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***Equilibrium: Unit 7***

*We are obviously nice enough to help all of you who don’t feel like searching for your practice packet, so thank us later :)*

***Equilibrium basics:***

* Equilibrium is when the ratesof the forward and the reverse reactions are ***equal***, but the concentrations are ***constant.***
* Let’s go over the Le Chatelier Rules:
1. If a substance or heat is added to the side that the substance is on, then it will shift away from that substance. (Add; away)
2. If a substance is taken away from the side that the substance is on, then it will shift away from that substance. (take away; toward)
3. If pressure is added,there is less room for moles to fit, so it shifts to the side with LESS MOLES OF GAS. If pressure is taken away, then there is more room for moles, so it shifts to the side with MORE MOLES OF GAS.
4. Catalysts speed up the forward AND the reverse reactions. Equilibrium doesn’t change.
5. So basically just add away, take away toward if you’re even lazier than I thought.
* When actually responding to a question you should follow the following wording
* When adding a catalyst or increasing the surface area of a solid: “Has no effect on equilibrium”
* Addition of species x: “Additional x will react (or decompose) with y to shift the reaction away from that side thus forming \_\_\_/ removing \_\_\_\_\_
* Removing species x: “Removing x will force the reaction to shift towards \_\_ to restore it thus increagins\_\_ / dectresing\_\_\_
* Inc. in pressure/ dec. in volume: “A reaction with lower volume will favor the side with less moles of gas this increasing \_\_”
* Inc in temperature: “An increase in tem favors the endothermic side.”

***Equilibrium expressions/Keq:***

Equilibrium expressions are written as products over reactants raised to their respective powers, which is determined by the number of moles. Refer to the example below:



***This does not include solids and pure substances.*** Always remember the if a reaction is product favored, the K constant will be larger than one. If reactant favored, K will be less than one. If both the reactants and products are equal, then you just so happened to be at equilibrium (lol u got lucky).

***Calculating Q;***

You calculate Q (Quotient) the same way you calculate K (Equilibrium),you just use it when it’s “Questionable”. K for a system *not* at equilibrium is Q. To find Q, substitute the initial concentrations of the reactants and products into the equilibrium expression. It is also products over reactants, raised to the power of their number of moles. K and Q are commonly asked to be compared.

1. If Q is larger than K, it went “too far,” because more products are made in this instance so the reaction must shift left towards the reactants to reach equilibrium.
2. If Q is smaller than K, it didn’t go “far enough,” so the reaction must continue forward towards the products to reach equilibrium.

KEEP IN MIND; SOLIDS CAN NEVER AFFECT EQUILIBRIUM, HOWEVER EQUILIBRIUM CAN AFFECT A SOLID. (confusing I know, but if Drury said it just go along with it…) depending on whether the equilibrium shifts towards it oe away from it. I would act like

***Overview of K&Q:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Kc | State of equilibrium |  | K&Q | State of equilibrium |
| Kc>>1 | Amount of products are greater |  | K > Q | Equilibrium shifts right |
| Kc<<1 | Amount of reactants are greater |  | Q < K | Equilibrium shifts left |
| Kc~1 | Fairly even amounts |  | K = Q | Automatically @ equilibrium. |

***Manipulating mass action equations.***

If the reaction is doubled, you must square the K value.

If the equation was reversed, the new k is the reciprocal of the original one.

If the equation was halved, it is the square root of the original.

***Ice box (everyone’s favorite)*:**$$

So, before you start any icebox problem, just contemplate why you took this course and then cry. After that, suck it up and start the problem.

**I:** represents initial concentrations (or pressures) for each species in the reaction mixture.

***C:***Change represents the change in the concentrations (or pressures) for each species as the system moves towards equilibrium.

**E:** represents the equilibrium concentrations (or pressures) of each species when the system is in a state of equilibrium.

What is an ICE Box used for?

* When calculating the concentration/ pressure of a species that is a reactant or product at equilibrium.
* Calculating the unknown species at equilibrium
* Calculating the change in equilibrium
* The magnitude of the equilibrium constant K, can be used to determine whether the equilibrium lies toward the reactant side of the product side
* \*\*\* In many cases of reactions, it is important to consider both the forward and reverse reactions \*\*\*0

**EXAMPLE: Suppose a tank initially contains H2S at a pressure of 10.0 atm and at a temperature of 800 K. When the reaction has come to equilibrium, the partial pressure of S2 vapor is 0.020 atm. Calculate Kp.**

 **2 H2S(g) ↔ 2 H2(g) + S2(g)**

 10 0 0

 -2x + 2x x

 10 - 2x 2x x

|  |  |  |
| --- | --- | --- |
| 9.96 |  .04 | .02 |

[H]^2 [S2] (.04)^2 (.02)

--------------- ---------------------- 3.2 x 10^-7 = Kp

[H2S]^2 (9.96)^2

|  |  |  |
| --- | --- | --- |
|  |  [A] |  [B] |
| I |  |  |
| C |  |  |
| E |  |  |

This is the formation of an icebox problem. Make sure you write the equation above the box for better organization. Have fun! (more sarcasm for you)