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.

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

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) $Kc = [HI]^2 / [H_2][I_2]$

Explanation:

For a general reaction aA + bB ⇌ cC + dD,

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

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

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

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 ⇌ cC,

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

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

So, **Kc = [C] / ([A][B]²)**.

13. (a) $\underset{2}{PCl_5} \rightleftharpoons \underset{0}{PCl_3} + \underset{0}{Cl_2}$

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

Volume of container = 2 *litre*.

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

14. (d) Δn = 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 ⇌ C,
Kc = [C] / ([A][B])

Each concentration term has unit mol L^{-1}, so
Kc = (mol L^{-1}) / (mol L^{-1} × mol L^{-1}) = mol^{-1} L^{1} = **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) $A + B \rightleftharpoons C + D$

	A	B	C	D
Initial	1	1	0	0
remaining at equilibrium	0.4	0.4	0.6	0.6

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