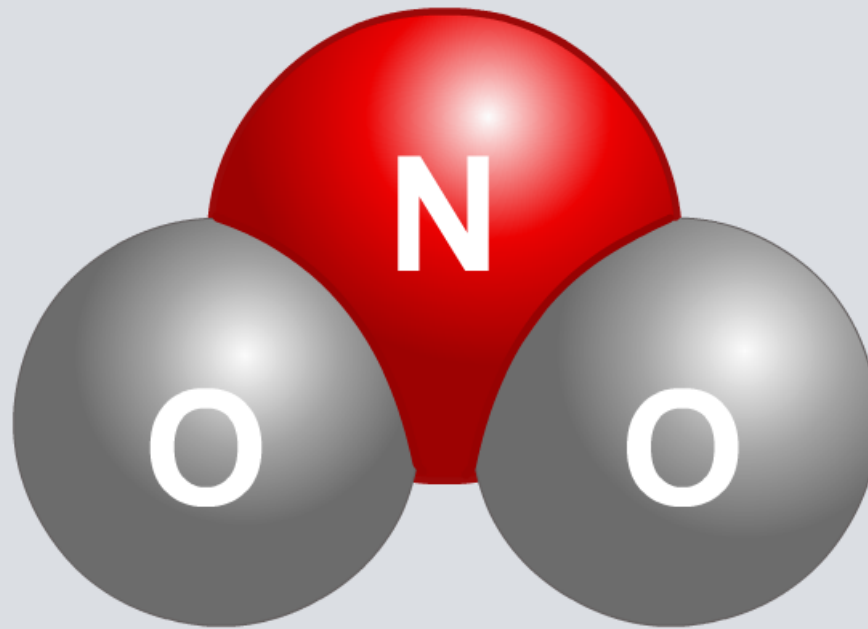


Equilibrium – Changing Conditions



Whenever a change is made to a reversible reaction in dynamic equilibrium, the equilibrium will shift to try and oppose the change.

Condition	Effect
Temperature	Increasing the temperature shifts the equilibrium in the direction that takes in heat.
Concentration	Increasing the concentration of a substance shifts the equilibrium in the direction that produces less of that substance.
Pressure	Increasing the pressure shifts the equilibrium in the direction that produces less gas.



All reactions are **exothermic** (give out heat) in one direction and **endothermic** (take in heat) in the other.

If the temperature is **increased**:

- equilibrium shifts to **decrease** the temperature
- equilibrium shifts in the **endothermic** direction

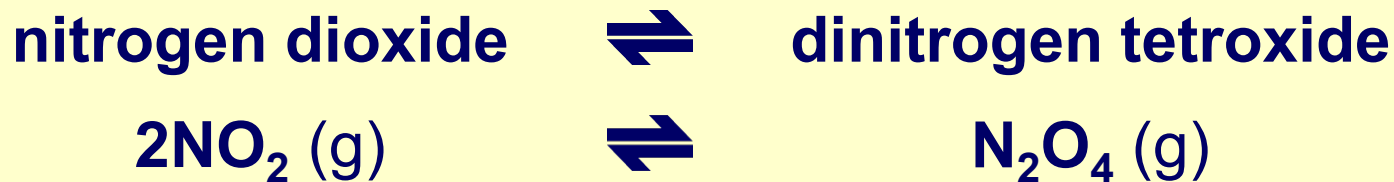
If the temperature is **decreased**:

- equilibrium shifts to **increase** the temperature
- equilibrium shifts in the **exothermic** direction



Opposing changes in temperature

Nitrogen dioxide is in constant equilibrium with dinitrogen tetroxide. The forward reaction is **exothermic** and the backwards reaction is **endothermic**.



What will happen if the temperature is **increased**?

- The equilibrium will shift to **decrease** the temperature, i.e. to the left (**endothermic**).
- More **NO₂** will be produced.

If the temperature is **decreased**, more **N₂O₄** will be produced.



Concentration and equilibrium

Changing the concentration of a substance affects the equilibrium of reversible reactions involving solutions.

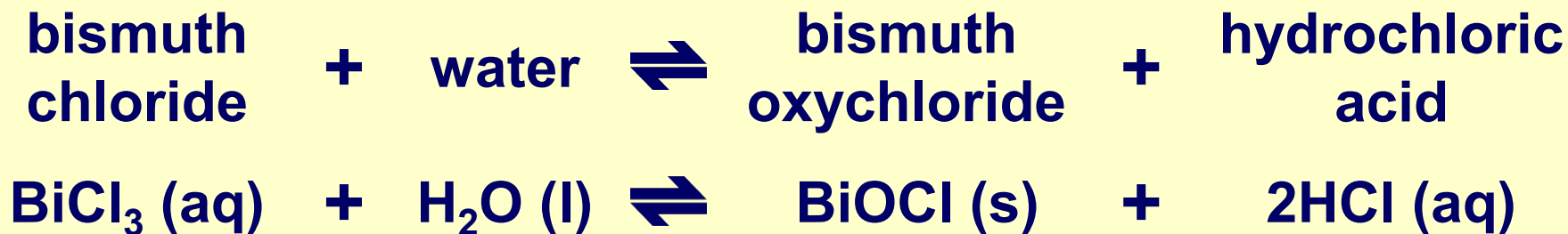
increasing the concentration of **substance A** = equilibrium shifts to **decrease** the amount of substance A

decreasing the concentration of **substance A** = equilibrium shifts to **increase** the amount of substance A



Opposing changes in concentration (1)

Bismuth chloride reacts with water to produce a white precipitate of bismuth oxychloride and hydrochloric acid.



