

K_p & K_c Relationship and Characteristics of K

21. (c) For this reaction there is no change in equilibrium constant by change of volume.

22. (c) If $\Delta n = 0$ then $K_p = K_c$

23. (a) $k_p = k_c (RT)^{\Delta n}$

$$\Delta n = 3 - 2 = 1; k_p > k_c.$$

24. (d) Equilibrium constant depends upon temperature.

25. (d) $2NOCl_{(g)} \rightleftharpoons 2NO_{(g)} + Cl_2_{(g)}$

$$K_p = K_c (RT)^{\Delta n}$$

$$K_p = 3 \times 10^{-6} (0.0821 \times 700) = 172.41 \times 10^{-6}$$

$$= 1.72 \times 10^{-4}$$

26 (b) $N_2 + O_2 \rightleftharpoons 2NO$

Explanation:

The relation between the two constants is $K_p = K_c (RT)^{\Delta n}$,

where $\Delta n = (\text{moles of gaseous products}) - (\text{moles of gaseous reactants})$.

If $\Delta n = 0$, then $(RT)^0 = 1$, so $K_p = K_c$.

Now check each:

- (a) $\Delta n = 2 - (1 + 3) = -2$
- (b) $\Delta n = 2 - (1 + 1) = 0$
- (c) $\Delta n = (1 + 1) - 1 = +1$
- (d) $\Delta n = (2 + 1) - 2 = +1$

Hence, for $N_2 + O_2 \rightleftharpoons 2NO$, $K_p = K_c$.

27. (b) $K' = K^n$; Hence $n = \frac{1}{2}$

$$\therefore K' = K^{1/2} = \sqrt{K}$$

28 (c) 16



Explanation:

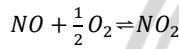
The equilibrium constant K_p depends **only on temperature** — not on pressure, volume, or concentration changes.

When the volume is reduced, the system temporarily shifts its equilibrium position (Le Chatelier's principle) to counter the change, but the **numerical value of K_p remains unchanged** as long as the temperature is constant.

Therefore, $K_p = 16$ even after the volume is halved.

29. (c) $2NO_2 \rightleftharpoons 2NO + O_2$ (i)

$$K = 1.6 \times 10^{-12}$$



.....(ii)

Reaction (ii) is half of reaction (i)

$$K = \frac{[NO]^2 [O_2]}{[NO_2]^2}$$

.....(i)

$$K' = \frac{[NO_2]}{[NO][O_2]^{1/2}}$$

.....(ii)

On multiplying (i) and (ii)

$$K \times K' = \frac{[NO]^2 [O_2]}{[NO_2]^2} \times \frac{[NO_2]}{[NO][O_2]^{1/2}} = \frac{[NO][O_2]^{1/2}}{[NO_2]} = \frac{1}{K'}$$

$$K \times K' = \frac{1}{K'^2}; K = \frac{1}{K'^2}; K' = \frac{1}{\sqrt{K}}$$

30. (b) $K_p = K_c(RT)^{\Delta n}; \Delta n = 1$

So K_c will be less than K_p .

31. (d) Changes with temperature

Explanation:

The **equilibrium constant (K)** depends **only on temperature**.

- A **catalyst** affects only the rate of attaining equilibrium, not the value of K.
- **Change in temperature** alters the equilibrium constant — it increases or decreases depending on whether the reaction is **endothermic or exothermic**.



32. (d) K_1 for $N_2 + 3H_2 \rightleftharpoons 2NH_3$

$$K_2 \text{ for } NH_3 \rightleftharpoons \frac{1}{2}N_2 + \frac{3}{2}H_2$$

$$K_1 \times K_2 = \frac{[NH_3]^2}{[N_2][H_2]^3} \times \frac{[N_2]^{1/2}[H_2]^{3/2}}{[NH_3]}$$

$$K_1 \times K_2 = \frac{1}{K_2}; K_2 = \frac{1}{\sqrt{K_1}}$$

33 (d) The forward reaction is favoured by the addition of a catalyst

Explanation:

A catalyst only speeds up both the forward and reverse reactions equally, helping the system reach equilibrium faster.

It does not shift the position of equilibrium or favour either direction.

34. (a) $K_p = K_c(RT)^{\Delta n}; \Delta n = 2 - 4 = -2$

$$K_p = 6 \times 10^{-2} \times (0.0812 \times 773)^{-2}$$

$$K_p = \frac{6 \times 10^{-2}}{(0.0812 \times 773)^2} = 1.5 \times 10^{-5}.$$

35. (b) $2.303 \log \frac{K_2}{K_1} = \frac{\Delta H}{R} \frac{[T_2 - T_1]}{T_1 \times T_2}$

$\Delta H = +ve$ for the reaction

36. (d) $N_2 + 3H_2 \rightleftharpoons \frac{4}{2} 2NH_3$

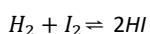
$$\Delta n = 2 - 4 = -2$$

$$K_p = K_c[RT]^{\Delta n}; K_p = K_c[RT]^{-2}$$

$$K_c = \frac{K_p}{[RT]^{-2}} = \frac{1.44 \times 10^{-5}}{[0.082 \times 773]^{-2}}$$

37. (d) Catalyst does not affect equilibrium constant.

38. (d) K for dissociation of $H_2I = ?$



$$K_a = 50, K_b = \frac{1}{50} = 0.02$$

39. (b) $2\underset{3}{SO_2} + O_2 \rightleftharpoons 2\underset{2}{SO_3}$ for this reaction

$$\Delta n = -1 ; \therefore K_c > K_p$$

40. (b) $CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$

$$K_p = P_{CO_2}$$

Solid molecule does not have partial pressure so in calculation of K_p only P_{CO_2} is applicable.

