

GCSE Chemistry

Worksheet: Energy transfer in exothermic and endothermic reactions

TIME 35 min	TOTAL 31 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Energy transfer in exothermic and endothermic reactions

NAME _____	CLASS _____	DATE _____
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

A student added 25 cm³ of sodium hydroxide solution to 25 cm³ of dilute hydrochloric acid in a polystyrene cup. The student measured the temperature before and during the reaction.

0 1 . 1

Starting temperature = 22 °C

Highest temperature reached = 27 °C

Calculate the temperature change.

.....

.....

.....

Temperature change = °C

[1 mark]

0 1 . 2

Is this reaction exothermic or endothermic?

Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 2

A student mixed pairs of chemicals and measured the temperature before and after each reaction.

Table 1 shows the results.

Table 1

Reaction	Chemicals mixed	Temperature before in °C	Temperature after in °C
A	magnesium and hydrochloric acid	19.5	29.0
B	citric acid and sodium hydrogencarbonate	20.0	15.5
C	sodium hydroxide and hydrochloric acid	19.5	26.0
D	zinc and copper sulfate	20.0	38.5

0 2 . 1

Which reaction, A, B, C or D, is endothermic?
Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 2 . 2

Calculate the temperature change in reaction D.

.....

.....

.....

Temperature change = °C

[1 mark]

0 2 . 3

Complete the sentence.

In an exothermic reaction, energy is transferred _____ the surroundings, so the temperature of the surroundings _____.

.....

.....

.....

.....

[2 marks]

0 2 . 4

Which of these is an endothermic reaction?

Tick (✓) **one** box.

Combustion of methane

☐

Neutralisation of an acid by an alkali

☐

Thermal decomposition of calcium carbonate

☐

Oxidation of iron in a hand warmer

☐

[1 mark]

0 3

A student investigates how the mass of sodium hydrogencarbonate added to citric acid solution affects the temperature change. The student:

1. measures 50 cm³ of citric acid solution into a polystyrene cup and records its temperature
2. adds a weighed mass of sodium hydrogencarbonate powder and stirs
3. records the lowest temperature reached.

The student repeats this with different masses of sodium hydrogencarbonate.

0 3 . 1

The temperature of the mixture decreased.

Is the reaction exothermic or endothermic? Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 3 . 2

What is the independent variable in this investigation?

Tick (✓) **one** box.

The volume of citric acid solution

☐

The mass of sodium hydrogencarbonate

☐

The lowest temperature reached

☐

The starting temperature of the solution

☐

[1 mark]

0 3 . 3

What is the dependent variable in this investigation?

.....

.....

[1 mark]

0 3 . 4

Give **two** variables the student should control.

.....

.....

.....

.....

[2 marks]

0 4

A student investigated the temperature change when different metal powders were added to copper sulfate solution.

This is the method used.

1. Measure 25 cm³ of copper sulfate solution into a polystyrene cup.
2. Record the temperature of the solution.
3. Add 1.0 g of metal powder and stir.
4. Record the highest temperature reached.
5. Repeat steps 1 to 4 with each of the other metals.

Table 2 shows the results.

Table 2

Metal	Temperature at start in °C	Highest temperature in °C	Temperature change in °C
Copper	20.0	20.0	0.0
Iron	19.5	30.0	10.5
Magnesium	19.5	57.0	X
Zinc	20.0	36.5	16.5

0 4 . 1

Calculate the value of X in Table 2.

.....

.....

.....

X = °C

[1 mark]

0 4 . 2

Describe the relationship between the reactivity of the metal and the temperature change.

.....

.....

[1 mark]

0 4 . 3

Explain why there was no temperature change when copper powder was added.

.....

.....

[1 mark]

0 4 . 4

Why did the student use a polystyrene cup rather than a glass beaker?

.....

.....

[1 mark]

0 4 . 5

Give **two** variables the student should have kept the same.

.....

.....

.....

.....

[2 marks]

0 5

A student dissolved calcium chloride in water in an insulated cup and recorded the highest temperature reached. The student did the experiment three times and recorded these highest temperatures:

34.5 °C 35.5 °C 35.0 °C

0 5 . 1

Use the readings to suggest the resolution of the thermometer the student used.

.....

.....

.....

Resolution = °C

[1 mark]

0 5 . 2

Calculate the mean highest temperature.

.....

.....

.....

Mean highest temperature = °C

[1 mark]

0 5 . 3

Calculate the uncertainty in the mean, using half the range of the three readings.

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.....

.....

Uncertainty = °C

[2 marks]

0 5 . 4

Another student did the same experiment once and recorded a highest temperature of 36.5 °C.
Use your answers to decide whether this reading is consistent with the first student's results.
Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

.....

0 6

A student added 30 cm³ of potassium hydroxide solution to 30 cm³ of dilute nitric acid in a polystyrene cup. The student measured the temperature before and during the reaction.

0 6 . 1

Starting temperature = 20.0 °C

Highest temperature reached = 27.0 °C

Calculate the temperature change.

