

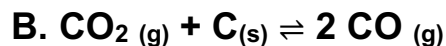
EQUILIBRIUM

This worksheet should help you identify how we can use equilibrium to understand chemical reactions. It is intended for you to work through it in order. (*Don't skip ahead.*) The double headed arrow (\rightleftharpoons) indicates equilibrium.

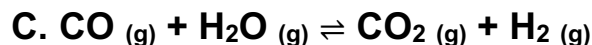
Consider three different chemical reactions that involve CO_2 :



$$K_c = 4.4 \times 10^{-6}$$



$$K_c = 1.9$$



$$K_c = ???$$

Write out the equilibrium expression for the three reactions, so that each produces 1 mole of CO_2 .

USE THESE EQUILIBRIUM EXPRESSIONS FOR THE REST OF THE WORKSHEET

What is the equilibrium constant of **Reaction C** if the equilibrium concentrations are:

$$[\text{CO}] = 0.011 \text{ M} \quad [\text{H}_2\text{O}] = 0.011 \text{ M} \quad [\text{CO}_2] = 0.109 \text{ M} \quad [\text{H}_2] = 0.109 \text{ M}$$

What is the value of K_p for each reaction (25 °C)?

What is the value of $\Delta G^\circ_{\text{rxn}}$ for each reaction (25 °C)?

Which reaction is the most spontaneous at 25 °C? Why?

Consider **Reaction B**: The initial concentrations are $[\text{CO}_2] = 0.00 \text{ M}$, $[\text{CO}] = 0.215 \text{ M}$, and 10.4 g C . The equilibrium concentration of $[\text{CO}] = 0.180 \text{ M}$. What is the equilibrium concentration of CO_2 ?

Consider **Reaction A**: When 1.12 mole of COF_2 is placed in a 2.00 L container, what is the concentration of CO_2 at equilibrium?

Assuming all three reactions have been optimized to have the same theoretical yield of CO_2 , which reaction will produce the most CO_2 before it reaches equilibrium? Why? Is this consistent with your $\Delta G^\circ_{\text{rxn}}$ values?

At some point in each reaction, Q is found to be 0.741. What direction would each reaction proceed to reach equilibrium?

When each reaction is at equilibrium, CO(g) is added to the mixture. How will each reaction respond?