Equilibrium Notes

O_2, C_2H_6

1. Write the equation for the combustion of ethane gas. How many L of CO_2 gas at 298 K and 760 mmHg are made when 20.0 grams of ethane burns completely?

$$C_2H_{6(g)} + \frac{7}{2}O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(\ell)}$$

$$2C_2H_{6(g)} + 7O_{2(g)} \rightarrow 4CO_{2(g)} + 6H_2O_{(\ell)}$$

20.0 g

? L
298 K
760 mmHg

$$20.0\text{ g } C_2H_6 \left| \frac{1\text{ mol } C_2H_6}{30.08\text{ g}} \right| \frac{4\text{ mol } CO_2}{2\text{ mol } C_2H_6} = 1.33\text{ mol } CO_2$$

$$V = \frac{nRT}{P} = \frac{(1.33\text{ mol})(.0821)(298\text{ K})}{1\text{ atm}} = 32.5\text{ L } CO_2$$

$3.0\text{ g } N_2 \left|\frac{1\text{ mol } N_2}{28.02\text{ g}}\right. = .11\text{ mol } N_2$ $2.0\text{ g } O_2 \left|\frac{1\text{ mol}}{32\text{ g}}\right. = .063\text{ mol } O_2$

2. 3.0 grams of Nitrogen gas and 2.0 grams of oxygen gas are mixed in a 2.00L container at 298 K. If the pressure of the nitrogen gas is 1.3097 atm what is the pressure of the O_2? P_{O_2}?

