OCR B GCSE Chemistry

Topic 6: Making useful chemicals

How do chemists control the rate of reactions?

Notes

1. Describe the effect on rate of reaction of changes in temperature, concentration, pressure, and surface area

- increasing temperature, concentration, pressure and surface area increases the rate of reaction

2. Explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles

- Increasing the temperature increases the rate of reaction. As increasing temperature increases the speed of the moving particles, so they collide more frequently and energetically.
- Increasing concentration of reacting solutions increases the rate of reaction, as it increases the frequency of collisions.
- Increasing pressure of reacting gases increases the rate of reaction, as it increases the frequency of collisions.

3. Explain the effects on rates of reaction of changes in the size of the pieces of a reacting solid in terms of surface area to volume ratio

- A greater surface area to volume ratio means a greater rate of reaction
- Look at the pictures of cubes above – from left to right surface area to volume ratio is increasing
- As this increases, there are more surfaces for a reaction to occur – increasing frequency of collisions and therefore increasing the rate

4. Describe the characteristics of catalysts and their effect on rates of reaction

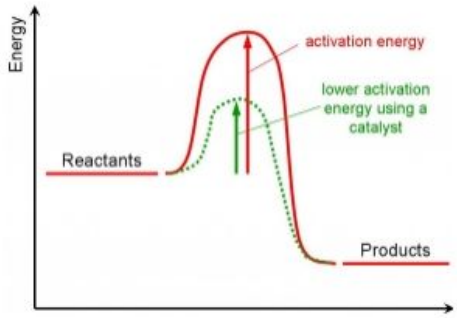
- Catalysts are substances that speed up chemical reactions without being changed or used up during the reaction, (enzymes are biological catalysts).

5. Identify catalysts in reactions

- Remains unchanged throughout the reaction- usually wouldn't be included in the equation

6. Explain catalytic action in terms of activation energy

- Catalysts increase rate of reaction by providing an alternative pathway, which has a lower activation energy – therefore there are now more particles / reactants with an energy greater than that of the activation energy, meaning rate of reaction increases

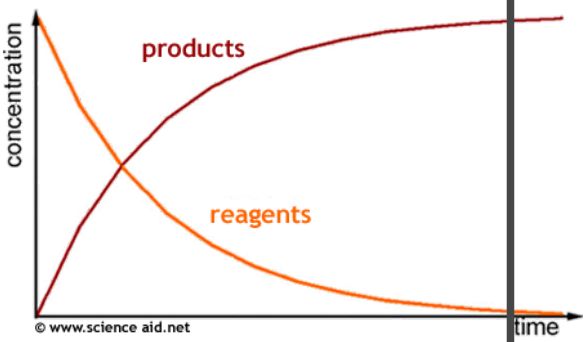


7. Suggest practical methods for determining the rate of a given reaction including:

- For reactions that produce gases:
  - Gas syringes or collection over water can be used to measure the volume of gas produced
  - Mass loss can be measured using a balance
- (HT only) measurement of physical factors
  - Colour change
  - Formation of a precipitate
- You would want to do multiple experiments changing the variable e.g. if it was temperature do the experiment at 20˚C, 25˚C, 30˚C etc... measuring the rate each time to then compare (possibly graphically)

8. Interpret rate of reaction graphs

- Concentration of products increases as the reaction proceeds
- Concentration of reactants decreases as the reaction proceeds
- The gradient of the line/slope = the rate of reaction
- 1/t is proportional to rate and gradients of graphs



9. (HT only) interpret graphs of reaction conditions versus rate (separate science only) NB: an understanding of orders of reaction is not required

- Straight line through the origin = rate is proportional to the reaction condition, therefore doubling the condition would double the rate
- Horizontal straight line = reaction condition has no effect on the rate
- Slightly curved line starting from origin = reaction condition affects rate – but is not directly proportional, i.e. might mean that if the condition changes by two times, the rate would change by two times

10. Use arithmetic computation and ratios when measuring rates of reaction

- Use equations below to find the rate of reaction to compare the effect of changes in surface area/particle size, concentration, temperature, use of a catalyst etc…
- Rates of reactions can be measured using the amount of product used, or amount of product formed over time:

$$\text{Rate of reaction} = \frac{\text{amount of reactant used}}{\text{Time}}$$

$$\text{Rate of reaction} = \frac{\text{amount of product formed}}{\text{Time}}$$

  - Quantity of reactant or product can be measured by the mass in grams or by a volume in cm^3
  - Units of rate of reaction may be given as g/s or cm^3/s
  - Use quantity of reactants in terms of moles and therefore, units for rate of reaction in mol/s

11. Draw and interpret appropriate graphs from data to determine rate of reaction

12. Determine gradients of graphs as a measure of rate of change to determine rate

when looking at a graph of mass of product against time:

- Reactions are usually fastest at the beginning, when the concentration of reactants is greatest. When the line becomes horizontal, the reaction has stopped.
- The steeper the line, the greater the rate of reaction.

13. Use proportionality when comparing factors affecting rate of reaction

- see 9

14. Describe the use of enzymes as catalysts in biological systems and some industrial processes

- in biological: systems they are used to catalyse: DNA replication, protein synthesis and digestion
- industrial processes- e.g. yeast is used in the fermentation of glucose