Chemical Equilibrium

#1

1   A + B ⇌ C $K_1 = 1.2 \times 10^3$

2   C ⇌ 2 D $K_2 = 4.8 \times 10^{-6}$

3   B + D ⇌ A $K_3 = 2.1 \times 10^5$

Calculate K for following chemical equilibria:

a   C ⇌ A + B

b   2 A ⇌ C + D

c   A + B ⇌ 2 D

d   2 B + C ⇌ 2 A

e   4 D ⇌ 2 C

Solution

a   C ⇌ A + B   Reaction a is the reverse reaction of reaction 1

$$K_a = \frac{1}{K_1} = \frac{1}{1.2 \times 10^3} = 8.3 \times 10^{-2}$$

b   2 A ⇌ C + D   Reaction b = reaction 1 – reaction 3
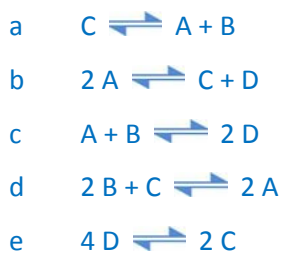
$$K_b = \frac{K_1}{K_3} = \frac{1.2 \times 10^3}{2.1 \times 10^5} = 5.7 \times 10^{-3}$$

c   A + B ⇌ 2 D   Reaction c = reaction 1 + reaction 2

$$K_c = K_1 \times K_2 = 1.2 \times 10^3 \times 4.8 \times 10^{-6} = 5.8 \times 10^{-3}$$

d   2 B + C ⇌ 2 A   Reaction d = reaction 2 + 2 × reaction 3

$$K_d = K_2 \times K_3^2 = 4.8 \times 10^{-6} \times \left(2.1 \times 10^{-5}\right)^2 = 2.1 \times 10^{-15}$$

e   4 D ⇌ 2 C   Reaction e is the reverse of 2 × reaction 2

$$K_e = \frac{1}{K_2^2} = \frac{1}{\left(4.8 \times 10^{-6}\right)^2} = 4.3 \times 10^{10}$$