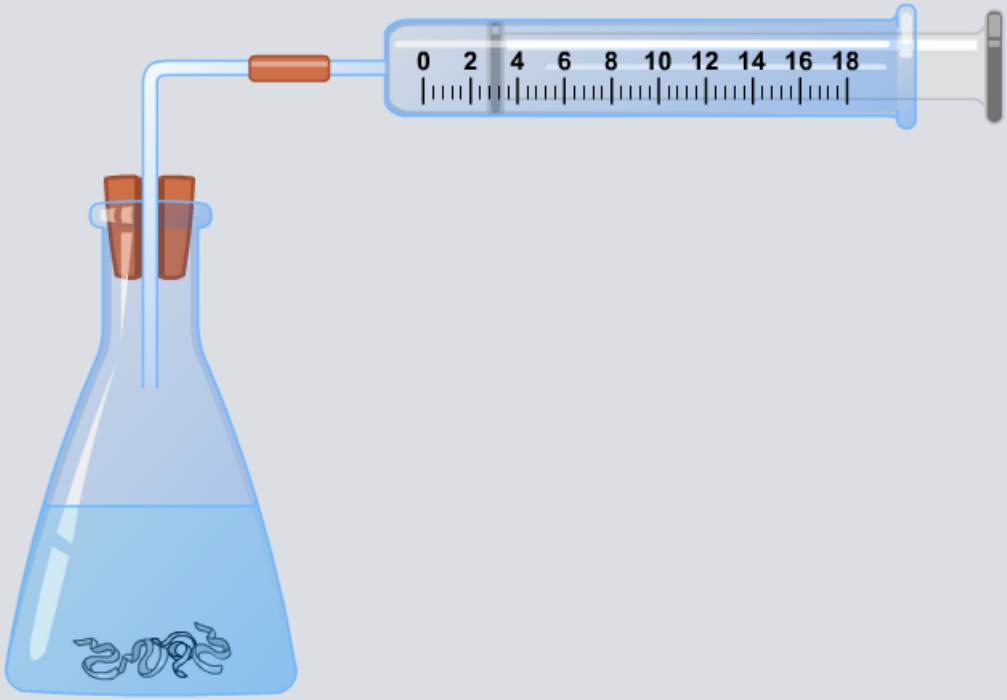
Rates of Reaction



Reactions, particles and collisions

Reactions take place when particles collide with a certain amount of energy.

The minimum amount of energy needed for the particles to react is called the **activation energy**, and is different for each reaction.

The rate of a reaction depends on two things:

- the **frequency** of collisions between particles
- the **energy** with which particles collide.

If particles collide with less energy than the activation energy, they will not react. The particles will just bounce off each other.

Changing the rate of reactions

Anything that increases the number of successful collisions between reactant particles will speed up a reaction.

What factors affect the rate of reactions?

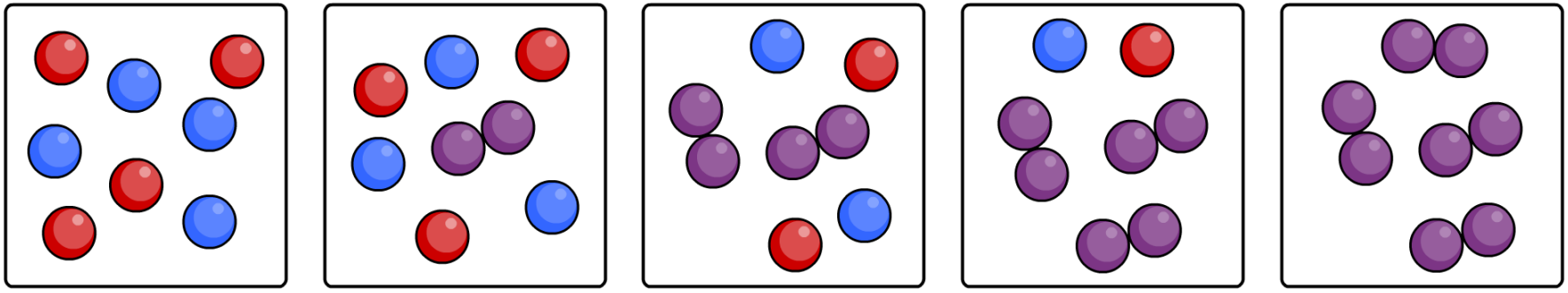
- increased **temperature**
- increased **concentration** of dissolved reactants, and increased **pressure** of gaseous reactants
- increased **surface area** of solid reactants
- use of a **catalyst**.

