

Exothermic/Endothermic Changes and Basic Energy Profiles

Q1. (2018) – 1a, 1b, 1d (i, ii)

- 1 Students are investigating exothermic and endothermic reactions. They are finding the temperature change in 50 cm^3 water when a solid dissolves in it. The apparatus is shown in Figure 1.

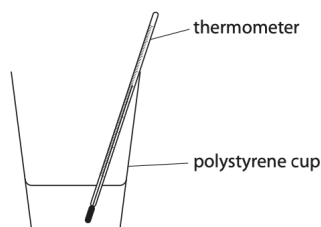


Figure 1

A)

- (a) The steps needed to carry out this experiment are **P, Q, R, S** and **T**. They are shown below.

They are not in the correct order.

- P** pour the 50 cm^3 water into the polystyrene cup
- Q** add the solid to the water and stir
- R** measure 50 cm^3 water using a beaker
- S** measure the initial temperature of the water
- T** measure the final temperature of the solution when all the solid has dissolved

Write the steps in the correct order, from left to right.

(2)

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B)

- (b) The dissolving of this solid in water is an exothermic change. The experiment is repeated a number of times. Compared with the initial temperature of the water, the final temperature of the solution is

(1)

- ☐ **A** always higher
- ☐ **B** always lower
- ☐ **C** sometimes higher and sometimes lower
- ☐ **D** always unchanged

C)

(d) Figure 2 shows a cold pack.

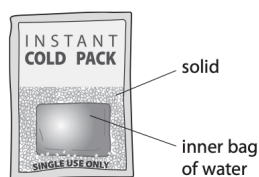


Figure 2

When the pack is squeezed hard the inner bag bursts.
Then the pack goes cold.

(i) Explain why the pack goes cold.

(2)

D)

(ii) Give the reason why the pack can be used only once.

(1)

Q2. (2018)

10 Ethanol can be used as a liquid fuel.

A student investigates how much heat energy is released when a known mass of ethanol is burned.

The apparatus is set up as shown in Figure 15.

A known volume of water is placed in a metal can.

The temperature of the water is measured.

The ethanol is ignited and placed under the beaker so that the flame is touching the beaker.

The water is heated by the flame.

The flame is extinguished.

The final temperature of the water is measured.

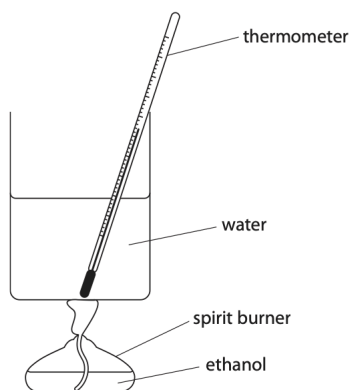


Figure 15

(a) The theoretical temperature rise for burning a given mass of ethanol is 82.4 °C.

In the experiment the actual temperature rise for burning this mass of ethanol was only 34.8 °C.

One reason why the temperature rise is less than expected is that the ethanol does not burn completely.

A)

(i) Give a reason why, even if the ethanol burns completely, the actual temperature rise is much less than the theoretical value.

(1)

B)

(ii) Explain how the method described above could be improved to give a temperature rise closer to the theoretical value.

(2)

Q3. (2019) – 4b

- 4 A student poured 50 cm^3 water into a beaker and measured the water's temperature.

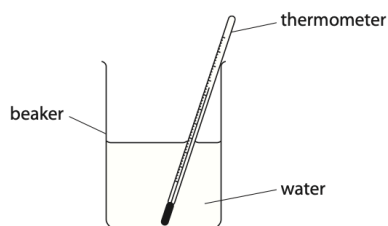


Figure 7

The student added 1.00 g calcium chloride to the water, stirred the mixture and then recorded the temperature.

- (b) The student's results were

temperature of water at start	= 21°C
temperature of mixture after stirring	= 32°C

Explain, using these results, the type of heat energy change that occurs when calcium chloride dissolves in water.

(2)

Q4. (2019) – 4d

- (d) State **one** way in which the apparatus could be changed to reduce the amount of heat energy lost during the experiment.

(1)

Q5. (2020) – 3b (iv)

- 3 (a) A student investigated the reaction between potassium iodide and lead nitrate.

- (b) In another experiment, a student investigated the temperature decrease when different amounts of ammonium nitrate crystals were dissolved in 100 cm^3 of water.

The apparatus used is shown in Figure 5.

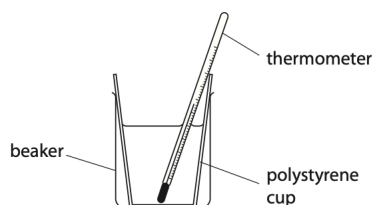


Figure 5

The student used the following method.

- step 1** pour 100 cm^3 of water into the polystyrene cup
- step 2** add one spatula of ammonium nitrate crystals to the water
- step 3** stir the mixture
- step 4** use the thermometer to record the lowest temperature reached by the mixture
- step 5** repeat steps 1 to 4 using different amounts of ammonium nitrate

(iv) Figure 6 shows the reaction profile for this reaction.

Use the words from the box to complete the labels on Figure 6.

activation energy	products	reactants
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(2)

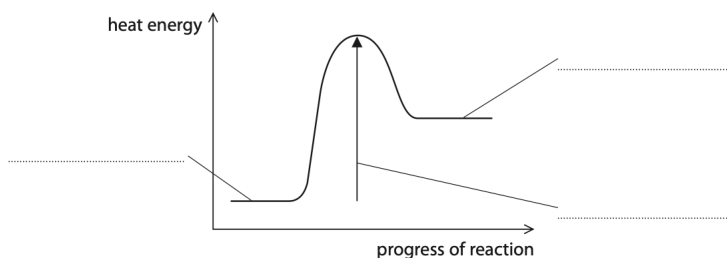


Figure 6

Q6. (2021) – 8b

(b) Dissolving ammonium chloride in water is an endothermic process. Figure 17 shows part of the reaction profile for this process.

