HOW FAST?

In the laboratory we can study what changes affect the rate of a reaction. Some reactions you have already come across are so fast that they appear to be instantaneous, for example when an insoluble salt is prepared by mixing together two soluble salts, the solid appears immediately. Other reactions take a few seconds, for example burning a small length of magnesium ribbon, and some reactions seem to take a very long time, like the tarnishing of a silver tray or the rusting of iron.

In order to follow a reaction in the laboratory we need an observable or measurable change. Changes we can measure include:

a. a change in pH; b. a change in temperature; c. a change in colour; d. a change in mass; e. the disappearance of a reactant; f. the appearance of a precipitate; g. a volume of gas given off.

Some of the easiest reactions to follow in the laboratory are those in which a gas is given off.

In order for substances to react they must collide with each other. If a collision is to cause a reaction to take place the collision must have enough energy and be in the right direction. Not all collisions result in a reaction: a certain energy threshold, called the activation energy, has to be reached. Each different reaction has its own activation energy.

In order to alter the rate of a reaction either the number or the energy of collisions must be changed. The more collisions there are, the faster the reaction. The harder the collisions are, the greater the proportion of collisions that will reach the activation energy. Both these facts lead to a faster reaction. Moreover, the higher the temperature, the quicker the reaction.

Pressure will have an effect only if the reaction involves gases. In a reaction between two gases an increased pressure will have the effect of forcing the gas particles closer together, i.e. increasing the concentration. This will lead to an increased rate of reaction.

In a reaction between a solid and a liquid or a solid and a gas, the smaller the pieces the solid is broken down into, the faster the rate of the reaction.

The rates of some reactions can be altered by adding other chemicals to the reaction mixture. A substance that can alter the rate of a reaction, without altering the reaction in any other way and without being used up during the reaction, is called a catalyst. Catalysts are very important in industry.

A large number of catalysts occurs in living cells. These are called enzymes. Many different chemical reactions happen inside each living cell. Without enzymes these reactions would happen so slowly the cells would die. An enzyme works by bringing the chemicals together at a particular location on its surface – the active site. Enzymes are specific to certain chemical reactions.

Unlike metal catalysts, enzymes are destroyed by high temperatures. They work best between 37°C and 40°C. Enzymes are also sensitive to acidity and alkalinity.

Some reactions can go in both directions, depending on the conditions. A balance is set up where the rate of the forward reaction is equal to the rate of the backward reaction. This is called a chemical equilibrium. When an equilibrium is set up the overall reaction appears to have stopped.

(from: Stone-Andrews-Williams, *Examining GCSE-Science*, Stanley Thornes Ltd.)

1 *Answer these questions about* How fast?

a. Why is it essential to be able to control the rates of chemical reactions in industrial chemistry? • **b.** Why is industry interested in speeding up chemical reactions? • **c.** Do all chemical reactions take place at the same rate? • **d.** What chemical changes can be observed and measured in a laboratory? • **e.** What is necessary for substances to react with one another? • **f.** What is meant by 'activation energy'? • **g.** How can the rate of a chemical reaction be changed? • **h.** How does temperature affect the rate of a chemical reaction? • **i.** Does pressure affect all chemical reactions? • **j.** How does the size of solid particles influence the rate of a chemical reaction? • **k.** How do enzymes act? • **l.** What is an 'active site'? • **m.** What are enzymes sensitive to? • **n.** What are reversible reactions?

2 *Match adjectives* a-h, *as they are used in the passage* How fast? *with their antonyms* 1-8. *Tip: copy the pairs in your indexed book.*

a.	instantaneous	☐	**1.** backward
b.	observable	☐	**2.** dead
c.	measurable	☐	**3.** gradual
d.	right	☐	**4.** imperceptible
e.	increased	☐	**5.** indeterminate
f.	living	☐	**6.** lesser
g.	specific	☐	**7.** vague
h.	forward	☐	**8.** wrong

3 *Give the comparative or superlative form of these adjectives to make antonyms of those from* How fast? *listed below:* big, difficult, low, slow, soft.

a. easiest .....
b. faster / quicker .....
c. harder .....
d. higher .....
e. smaller .....

4 *Match verbs* a-h, *as they are used in the passage* How fast?, *with their synonyms* 1-8. *Tip: copy the pairs in your indexed book.*

a.	affect	☐	**1.** function
b.	appear	☐	**2.** get to
c.	follow	☐	**3.** influence
d.	need	☐	**4.** intensify
e.	reach	☐	**5.** monitor
f.	force	☐	**6.** push
g.	increase	☐	**7.** require
h.	work	☐	**8.** seem

5 *Match phrasal verbs* a-h, *as they are used in the passage* How fast? *with their synonyms* 1-8. *Tip: copy the pairs in your indexed book.*

a.	come across	☐	**1.** be consumed
b.	give off	☐	**2.** collide
c.	come into contact	☐	**3.** combine
d.	take place	☐	**4.** emit
e.	result in	☐	**5.** encounter
f.	break down	☐	**6.** happen
g.	be used up	☐	**7.** lead to
h.	bring together	☐	**8.** separate