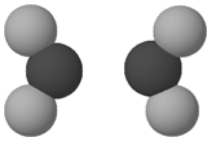
Reaction Reversibility

Read 14.2 (pg. 553)



1. Colourless N_2O_4 gas breaks down into brown NO_2 gas. Write the equilibrium equation for this reaction.
2. How is the existence of equilibrium indicated in a chemical equation?
3. Because the two gasses in this equilibrium are different colours, their concentrations can be determined using a spectrophotometer. The following chart indicates what happens over time following the addition of 1 mol N_2O_4 to an empty 1 L vessel. Plot the data (include title and label axes).

Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12
$[N_2O_4]$	1.00	0.70	0.45	0.35	0.30	0.27	0.25	0.23	0.22	0.21	0.20	0.20	0.20
$[NO_2]$	0	0.60	1.10	1.30	1.40	1.46	1.50	1.54	1.56	1.58	1.60	1.60	1.60

4. Was all of the N_2O_4 used up in the reaction? How does the graph show this?
5. According to the graph, how many moles of NO_2 were produced?
6. How many moles of NO_2 would have been produced if all of the N_2O_4 was used up?
7. Use the collision theory to explain why all of the N_2O_4 is not used up and why equilibrium is eventually established (think about forward versus reverse reactions, and how concentration affects reaction rate).
8. Assume the spectrophotometer cannot directly measure $[N_2O_4]$, but can measure $[NO_2]$ because of its brown colour. Explain how the $[N_2O_4]$ values would be calculated.
9. Define reaction reversibility.
10. Can the same equilibrium be reached starting with pure NO_2? If so, how much NO_2 would be required?
11. HI can form via the equation: $H_2(g) + I_2(g) \leftrightarrows 2HI(g)$. 1 mol H_2 and 1 mol I_2 were placed in a 1 L vessel (no HI was present initially). At equilibrium [HI] was measured to be 1.56 mol/L. Sketch a graph for the equilibrium reaction, clearly indicating the starting and equilibrium concentrations of all chemicals. (Be careful to draw the general shape of the lines correctly: straight vs. curving up vs. curving down).
12. Ammonia is produced via the reaction: $N_2(g) + 3H_2(g) \leftrightarrows 2NH_3(g)$. 1 mol N_2 and 3 mol H_2 were placed in an empty **2 L** container. The equilibrium [ ] of N_2 was 0.3 mol/L. Sketch a graph for this reaction.