

ALTERING EQUILIBRIUM

- 1) a) i) Imposed Change - \uparrow Temp.
Response - reverse reaction, equil. shifts left
 $\therefore [CO] \uparrow, [O_2] \uparrow, [CO_2] \downarrow$
- ii) Imposed Change - $\uparrow [O_2]$
Response - forward reaction, equil. shifts right
 $\therefore [CO] \downarrow, [O_2]_{\text{net}} \uparrow, [CO_2] \uparrow$
- iii) Imposed Change - \downarrow Pressure
Response - reverse reaction, equil. shifts left
 $\therefore [CO] \downarrow_{\text{net}}, [O_2] \downarrow_{\text{net}}, [CO_2] \downarrow$
- iv) A catalyst would have no effect on the equilibrium concentrations of the substances, since it would speed up both the forward and reverse reactions by an equal amount. Thus the equilibrium concentrations would not change.

- b) i) Imposed Change - $\downarrow [NO]$
Response - forward reaction, equil. shifts right
 $\therefore [N_2O_3] \downarrow, [NO]_{\text{net}} \downarrow, [NO_2] \uparrow$
- ii) Imposed Change - \uparrow Temp.
Response - forward reaction, equil. shifts right
 $\therefore [N_2O_3] \downarrow, [NO] \uparrow, [NO_2] \uparrow$
- iii) Imposed Change - $\downarrow V, \uparrow P$
Response - reverse reaction, equil. shifts left
 $\therefore [N_2O_3] \uparrow, [NO] \downarrow_{\text{net}}, [NO_2] \uparrow_{\text{net}}$
- iv) Imposed Change - $\downarrow [N_2O_3]$
Response - reverse reaction, equil. shifts left
 $\therefore [N_2O_3]_{\text{net}} \downarrow, [NO] \downarrow, [NO_2] \downarrow$

(2)

2) High Temperature
Increasing [reactants]
Decreasing [product] } All of these imposed changes would cause the forward reaction to occur thus giving a better yield of NO(g)

3) It initially darkens and always remains darker than it was originally because the molecules are pushed closer together. Thus the colour appears more intense.

The colour becomes progressively lighter due to the ~~equilibrium~~ imposed change on the reaction.

Imposed Change - increase pressure

Response - reverse reaction occurs.

\therefore $[\text{N}_2\text{O}_4]$ (colourless) \uparrow
 $+$ $[\text{NO}_2]$ (red-brown) \downarrow } Thus it becomes progressively lighter.

4. decrease

5. A catalyst does not change the equilibrium concentrations.

6. right

7. a. $[\text{CH}_3\text{OH}]$ increased
b. $[\text{CH}_3\text{OH}]$ increased
c. $[\text{CH}_3\text{OH}]$ increased
d. $[\text{CH}_3\text{OH}]$ unchanged

8. a. right d. left
b. left e. no change
c. right

9. a. $[\text{NO}_2]$ ~~decreased~~ increased net.
b. $[\text{NO}_2]$ increased
c. $[\text{NO}_2]$ unchanged

10. Add SO_2 , add O_2 , lower the temperature, increase the pressure.