Le Chatelier's Principle
(Chemistry 12)

A Use Le Chatelier's Principle to describe the effect of the following changes on the position of the equilibrium.

1) The equilibrium is: $N_2O_3(g) \rightleftharpoons NO(g) + NO_2(g)$.
   a) increase the [NO]
   b) increase the $[N_2O_3]$
   c) increase the pressure by decreasing the volume
   d) add a catalyst

2) The equilibrium is: $2\,H_2(g) + 2\,NO(g) \rightleftharpoons N_2(g) + 2\,H_2O(g)$.
   a) decrease the $[N_2]$
   b) decrease the [NO]
   c) decrease the pressure by increasing the volume

3) The equilibrium is: $2\,CO(g) + O_2(g) \rightleftharpoons 2\,CO_2(g) + 566\ kJ$.
   a) increase the temperature
   b) increase the $[O_2]$
   c) introduce a catalyst

4) The equilibrium is: $I_2(g) + Cl_2(g) \rightleftharpoons 2\,ICl(g)$; $\Delta H = 35.0$ kJ.
   a) decrease the temperature
   b) decrease the $[Cl_2]$
   c) increase the pressure by decreasing the volume

B Show the following situations graphically.

NOTE: In Exercises 24–26 the relative positioning of the molecules is not relevant; simply place them on the graph so the reactants are separated from the products. The only thing required here is to show what an individual substance's concentration does after the conditions change.

5) The equilibrium is: $H_2(g) + I_2(g) \rightleftharpoons 2\,HI(g) + 52$ kJ.
   a) increase the temperature
   b) inject some $H_2(g)$
   c) decrease the volume
   d) add a catalyst

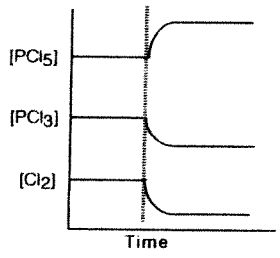
6) The equilibrium is: $2\,SO_2(g) + O_2(g) \rightleftharpoons 2\,SO_3(g)$; $\Delta H = -197$ kJ.
   a) inject some $SO_2(g)$
   b) increase the volume
   c) decrease the temperature
   d) increase the $[SO_3]$

7) The equilibrium is: $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$; $\Delta H = -41$ kJ.
   a) inject some $CO_2(g)$
   b) remove some of the $H_2O(g)$ with a very rapidly acting drying agent
   c) increase the temperature
   d) decrease the pressure by increasing the volume

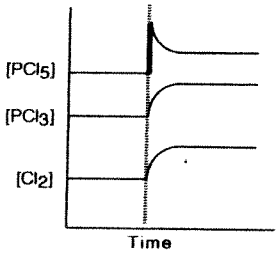
C Interpret the following graphs in terms of the changes which must have been imposed on the equilibrium.

8) The equilibrium is: $PCl_5(g) + 92.5\ kJ \rightleftharpoons PCl_3(g) + Cl_2(g)$.

a)

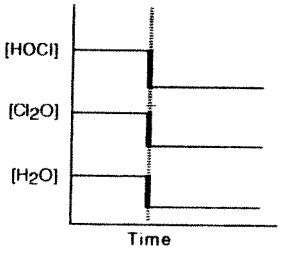


b)

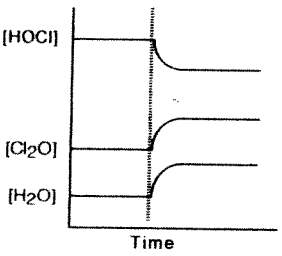


9) The equilibrium is: $H_2O(g) + Cl_2O(g) \rightleftharpoons 2\,HOCl(g) + 70$ kJ.

a)



b)



Answers:

A

1) (a) shift to reactant side (b) shift to product side (c) shift to reactant side (d) no shift

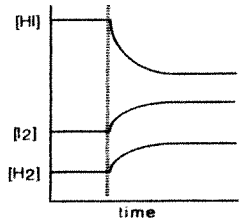
2) (a) shift to product side (b) shift to reactant side (c) shift to reactant side

3) (a) shift to reactant side (b) shift to product side (c) no shift

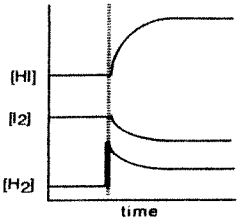
4) (a) shift to reactant side (c) no shift (same numbers of gas particles on both sides)
(b) shift to reactant side

B

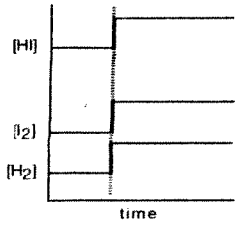
5) (a)



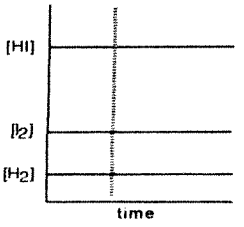
(b)



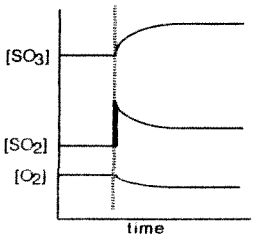
(c)



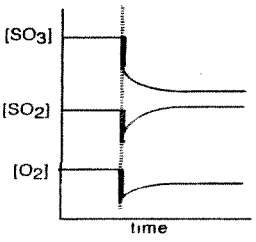
(d)



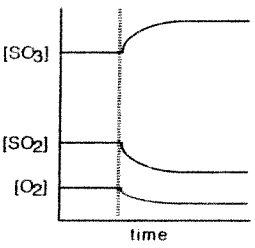
6) (a)



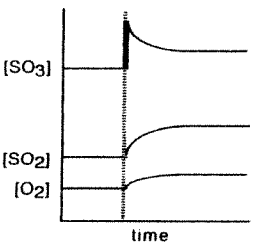
(b)



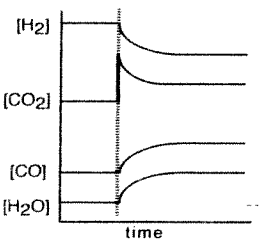
(c)



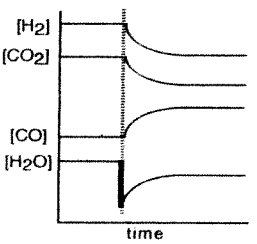
(d)



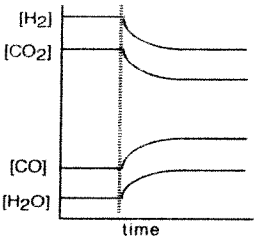
7) (a)



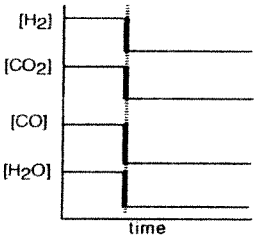
(b)



(c)



(d)



C

8) (a) temperature is decreased (b) some PCl_5 is injected

9) (a) pressure is decreased by increasing the volume (b) temperature is increased