$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

b. Double arrow because it is not so favored → 15% goes to products

1. Widely used for fertilizer (& explosives)

Whether a process is reactant or product favored depends on the ving forces

. K: equilibrium constant

$O_2(g) + O(g) \rightleftharpoons O_3(g)$, ozone formed and degraded at different ites

b. At equilibrium, the rate of formation equals the rate of destruction

1. rate formation = rate destruction

. To predict whether reaction is reactant-favored or product-favored, look at K

1. If $K > 1$, products favored

2. If $K < 1$, reactants favored

$N_2O_4(g) \rightarrow 2NO_2(g)$, initial concentrations don't effect K, same equilibrium concentrations are found → same K

eriving an expression for K

For the forward rxn, $rate_f = k_f[N_2O_4]$

b. For the reverse rxn, $rate_r = k_r[NO_2]^2$ ← coefficient

At equilibrium, $rate_f = rate_r$, so $k_f[N_2O_4] = k_r[NO_2]^2$

b. $K = \frac{[NO_2]^2}{[N_2O_4]} = \frac{\text{products}}{\text{reactants}}$

1. K = equilibrium constant (this is uppercase!)

2. k = rate constant

or a general reaction, $aA + bB \rightleftharpoons dD + eE$

. $K = \frac{[D]^d[E]^e}{[A]^a[B]^b} = \frac{\text{products}}{\text{reactants}}$, K is unitless and concentrations are molar at EQUILIBRIUM

D. What is K for $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$?

a. $K = \frac{[NH_3]^2}{[N_2][H_2]^3}$

1. K depends on the temperature, which may be a driving force

E. Gases

a. K_p: the equilibrium constant in terms of pressures

1. Can be done because pressure is proportional to concentration

aa. $K_p = \frac{(P_D)^d (P_E)^e}{(P_A)^a (P_B)^b}$

How do K_c and K_p Relate?

a. $P = \frac{nRT}{V}$, $\frac{n}{V}$ is concentration

1. So, $K_p = K_c(RT)^{\Delta n}$, where Δn is moles products − moles reactants

aa. K_c and K_p may or may not be the same

What does K mean?

a. $K >> 1$, product favored, equilibrium lies to the right

aa. $K << 1$, reactant favored, equilibrium lies to the left

aaa. $10^{-3} \leq K \leq 10^3$, significant amounts of products and reactants

Manipulating Expressions for K

1. If you flip a reaction then its K is $1/K$

a. If you multiply a reaction by a constant, then its K is K^2

aa. If you add reactions together, then multiply the K's