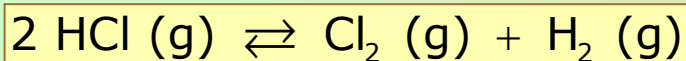


Tables of chemical equilibrium

Consider this chemical equation: $2 \text{HCl (g)} \rightleftharpoons \text{Cl}_2 \text{(g)} + \text{H}_2 \text{(g)}$
 In a 4 L container initially we have 2 mol of HCl and the pressure is 10 atm. At the equilibrium the dissociation percent of HCl is 20 %.
 Determine the equilibrium constants K_c and K_p .

The table in terms of # of moles.

In our case:



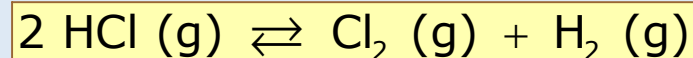
n_{initial}	2	0	0
Δn	-2x	x	x
n_{equil}	2-2x	x	x

Where:

$$2x = \frac{20}{100} * 2 \text{ mol} = 0.4 \text{ mol}$$

$$K_c = \frac{[\text{Cl}_2][\text{H}_2]}{[\text{HCl}]^2} = \frac{(0.05 \text{ M})^2}{(0.4 \text{ M})^2} = 0.0156$$

In general:



n_{initial}	n_0	0	0
Δn	-2x	x	x
n_{equil}	$n_0 - 2x$	x	x

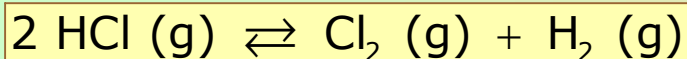
When initially only reactant

$$K_c = \frac{[\text{Cl}_2][\text{H}_2]}{[\text{HCl}]^2} = \frac{(x/V)^2}{[(n_0 - 2x)/V]^2} = \frac{x^2}{(n_0 - 2x)^2}$$

Tables of chemical equilibrium

Consider this chemical equation: $2 \text{HCl (g)} \rightleftharpoons \text{Cl}_2 \text{(g)} + \text{H}_2 \text{(g)}$
 In a 4 L container initially we have 2 mol of HCl and the pressure is 10 atm. At the equilibrium the dissociation percent of HCl is 20 %.
 Determine the equilibrium constants K_c and K_p .

The table in terms of # of moles:
 In our case:



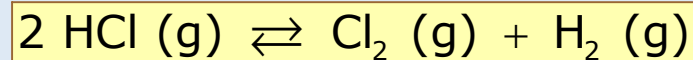
n_{initial}	2	0	0
Δn	-2α	α	α
n_{equil}	$2(1-\alpha)$	α	α

Where:

$$\alpha = \frac{20}{100} = 0.2$$

$$K_c = \frac{[\text{Cl}_2][\text{H}_2]}{[\text{HCl}]^2} = \frac{(0.05 \text{ M})^2}{(0.4 \text{ M})^2} = 0.0156$$

In general:



n_{initial}	n_0	0	0
Δn	$-n_0\alpha$	$n_0\alpha/2$	$n_0\alpha/2$
n_{equil}	$n_0(1-\alpha)$	$n_0\alpha/2$	$n_0\alpha/2$

When initially only reactant

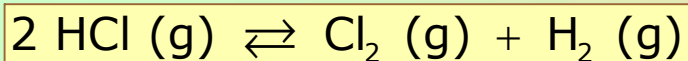
$$K_c = \frac{[\text{Cl}_2][\text{H}_2]}{[\text{HCl}]^2} = \frac{(n_0\alpha/2V)^2}{[n_0(1-\alpha)/V]^2} = \frac{\alpha^2}{4(1-\alpha)^2}$$

Tables of chemical equilibrium

Consider this chemical equation: $2 \text{HCl (g)} \rightleftharpoons \text{Cl}_2 \text{(g)} + \text{H}_2 \text{(g)}$
 In a 4 L container initially we have 2 mol of HCl and the pressure is 10 atm. At the equilibrium the dissociation percent of HCl is 20 %.
 Determine the equilibrium constants K_c and K_p .

The table in terms of concentrations.

In our case:



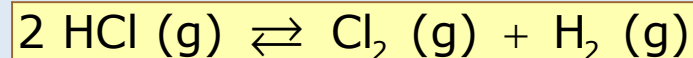
c_{initial}	0.5	0	0
Δc	-2x	x	x
c_{equil}	0.5-2x	x	x

Where:

$$2x = \frac{20}{100} * 0.5 \frac{\text{mol}}{\text{L}} = 0.1 \text{ M}$$

$$K_c = \frac{[\text{Cl}_2][\text{H}_2]}{[\text{HCl}]^2} = \frac{(0.05 \text{ M})^2}{(0.4 \text{ M})^2} = 0.0156$$

In general:



c_{initial}	c_0	0	0
Δc	-2x	x	x
c_{equil}	c_0-2x	x	x

When initially only reactant

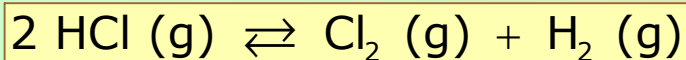
$$K_c = \frac{[\text{Cl}_2][\text{H}_2]}{[\text{HCl}]^2} = \frac{(x)^2}{(c_0-2x)^2}$$

Tables of chemical equilibrium

Consider this chemical equation: $2 \text{HCl (g)} \rightleftharpoons \text{Cl}_2 \text{(g)} + \text{H}_2 \text{(g)}$
 In a 4 L container initially we have 2 mol of HCl and the pressure is 10 atm. At the equilibrium the dissociation percent of HCl is 20 %.
 Determine the equilibrium constants K_c and K_p .

