

Law of equilibrium and Equilibrium constant

1. (d) Equilibrium constant for the reaction, $3A + 2B \rightleftharpoons C$ is

$$K = \frac{[C]}{[A]^3 [B]^2}.$$

2. (d) Suppose 1 mole of A and B each taken then 0.8 mole/litre of C and D each formed remaining concentration of A and B will be $(1 - 0.8) = 0.2$ mole/litre each.

$$K_c = \frac{[C][D]}{[A][B]} = \frac{0.8 \times 0.8}{0.2 \times 0.2} = 16.0$$

3. (c)
- | | |
|--------------------|----------------------------------|
| | $A + B \rightleftharpoons C + D$ |
| Initial conc. | 4, 4 0 0 |
| After T time conc. | (4-2) (4-2) 2 2 |
- Equilibrium constant = $\frac{[C][D]}{[A][B]} = \frac{2 \times 2}{2 \times 2} = 1$

4. (a) $H_2 + I_2 \rightleftharpoons 2HI$; $[HI] = 0.80$, $[H_2] = 0.10$, $[I_2] = 0.10$

$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{0.80 \times 0.80}{0.10 \times 0.10} = 64$$

5. (a) Those reaction which have more value of K proceeds towards completion.
 6. (d) K_c is a characteristic constant for the given reaction.
 7. (c) Equilibrium constant is independent of original concentration of reactant.
 8. (a) K_p is constant and does not change with pressure.
 9. (a) For reaction $A + 2B \rightleftharpoons C$

$$K = \frac{[C]}{[A][B]^2} = \frac{0.216}{0.06 \times 0.12 \times 0.12} = 250.$$

- 10 (d) $K_c = [HI]^2 / [H_2][I_2]$

Explanation:

For a general reaction $aA + bB \rightleftharpoons cC + dD$,

the equilibrium constant $K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$

Applying this to $H_2 + I_2 \rightleftharpoons 2HI$,

$$K_c = [HI]^2 / ([H_2][I_2]).$$



11. (b) $A + 2B \rightleftharpoons C + 3D$

$$K = \frac{[pC][pD]^3}{[pA][pB]^2} = \frac{0.30 \times 0.50 \times 0.50 \times 0.50}{0.20 \times 0.10 \times 0.10} = 18.75$$

12. (c) $[C] / ([A][B]^2)$

Explanation:

For a general reaction $aA + bB \rightleftharpoons cC$,

the equilibrium constant $K_c = \frac{[C]^c}{([A]^a[B]^b)}$.

Here, $a = 1$, $b = 2$, $c = 1$

So, $K_c = [C] / ([A][B]^2)$.

13. (a) $P\underset{2}{Cl}_5 \rightleftharpoons P\underset{0}{Cl}_3 + \underset{0}{Cl}_2$

$$\frac{2 \times 60}{100} \quad \frac{2 \times 40}{100} \quad \frac{2 \times 40}{100}$$

Volume of container = 2 litre.

$$K_c = \frac{\frac{2 \times 40}{100 \times 2} \times \frac{2 \times 40}{100 \times 2}}{\frac{2 \times 60}{100 \times 2}} = 0.266$$

14. (d) $\Delta n = 1$ for this change

So the equilibrium constant depends on the unit of concentration.

15. (d) Unit of $K_p = (atm)^{\Delta n}$

Unit of $K_c = (mole / litre)^{\Delta n}$

$$= [mole / litre]^0 = 0$$

16. (c) $K = \frac{[NO_2]^2}{[N_2O_4]} = \frac{\left[2 \times \frac{10^{-3}}{2}\right]^2}{\left[\frac{.2}{2}\right]} = \frac{10^{-6}}{10^{-1}} = 10^{-5}$.





- 17 (a) Number of molecules per litre

Explanation:

In equilibrium calculations, concentration is usually expressed in **moles per litre (mol/L)**, which corresponds to the **number of molecules per litre** when converted using Avogadro's number.

- 18 (a) mol litre⁻¹

Explanation:

For the reaction $A + B \rightleftharpoons C$,

$$K_c = [C] / ([A][B])$$

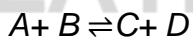
Each concentration term has unit mol L⁻¹, so

$$K_c = (\text{mol L}^{-1}) / (\text{mol L}^{-1} \times \text{mol L}^{-1}) = \text{mol}^{-1} \text{L}^1 = \text{mol L}^{-1}.$$

19. (b) For $A + B \rightleftharpoons C + D$

$$K = \frac{[C][D]}{[A][B]} = \frac{0.4 \times 1}{0.5 \times 0.8} = 1.$$

20. (c)



Initial

1 1 0 0

remaining at equilibrium 0.4 0.4 0.6 0.6

$$K = \frac{[C][D]}{[A][B]} = \frac{0.6 \times 0.6}{0.4 \times 0.4} = \frac{36}{16} = 2.25.$$

