1. Identify the Bronsted-Lowry acid/base pairs (acid, base, conjugate base, conjugate acid) in the following reactions.

   (a) $HNO_3(aq) + H_2O(\ell) \longrightarrow H_3O^+(aq) + NO_3^-(aq)$
   Acid: HNO_3, conjugate base: NO_3^-
   Base: H_2O, conjugate acid: H_3O^+

   (b) $CH_3NH_2(aq) + H_2O(\ell) \rightleftharpoons CH_3NH_3^+(aq) + OH^-(aq)$
   Acid: H_2O, conjugate base: OH^-
   Base: CH_3NH_2, conjugate acid: $CH_3NH_3^+$

   (c) $CO_3^{2-} + H_2O(\ell) \rightleftharpoons HCO_3^-(aq) + OH^-(aq)$
   Acid: H_2O, conjugate base: OH^-
   Base: CO_3^{2-}, conjugate acid: HCO_3^-

2. Write the formula for the conjugate base of each acid.

   (a) $HSO_3(aq)$ SO_3^-

   (b) $HF(aq)$ F^-

3. Write the formula for the conjugate acid of each base.

   (a) $NH_3(aq)$ NH_4^+

   (b) $HSO_4^-(aq)$ H_2SO_4

4. Answer with the correct number of significant figures.

   (a) $-log(2.3 \times 10^{-5}) = 4.64$

   (b) $-log(1.45 \times 10^{-8} = 7.839$

   (c) $10^{-1.6} = 0.03$

   (d) $10^{-5.87} = 1.3 \times 10^{-6}$

5. HCO_3^- is amphoteric. Write a chemical reaction to show how it can act as an acid and another reaction to show how it can act as a base.

   $HCO_3^-(aq) + H_2O(\ell) \rightleftharpoons CO_3^{2-}(aq) + H_3O^+(aq)$

   $HCO_3^-(aq) + H_2O(\ell) \rightleftharpoons H_2CO_3(aq) + OH^-(aq)$

6. Calculate the missing components of the table (answer in the correct number of significant figures).

$[H_3O^+]$ (M)	$[OH^-]$ (M)	pH	pOH	Acidic or Basic?
3.5×10^{-3}	2.9×10^{-12}	2.46	11.54	acidic
2.7×10^{-8}	3.7×10^{-7}	7.57	6.43	basic
5.6×10^{-5}	1.8×10^{-10}	4.25	9.75	acidic
8.3×10^{-12}	1.2×10^{-3}	11.08	2.92	basic

7. Like all equilibrium constants, the value of K_w depends on temperature. At body temperature (37 °C), $K_w = 2.4 \times 10^{-14}$. What are the $[H_3O^+]$ and pH of pure water at body temperature?

   Remember, $K_w = [H_3O^+][OH^-]$.

   In pure water, $[H_3O^+] = [OH^-]$ because H_2O is the only possible source of each. For every H_3O^+ formed, an OH^- must also be formed.

   Therefore: $K_w = 2.4 \times 10^{-14} = [x][x] = x^2$
   $x = 1.5 \times 10^{-7}$
   So $[H_3O^+] = 1.5 \times 10^{-7}\ M$ and $pH = 6.81$
   (Note: This is still a neutral solution, not an acid or base. $pOH = 6.81$ also.)