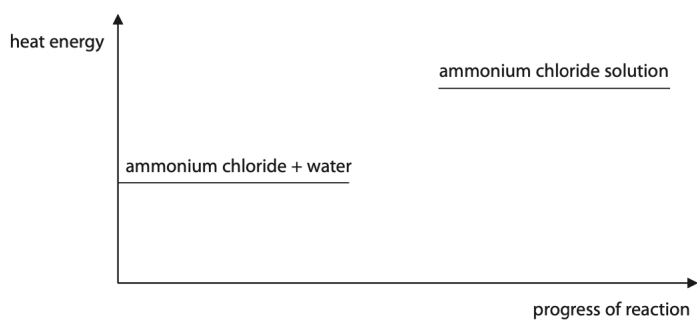


Figure 17

A)

(i) Explain how Figure 17 shows that dissolving ammonium chloride in water is an endothermic process.

(2)

B)

(ii) Complete the reaction profile in Figure 17 and label the activation energy.

(2)

Q7. (2022)

4 Some reactions are exothermic and some reactions are endothermic.

(a) What does an exothermic reaction always give out?

(1)

- ☐ A heat energy
- ☐ B light
- ☐ C a gas
- ☐ D sound

Q8. (2022) – 4b (iv)

- (b) In an experiment, a solid is mixed with a liquid.
The temperature change of the mixture is measured.

Figure 6 shows the apparatus that is used.

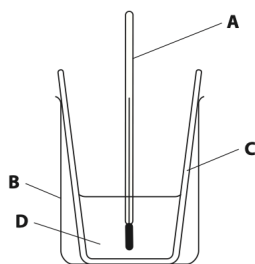


Figure 6

- (iv) The results of the experiment are given in Figure 7.

temperature of liquid at start in °C	18.6
temperature of products at end in °C	16.1

Figure 7

Calculate the change in temperature.

Give a sign and a unit in your answer.

(3)

temperature change = ...

Q9. (2023) – 2b

- 2 A student investigated the temperature change that took place when different salts were dissolved in water.

The student used the following method.

step 1 pour 50 cm³ of water into a polystyrene cup and record the temperature of the water

step 2 find the mass of an empty boiling tube

step 3 add 2 spatula measures of a salt to the boiling tube and find its new mass

step 4 add the salt to the water

step 5 stir the mixture and record the temperature after 2 minutes.

Figure 3 shows the apparatus used.

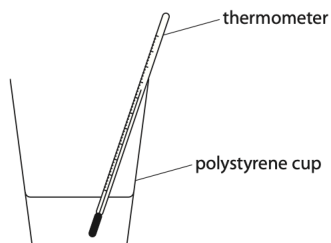


Figure 3

- (b) The student repeated the method for three different salts, **A**, **B** and **C**.

The same mass of each salt was used.

Figure 5 shows the temperature readings obtained for the three different salts.

salt	starting temperature of the water in °C	temperature of the mixture after 2 minutes in °C	temperature change in °C
A	20.5	25.6	+5.1
B	20.5	19.8	-0.7
C	20.5	29.2	

Figure 5

A)

- (i) Calculate the temperature change for salt **C**.

Include a sign to show if the temperature change is an increase or a decrease.

(2)

temperature change = ... °C

B)

- (ii) Explain which salt produces the biggest exothermic change.

(2)

Q10. (2024)

- 4 (a) In one reaction the temperature of the reaction mixture decreases.

Which word describes this type of reaction?

(1)

- ☐ **A** displacement
☐ **B** endothermic
☐ **C** exothermic
☐ **D** neutralisation

Q11. (2024) – 4b (iv)

- (b) In an experiment, a salt is dissolved in water.

The temperature change is measured.

Figure 7 shows the apparatus that is used.

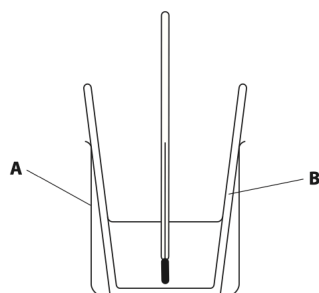


Figure 7

(iv) Four different salts, **P**, **Q**, **R** and **S**, are dissolved in water.

Figure 8 shows the starting temperature of the water and the final temperature of the solution after the salt dissolves.

	salt P	salt Q	salt R	salt S
starting temperature in °C	20.0	20.0	20.0	20.0
final temperature in °C	22.4	19.5	23.0	18.5
temperature change in °C	+2.4	−0.5		
salt that absorbed most heat energy when it dissolved				

Figure 8

Complete the table

- to show the temperature changes when salt **R** and salt **S** dissolve
- by placing a tick (✓) in the box, on the bottom row, for the salt that **absorbs** the most heat energy when it dissolves.

(4)

Q12. (2024) – 5c

(c) When some impure hydrocarbon fuels are burned, sulfur dioxide is one of the products.

Some sulfur dioxide gas is dissolved in water to form solution **W**.

When solution **W** is added to sodium hydroxide solution of pH 12

- the pH changes
- the temperature increases.

Explain how the pH changes and why the temperature increases.

(3)