$$P_T = \frac{n_T RT}{V}$$

$$P_T = \frac{(.173\text{ mol})(.0821)(298\text{K})}{2.00\text{L}}$$

$P_T = 2.07$ atm

$P_T = P_{N_2} + P_{O_2}$

$P_{O_2} = 2.07 - 1.3097$

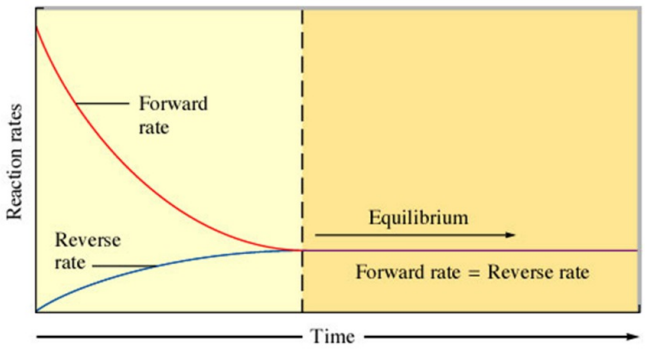
$P_{O_2} = .76$ atm

$$P_{O_2} = \frac{n_{O_2} RT}{V}$$

$$P_{O_2} = \frac{(.063\text{ mol})(.0821)(298\text{K})}{2.0\text{L}}$$

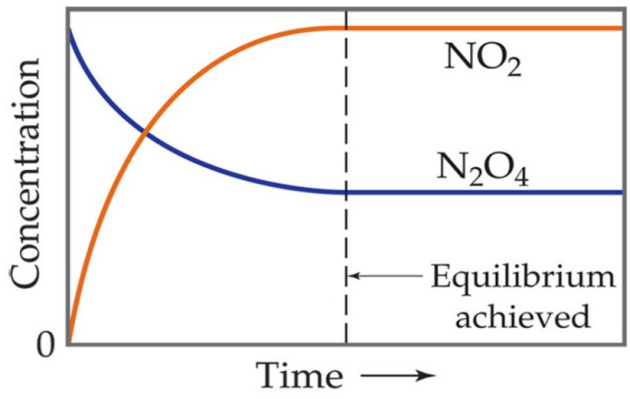
$P_{O_2} = .76$ atm

3. What is Equilibrium?



rate forward RXN = Rate reverse RXN

$\therefore [R]$ & $[P]$ Remains constant



* Does not = SAME $[R]$ & $[P]$

4. What sign in a chemical equation tells you "Equilibrium"?

5. What is the generic formula of the Equilibrium Constant Expression for concentration? For Pressure?

$$aA(g) + bB(g) \leftrightarrow cC(g) + dD(g)$$

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

$$K = \frac{P}{R}$$

$$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$$

6. What types of species are used in K expressions?

gases & aqueous

7. Does K change when starting concentrations/pressures are changed?

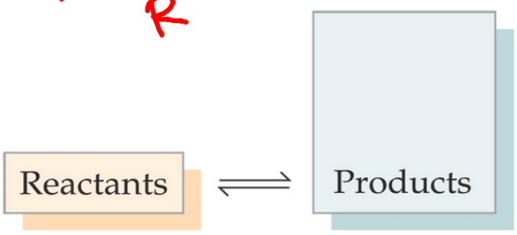
No

8. Does K change when temperature is changed?

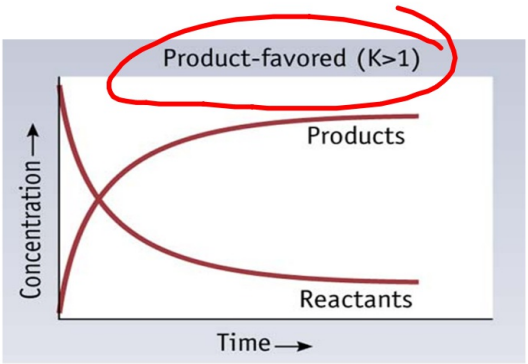
yes

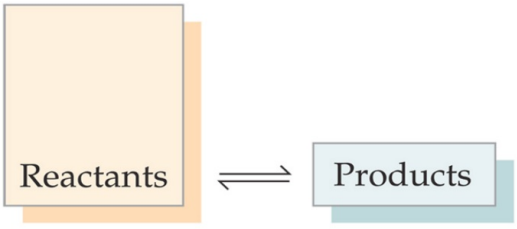
9. How can the value of K be used to tell you which side is favored?

$K = \frac{P}{R}$

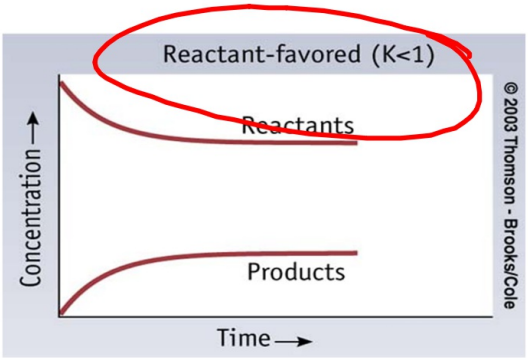


$K \gg 1$





$K \ll 1$



10. What are the 3 rules for adjusting an equilibrium constant expression and explain how they work?

$K = \frac{P}{R}$

① Reverse RXN $= \frac{1}{K}$

$A \leftrightarrow B \quad K = \frac{[B]}{[A]}$

$B \leftrightarrow A \quad K = \frac{[A]}{[B]}$

② Multiply Coefficients in Eqn. = Raise K to the power that you multiplied the coefficients

$2A \leftrightarrow 2B \quad K = \frac{[B]^2}{[A]^2}$

$K_2 = (K_1)^2$

③ Add Eqns = multiply the individual K values together

$A \leftrightarrow B \quad K_1$

$C \leftrightarrow D \quad K_2$

$A + C \leftrightarrow B + D \quad K_3 = K_1 K_2$

$2HI_{(g)} \leftrightarrow H_{2(g)} + I_{2(g)} \quad K_{c_1} = 1.45 \times 10^{-4}$

$2H_{2(g)} + 2I_{2(g)} \leftrightarrow 4HI_{(g)} \quad K_{c_2} = ?$

Reverse = $\frac{1}{K_{c_1}}$

Mult. coeff X2 = $(K_{c_1})^2$

$K_{c_2} = \left(\frac{1}{K_{c_1}}\right)^2 = \left(\frac{1}{1.45 \times 10^{-4}}\right)^2 = \boxed{4.76 \times 10^7}$

11. What is the mathematical relationship between Kp and Kc?

12. In the mathematical relationship what is delta n? What value of R is used?

13. What is the Reaction Quotient (Q)? How is it used to decide which way a reaction will shift to reach equilibrium if the reaction is not yet at equilibrium?

14. What is LeChatlier's Principal?