Answer Key

Chapter 3: Standard Review Worksheet

1. The symbols for some elements may refer to an archaic name for the element or to the element's name in a modern language other than English. Here are some examples:

Element	English Name	Derivation of Name
Na	sodium	Latin: *natrium*
K	potassium	Latin: *kalium*
Fe	iron	Latin: *ferrum*
W	tungsten	German: *wolfram*

2. A compound is a distinct, pure substance that is composed of two or more elements held together by chemical bonds. Carbon dioxide and water are two examples, but answers will vary.

3. Rutherford's experiment involved shooting a beam of particles at a thin sheet of metal foil. According to the then-current "plum pudding" model of the atom, most of these positively charged particles should have passed right through the foil. However, Rutherford detected that a significant number of particles effectively bounced off something and were deflected backwards to the source of particles and that other particles were deflected from the foil at large angles. Rutherford realized that his observations could be explained if the atoms of the metal foil had a small, dense, positively charged nucleus with a significant amount of empty space between nuclei. The empty space between nuclei would allow most of the particles to pass through the atom. However, if a particle hit a nucleus head-on, it would be deflected backwards at the source. If a positively charged particle passed near a positively charged nucleus (but did not hit the nucleus head-on), then the particle would be deflected by the repulsive forces between the positive charges. Rutherford's experiment conclusively disproved the "plum pudding" model for the atom, which envisioned the atom as a uniform sphere of positive charge with enough negatively charged electrons scattered through the atom to balance the positive charge.

4. It is the number and arrangement of the *electrons* in an atom that are responsible for the chemical behavior of the atom. The electrons are found in nearly the entire region of space occupied by an atom, from just outside the nucleus all the way out to the outermost *edge* of the atom. When two atoms approach each other in space prior to a reaction taking place, the electrons from one atom interact with the electrons of the other atom. The nucleus is so small compared with the overall size of the atom that the nuclei of atoms do not interact with each other.

5. Isotopes have the same atomic number (number of protons in the nucleus) but have different mass numbers (total number of protons and neutrons in the nucleus). The different isotopes of an atom are indicated by symbolism of the form ${}^{A}_{Z}\mathrm{X}$, in which Z represent the atomic number and A the mass number of element X. For example, ${}^{13}_{6}\mathrm{C}$ represents a nuclide of carbon with atomic number 6 (6 protons in the nucleus) and mass number 13 (reflecting 6 protons plus 7 neutrons in the nucleus).

6. The periodic table arranges the elements in order of increasing atomic number. The table is further arranged by placing elements with similar electronic structure (and hence similar chemical properties) into the same vertical column (group). Since the periodic table is arranged with the elements in the same vertical column having *similar* electronic structures, the mere *location* of an element in the periodic table can be an indication of what simple ions the element forms. For example, the Group 1 elements all form 1+ ions

(Li^+, Na^+, K^+, Rb^+, and Cs^+), whereas the Group 7 elements all form 1– ions (F^-, Cl^-, Br^-, and I^-). You will learn more about how the charge of an ion is related to an atom's electronic structure in a later chapter.

7. A positive ion forms when an atom or molecule loses one or more of its electrons (negative charges). For example, sodium atoms and magnesium atoms form ions as indicated below:
   $Na\ (atom) \rightarrow Na^+\ (ion) + e^-$ $\qquad$ $Mg\ (atom) \rightarrow Mg^{2+}\ (ion) + 2e^-$

   The resulting ions contain the same number of protons and neutrons in their nuclei as do the atoms from which they are formed because the only change that has taken place involves the electrons (which are not in the nucleus). These ions contain fewer electrons than the atoms from which they are formed. A negative ion forms when an atom or molecule *gains* one or more electrons from an outside source (another atom or molecule). For example, chlorine atoms and oxygen atoms form ions as indicated below:
   $Cl\ (atom) + e^- \rightarrow Cl^-\ (ion)$ $\qquad$ $O\ (atom) + 2e^- \rightarrow O^{2-}\ (ion)$

8. Although an ionic substance is made up of positively and negatively charged particles, there is no net electrical charge on a sample of such a substance because the total number of positive charges is balanced by an equal number of negative charges.

9.

Name	**Symbol**	**Atomic Number**
potassium	K	19
calcium	Ca	20
bromine	Br	35
neon	Ne	10
aluminum	Al	13
gold	Au	79
mercury	Hg	80
iodine	I	53

10. a. silicon, 14; b. carbon, 12; c. fluorine, 9; d. beryllium, 4; e. oxygen, 8; f. chromium, 24.

11. a. krypton, Kr; b. uranium, U; c. phosphorus, P; d. gold, Au; e. copper, Cu; f. oxygen, O.

12. a. 35p, 44n, 35e; b. 92p, 146n, 92e; c. 1p, 0n, 1e

13. a. Ag^+; b. Al^{3+}; c. Br^-; d. K^+; e. S^{2-}; f. Ca^{2+}

14. a. 1p, 0e; b. 7p, 10e; c. 9p, 10e