ChemQuest 64

The Reaction Quotient

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hour: \_\_\_\_\_

**Critical Thinking Questions**

1. If Kc for a given reaction is very large would there be a large amount of products or reactants in the mixture?
2. If Kc for a given reaction is very small would there be a large amount of products or reactants in the mixture?
3. Offer a mathematical explanation for your answers to questions 1 and 2.

**Information**: The Reaction Quotient

The reaction quotient, Qc, is calculated in the same way as you would calculate the equilibrium constant. For the reaction *a*A + *b*B 🡨🡪 *c*C + *d*D, the reaction quotient is:

It is important to keep in mind that the reaction quotient does not involve equilibrium concentrations. The concentrations used to calculate Qc are at any time, not just at equilibrium.

**Critical Thinking Questions**

1. Consider the following reaction: CO + 3H2 🡨🡪 CH4 + H2O. While carrying out a reaction between carbon monoxide and hydrogen, a scientist analyzed the mixture and found that in the 3.5 L container there were 0.35 moles of CO, 0.42 moles of H2, 0.29 moles of CH4, and 0.38 moles of H2O. What is the reaction quotient for this mixture?

**Information**: What Qc Tells Us

As a reaction proceeds it will always tend to go toward equilibrium. For example, the equilibrium constant for the reaction described in question 4 is 3.92. The concentration of products and reactants will adjust themselves so that as the reaction progresses until the products divided by reactants (raised to the appropriate power) will equal 3.92.

**Critical Thinking Questions**

1. Given your answer to question 4 and the fact that Kc equals 3.92 for the reaction, what must happen for the reaction to reach equilibrium?

A) more products must form B) more reactants must form

1. At a certain time during a reaction whose equilibrium constant was 12.5, it was found that the reaction quotient was 4.2. Predict what will happen to the concentration of reactants and products as the reaction progresses.
2. At a certain time during a reaction whose equilibrium constant was 0.45, it was found that the reaction quotient was 2.1. Predict what will happen to the concentration of products and reactants as the reaction progresses.
3. Given your answers to questions 6 and 7, complete the following sentences.

If Qc is greater than Kc, then the concentration of products needs to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

If Qc is less than Kc, then the concentration of products needs to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Consider the equilibrium reaction of hydrogen gas reacting with nitrogen gas to produce ammonia, NH3. Kc for the reaction is 0.500. A 50.0 L reaction vessel contains 1.00 mol N2, 3.00 mol H2, and 0.500 mol of NH3. Will more NH3 be formed or will more N2 and H2 form as the reaction proceeds?