Calculation of K_c/K_p

1. Calculate K_p for the following reaction at 125°C.

$$2\ NH_3\ (g) \rightleftarrows\ N_2\ (g)\ +\ 3\ H_2\ (g)$$

The equilibrium pressures are: $P_{NH_3} = 0.541\ atm,\ P_{N_2} = 3.73\ atm, and\ P_{H_2} = 11.2\ atm$

$$K_p = \frac{P_{H_2}^3\ P_{NH_3}}{P_{NH_3}^2} = \frac{(11.2)^3 \times (3.73)}{(0.541)^2} = 1.79 \times 10^4$$

2. Consider the following reaction at 100°C. The initial concentration of $[CO_2]$ = 0.325 M and $[H_2]$ = 0. 0768 M. The equilibrium concentration of [CO] = 0.0221 M.

$$CO_2\ (g) + H_2\ (g) \rightleftarrows\ CO\ (g) + H_2O\ (g)$$

a) Write an ICE table.

	CO_2 (g)	+ H_2 (g)	⇄ CO (g)	+ H_2O (g)
I	0.0821 M	0. 0768 M	0	0
C	-x	-x	+x	+x
E	0.0821 – x	0. 0768 - x	x	x

X = 0.0221 M

b) Calculate the equilibrium concentrations of each species.

$[CO_2]_{eq}$ = 0.0821 M – 0.0221 M = 0.0600 M
$[H_2]_{eq}$ = 0.0768 M – 0.0221 M = 0.057 M
$[CO]_{eq} = [H_2O]_{eq}$ = 0.0221 M

c) Calculate K_c.

$$K_c = \frac{[CO][H_2O]}{[CO_2][H_2]} = \frac{(0.0221)(0.0221)}{(0.0600)(0.057)} = 1.43 \times 10^{-1}\ M$$

d) Are there more reactants or products at equilibrium?
reactants