The table in terms of concentrations.

In our case:



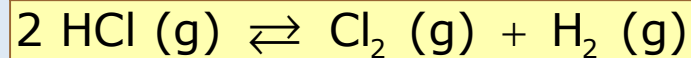
c_{initial}	0.5	0	0
Δc	-0.5α	0.25α	0.25α
c_{equil}	$0.5 (1-\alpha)$	0.25α	0.25α

Where:

$$\alpha = \frac{20}{100} = 0.2$$

$$K_c = \frac{[\text{Cl}_2][\text{H}_2]}{[\text{HCl}]^2} = \frac{(0.05 \text{ M})^2}{(0.4 \text{ M})^2} = 0.0156$$

In general:



c_{initial}	c_0	0	0
Δc	$-c_0 \alpha$	$c_0 \alpha / 2$	$c_0 \alpha / 2$
c_{equil}	$c_0 (1-\alpha)$	$c_0 \alpha / 2$	$c_0 \alpha / 2$

When initially only reactant

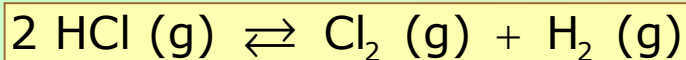
$$K_c = \frac{[\text{Cl}_2][\text{H}_2]}{[\text{HCl}]^2} = \frac{\alpha^2}{4(1-\alpha)^2}$$

Tables of chemical equilibrium

Consider this chemical equation: $2 \text{HCl (g)} \rightleftharpoons \text{Cl}_2 \text{(g)} + \text{H}_2 \text{(g)}$
 In a 4 L container initially we have 2 mol of HCl and the pressure is 10 atm. At the equilibrium the dissociation percent of HCl is 20 %.
 Determine the equilibrium constants K_c and K_p .

The table in terms of pressure.

In our case:



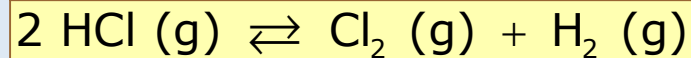
P_{initial}	10	0	0
Δp	-2x	x	x
p_{equil}	10-2x	x	x

Where:

$$2x = \frac{20}{100} * 10 \text{ atm} = 2 \text{ atm}$$

$$K_p = \frac{P_{\text{Cl}_2} P_{\text{H}_2}}{P_{\text{HCl}}^2} = \frac{(1 \text{ atm})^2}{(8 \text{ atm})^2} = 0.0156$$

In general:



P_{initial}	p_0	0	0
Δp	-2x	x	x
p_{equil}	$p_0 - 2x$	x	x

When initially only reactant

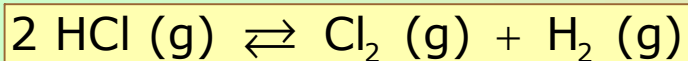
$$K_p = \frac{P_{\text{Cl}_2} P_{\text{H}_2}}{P_{\text{HCl}}^2} = \frac{x^2}{(p_0 - 2x)^2}$$

Tables of chemical equilibrium

Consider this chemical equation: $2 \text{HCl (g)} \rightleftharpoons \text{Cl}_2 \text{(g)} + \text{H}_2 \text{(g)}$
 In a 4 L container initially we have 2 mol of HCl and the pressure is 10 atm. At the equilibrium the dissociation percent of HCl is 20 %.
 Determine the equilibrium constants K_c and K_p .

The table in terms of pressure.

In our case:



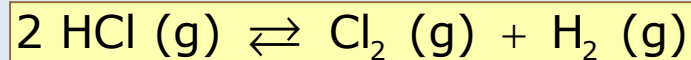
P_{initial}	10	0	0
Δp	-10α	5α	5α
p_{equil}	$10 (1-\alpha)$	5α	5α

Where:

$$\alpha = \frac{20}{100} = 0.2$$

$$K_p = \frac{P_{\text{Cl}_2} P_{\text{H}_2}}{P_{\text{HCl}}^2} = \frac{(1 \text{ atm})^2}{(8 \text{ atm})^2} = 0.0156$$

In general:



P_{initial}	p_0	0	0
Δp	$-p_0 \alpha$	$p_0 \alpha/2$	$p_0 \alpha/2$
p_{equil}	$p_0 (1-\alpha)$	$p_0 \alpha/2$	$p_0 \alpha/2$

When initially only reactant

$$K_p = \frac{P_{\text{Cl}_2} P_{\text{H}_2}}{P_{\text{HCl}}^2} = \frac{\alpha^2}{4 (1-\alpha)^2}$$