DEMO

$$NO_2\,(g) \rightleftarrows N_2O_4(g)$$

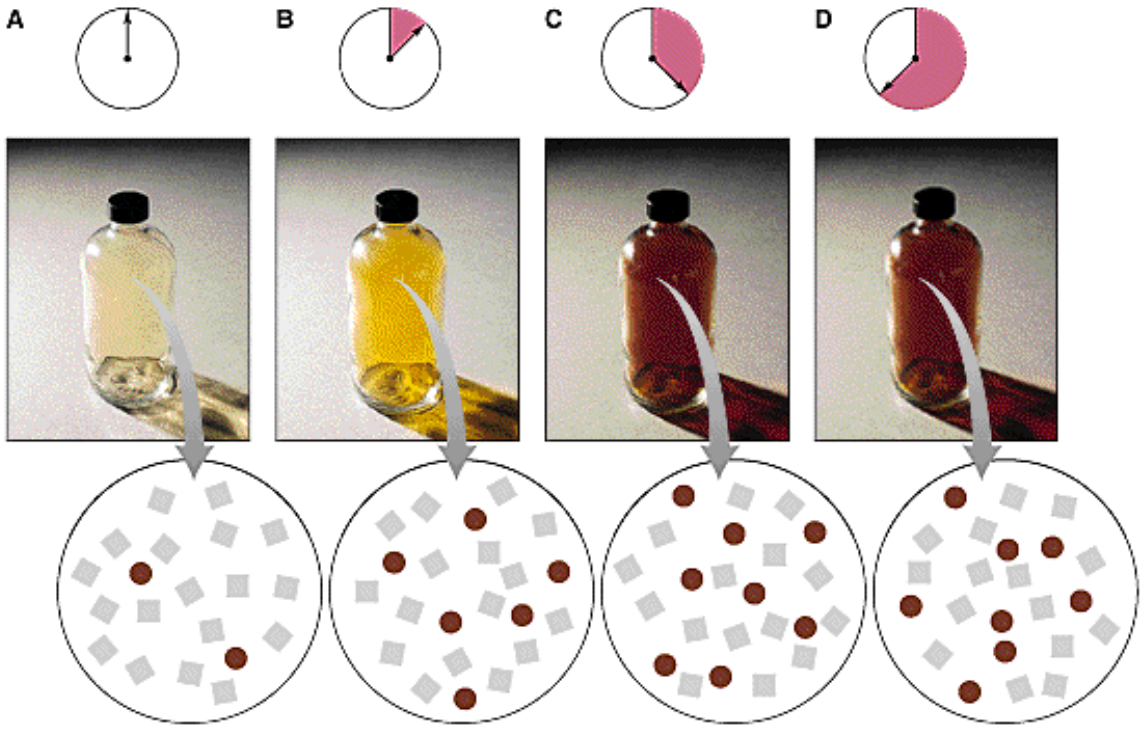
NOTICE THE EQUILIBRIUM SHIFTING BACK AND FORTH!

We observe the Dynamic Chemical Equilibrium through this MACROSCOPIC PROPERTY:

dark brown gas ⇄ light brown gas (or colourless)

NO2 (g) ⇄ **N2O4(g)**

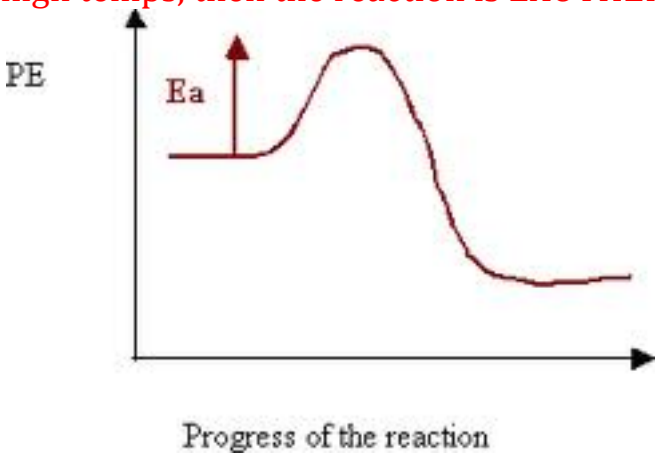
hot water *cold water*



EFFECT OF TEMPERATURE ON REACTION EQUILIBRIA

ACTIVATION ENERGY DIAGRAM FOR THIS REACTION:

