Answers to Exercise 6.2
Reactions of Metals with Acids (Including Water)

1. The metal loses one or more electrons to form a cation (M^+, M^{2+}, M^{3+}, etc.).
These electrons are gained by H^+ giving neutral hydrogen ($H_2(g)$).
For every electron lost by a metal atom, one H^+ ion is required to take it.

This is what happens when <u>most</u> metals react with <u>most</u> acids.
There is a group of acids called "oxidizing acids" which do not produce hydrogen gas when they react with metals. Nitric acid (HNO_3) is an oxidizing acid that you will react with copper in the Copper Cycle lab. We will discuss oxidizing acids when we discuss the Group 13 metals.

2.
(a) Cl^- (b) Br^- (c) H_2O (d) OH^-

3.
(c) $Na^+,\ H_2$ (d) $Sr^{2+},\ H_2$
(a) $Li^+,\ Cl^-, H_2$ (b) $Mg^{2+},\ Cl^-, H_2$
(e) $K^+,\ OH^-, H_2$ (f) $Ba^{2+},\ OH^-, H_2$

4.
(a) $2Na(s) + 2H^+(aq) \rightarrow 2Na^+(aq) + H_2(g)$
(b) $Sr(s) + 2H^+(aq) \rightarrow Sr^{2+}(aq) + H_2(g)$
(c) $2Li(s) + 2HCl(aq) \rightarrow 2LiCl(aq) + H_2(g)$
(d) $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$
(e) $2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$
(f) $Ba(s) + 2H_2O(l) \rightarrow Ba(OH)_2(aq) + H_2(g)$

The products of each reaction were predicted in question 3. For question 4, you had to reformat this information into a balanced chemical equation and add states of matter.

Because water is present in at least one reactant of each reaction (either as H_2O or as an aqueous reagent like $H^+(aq)$ or HCl(aq)), you must consider whether each ionic compound produced precipitates as a solid (s) or remains dissolved in aqueous solution (aq).

This means you need to know some general solubility rules.

e.g. Ionic solids in which the cation is from Group 1 are generally soluble in water.

It is also acceptable to write a net ionic equation for each of these reactions (see below); however, you must still consider whether the ions produced remain dissolved in aqueous solution or precipitate as an ionic solid. You must also make sure that the charges are balanced.
(a) $2Na(s) + 2H^+(aq) \rightarrow 2Na^+(aq) + H_2(g)$
(b) $Sr(s) + 2H^+(aq) \rightarrow Sr^{2+}(aq) + H_2(g)$
(c) $2Li(s) + 2H^+(aq) \rightarrow 2Li^+(aq) + H_2(g)$
(d) $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$
(e) $2K(s) + 2H_2O(l) \rightarrow 2K^+(aq) + 2OH^-(aq) + H_2(g)$
(f) $Ba(s) + 2H_2O(l) \rightarrow Ba^{2+}(aq) + 2OH^-(aq) + H_2(g)$