Rates of reaction

The rate of a chemical reaction is a measure how fast the reaction takes place.Fast reactions complete in shortest time.

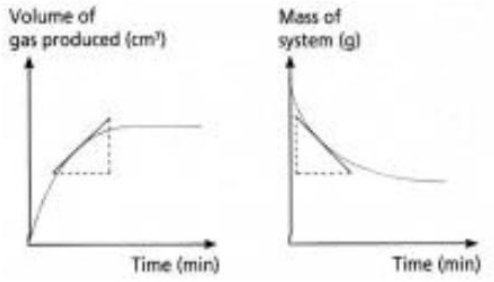
Finding suitable measuring change.
1. Colour
2.Formation of precipitate.
3.Change in mass(eg a gas escape causing a loss of mass)
4.Volume of gas evolved.
5.Temperature

The amount of reactants and products change during a chemical reaction.

We can measure the speed of reaction by measuring:

— how quickly a product is formed per unit time

— how quickly a reactant is used up per unit time



Gradient of tangent to any point on the curve

–> Rate of Reaction at any instant

Steeper the gradient

–> faster the reaction

At start of reaction, graph is the steepest

–> Rate at the start of ANY reaction is always Fastest

As reaction progresses, gradient becomes gentler

–> Reaction is Slowing Down

After sometime, the graph levels off

–> point of leveling off signifies the End of Reaction

Collision theory of rates of reaction

The particles of the reacting substance must collide with each other and a fixed amount of energy (activation energy Ea) must be reached if the reaction is to take place. The two above conditions must be there to change reactant in to product.

Not all collisions result in a reaction. If a collision between particles is with sufficient energy a reaction will take place and that collision is called the successful collision.

A reaction is speeded up if the successful collision increase.

Effect by which rate of reactions can be increasesd.

1.Concentration

2. Pressure

3.Temperature.

4.Particle size.

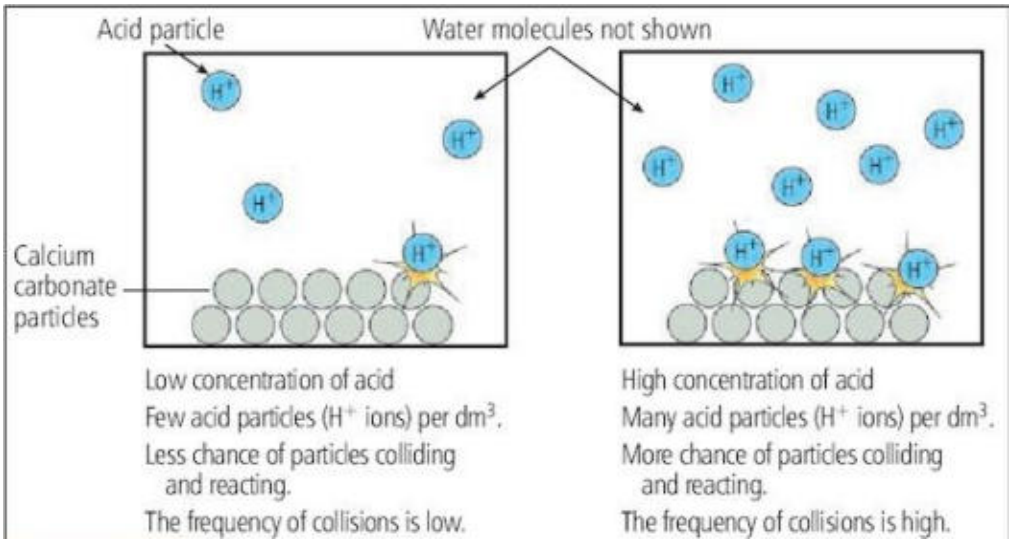
5.Catalyst

Effect of concentration on the rate of reaction.

The more concentrated the reactants, the greater will be the rate of reaction.

Reason: More particles per unit volume so particles are close together which increases the rate of collision per unit time so more numbers of successful collision.

In both cases either the reactant is limiting or excess will increase the rate of reaction the difference is in the amount of product.