.....

.....

.....

Temperature change = °C

[1 mark]

0 6 . 2

Is this reaction exothermic or endothermic?

Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 6 . 3

Suggest why the student used a polystyrene cup rather than a glass beaker.

.....

.....

[1 mark]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Chemistry · Worksheet: Energy transfer in exothermic and endothermic reactions · 31 marks

Question 1 (3 marks)

01.1 [1 mark]

Answer: 5 °C

- 5 (°C) (1)
-

01.2 [2 marks]

Answer: Exothermic: the temperature increased, because energy was transferred to the surroundings.

- exothermic (1)
 - the temperature increased / energy was transferred to the surroundings (1)
-

Question 2 (6 marks)

02.1 [2 marks]

Answer: B, because the temperature decreased.

- B (1)
- the temperature decreased / the temperature after mixing was lower than before (1)

Notes: The reason can score only if B is given. Allow 'energy was taken in from the surroundings'.

02.2 [1 mark]

Answer: 18.5 °C

- 18.5 (°C) (1)
-

02.3 [2 marks]

Answer: to; increases

- to (1)
- increases (1)

Notes: Allow 'goes up' or 'rises' for increases.

02.4 [1 mark]

Correct: Thermal decomposition of calcium carbonate

Question 3 (6 marks)

03.1 [2 marks]

Answer: Endothermic, because energy is taken in from the surroundings (the temperature decreases).

- endothermic (1)
- (energy is taken in from the surroundings, so) the temperature of the mixture decreases (1)

Notes: The reason mark depends on 'endothermic'.

03.2 [1 mark]

Correct: The mass of sodium hydrogencarbonate

03.3 [1 mark]

Answer: The temperature change (starting temperature – lowest temperature).

- the temperature change / decrease (starting temperature – lowest temperature) (1)

Notes: Allow 'the lowest temperature reached'.

03.4 [2 marks]

Answer: The volume of citric acid solution; the concentration of the citric acid solution.

- volume of citric acid solution (1)
- concentration of citric acid solution (1)
- starting temperature of the citric acid solution (1)
- type of cup / whether a lid is used (1)
- amount of stirring (1)

Any 2 of the points above.

Question 4 (6 marks)

04.1 [1 mark]

Answer: 37.5 °C

- 37.5 (°C) (1)

04.2 [1 mark]

Answer: The more reactive the metal, the greater the temperature change.

- the more reactive the metal, the greater the temperature change (1)

Notes: Allow the converse. Do not accept 'magnesium had the biggest temperature change' on its own.

04.3 [1 mark]

Answer: No reaction happened because copper cannot displace copper.

- no reaction took place (because copper is not more reactive than the copper in copper sulfate) (1)

04.4 [1 mark]

Answer: Polystyrene is a good thermal insulator, so less energy is transferred to the surroundings.

- polystyrene is a (good thermal) insulator / reduces energy transfer to the surroundings (1)

Notes: Ignore 'keeps the heat in' unless energy transfer or insulation is mentioned.

04.5 [2 marks]

Answer: Any two from: volume of solution, concentration of solution, mass of metal, particle size of metal, starting temperature.

- volume of copper sulfate solution (1)
- concentration of copper sulfate solution (1)
- mass of metal (powder) (1)
- particle size of the metal / all metals used as powders (1)
- starting temperature of the solution (1)

Any 2 of the points above.

Notes: Do not accept 'amount of metal' unless mass is stated.

Question 5 (6 marks)

05.1 [1 mark]

Answer: 0.5 °C (every reading ends in .0 or .5)

- 0.5 (°C) (1)

05.2 [1 mark]

Answer: 35.0 °C

- 35.0 (°C) (1)

05.3 [2 marks]

Answer: ± 0.5 °C

- range = $35.5 - 34.5 = 1.0$ (°C) (1)
- uncertainty = $1.0 \div 2 = (\pm)0.5$ (°C) (1)

05.4 [2 marks]

Answer: Not consistent: the first student's results give 35.0 ± 0.5 °C, i.e. 34.5 °C to 35.5 °C, and 36.5 °C is outside this range.

- the first student's results give a range of 34.5 °C to 35.5 °C (35.0 ± 0.5 °C) (1)
- 36.5 °C is outside this range, so it is not consistent (it may be anomalous) (1)

Notes: Allow ECF from the mean and uncertainty calculated. 'Not consistent' with no reason scores 0.

Question 6 (4 marks)

06.1 [1 mark]

Answer: 7.0 °C

- 7.0 (°C) (1)

06.2 [2 marks]

Answer: Exothermic: the temperature increased, because energy was transferred to the surroundings.

- exothermic (1)
- the temperature increased / energy was transferred to the surroundings (1)

06.3 [1 mark]

Answer: Polystyrene is a good thermal insulator, so less energy is transferred between the mixture and the surroundings.

- polystyrene is a (better thermal) insulator, so it reduces energy transfer to or from the surroundings (1)