Name: _____

Chemical Equilibrium

1. Write the concentration-based reaction quotient expression for each of the following reactions:

   a. $3\ O_2\ (g) \rightleftharpoons 2\ O_3\ (g)$

   b. $N_2\ (g) + 3\ H_2\ (g) \rightleftharpoons 2\ NH_3\ (g)$

   c. $4\ NH_3\ (g) + 7\ O_2\ (g) \rightleftharpoons 4\ NO_2\ (g) + 6\ H_2O\ (g)$

2. Gaseous nitrogen dioxide forms dinitrogen tetroxide according to this equation:

   $$2\ NO_2\ (g) \rightleftharpoons N_2O_4\ (g)$$

   When 0.10 mol NO_2 is added to a 1.0-L flask at 25 °C, the concentration changes so that at equilibrium, $[NO_2] = 0.016$ M and $[N_2O_4] = 0.042$ M.

   a. What is the value of the reaction quotient before any reaction occurs?

   b. What is the value of the equilibrium constant for the reaction?

3. Calculate the reaction quotient and determine the direction in which each of the following reactions will proceed to reach equilibrium.

   a. A 1.00-L flask containing 0.0500 mol of NO (g), 0.0155 mol of Cl_2 (g), and 0.500 mol of NOCl:

   $$2NO\ (g) + Cl_2\ (g) \rightleftharpoons 2\ NOCl\ (g) \qquad K_c = 4.6\times10^4$$

   b. A 5.0-L flask containing 17 g of NH_3, 14 g of N_2, and 12 g of H_2:

   $$N_2\ (g) + 3\ H_2\ (g) \rightleftharpoons 2\ NH_3\ (g) \qquad K_c = 0.060$$

   c. A 2.00-L flask containing 230 g of SO_3(g):

   $$2\ SO_3\ (g) \rightleftharpoons 2\ SO_2\ (g) + O_2\ (g) \qquad K_c = 0.230$$