

GCSE Physics

Worksheet: Energy transfers in a system

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Energy transfers in a system

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

Energy is transferred when a cyclist rides a bicycle.

0 1 . 1

Which statement about energy is correct?

Tick (✓) **one** box.

Energy can be created but not destroyed.

☐

Energy can be destroyed but not created.

☐

Energy cannot be created or destroyed.

☐

Energy is used up when it is transferred.

☐

[1 mark]

0 1 . 2

The cyclist oils the bicycle chain regularly.

Explain how oiling the chain reduces unwanted energy transfers.

.....

.....

.....

.....

[2 marks]

0 1 . 3

What happens to the energy that is wasted?

Tick (✓) **one** box.

It is destroyed.

☐

It is dissipated to the surroundings.

☐

It is stored in the chemical store of the cyclist.

☐

It is transferred back to the kinetic store of the bicycle.

☐

[1 mark]

0 2

0 2 . 1

Which of these is a way of reducing unwanted energy transfers caused by friction in a machine?

Tick (✓) **one** box.

Lubricating the moving parts

☐

Painting the machine a dark colour

☐

Running the machine faster

☐

Using heavier moving parts

☐

[1 mark]

0 2 . 2

Complete the sentence.

The higher the thermal conductivity of a material, the the rate of energy transfer by conduction through the material.

.....

.....

.....

[1 mark]

0 2 . 3

Which **two** changes would reduce the rate of energy transfer through the walls of a house?

Tick (✓) **two** boxes.

Making the walls thicker

☐

Using a wall material with a higher thermal conductivity

☐

Filling the gap between the inner and outer walls with foam insulation

☐

Painting the inside of the walls white

☐

[2 marks]

0 3

A student investigates how the thickness of a woollen jacket affects the rate of cooling of a beaker of hot water. Beakers with 1, 2, 3 and 4 layers of the same woollen material are filled with the same volume of hot water at the same starting temperature, and the temperature is recorded every minute for 10 minutes.

0 3 . 1

Write a hypothesis for this investigation.

.....

.....

[1 mark]

0 3 . 2

Identify the independent variable and the dependent variable in this investigation.

.....

.....

.....

.....

[2 marks]

0 3 . 3

Give one hazard in this investigation and a suitable control measure.

.....

.....

.....

.....

[2 marks]

0 4

A cyclist oils the chain of their bicycle.

0 4 . 1

Explain how oiling the chain reduces unwanted energy transfers when the bicycle is ridden.

.....

.....

.....

.....

[2 marks]

0 4 . 2

The cyclist says: ‘Now that the chain is oiled, all of the energy transferred by my legs will end up in the kinetic energy store of the bicycle and me.’
Explain why the cyclist is wrong.

.....

.....

.....

.....

[2 marks]

0 5

A student measures the time taken for the temperature of an insulated beaker of water to fall by 10 °C. The student repeats the measurement three times, with the same beaker and insulation, obtaining 218 s, 224 s and 221 s.

0 5 . 1

Are these three results repeatable? Justify your answer.

.....

.....

[1 mark]

0 5 . 2

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

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.....

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.....

.....

Mean time = s

[3 marks]

0 5 . 3

Identify one random error that could affect a single timing in this investigation, and suggest how its effect could be reduced.

.....

.....

.....

.....

[2 marks]

0 6

A student measures the temperature of water in an insulated beaker every minute using a thermometer with a resolution of 0.5°C .

0 6 . 1

State the uncertainty in a single temperature reading taken with this thermometer.

.....

.....

.....

Uncertainty = $^{\circ}\text{C}$

[1 mark]

0 6 . 2

A different student, using a different thermometer, repeats the investigation and obtains very similar results.

What does this show about the results? Explain the term you use.

.....

.....

.....

.....

[2 marks]

0 7

A student investigated how well different materials insulate a beaker of hot water.
The student:

- poured 200 cm³ of hot water into a beaker
- wrapped the beaker in one layer of a material
- measured the temperature of the water at the start and after 10 minutes.

The student repeated this for different materials and with no insulation. Table 1 shows the results.

Table 1

Material	Temperature at the start in °C	Temperature after 10 minutes in °C
bubble wrap	80	64
cotton wool	80	69
newspaper	80	66
no insulation	80	57

0 7 . 1

Calculate the decrease in temperature of the water in the beaker wrapped in cotton wool.

.....

.....

.....

Decrease in temperature = °C

[1 mark]

0 7 . 2

Which material was the best thermal insulator?
Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 7 . 3

Give **two** control variables in this investigation.

.....

.....

.....

.....

[2 marks]

0 7 . 4

Suggest why the student also measured the temperature of water in a beaker with no insulation.

.....

.....

[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 Physics · Worksheet: Energy transfers in a system · 32 marks

Question 1 (4 marks)

01.1 [1 mark]

Correct: Energy cannot be created or destroyed.

