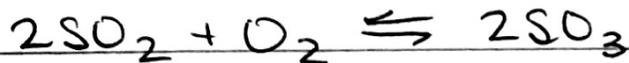
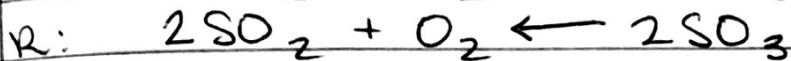
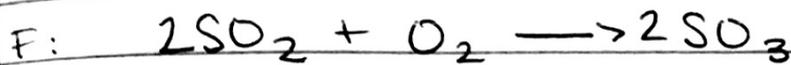


Chemical Equilibrium

Key Concepts

- How do amounts of reactant/products change at equilibrium?
- what 3 stresses cause change in equilibrium position?

Reversible Reactions - forward & reverse reactions occur simultaneously

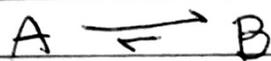


When forward & reverse reactions are happening at equal rates, \rightarrow mol/sec they are in Chemical Equilibrium no net change occurs in the system.



* However, the concentration of reactants & products don't need to be equal.

The relative concentration of reactants to products at equilibrium is called equilibrium position. This tells us whether reactants or products are favored.



1%

99%

6. Consider an initial concentration of 5.00 moles of A and zero moles of B for the reaction in Model 1. If 60% of the available A molecules react each minute, calculate the concentration of A and B after one minute. Fill in the table below with your answers. Be prepared to discuss your method of calculation with the class.

	A
Initial Starting moles of A	5.00 moles
Change Forward Moles of A reacted	- 3
End Moles of A after 1 minute	= 2

→

	B
0.00 moles	Initial Starting moles of B
+ 3	Change Forward Moles of B made
= 3	End Moles of B after 1 minute

7. Did you use the mole ratio between substance A and substance B in Question 6? If not, make a correction.

8. Consider an initial concentration of 5.00 moles of A and 2.00 moles of B for the reaction in Model 1. If 60% of the available A molecules react each minute, and 20% of the available B molecules also react each minute, calculate the concentrations of A and B after one minute. Fill in the table below with your answers. *Hint:* Since the forward and reverse reactions happen simultaneously, calculate the “change reverse” based on the initial 2.00 moles of B.

	A
Initial Starting moles of A	5.00 moles
Change Forward Moles of A reacted	- 3
Change Reverse Moles of A reacted	+ .4
End Moles of A after 1 minute	= 2.4

→

←

	B
2.00 moles	Initial Starting moles of B
+ 3	Change Forward Moles of B made
- .4	Change Reverse Moles of B reacted
= 4.6	End Moles of B after 1 minute



9. Obtain a set of starting conditions from the instructor. Enter the initial moles of A and B in Model 2 as well as the percent of A molecules that react each minute (over the first forward arrow) and the percent of B molecules that react each minute (over the first reverse arrow).

Example Set A

Model 2 - Reaching Equilibrium

		A 60% change per min				B 20%	
1 minute	Initial		10 moles				0 moles
	Change Forward	-	6	→		+	6
	Change Reverse	+	0	←		-	0
	End	=	4 *			=	6 *
2 minutes	Change Forward	-	2.4	→		+	2.4
	Change Reverse	+	1.2	←		-	1.2
	End	=	2.8 *	←	→	=	7.2 *
3 minutes	Change Forward	-	1.68	→		+	1.68
	Change Reverse	+	1.44	←		-	1.44
	End	=	2.56 *			=	7.44 *
4 minutes	Change Forward	-	1.54	→		+	1.54
	Change Reverse	+	1.48	←		-	1.48
	End	=	2.53			=	7.5
5 minutes	Change Forward	-	1.52	→		+	1.52
	Change Reverse	+	1.5	←		-	1.5
	End	=	2.51			=	7.52
6 minutes	Change Forward	-	1.51	→		+	1.51
	Change Reverse	+	1.5	←		-	1.5
	End	=	2.5			=	7.53
7 minutes	Change Forward	-	1.5	→		+	1.53
	Change Reverse	+	1.51	←		-	1.51
	End	=	2.51			=	7.52
8 minutes	Change Forward	-	1.51	→		+	1.51
	Change Reverse	+	1.5	←		-	1.5
	End	=	2.52			=	7.51
9 minutes	Change Forward	-	1.51	→		+	1.51
	Change Reverse	+	1.5	←		-	1.5
	End	=	2.51			=	7.52

Model 3 – Comparing Equilibrium Conditions

	Initial moles A	Initial moles B	Percent reacted ^A forward	Percent reacted ^B reverse	react. Equilibrium moles A	prod Equilibrium moles B	Ratio of product to reactant
A	10.00	0.00	60.0%	20.0%	2.5	7.5	3:1
B	5.00	5.00	60.0%	20.0%	2.5	7.5	3:1
C	0.00	10.00	60.0%	20.0%	2.5	7.5	3:1
D	8.00	0.00	60.0%	20.0%	2	6	3:1
E	0.00	4.00	60.0%	20.0%	1	3	3:1
F	10.00	0.00	25.0%	50.0%	6.7	3.3	1:2
G	5.00	5.00	25.0%	50.0%	6.67	3.33	1:2
H	0.00	10.00	25.0%	50.0%	6.88	3.43	1:2
I	8.00	0.00	25.0%	50.0%	5.33	2.67	1:2
J	0.00	4.00	25.0%	50.0%	2.66	1.34	1:2

Le Chatelier's Principle

When an equilibrium is disturbed, it makes adjustments to restore it.

Stressors:

Concentration of reactants or products
Temperature
Pressure

Concentration

adding more of a reactant or product will shift equilibrium away from increased concentration.

or taking it
↑ away

reactants \rightleftharpoons products

increases %

←
shift

↑
add these

→ real world example!

we breathe to remove carbon dioxide
∴ reduce concentration of carbonic acid.

Temperature

Heat can be treated as a product or reactant (depending if reaction is endo or exothermic)

Shift accordingly...

Review what ΔH tells us!!

