy of Li has 1 electron, and electrons increase by one, totaling 8 in outer energy level for Ne. Na, Mg, Al, Si, P, S, Cl, Ar have three occupied energy levels. First two energy levels are full. Third energy level of Na has 1 electron, and electrons increase by one, totaling 8 in outer energy level for Ar. K and Ca have four occupied energy levels. First three energy levels are full. K has 1 electron and Ca has two in outer energy level. **4.** The pattern of outer energy level electrons from Practice Problem 3 is repeated by placing dots around the atomic symbol for each element. **5. (a)** 7 **(b)** 2 **(c)** 3 **(d)** 2 **(e)** 1 **(f)** 4 **(g)** 5 **(h)** 6 **(i)** 5 **(j)** 8 **6.** Ba has two dots; Ga has 3 dots; Sn has 4 dots; Bi has 5 dots; I has 7 dots; Cs has 1 dot; Kr has 8 dots; Xe has 8 dots. **7. (a)** Ba, Mg, Be **(b)** Ca, Ga, Se **(c)** Rb, Br, Kr **(d)** Ca, Se, Br **(e)** Cs, Ba, Sr **(f)** Se, Br, Cl **(g)** Ca, Mg, Li **(h)** Sr, Te, Se **(i)** In, I, Br **(j)** Se, S, O **8. (a)** Xe, Ar, He **(b)** In, Sn, Sb **(c)** Ba, Sr, Ca **(d)** K, Br, Kr **(e)** Rb, K, Ca **(f)** Rb, Br, Kr **9. (a)** B **(b)** In **(c)** I **(d)** N **(e)** K **(f)** Tl **Section Review: 2.1: 1. (a)** silver **(b)** 47 **(c)** 47 **(d)** 61 **(e)** arsenic **(f)** 33 **(g)** 75 **(h)** 33 **(i)** bromine **(j)** 80 **(k)** 35 **(l)** 35 **(m)** gold **(n)** 79 **(o)** 79 **(p)** 100 **(q)** tin **(r)** 50 **(s)** 119 **(t)** 50 **3. (a)** last pair has same protons and electrons, but different neutrons **(b)** last pair has same value for Z; first pair has same value for A **2.2: 2.** 1 (1A), 18 (8A), 17 (7A), 2 (2A) **3. (a)** Si; Sb; Te; Br **6. (a)** 8; 7; 6; 2; 1; 7; 2; 5; 2; 4. **(c)** non-metal; non-metal; non-metal; metal; metal; non-metal; non-metal; metal, metal; metalloid **7.** two: mercury and bromine **9. (b)** Triads 2 and 3 **11. (b)** Na, Mg, and Al have same number of energy levels, as do Li and C **(c)** Li, Na, and K have same number of valence electrons **2.3: 2. (a)** Cl, S, Mg **(b)** B, Al, In **(c)** Ne, Ar, Xe **(d)** Xe, Te, Rb **(e)** F, P, Na **(f)** O, N, S **3. (a)** Cl, Br, I **(b)** Se, Ge, Ga **(c)** Kr, Ca, K **(d)** Li, Na, Cs **(e)** Cl, Br, S **(f)** Ar, Cl, K **4. (a)** Ca, **(b)** Li **(c)** Se **(d)** Cs