Speaker one

Have you ever had a bump or a sprain and needed a cold compress?

Speaker two

Yes, all the time.

Now, some cold packs use a chemical reaction to absorb heat. This is an example of something known as an endothermic reaction. And have you ever felt the heat from a candle?

Speaker one

Yes.

Speaker two

Well, that is an exothermic reaction.

Speaker one

Now, what do these terms actually mean?

Speaker two

Oh, let me tell you!

An exothermic process transfers energy from the reacting molecules to the surroundings, causing the temperature over the immediate environment to rise or get hotter.

Speaker one

Now, chemical reactions which take energy from the surroundings are called endothermic reactions.

This energy transfer makes the environment cooler.

Speaker two

You can tell the difference between an endothermic and exothermic reaction by measuring the temperature changes which occur during the reaction.

Speaker one

We're going to investigate how changing the volume of one of the reactants affects the maximum temperature reached during an exothermic reaction between hydrochloric acid and sodium hydroxide.

Speaker two

Now, our independent variable will be the volume of sodium hydroxide.

The volume of hydrochloric acid will be one of our control variables.

We're going to be measuring the maximum temperature reached during the reaction, which will be our dependent variable.

Speaker one

This is the equipment you'll need. Now, do pause the video and take a look.

Now remember, because we're working with acids and alkalis we're going to need to put safety

gloves and safety specs on.

Speaker one

Now, we're working with an insulated cup because we want to keep the heat given out in the reaction to be held in the reaction vessel so we can measure it.

The cup is a great thermal insulator, so it will minimise the heat loss to the surrounding areas. The lid also helps to reduce heat loss.

Speaker two

So, measure 30cm^3 of hydrochloric acid. Pour it into the insulated cup and add the thermometer.

Write down the starting temperature of the acid.

Keeping the starting temperature of the reaction constant is another one of our control variables. Add 5cm^3 of sodium hydroxide into the measuring cylinder.

Pour the sodium hydroxide into the hydrochloric acid and put the lid on.

Now gently swirl the contents to distribute the heat, just gently.

Watch the thermometer and note the highest temperature. I reckon we've hit the maximum, so for us there, that is 23 degrees.

Speaker one

Just record the highest temperature each time on your table. Then clean and dry the insulating cup and the lid

Speaker two

We're going to continue. We're going to add 5cm³ more. Okay.

Speaker one

Okay. I'll swirl when you're done.

Speaker two

Go on, swirl.

Speaker one

Swirl, swirl. I'm swirling, I'm swirling.

Speaker two

It's all heating up. I'd call that 25.

Speaker one

Yep, I think it's about 25.

Speaker two

We're then going to repeat the entire experiment two more times. This will allow us to identify and discard any anomalous results.

We can then calculate the mean maximum temperature rise for each value of the independent variable. We can then plot a graph of our results.

Initially, the more sodium hydroxide we add the higher the maximum temperature. The sodium hydroxide is the limiting reactant at this point.

So adding more of it increases the chemical reaction taking place so more energy is transferred. Now you might have noticed that eventually we reach a limit to the maximum temperature. This is where we've added exactly the right amount of sodium hydroxide to react with all of the hydrochloric acid.

Speaker one

If we continue to add more sodium hydroxide after this point the same total amount of energy is released.

However, the energy is now spread over a bigger volume of solution.

So the maximum temperature reached starts to drop off.

Speaker two

I don't know why I did that. Remember, exothermic RELEASES energy.

Energy EXITS and makes the surrounding warmer.

Speaker one

Yes. And in an endothermic reaction, energy ENTERS, making the surrounding temperature decrease.