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FREE LEARNING NOTES FOR ZAMBIA

FORM 2

Chemistry

Rates of chemical reactions

Lesson notes for learners · Competence-Based Curriculum

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Some reactions are slow and some are fast. A compost heap on a farm takes months to turn plant waste into fertiliser, while hot vinegar on a crushed egg shell fizzes and dissolves it in seconds. The study of how fast reactions go is called chemical kinetics, and it matters in manufacturing, mining, agriculture, protecting the environment and finding better sources of energy.

AFTER THESE NOTES YOU SHOULD BE ABLE TO

- Say what the rate of a chemical reaction means
- Describe rate as the amount of reactants used up or products formed in a given time
- Carry out a simple experiment with magnesium ribbon and hydrochloric acid
- Use the time a reaction takes to compare how fast different reactions are

KEY WORDS

rate of reaction	the speed at which a given reaction takes place
chemical kinetics	the study of the rates of chemical reactions
reactant	a substance that is used up in a reaction
product	a substance that is formed in a reaction
reaction time	the time a reaction takes to finish

1 What is the rate of a reaction

The rate of a chemical reaction is the speed at which the reaction takes place. We can describe it as the amount of reactants used up, or the amount of products formed, in a unit of time.

Controlling the rate of reactions is important. It helps industries work efficiently, keeps processes safe and makes them sustainable.

2 Measuring the rate with magnesium and acid

You can see a rate in the laboratory. Measure 20 cm3 of 1.0 M hydrochloric acid into a 250 cm3 beaker. Place a 3 cm piece of magnesium ribbon in the acid and start the stopwatch at once. Watch the bubbles and the ribbon getting smaller. Stop the watch when the ribbon has completely reacted or the fizzing stops, and record the time. Work carefully because you are handling acid.

A short time means a fast reaction and a long time means a slow reaction. The rate can be seen from the bubbling or from the solid disappearing. Measuring the time lets you compare the rates of different reactions.

Reaction time	What it tells you about the rate
Short time	Fast reaction, high rate
Long time	Slow reaction, low rate

Figure 1. Comparing reaction time and rate

3 Rates in daily life

Compare two reactions: calcium carbonate reacting with an acid, and bananas ripening. The egg shell and vinegar reaction finishes in seconds, while the ripening of bananas takes days. Comparing the time each one takes is how we say which has the higher rate.

TRY THIS

In groups, do the magnesium ribbon and hydrochloric acid experiment if your teacher allows it. Record the time taken, write what you saw happening to the ribbon, and share with another group. Then list two reactions you know at home that are fast and two that are slow.

REMEMBER

- Rate of reaction is the speed at which a reaction takes place
- It is the amount of reactants used up or products formed per unit time
- A shorter reaction time means a faster rate
- Bubbling or a solid disappearing shows a reaction going on
- Controlling rates helps industry to be efficient, safe and sustainable

? Check yourself

1. What is meant by the rate of a chemical reaction?
2. Write two ways of describing the rate of a reaction in terms of substances.
3. Name two fields where chemical kinetics is important.
4. What does a longer reaction time tell you about the rate?
5. Name two things you can observe that show magnesium is reacting with acid.
6. At Kapoche school, two groups each put a 3 cm piece of magnesium ribbon into 20 cm3 of 1.0 M hydrochloric acid. Group A's ribbon disappears after 40 seconds and Group B's

after 90 seconds. (a) Which group had the faster reaction? (b) Explain how you know. (c) Say what the group should do to make sur

7. A learner says a compost heap and a crushed egg shell in hot vinegar react at the same rate because both break down in the end. (a) Do you agree? (b) Use the idea of reaction time to explain. (c) Describe how you would compare the two reactions.

ANSWERS

1. The speed at which a given reaction takes place.
2. The amount of reactants used up per unit time, or the amount of products formed per unit time.
3. Any two of manufacturing, environmental conservation, mining, agriculture, developing efficient energy sources.
4. The reaction is slower, so the rate is lower.
5. Bubbling and the magnesium ribbon disappearing.
6. (a) Group A. (b) A shorter time means a faster rate. (c) Use the same size of ribbon, the same volume and strength of acid, and time both from the moment the ribbon goes in.
7. (a) No. (b) The egg shell dissolves in seconds and the compost takes months, so the egg shell reaction is much faster. (c) Record the time each takes to finish and compare the times.

Written by 25Schools to follow the Form 2 Chemistry syllabus of the Zambian competence-based curriculum. Free for learners to read, download and share. More notes and quizzes at 25schools.com.