Slower and slower!

Reactions do not proceed at a steady rate. They start off at a certain speed, then get slower and slower until they stop.

As the reaction progresses, the concentration of reactants decreases.

This reduces the frequency of collisions between particles, and so the reaction slows down.



0% 25% 50% 75% 100%

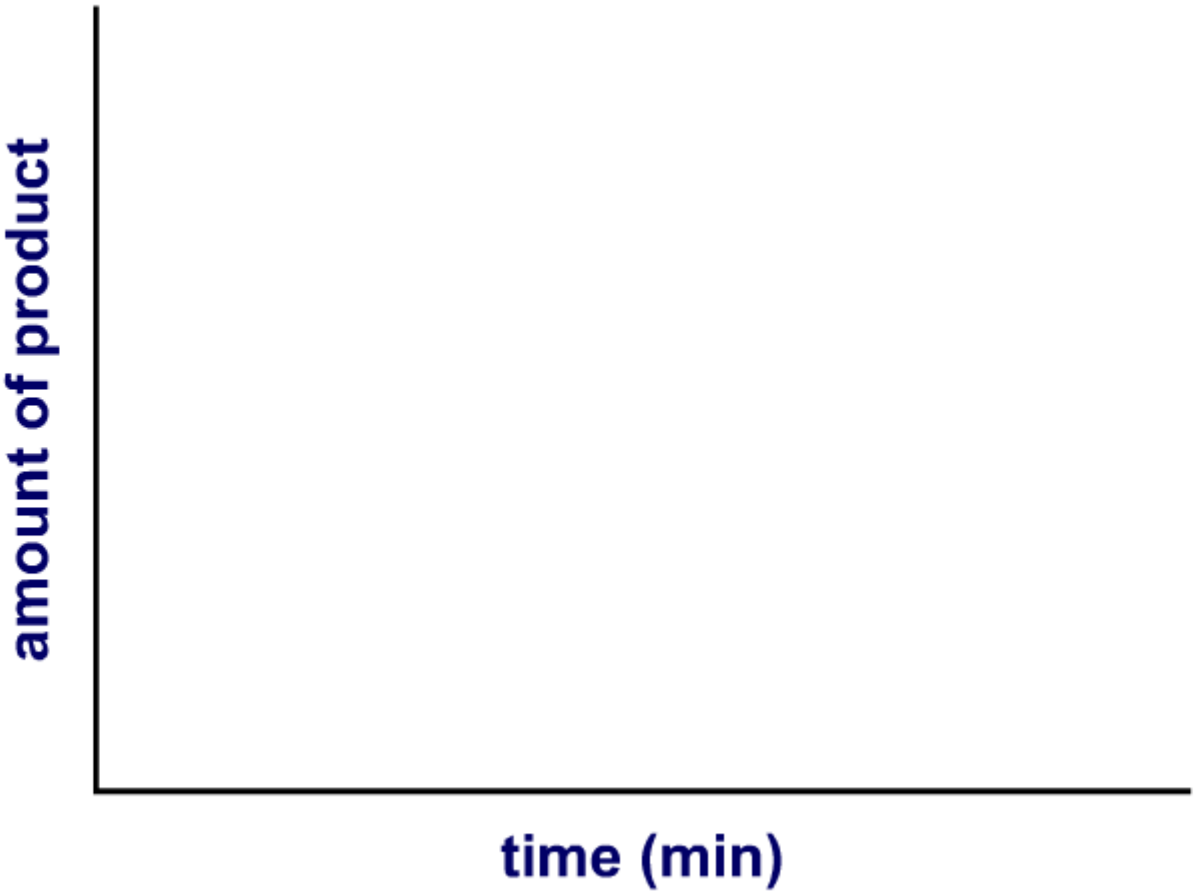
reactants

product

