Chapter 1 Homework Problems

1. Images A – I depict various types of matter on the atomic scale. List the image letter(s) described by each of the following:

   [Arrow points to images]
   _________ (a) A mixture that fills its container
   _________ (b) A substance that cannot be broken down into simpler ones
   _________ (c) An element with a definite shape
   _________ (d) A homogeneous mixture
   _________ (e) An element with an indefinite shape, but a definite volume
   _________ (f) A gas consisting of diatomic particles
   _________ (g) A molecular gas that obeys the law of definite proportions
   _________ (h) A substance with a 2:1 fixed ratio of its component atoms
   _________ (i) Matter that can be separated into its component substances by physical means
   _________ (j) A heterogeneous mixture

2. List two differences between a compound and a mixture.

3. The tap water leaves white deposits when it evaporates. Is tap water a mixture or a compound? Explain.

4. Fill in the missing atomic symbol (\( \text{A}_Z \text{X}^C \)) and numbers of subatomic particles.

   \[
   \begin{array}{ccc}
   & 7 \text{ protons} & \text{______ protons} \\
   \text{_______} & 8 \text{ neutrons} & \text{______ neutrons} \\
   & 10 \text{ electrons} & \text{_______ electrons} \\
   \end{array}
   \]

   \[\text{204} \text{Pb}^{2+} \]
5. Hydrogen has three isotopes (\(^1\text{H}, \; ^2\text{H}, \; \text{and} \; ^3\text{H}\)), and chlorine has two isotopes (\(^{35}\text{Cl} \; \text{and} \; ^{37}\text{Cl}\)).

   (a) How many isotopic combinations of HCl are there? _____  
       Write the formula for each.

   (b) How many mass spectrometer peaks would you expect to see? _____  
       Write the mass of each peak.

6. Boron has two naturally occurring isotopes, \(^{10}\text{B} \; (\text{abundance} \; 19.9\%) \; \text{and} \; ^{11}\text{B} \; (\text{abundance} \; 80.1\%)\).  
   Although the \(\text{B}_2\) molecule does not exist naturally on Earth, it has been produced in the laboratory 
   and been observed in stars.

   (a) How many different \(\text{B}_2\) molecules are possible? _____  

   (b) What are the masses and percent abundances of each?

7. Naturally occurring silver consists of two isotopes: \(^{107}\text{Ag} \; (\text{relative mass} \; 106.9051 \; \text{amu, abundance} \; 51.84\%) \; \text{and} \; ^{109}\text{Ag} \; (\text{relative mass} \; 108.9048 \; \text{amu, abundance} \; 48.16\%)\).  
   What is the average atomic mass of silver?  Be sure to give your answer with the correct number of significant figures based on 
   the data provided in this problem (not the value provided on the periodic table in the front of the text).
8. A sample of naturally occurring silicon consists of $^{28}\text{Si}$ (relative mass 27.9769 amu), $^{29}\text{Si}$ (relative mass 28.9765 amu), $^{30}\text{Si}$ (relative mass 29.9738 amu). If the average atomic mass of silicon is 28.0855 amu and the natural abundance of $^{29}\text{Si}$ is 4.68%, what are the abundances of $^{28}\text{Si}$ and $^{30}\text{Si}$?

9. What is the difference between an $\alpha$ particle and a helium atom?

10. Isotope A decays into isotope E through the following radioactive decay series, in which the daughter products of the individual decay events are themselves radioactive and undergo further decay until a stable nucleus is ultimately reached.

   (a) Write a balanced nuclear equation for the decay of isotope B to isotope C. Indicate the type of radioactive decay above the arrow.

   (b) Write a balanced nuclear equation for the decay of isotope D to isotope E. Indicate the type of radioactive decay above the arrow.
11. Write balanced nuclear equations for the following processes:

(a) Electron capture of $^{126}$Ba

(b) Positron emission of $^{125}$Ba

12. Two radioactive isotopes of iodine are $^{136}$I and $^{122}$I. One decays by $\beta^-$ emission and one decays by positron emission. Which does which? Explain.

13. Describe the type of bonding that typically occurs between two nonmetals.

14. How can ionic compounds be neutral if they consist of positive and negative ions?

15. Is potassium nitrate (KNO$_3$) held together by ionic attractions, covalent bonding, or both? Explain.
16. Give the name and formula of the compound formed from the following elements:

   (a) cesium and bromine
   (b) sulfur and barium
   (c) calcium and fluorine

17. Give the systematic names for the following formulas:

   (a) Na₃HPO₄
   (b) Sn(SO₃)₂
   (c) FeCO₃
   (d) NaNO₂

18. Give the formulas for the following names:

   (a) ammonium perchlorate
   (b) potassium dichromate
   (c) copper (II) nitrate
   (d) potassium carbonate dihydrate

19. Give the name and formula for the acid derived from each of the following anions:

   (a) perchlorate
   (b) NO₃⁻
   (c) bromite
   (d) F⁻

20. Give the formulas of the compounds in each set:

   (a) lead (II) oxide and lead (IV) oxide
   (b) lithium nitride, lithium nitrite, and lithium nitrate
   (c) strontium hydride and strontium hydroxide
   (d) magnesium oxide and manganese (II) oxide
21. Before the use of systematic names, many compounds had common names. Give the systematic name for each of the following:

(a) blue vitriol, CuSO₄ · 5 H₂O
(b) slaked lime, Ca(OH)₂
(c) oil of vitriol, H₂SO₄
(d) washing soda, Na₂CO₃
(e) muriatic acid, HCl
(f) Epsom salt, MgSO₄ · 7 H₂O
(g) chalk, CaCO₃
(h) dry ice, CO₂
(i) baking soda, NaHCO₃
(j) lye, NaOH

22. Use the periodic table group and the naming rules for oxyanions to determine the names of the following polyatomic ions:

(a) SeO₄²⁻
(b) AtO⁻
(c) IO₄⁻
(d) HSeO₄⁻
(e) TeO₃²⁻