CONCEPT: ICE CHARTS

Calculating Equilibrium Amount

- An **ICE (I_____, C_____, E_____) Chart** is a table used to simplify the calculations of _____ reactions.
  - □ Used when missing _____ equilibrium amount for the compounds in a balanced equilibrium reaction.
  - □ The units of an ICE Chart are either in _____ (K_p) or _____ (K_c).

EXAMPLE: The equation for the formation of hydrogen iodide from H_2 and I_2 is given as:

$$H_2\,(g) + I_2\,(g) \rightleftharpoons 2\,HI\,(g)$$

The value of K_c for the reaction is 0.0218 at 25°C. What is the equilibrium concentration of HI in a sealed reaction vessel, if the initial concentrations of H_2 and I_2 are both 0.10 M and initially there is no HI present?

STEP 1: Setup an ICE Chart if missing _____ equilibrium amount for the compounds in the balanced equilibrium reaction.

ICE Chart Formation

	$H_2\,(g)$	+	$I_2\,(g)$	⇌	$2\,HI\,(g)$
I_____					
C_____					
E_____					

STEP 2: Using the _____ Row, place the amount given for any compound.

STEP 3: We _____ reactants to _____ products.

- □ Using the _____ Row, place an _____ for the reactants and a _____ for the products.
  - The _____ of the compound must be placed before the _____ variable.

STEP 4: Using the _____ Row, setup the equilibrium constant expression and solve.

- □ Check if a shortcut can be utilized to avoid the _____ formula.
  - If both shortcuts _____ then it must be used.

ICE Chart Shortcuts

Shortcut #1: _____ Root Method

When both the top and bottom of the expression are squared.

$$0.0218 = \frac{[2x]^2}{[0.10 - x]^2}$$

Shortcut #2: ____ Approximation Method

When the ratio of $[\ ]_0$ to K is _____ 500 you can ignore the _____.

$$\frac{[\ ]_0}{K} = \frac{0.55\ M}{2.5 \times 10^{-4}} = \qquad 2.5 \times 10^{-4} = \frac{[x^2]}{[0.55 - x]}$$

_____ Formula

$$\frac{- \quad \pm\sqrt{\quad -}}{2a}$$

CONCEPT: ICE CHARTS

PRACTICE: At a given temperature the gas phase reaction: N_2 (g) + O_2 (g) ⇌ 2 NO (g) has an equilibrium constant of 4.18×10^{-7}. What will be the concentration of NO at equilibrium if 2.00 moles of nitrogen and 6.00 moles oxygen are allowed to come to equilibrium in a 2.0 L flask?

PRACTICE: Consider the following reaction:

$$COBr_2\,(g) \rightleftharpoons CO\,(g) + Br_2\,(g)$$

A reaction mixture initially contains 0.15 atm $COBr_2$. Determine the equilibrium concentration of CO if K_p for the reaction at 25ºC is 4.08.

CONCEPT: ICE CHARTS

Calculating Equilibrium Constant

- Recall, the equilibrium constant (K) is a _____ of product to reactant amounts at equilibrium.
  - □ When only given ____ equilibrium amount the equilibrium constant K can be determined.

EXAMPLE: An important reaction in the formation of acid rain is,

$$2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g)$$

Initially, 0.30 M SO_2 and 0.20 M O_2 are mixed and allowed to react in an evacuated flask at 340ºC. When an equilibrium is established the equilibrium amount of SO_3 was found to be 0.0150 M. Calculate the equilibrium constant, K_c, for the reaction at 340ºC.

Follow the **STEPS 1** to **4** in order to determine the equilibrium constant expression for the reaction.

ICE Chart Formation

	$2\ SO_2(g)$	+	$O_2(g)$	$\rightleftharpoons$	$2\ SO_3(g)$
I_____					
C_____					
E_____					

STEP 5: Make the given equilibrium amount _____ to the value in the **EQUILIBRIUM ROW** of the compound to solve for x.

- □ Plug the value for x into the equilibrium constant expression to solve for _____.

CONCEPT: ICE CHARTS

PRACTICE: At a certain temperature, 0.810 mol NO is placed in a 5.00 L container. At equilibrium, 0.075 mol N_2 is present. Calculate K_c.

$$2\ NO\,(g) \rightleftharpoons N_2\,(g) + O_2\,(g)$$

PRACTICE: When 0.600 atm of NO_2 was allowed to come to equilibrium the total pressure was 0.875 atm. Calculate the K_p of the reaction.

$$2\ NO_2\,(g) \rightleftharpoons 2\ NO\,(g) + O_2\,(g)$$