percentage completion of reaction

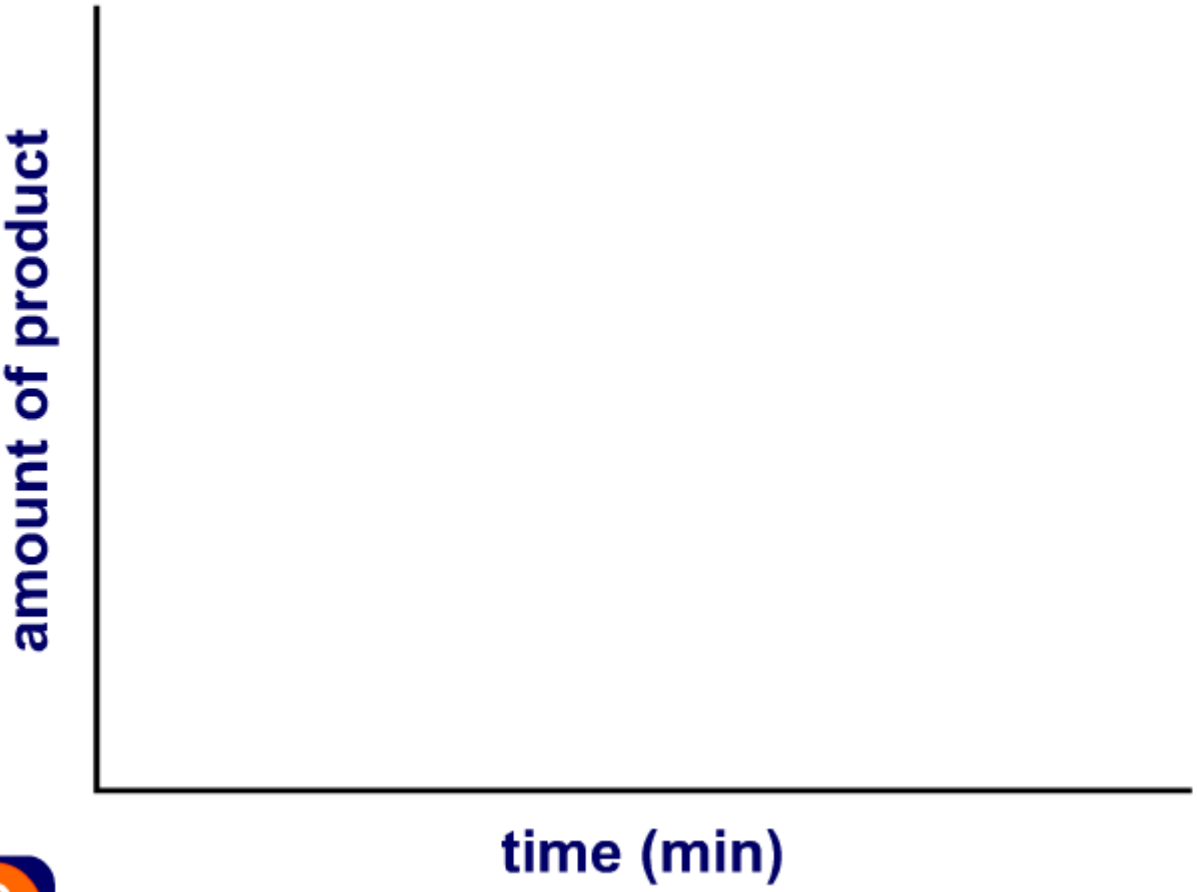
Graphing rates of reaction

What can a graph show about the rate of a reaction?



Reactant–product mix

What can a graph show about the reactant/product mix?



How can rate of reaction be measured?

Measuring the rate of a reaction means measuring the change in the amount of a reactant or the amount of a product.

