Edexcel IGCSE Chemistry

Topic 3: Physical chemistry

Reversible reactions and equilibria

Notes

3.17 know that some reactions are reversible and this is indicated by the symbol ⇌ in equations

- In some chemical reactions, the products of the reaction can react to produce the original reactants
    - These are called reversible reactions
    - The direction of the reaction can be changed by changing the conditions

E.g. The Haber Process

nitrogen + hydrogen ⇌ ammonia

3.18 describe reversible reactions such as the dehydration of hydrated copper(II) sulfate and the effect of heat on ammonium chloride

- Dehydration of hydrated copper(II) sulfate
    - Anhydrous copper(II) sulfate + water ⇌ hydrated copper(II) sulfate
    - White solid turns blue in presence of water
    - Forward reaction add water
    - Reverse reaction heat the hydrated copper(II) sulfate (water evaporates)
- Effect of heat on ammonium chloride
    - Ammonium chloride ⇌ ammonia + hydrogen chloride
    - The white solid (ammonium chloride) breaks down into ammonia and hydrogen chloride (colourless gases) using heat
    - These gases can then react to form ammonium chloride

3.19 (chemistry only) know that a reversible reaction can reach dynamic equilibrium in a sealed container

- When a reversible reaction occurs in a closed system/sealed container, equilibrium is reached when the reactions occur at exactly the same rate in each direction

3.20 (chemistry only) know that the characteristics of a reaction at dynamic equilibrium are: the forward and reverse reactions occur at the same rate, the concentrations of reactants and products remain constant

- A reaction at dynamic equilibrium: one in which the forward and reverse reactions occur at the same rate and the concentrations of reactants and products remain constant

3.21 (chemistry only) understand why a catalyst does not affect the position of equilibrium in a reversible reaction

- A catalyst overall increases the rate of reaction, it increases the rate of a reaction by speeding up the forward AND reverse reactions EQUALLY, therefore it helps a reversible reaction reach equilibrium quicker and DOES NOT have an effect on the position of equilibrium

3.22 (chemistry only) know the effect of changing either temperature or pressure on the position of equilibrium in a reversible reaction: an increase (or decrease) in temperature shifts the position of equilibrium in the direction of the endothermic (or exothermic) reaction, an increase (or decrease) in pressure shifts the position of equilibrium in the direction that produces fewer (or more) moles of gas; References to Le Chatelier's principle are not required

- The relative amounts of all the reacting substances at equilibrium depend on the conditions of the reaction.
- If a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change.

changing the pressure:

- In gaseous reactions, an increase in pressure will favour the reaction that produces the least number of molecules as shown by the symbol equation for that reaction.
- If pressure is increased: equilibrium shifts to side of equation with fewer moles of gas (e.g. $N_2 + 3H_2 \rightleftharpoons 2NH_3$, left side has 4 moles of gas (1+3) and right has 2 moles of gas. If you increase the pressure equilibrium moves right as there are fewer moles of gas on the right hand side, making more product)
- if pressure is decreased: equilibrium will shift to side of equation with more moles of gas (e.g. for previous example equilibrium would move left, making more reactant.

If a reaction produces a...	...larger volume (more moles) of gas	...smaller volume (fewer moles) of gas
An increase in pressure...	Decreases yield of reaction	Increases yield of reaction
A decrease in pressure...	Increases yield of reaction	Decreases yield of reaction

changing the temperature:

- If temperature is increased: equilibrium moves in the direction of the endothermic reaction (e.g. if forwards reaction is endothermic and temperature is increased, equilibrium shifts right to produce more product)
- If temperature is decreased: equilibrium moves in the direction of the exothermic reaction
- For the forwards being exo/endothermic and yield meaning the amount of product from the forwards reaction:

	exothermic	endothermic
increase in temperature	decreases yield of reaction	increases yield of reaction
decrease in temperature	increases yield of reaction	decreases yield of reaction