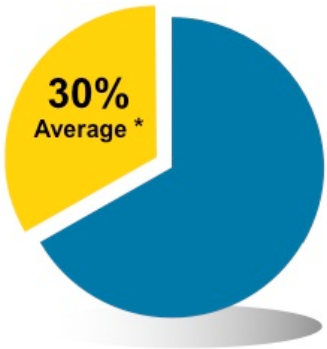
If $N_2O_4(g)$ predominates in cold temps and NO_2 (g) predominates at high temps, then the reaction is EXOTHERMIC:



This reversible reaction reached a state of equilibrium and showed the following characteristics:

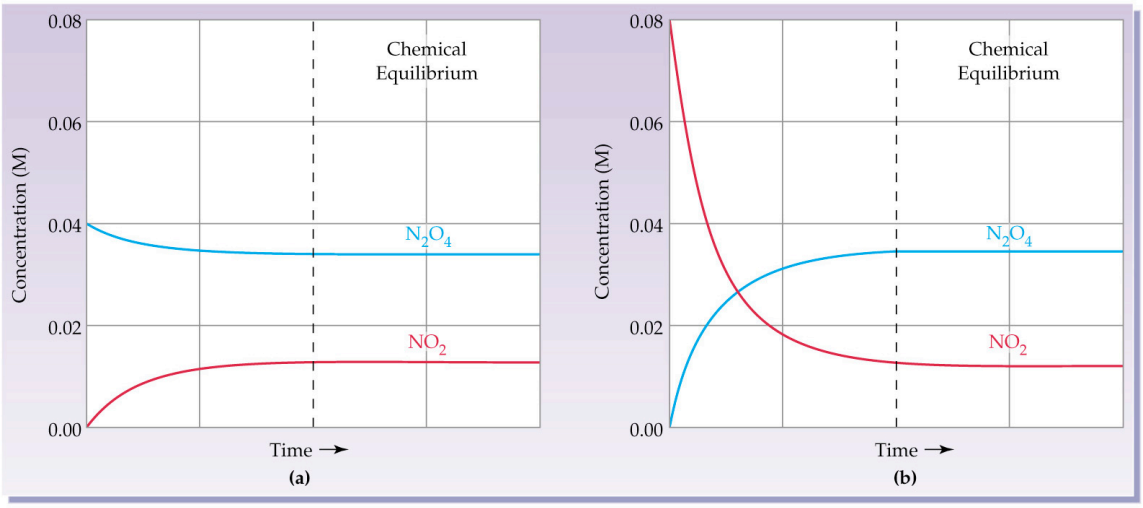
1) the system was closed
2) opposite reactions occurred at the same rate
3) equilibrium was reached by starting with either reactants or products
4) the temperature was constant (constant at 0^oC or constant at 100^oC)

Graphical representation of the relative concentrations of NO_2 and N_2O_4 at equilibrium at 0^oC and 100^oC:



where the 30% portion represents **NO_2 (g)**
and the rest represents N_2O_4(g)

Graphical representations of changing concentrations of NO_2 and N_2O_4 at 100^oC as equilibrium is reached:



ANALYSIS.

1) What macroscopic property did we observe to show that the reaction rate (forward or reverse) is constant?

2) What macroscopic property did we observe to show that temperature affects an equilibrium reaction?

3) Based on our macroscopic observations or on graphical information, which gas predominates at low temperatures?

4) What would you expect to happen if you mixed a tube containing pure NO_2 with another tube containing pure N_2O_4 at room temp?

ANALYSIS.

1) What macroscopic property did we observe to show that the reaction rate (forward or reverse) is constant?

-the colour (at 0°C or at 100°C) remained a constant, therefore the N_2O_4 (or NO_2) was being made at the same rate as it was being used up.

2) What macroscopic property did we observe to show that temperature affects an equilibrium reaction?

-the colour became lighter or darker when the temp. changed - meaning there was more or less NO_2 present.

3) Based on our macroscopic observations or on graphical information, which gas predominates at low temperatures?

-N_2O_4 predominated at low temp.

-NO_2 predominated at high temp.

4) What would you expect to happen if you mixed a tube containing pure NO_2 with another tube containing pure N_2O_4 at room temp?

-the tubes should become the same colour - eventually the two gases will reach equilibrium and attain the same constant colour.