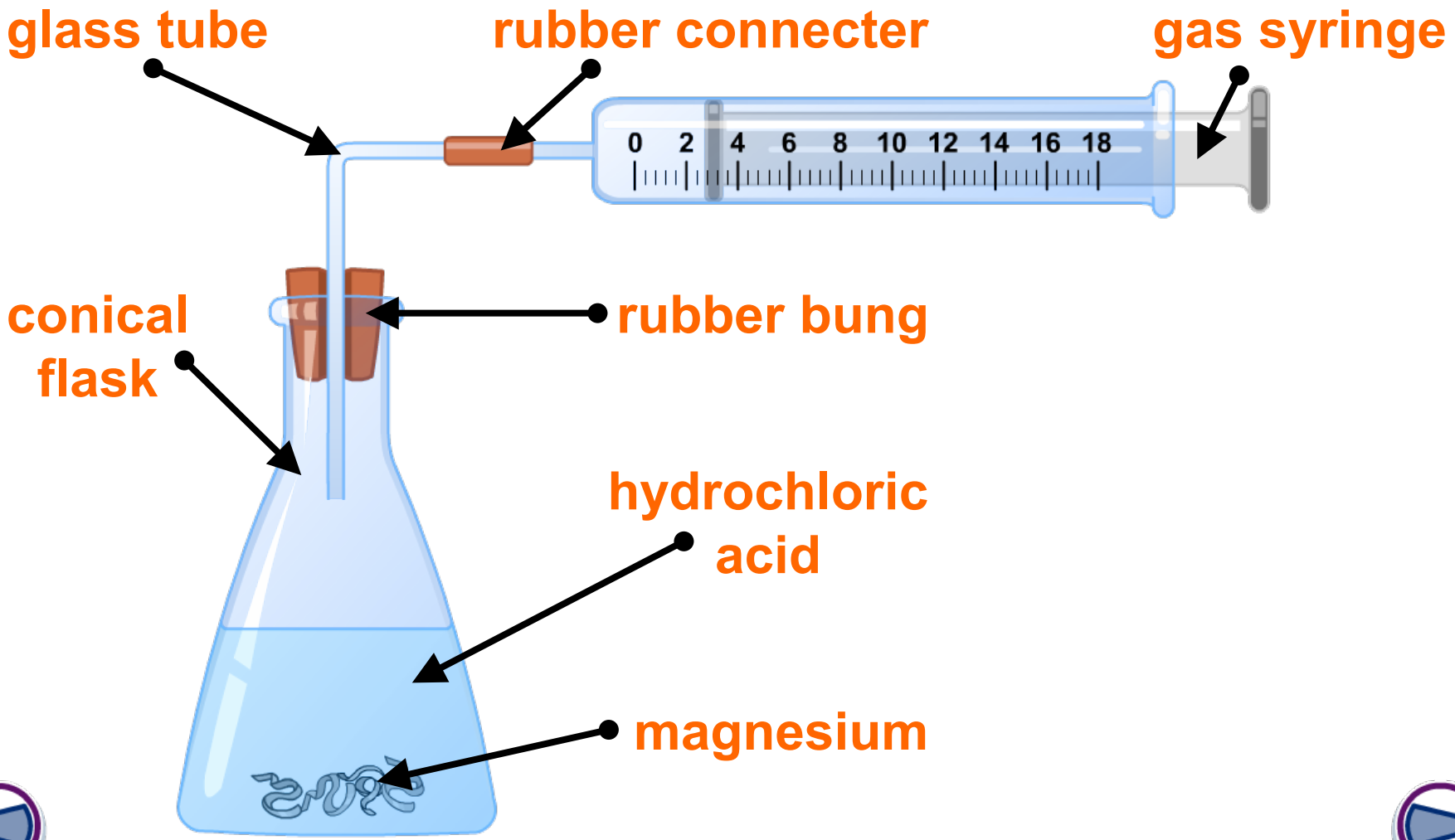
What can be measured to calculate the rate of reaction between magnesium and hydrochloric acid?

magnesium + hydrochloric acid → magnesium chloride + hydrogen

- The amount of hydrochloric acid used up (cm^3/min).
- The amount of magnesium chloride product (cm^3/min).
- The amount of hydrogen product (cm^3/min).