01.2 [2 marks]

Answer: Oil (lubrication) reduces friction between the moving parts, so less energy is dissipated to the thermal store of the chain and surroundings.

- (lubrication) reduces friction (between the moving parts) (1)
 - so less energy is dissipated / wasted / transferred to the thermal store (of the chain or surroundings) (1)
-

01.3 [1 mark]

Correct: It is dissipated to the surroundings.

Question 2 (4 marks)

02.1 [1 mark]

Correct: Lubricating the moving parts

02.2 [1 mark]

Answer: higher

- higher / greater / faster (1)
-

02.3 [2 marks]

Correct: Making the walls thicker; Filling the gap between the inner and outer walls with foam insulation

Question 3 (5 marks)

03.1 [1 mark]

Answer: The more layers of wool used, the more slowly the water cools (the smaller the temperature drop in a given time).

- a thicker (more layers of) woollen jacket gives a slower rate of cooling / a smaller temperature drop in a given time (1)

03.2 [2 marks]

Answer: Independent: the number of layers of wool (thickness of insulation). Dependent: the temperature (drop) of the water after a given time.

- independent variable: the number of layers of wool / thickness of the insulation (1)
- dependent variable: the temperature of the water (or the temperature drop) after a given time (1)

03.3 [2 marks]

Answer: Hot water can scald; use a heatproof mat and take care when pouring, or wear eye protection.

- a hazard, e.g. hot water can scald, or spilled water is a slip hazard (1)
- a control measure that matches the hazard, e.g. use a heatproof mat and pour carefully away from skin, or mop up spills promptly and wear eye protection (1)

Question 4 (4 marks)

04.1 [2 marks]

Answer: The oil lubricates the chain, reducing the friction between the moving parts, so less work is done against friction and less energy is dissipated to the thermal energy store of the chain and surroundings.

- the oil (lubrication) reduces the friction between the moving parts of the chain and gears (1)
- so less energy is dissipated to the thermal energy store of the chain / surroundings (less work is done against friction) (1)

04.2 [2 marks]

Answer: Some energy is always dissipated in any energy transfer: work is still done against air resistance and friction in the wheel bearings and tyres, heating the surroundings, and some energy is transferred as sound.

- in every energy transfer some energy is dissipated / wasted (1)
 - e.g. work is still done against air resistance or friction in the bearings / tyres (heating the surroundings), or energy is transferred as sound (1)
-

Question 5 (6 marks)

05.1 [1 mark]

Answer: Yes: repeating the same method with the same equipment gives similar results (within a few seconds of each other).

- yes — they are close to each other / show little spread, obtained using the same method and equipment (they are repeatable) (1)

05.2 [3 marks]

Answer: 221 s, uncertainty = ± 3 s

- mean = $(218 + 224 + 221) \div 3$ (1)
- = 221 (s) (1)
- uncertainty = $\pm$ half the range = $\pm (224 - 218) \div 2 = \pm 3$ (s) (1)

05.3 [2 marks]

Answer: Parallax error when reading the thermometer scale; reduce it by reading the scale at eye level. (Or: variation in the student's reaction time starting/stopping the stopwatch; reduce it by using a data logger.)

- a random error, e.g. parallax error reading the thermometer, reaction time starting/stopping the stopwatch, or a draught affecting individual readings (1)
- a sensible way to reduce its effect, e.g. read the thermometer at eye level, use a data logger/temperature sensor instead of a stopwatch and thermometer, or shield the beaker from draughts (1)

Question 6 (3 marks)

06.1 [1 mark]

Answer: ± 0.25 °C

- ± 0.25 (°C) (half the resolution) (1)

06.2 [2 marks]

Answer: The results are reproducible — similar results are obtained using different equipment or a different person.

- reproducible (1)
 - (reproducible means) similar results are obtained using different equipment / people / methods (1)
-

Question 7 (6 marks)

07.1 [1 mark]

Answer: 11 °C

- 11 (°C) (1)

07.2 [2 marks]

Answer: Cotton wool — the water cooled by the smallest amount in 10 minutes.

- cotton wool (1)
- smallest temperature decrease (in the same time) / lowest rate of cooling (1)

Notes: The reason mark depends on cotton wool being chosen.

07.3 [2 marks]

Answer: Any two from: volume of water; starting temperature; thickness (number of layers) of material; time; size/type of beaker; room temperature; use of a lid.

- volume / mass of water (1)
- starting temperature of the water (1)
- thickness / number of layers of material (1)
- time (10 minutes) (1)
- size / type of beaker (1)
- temperature of the room (1)
- whether a lid is used (1)

Any 2 of the points above.

07.4 [1 mark]

Answer: As a control, to compare with the insulated beakers and show the effect of each material.

- as a control / for comparison (to show the effect of the insulation) (1)
-