With excess of an acid same final volume despite of the concentration.

With acid as an limiting factor change the volume produce,more concentrated acid if limiting produce more volume of gas.
Amount of product depends upon amount of limiting reagent.

Effect of temperature using the idea of particles:

Particles have more kinetic energy. So particles move faster.More collisions per unit time.so greater

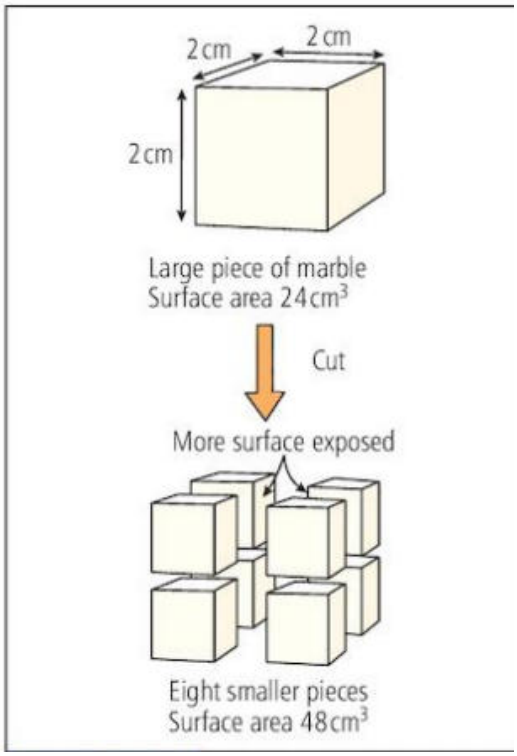
percentage of collisions are sucessful. More particles have energy equal to or greater to activation energy for collisions.

Note For students: With high temperature gradient is more steeper but no change in amount of product.

Effect of surface area on rate of reaction:

Greater the surface area so faster is the rate of reaction because more surface is available to collide with.

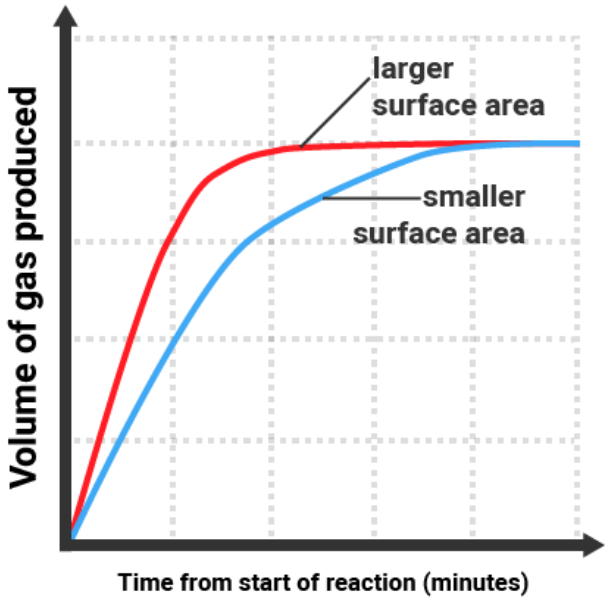
If we cut substance in to smaller pieces the surface area increases so do the rate of reaction.



rate of reaction is more fast when use powder instead of large pieces but amount of product will be same.

Explosive reactions

Many industrial processes cause fine powders to get into the air. These powders are highly combustible. They burn very readily in air because of their very large surface area. A lit match or a spark from a machine can cause them to explode. Examples are flour in flour mills, wood dust in sawmills and coal dust in coal mines. In coal mines there is another hazard. The methane gas which is often present can form an explosive mixture with air.



Pressure in a gas system: increasing pressure in a gas system decreases distance between particles. There are more particles per unit volume so more collision per unit time, so more successful collisions, faster reaction.

(a) Low pressure (b) High pressure

Catalyst: catalyst is a substance which speeds a chemical reaction with out being used up.

Adding a catalyst ***increases the rate of reaction*** by allowing an ***alternative pathway with a lower activation energy*****.** More particles will have an energy ***greater than or equal to activation energy***.