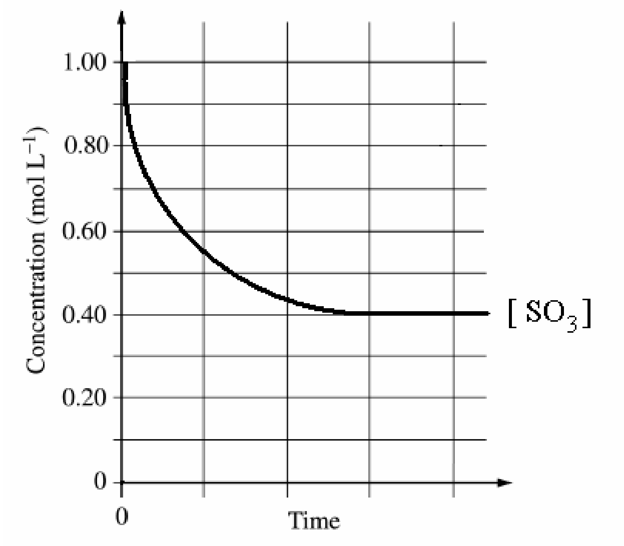
AP CHEMISTRY

TOPIC 6: EQUILIBRIUM, REVIEW EXAMPLES

Day 70:

$$2\ SO_{3\,(g)} \rightleftharpoons 2\ SO_{2\,(g)} + O_{2\,(g)}$$

1. After a 3.0 mole sample of $SO_{3\,(g)}$ is placed into an evacuated 3.0 L container at 300. K, the reaction represented above occurs. The concentration of $SO_{3\,(g)}$ as a function of time is shown below.



(a) Write the expression for the equilibrium constant, K , for the reaction.

$$K_c = \frac{\left[\ SO_2\ \right]^2 \left[\ O_2\ \right]}{\left[\ SO_3\ \right]^2}$$

(b) What is [SO_3] at equilibrium?

From the graph, [SO_3] = 0.40 M

(c) Determine the equilibrium concentrations of $SO_{2\,(g)}$ and $O_{2\,(g)}$.

	$2\ SO_3$	$\rightleftharpoons$	$2\ SO_2$	+	O_2
I	1.00 M		0		0
C	- 2x = - 0.60 M		+ 2x = + 0.60 M		+ x = + 0.30 M
E	1.0 – 2x = 0.40 M		2x = 0.60 M		x = 0.30 M

[SO_2] = 0.60 M , [O_2] = 0.30 M

Stoichiometric relationship between SO_3 reacting and $SO_{2\,(g)}$ and $O_{2\,(g)}$ forming. This is NOT a rule of 5% type of question. YOU KNOW exactly what the concentrations of the reactant and each product is at equilibrium.

(d) On the graph, make a sketch that shows how the concentrations of $SO_{2\ (g)}$ and $O_{2\ (g)}$ changes as a function of time.

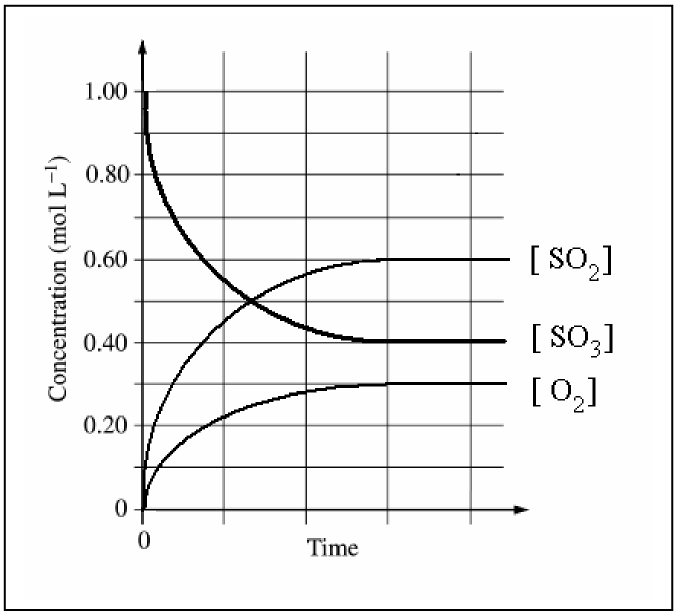
From the graph, [SO_2]$_{eq}$ is 0.60 M, and [O_2]$_{eq}$ is 0.30 M,

The curve should have the following characteristics (for SO_2):

- *start at 0 M;*
- *increase to 0.60 M;*
- *reach equilibrium at the same time [SO_3] reaches equilibrium. the reacts and products will reach equilibrium at the SAME TIME !*

The curve should have the following characteristics (for O_2):

- *start at 0 M;*
- *increase to 0.30 M;*
- *reach equilibrium at the same time [SO_3] reaches equilibrium. the reacts and products will reach equilibrium at the SAME TIME !*



(e) Calculate the value of the following equilibrium constants for the reaction at 300 K:

(i) K_c

$$K_c = \frac{\left[\ 0.60\ M\right]^2 \left[\ 0.30\ M\right]}{\left[\ 0.40\ M\right]^2} = 0.675\ M$$

(ii) K_p

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

$$\Delta n\ =\ \left(2+1\right)-2\ =\ +1$$

$$K_p = K_c\left(RT\right)^1$$

$$K_p = \left(\frac{0.675\ mol}{L}\right)\left[\left(\frac{0.0821\ atm\cdot L}{mol\cdot K}\right)\left(300\ K\right)\right]^1 = 16.6\ atm$$