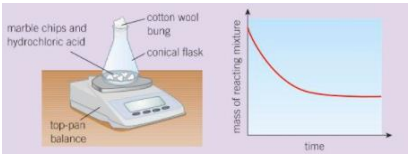
C8 Rates and Equilibrium

Measuring Rate

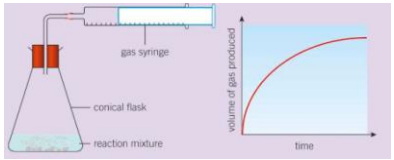
To measure the rate of a reaction you can:

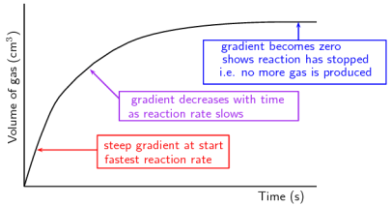
- **Measure how fast the reactants are used up**
- **Measure how fast the products are made**

e.g. Measure mass lost due to gas formed



e.g. Measure volume of gas made

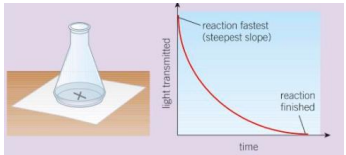




Rate = volume of gas ÷ time

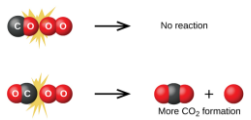
cm³/s

e.g. Measure time for insoluble product to form



Collision theory

For a reaction to happen reactants must: **collide** with **enough energy** (activation energy)



A successful collision is one that leads to a reaction

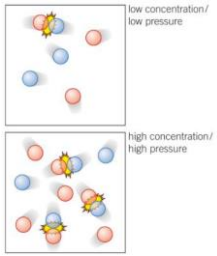
So to increase the rate of a reaction you must either

- **Increase the frequency of collisions**
- **Increase the energy of the collisions**
- **Decrease the energy needed for a collision to be successful**

Factors affecting rate

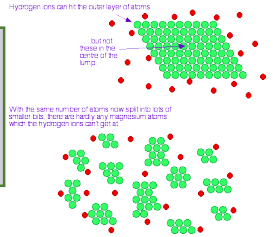
Concentration and Pressure

More particles in the same space. **More frequent collisions**



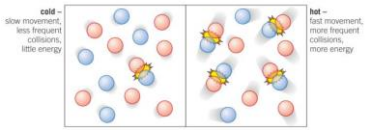
Surface area

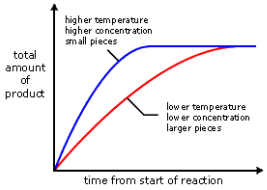
More particles available to react. **More frequent collisions**



Temperature

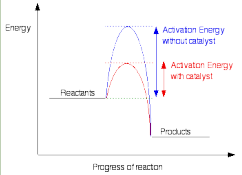
Particles **move faster**.
So they **collide more frequently**.
Particles collide **with more energy**.
So more of the collisions are **successful**.





Catalysts

Lower the energy needed for successful collisions. (Activation energy) **Not used up**. Biological catalysts are called **enzymes**



Reversible reactions

Can go in both directions.

$$A + B \rightleftharpoons C + D$$

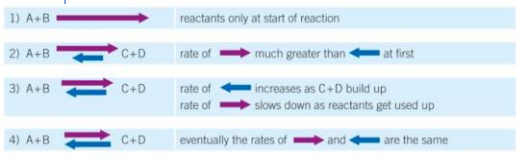
If a reaction is exothermic in one direction it is endothermic in the other direction.

endothermic (in forward reaction)

hydrated copper(II) sulfate (blue) $CuSO_4.5H_2O$ ⇌ anhydrous copper(II) sulfate (white) $CuSO_4$ + water $5H_2O$

exothermic (in reverse reaction)

In a **closed system** (where nothing can get in or out) an **equilibrium** is reached where the **rate of reaction is the same in both directions**.



At equilibrium:

- Rate of forward reaction = rate of reverse reaction.
- Mount of products and reactants don't change.