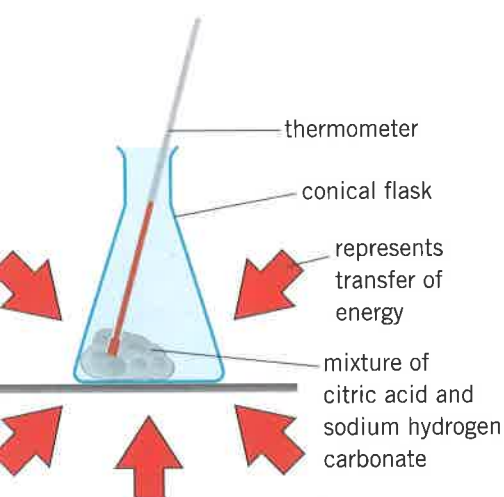


6.4.1 Exothermic and endothermic

Learning objectives

After this section you will be able to:

- describe exothermic and endothermic changes
- use experimental observations to distinguish exothermic and endothermic reactions.



▲ The reaction of citric acid with sodium hydrogen carbonate is endothermic.

Have you ever used a cold pack on an injury? How did the pack get cold?

One type of cold pack includes two substances. An outer bag contains liquid water. An inner bag contains solid ammonium nitrate. When you break the inner bag, the water and ammonium nitrate mix. The solid dissolves in the water, and the mixture cools. The injured body part transfers energy to the mixture, so the injury cools down and feels better. The mixture slowly returns to the temperature of the surroundings.



◀ A cold pack on a sports injury.

What is an endothermic change?

The process in the cold pack is an **endothermic change**. In this type of change, energy is transferred *from* the surroundings to substances that are reacting, changing state, or dissolving. Endothermic changes include:

- some chemical reactions
- melting and boiling
- dissolving some substances in water.

Tom has some citric acid crystals. Their temperature is 20 °C. He adds sodium hydrogen carbonate powder. There is a chemical reaction. The reacting mixture feels cold. Its temperature goes down to 10 °C. The temperature decrease shows that it is an **endothermic reaction**.

Once the reaction is complete, Tom leaves his mixture of products in the lab. After a while its temperature returns to 20 °C.

A State what an endothermic reaction is.

What is an exothermic change?

Some changes are exothermic. In this type of change, energy is transferred *to* the surroundings *from* substances that are reacting, changing state, or dissolving. **Exothermic changes** include:

- chemical reactions, for example, combustion
- freezing and condensing
- dissolving some substances in water.



◀ Burning reactions transfer energy to the surroundings. They are exothermic.

Zoe has some dilute sulfuric acid. She also has some sodium hydroxide solution. The temperature of both solutions is 20 °C. Zoe mixes them. There is a chemical reaction. She measures the temperature again. It is 30 °C. The temperature increase shows that it is an **exothermic reaction**.

Once the reaction is complete, Zoe leaves the mixture of products in the lab. After a while its temperature returns to 20 °C.

Literacy

Here's an easy way to remember the difference between exothermic and endothermic reactions:

Exothermic reactions transfer energy out. You go out through an **exit**.

Endothermic reactions transfer energy in. You go in through an **entrance**.

Key Words

endothermic change, endothermic reaction, exothermic change, exothermic reaction

Summary Questions

1 Copy the sentences below, choosing the correct bold words. All chemical reactions involve **colour/energy** transfers. If the temperature increases, the change is **exothermic/endothermic**. If the temperature decreases, the change is **exothermic/endothermic**. Boiling and melting are **exothermic/endothermic** changes. (4 marks)

2 The table shows the temperature changes when some substances dissolve in water. Write down the names of the substances that dissolve exothermically. Explain your choices. (3 marks)

Name of substance	Temperature before dissolving (°C)	Temperature after dissolving (°C)
potassium chloride	20	10
calcium chloride	20	35
sodium hydrogen carbonate	20	15
sodium carbonate	20	24

3 Use data from the table in question 2 to select two substances that could be used, along with water, for a hand warmer, and two that could be used for a cool pack. Justify your choices. (4 marks)

4 Write a paragraph to compare exothermic and endothermic changes. Include examples to illustrate your answer. (6 marks)

You can get frostbite from cold packs if you don't use them properly. Never leave them on your skin for longer than the pack says.