CONCEPT: CALCULATING K FOR OVERALL REACTION

- Recall: many reactions cannot be carried out in ___ step, but instead require _____ steps to get the final product.
  - □ **Keq** of the overall reaction is the _____ of **Keq** values of these multiple steps.

EXAMPLE: Calculate the equilibrium constant for the overall reaction: $C\ (s) + CO_2\ (g) \rightleftharpoons 2\ CO\ (g)$ **Keq = ?** given the following partial reactions:

$H_2\ (g) + CO_2\ (g) \rightleftharpoons H_2O\ (g) + CO\ (g)$ **Keq = 7.65×10^{-1}**

$2\ H_2\ (g) + CO_2\ (g) \rightleftharpoons 2\ H_2O\ (g) + C\ (s)$ **Keq = 2.75×10^{-1}**

STEP 1: Start with the first compound in the overall reaction and **locate** it in the set of partial reactions.

- □ Compound from partial reaction must match (_____ , _____) with the one from the overall equation.
  - This may require you to reverse, multiply or divide the partial reaction, which will also affect **Keq**.

STEP 2: Keep moving onto the next compound in the overall reaction until you **locate** all compounds in partial reactions.

- □ skip compound found in multiple reactions

STEP 3: Combine the partial reactions and **cross out** reaction intermediates if present.

- □ **Reaction Intermediates**: Compounds that look the same, with one as a reactant and the other a product.

STEP 4: **Multiply** all the **Keq** values to obtain **Keq** of the overall reaction.

CONCEPT: CALCULATING K FOR OVERALL REACTION

PRACTICE: Calculate Kc for: $C\ (s) + \frac{1}{2}\ O_2\ (g) + H_2\ (g) \rightleftharpoons \frac{1}{2}\ CH_3OH\ (g) + \frac{1}{2}\ CO\ (g)$ Kc = ?

Given the following reactions:

$4\ C\ (s) + 2\ O_2\ (g) \rightleftharpoons 4\ CO\ (g)$ $\quad Kp = 2.11 \times 10^{43}$

$CH_3OH\ (g) + H_2O\ (g) \rightleftharpoons CO_2\ (g) + 3\ H_2\ (g)$ $\quad Kp = 7.17 \times 10^{-2}$

$CO\ (g) + H_2O\ (g) \rightleftharpoons CO_2\ (g) + H_2\ (g)$ $\quad Kp = 2.00 \times 10^{3}$