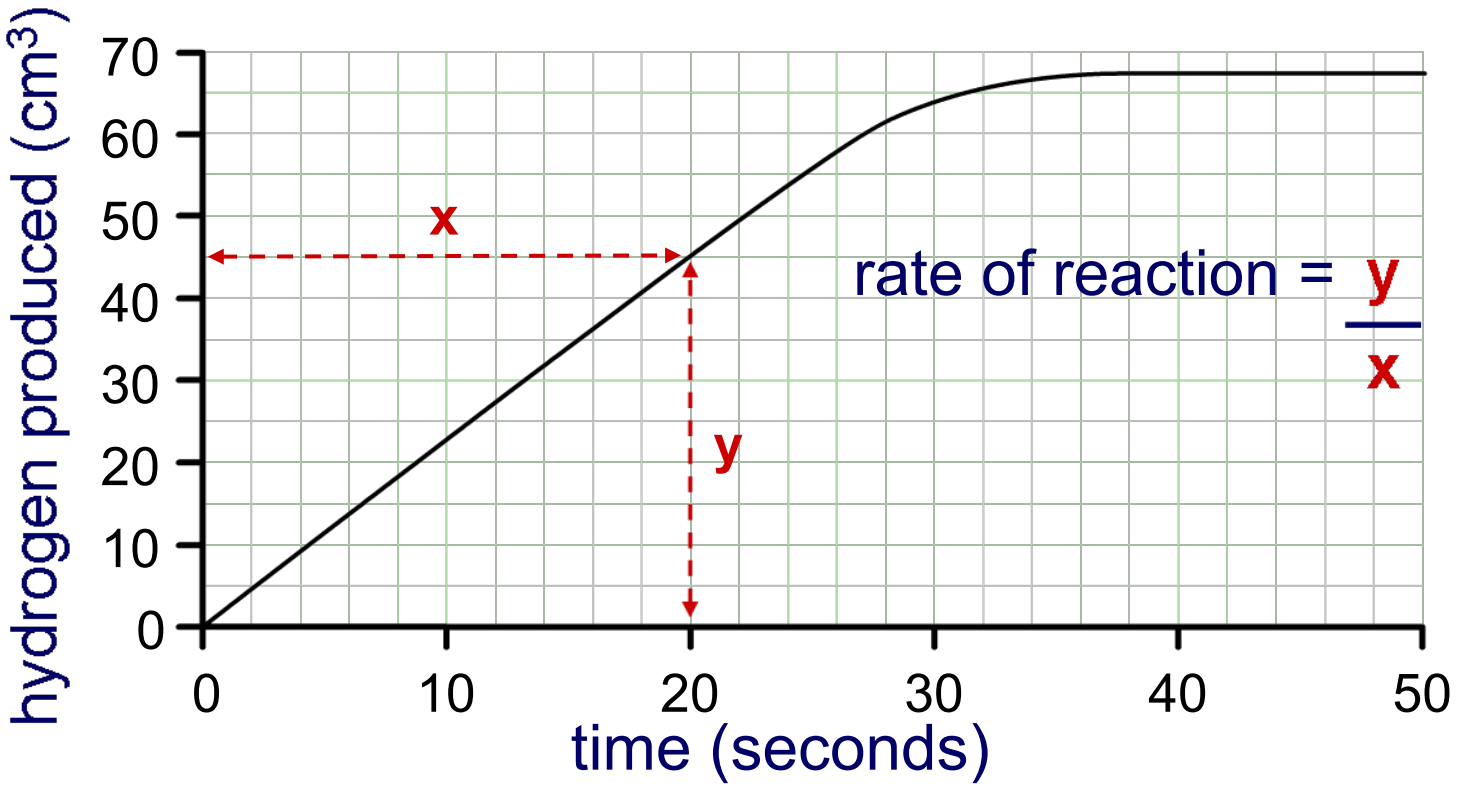
Setting up rate experiments

What equipment is needed to investigate the rate of hydrogen production?



Calculating rate of reaction from graphs

How can the rate of reaction be calculated from a graph?



