Answer all the questions below then check your answers

1. Define surface area in the context of a solid reactant.

2. State the relationship between surface area and the rate of reaction.

3. Explain, using the particle model, why increasing surface area increases the rate of reaction.

4. Explain why firewood burns faster when chopped up into smaller pieces.

5. A student investigates the reaction between calcium carbonate (marble chips) and hydrochloric acid. They use different sizes of marble chips. Describe how the student could measure the rate of reaction.

6. Explain why indigestion tablets that dissolve quickly are designed to have a large surface area.

7. Describe an experiment to investigate how the surface area of calcium carbonate (marble chips) affects the rate of reaction with hydrochloric acid. Include the equipment you would use, the variables you would control, and how you would present your results. You will be measuring the rate by recording the volume of gas released.

8. Catalytic converters in cars use a honeycomb structure with a large surface area. Explain how this structure helps reduce pollution.

Answers

1. Define surface area in the context of a solid reactant.

   Surface area is the total area of the exposed surfaces of a solid object.

2. State the relationship between surface area and the rate of reaction.

   Increasing the surface area of a solid reactant generally increases the rate of reaction.

3. Explain, using the particle model, why increasing surface area increases the rate of reaction.

   A larger surface area exposes more reactant particles to the other reactant. This leads to more frequent collisions, increasing the chances of successful reactions.

4. Explain why firewood burns faster when chopped up into smaller pieces.

   Firewood burns faster when it's chopped into smaller pieces because the increased surface area allows more wood to react with oxygen in the air.

5. A student investigates the reaction between calcium carbonate (marble chips) and hydrochloric acid. They use different sizes of marble chips. Describe how the student could measure the rate of reaction.

   - The volume of carbon dioxide gas produced over time (using a gas syringe).
   - The change in mass as carbon dioxide gas escapes (using a balance).
   - The time taken for the marble chips to disappear completely.

6. Explain why indigestion tablets that dissolve quickly are designed to have a large surface area.

A larger surface area means the tablet dissolves faster, releasing the active ingredients more quickly. This allows them to neutralize stomach acid faster and provide relief from indigestion sooner.

7. Describe an experiment to investigate how the surface area of calcium carbonate (marble chips) affects the rate of reaction with hydrochloric acid. Include the equipment you would use, the variables you would control, and how you would present your results. You will be measuring the rate by recording the volume of gas released.

Equipment: Hydrochloric acid (same concentration), marble chips of different sizes, conical flask, stopwatch, measuring cylinder, gas syringe.

Method:

Measure a set volume of hydrochloric acid (e.g., 25 cm^3).

Add a set mass of marble chips (e.g., 5 g) to the flask.

Quickly connect the gas syringe and start the stopwatch.

Record the volume of gas produced at regular intervals (e.g., every 10 seconds).

Repeat with different sizes of marble chips.

Variables:

Independent: Surface area of marble chips (by using different sizes)

Dependent: Volume of gas produced over time

Control: Mass of marble chips, concentration of acid, temperature, size of flask

Results: Plot graphs of volume of gas produced against time for each chip size. A steeper line indicates a faster rate of reaction.

8. Catalytic converters in cars use a honeycomb structure with a large surface area. Explain how this structure helps reduce pollution.

The honeycomb structure of a catalytic converter maximizes the surface area of the catalyst (often platinum, palladium, or rhodium). This large surface area allows more pollutant gases (like carbon monoxide and nitrogen oxides) to come into contact with the catalyst, increasing the rate of the reactions that convert these harmful gases into less harmful ones (like carbon dioxide, nitrogen, and water).