EQUILIBRIUM CALCULATIONS

Two types of questions:

1. calculating K_{eq} from known concentration values

2. calculating concentration values when K_{eq} is given

EQUILIBRIUM CALCULATIONS

Calculating K_{eq}

Example #1

$$N_2O_{4(g)} <===> 2\ NO_{2(g)}$$

At 25°C, the equilibrium concentrations are:

$[N_2O_4] = 0.0292$ mol / L

$[NO_2] = 0.0116$ mol / L

Calculate K_{eq} at 25°C.

$$\therefore k_{eq} = 4.61 \times 10^{-3}$$

EQUILIBRIUM CALCULATIONS

Calculating K_{eq}

Example #2

$$N_{2(g)} + 3\ H_{2(g)} <====> 2\ NH_{3(g)}$$

At 200°C, the concentrations at equilibrium are:

$[N_2] = 2.12$, $[H_2] = 1.75$, and $[NH_3] = 84.3$

Calculate K_{eq} at 200°C.

.: the k_{eq} is 625

EQUILIBRIUM CALCULATIONS

Calculating K_{eq}

Example #3

$$H_{2(g)} + I_{2(g)} <====> 2\ HI_{(g)}$$

Initial moles in a 2.00 L flask:
$[H_2]$ = 0.200 mol and $[I_2]$ = 0.200 mol

At equilibrium, $[I_2]$ = 0.020 mol / L.

a)What is K_{eq} at steady conditions?
b)What percent of iodine vapour reacted?

EQUILIBRIUM CALCULATIONS

ICE tables

Whenever questions involve initial conditions changing to reach equilibrium, ICE tables are a good method to organize your information.

I = initial concentrations

C = change in concentrations

E = equilibrium concentrations

EQUILIBRIUM CALCULATIONS

Calculating K_{eq} - Example #3

Initial moles in a 2.00 L flask: $[H_2]$ = 0.200 mol and $[I_2]$ = 0.200 mol

At equilibrium, $[I_2]$ = 0.020 mol / L.

$$H_{2(g)} + I_{2(g)} <=> 2\ HI_{(g)}$$

I

C

E

a) What is K_{eq} at steady conditions?

b) What percent of iodine vapour reacted?

.: $\%I_2$ reacted = 80%

.: K_{eq} = 64

EQUILIBRIUM CALCULATIONS

Calculating K_{eq}

Example #4

2.00 mol of HI in 2.00 L flask at 425°C react to produce H_2 and I_2. At equilibrium, $[H_2]$ and $[I_2]$ = 0.214 mol / L.

What is K_{eq} for this reaction?

EQUILIBRIUM CALCULATIONS

Calculating K_{eq} - Example #4

2.00 mol of HI in 2.00 L flask at 425°C react to produce H_2 and I_2. At equilibrium, $[H_2]$ and $[I_2]$ = 0.214 mol / L.

What is K_{eq} for this reaction?

$$2\ HI_{(g)} \quad <=> \quad H_{2(g)} + I_{2(g)}$$

I
C
E

.: the K_{eq} is 0.140

EQUILIBRIUM CALCULATIONS

Calculating K_{eq}

Example #5

$$N_{2(g)} + 3\ H_{2(g)} <====> 2\ NH_{3(g)}$$

Initial concentrations:

$[N_2] = 0.32$ M and $[H_2] = 0.66$ M

What is K_{eq} when equilibrium $[H_2]$ is 0.30 M?

EQUILIBRIUM CALCULATIONS

Calculating K_{eq} - Example #5

Initial concentrations: $[N_2]$ = 0.32 M and $[H_2]$ = 0.66 M

What is K_{eq} when equilibrium $[H_2]$ is 0.30 M?

$$N_{2(g)} + 3\ H_{2(g)} <=> 2\ NH_{3(g)}$$

I

C

E

$\therefore k_{eq} = 11$

EQUILIBRIUM CALCULATIONS

Calculating K_{eq} - Example #6

Calculate K_{eq}.

$$2\ C_{(s)} + O_{2(g)} \text{ <====> } 2\ CO_{(g)}$$

I	10	8	20
C			
E		15	

$\therefore k_{eq} = 2$

EQUILIBRIUM CALCULATIONS

Homework:

- Textbook Questions
- Read Section 7.1
- p 428 #1
- p 437 # 6, 7
- p 438 # 3, 4, 7, 8, 9
- p 448 – 449 #6