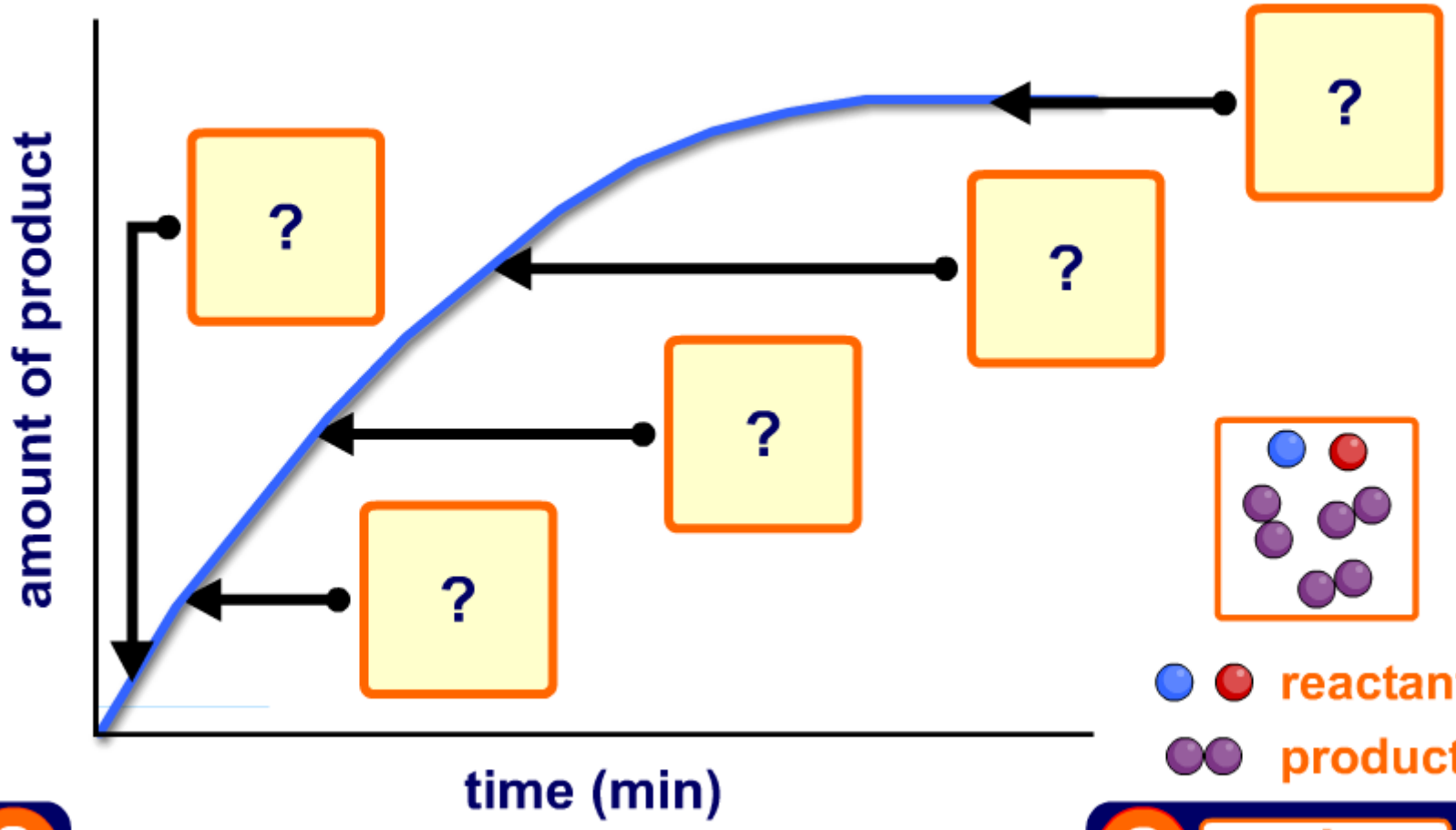
The gradient of the graph is equal to the initial rate of reaction at that time.

$$\text{rate of reaction} = \frac{45\,\text{cm}^3}{20\,\text{s}}$$

rate of reaction = **2.25 cm³/s**

The reactant/product mix

Match the reactant/product mix to the stages of the reaction



solve

Collisions and reactions: summary