Reversible reactions and equilibria

13. ⇌: Reversible chemical reactions: ⇌ used in equations
direction of reversible reaction altered by changing reaction conditions

14. **dynamic equilibrium**

Both reactions occur at same time/rate
Concentrations/amount in moles of each product/reactant remain constant
Only in closed system: no reactant/product can escape

As reactants react, their concentrations fall – forward reaction slows down
As more product produced, their concentrations rise – backwards reaction speeds up
After while – both at same rate

15. **formation of ammonia**

reversible reaction that can reach equilibrium
nitrogen (extracted from air) + **hydrogen** (obtained from natural gas)
put together in compressor: increases pressure
Purified gases passed over catalyst at high temperature/pressure
Some hydrogen/nitrogen reacts forming ammonia – reversible reaction
Condenser: ammonia liquifies and is removed
Remaining hydrogen/nitrogen is recycled back into process

16. **Haber process conditions:**

450 °C temperature 200 atmospheric pressure iron catalyst

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17. **position of dynamic equilibrium affects**

Le Chatelier's Principle: position of equilibrium shifts towards favoured side – depending on conditions
Controls concentration of reactions & products in system

Temperature

Positive energy change: endothermic
Increase temperature: supplying reaction with energy – favours **endothermic** reaction to absorb extra heat

Negative energy change: exothermic
Decrease temperature: limits reaction's energy – favours **exothermic** reaction to produce more heat

Pressure – only interested in gases
Increase pressure: favours side with **less** gas molecules
Decrease pressure: favours side with **more** gas molecules

Concentration

Concentration of something **increased** – **other** side favoured
Decreased – **same** side favoured

Catalyst

Increases rate of both reactions – no impact on equilibrium