What will happen if **more H_2O** is added?

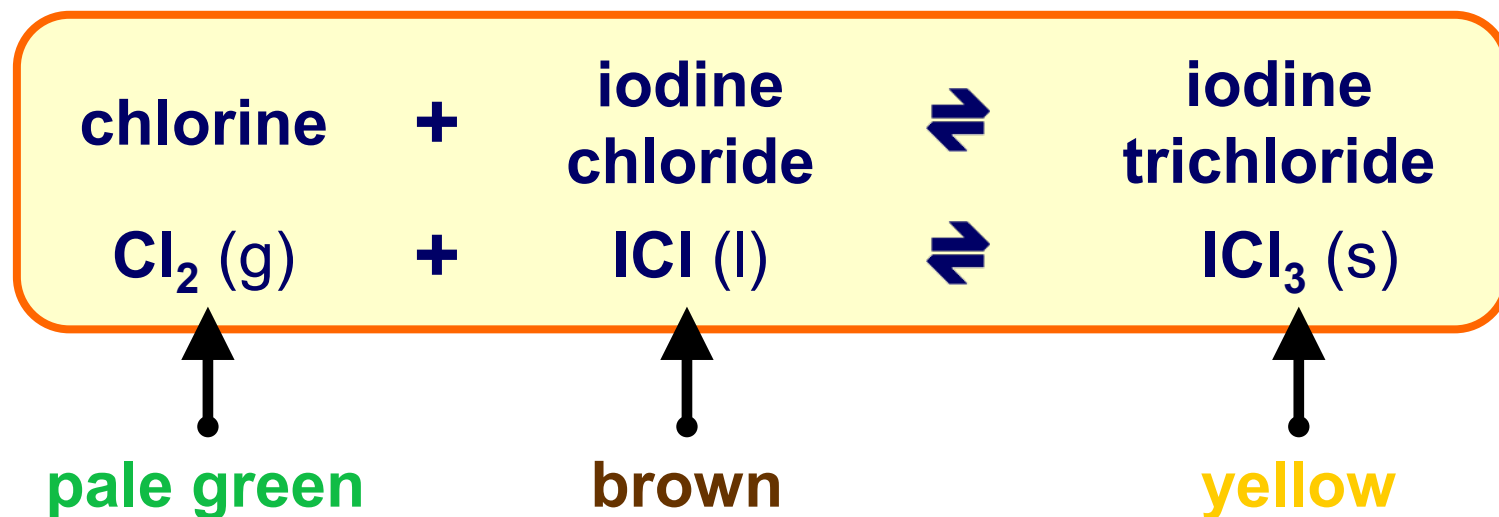
- The equilibrium will shift to **decrease** the amount of water, i.e. to the right.
- More **BiOCl** and **HCl** will be produced.

If H_2O is **removed**, more **BiCl_3** and **H_2O** will be produced.



Opposing changes in concentration (2)

Chlorine gas reacts with iodine chloride to produce iodine trichloride.



What effect will adding **more Cl_2** have on the color of the mixture?

It will become **more yellow.**

What effect will **removing Cl_2** have on the color of the mixture?

It will become **more brown.**

Changing the pressure has an effect on the equilibrium of reversible reactions involving gases.

If the pressure is **increased**:

- equilibrium shifts to **decrease** the pressure
- equilibrium shifts in the direction of **fewest** molecules

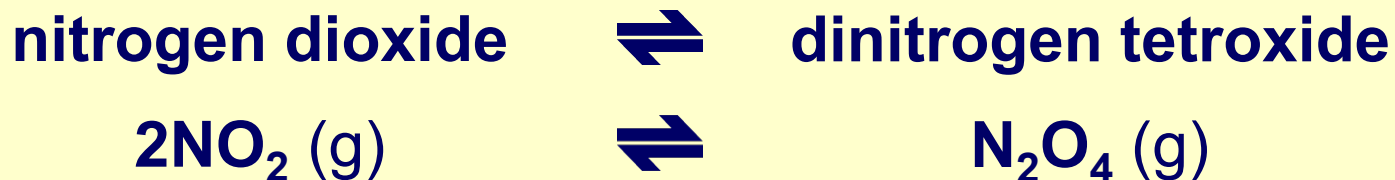
If the pressure is **decreased**:

- equilibrium shifts to **increase** the pressure
- equilibrium shifts in the direction of **most** molecules



Opposing changes in pressure

Nitrogen dioxide is in constant equilibrium with dinitrogen tetroxide. Two molecules of nitrogen dioxide react to form one molecule of dinitrogen tetroxide.



What will happen if the pressure is **increased**?

- The equilibrium will shift to **reduce** the number of molecules, i.e. to the right (only 1 molecule).
- More N_2O_4 will be produced.

If the pressure is **decreased**, more NO_2 will be produced.



Dynamic equilibrium and change

