**Answers to Chapters 6 & 7 Study Questions**

1. a) 3(12.0) + 8(1.01) + 3(16.0) = 92.1 g/mole  b) 92.1 g  c) 6.02 x $10^{23}$ molecules

   d) $0.217\ moles \times \frac{92.1\ g}{1\ mole}$ = 20.0 g  e) $783\ g \times \frac{1\ mole}{92.1\ g}$ = 8.50 moles

2. a) 4 atoms (one N + 3 H)

   b) $1\ mole\ NH_3 \times \frac{6.02 \times 10^{23}\ molecules}{1\ mole\ NH_3} \times \frac{4\ atoms}{1\ molecule}$ = 2.41 x $10^{24}$ atoms

   c) $3.40\ g\ NH_3 \times \frac{1\ mole\ NH_3}{17.0\ g\ NH_3} \times \frac{6.02 \times 10^{23} molecules}{1\ mole\ NH_3} \times \frac{4\ atoms}{1\ molecule}$ = 4.82 x $10^{23}$ atoms

3. Molar mass of $NaNO_2$ = 23.0 + 14.0 + 2(16.0) = 69.0 g/mole
   % Na = 23.0/69.0 = 33.3% Na; % N = 14.0/69.0 = 20.3% N; %O = 2(16.0)/69.0 = 46.4% O
   33.3% Na, 20.3% N and 46.4% O.

4. a) In 100 g of this compound, there are 40.7 g C, 5.1 g H, and 54.2 g O

   $40.7\ g\ C \times \frac{1\ mole\ C}{12.0\ g\ C}$ = 3.39 moles C  3.39/3.39 = 1 x 2 = 2

   $5.1\ g\ H \times \frac{1\ mole\ H}{1.0\ g\ H}$ = 5.1 moles H  5.1/3.39 = 1.5 x 2 = 3

   $54.2\ g\ O \times \frac{1\ mole\ O}{16.0\ g\ O}$ = 3.39 moles O  3.39/3.39 = 1 x 2 = 2

   empirical formula = $C_2H_3O_2$

   b) Molar mass of $C_2H_3O_2$ = 2(12.0) + 3(1.0) + 2(16.0) = 59.0 g/mole
   118/59.0 = 2 $\rightarrow$ molecular formula = $C_4H_6O_4$

5. a) In 25.0 g of compound, there are 7.20 g Mg, 3.55 g C and 25.0-(7.20+3.55) = 14.25 g O.

   $7.20\ g\ Mg \times \frac{1\ mole\ Mg}{24.3\ g\ Mg}$ = 0.296 moles Mg  0.296/0.296 = 1

   $3.55\ g\ C \times \frac{1\ mole\ C}{12.0\ g\ C}$ = 0.296 moles C  0.296/0.296 = 1

   $14.25\ g\ O \times \frac{1\ mole\ O}{16.0\ g\ O}$ = 0.891 moles O  0.891/0.296 = 3

   formula = $MgCO_3$

b) % Mg = 7.20/25.0 = 28.8% Mg; %C = 3.55/25.0 = 14.2 % C; % O = 14.25/25.0 = 57.0% O.
   28.8% Mg, 14.2 % C and 57.0% O.

(You should get the same result if you used molar mass and atomic masses.)

c) $13.9\ g\ cpd \times \frac{28.8\ g\ Mg}{100\ g\ compound} = 4.00$ g Mg

d) $0.290\ mol\ C \times \frac{12.0\ g\ C}{1\ mole\ C} \times \frac{100\ g\ compound}{14.2\ g\ C} = 24.5$ g compound

6. Chemical reactions are frequently accompanied by:
   a) bubbles which show that a gas is one of the products of the reaction.
   b) heat changes; heat is evolved in exothermic reactions; heat is used up in endothermic reactions. Exothermic reactions also often result in the production of light and sound.
   c) color changes which often signify a change in chemical composition.
   d) the formation of a precipitate which represents the formation of an insoluble ionic compound from soluble ionic compounds.

7. a) **4** $Fe(s)$ + **3** $O_2(g)$ → **2** $Fe_2O_3(s)$

   b) $B_2H_6(l)$ + **3** $O_2(g)$ → $B_2O_3(s)$ + **3** $H_2O(l)$

   c) **4** $PH_3(g)$ + **8** $O_2(g)$ → **6** $H_2O(l)$ + $P_4O_{10}(s)$

8. a) $PH_3(g)$ and $O_2(g)$ b) $H_2O(l)$ and $P_4O_{10}(s)$ c) 6

9. a) 6 $Li(s)$ + $N_2(g)$ → 2 $Li_3N(s)$

   b) $C_3H_8(g)$ + 5 $O_2(g)$ → 3 $CO_2(g)$ + 4 $H_2O(l)$

10. mass of Zn = 33.64 g - 32.00 g = 1.64 g Zn
    mass of O = 34.04 g - 33.64 g = 0.40 g O.

    # moles Zn: $1.64\ g\ Zn \times \frac{1\ mole\ Zn}{65.4\ g\ Zn} = 0.0251$ moles Zn  0.0251/0.025 = 1

    # moles O: $0.40\ g\ O \times \frac{1\ mole\ O}{16.0\ g\ O} = 0.025$ moles O  0.025/0.025 = 1

    formula = ZnO