CONCEPT: Kp AND Kc

- Recall, *equilibrium constant (Keq)* can be expressed as _____ or _____
  - □ Kp: used when dealing with gases (_____)
  - □ Kc: used when dealing with aqueous solutions in _____ (M)
- Kp and Kc are related through the following formula:

Kp vs Kc Formula

$K_{\_} = K_{\_}(RT)^{\_\_}$

- □ $K_{\_}$ & $K_{\_}$ = equilbrium constants
- □ R = gas constant = 0.08206 $\frac{L \cdot atm}{mol \cdot K}$
- □ T = temperature in Kelvin

$\Delta n = n$ _____ - n _____

- □ moles (n) = gas coefficients

EXAMPLE: Calculate Kp for the following reaction with Kc = 0.77 at 570 K:

$$2A\,(g) + B\,(s) \rightleftharpoons CD\,(g) + 3E\,(g)$$

CONCEPT: Kp AND Kc

PRACTICE: Partial pressures of the following equilibrium mixture at 955 K are: 130 torr methane, 92 torr hydrogen sulfide, 167 torr hydrogen gas and 532 torr carbon disulfide. What is the value of K_c at 955 K?

$$CH_4\,(g) + 2\,H_2S\,(g) \rightleftharpoons 4\,H_2\,(g) + CS_2\,(g)$$

PRACTICE: Consider the hypothetical reaction: ? X (g) + 3 Y (g) $\rightleftharpoons$ 3 Z (g), where Kp = 1.16×10^{-3} and Kc = 1.3 at 135ºC. Find the value of the coefficient of X.

CONCEPT: Kp AND Kc

$$K_p = K_c (RT)^{\Delta n}$$

Value of Δn

- The value of _____ can help determine if Kc is greater, less than or equal to Kp.
  - □ If _____ moles of gas ($\Delta n \geq 1$), then Kp > Kc

$\Delta n \geq 1$: Kc Kp	$\Delta n < 0$: Kc Kp	$\Delta n = 0$: Kc Kp

EXAMPLE: For the following reactions, identify whether Kp is greater than, less than or equal to Kc.

a) $4\ NH_3\ (g) + 3\ O_2\ (g) \rightleftharpoons 2\ N_2\ (g) + 6\ H_2O\ (g)$ _____

b) $2\ HI\ (g) \rightleftharpoons H_2\ (g) + I_2\ (g)$ _____

c) $CO\ (g) + 3\ H_2\ (g) \rightleftharpoons CH_4\ (g) + H_2O\ (g)$ _____

PRACTICE: For which reaction(s) will Kp = Kc?

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

b) $CaCO_3\ (s) \rightleftharpoons CaO\ (s) + CO_2\ (g)$

c) $2\ CH_4\ (g) \rightleftharpoons C_2H_2\ (g) + 3\ H_2\ (g)$

d) $H_2O\ (g) + CO\ (g) \rightleftharpoons H_2\ (g) + CO_2\ (g)$

PRACTICE: Select the correct choice below for the reaction: $PCl_5\ (g) \rightleftharpoons PCl_3\ (g) + Cl_2\ (g)$

a) Kp = Kc b) Kp > Kc c) Kp < Kc d) Keq = Kp e) None of the following