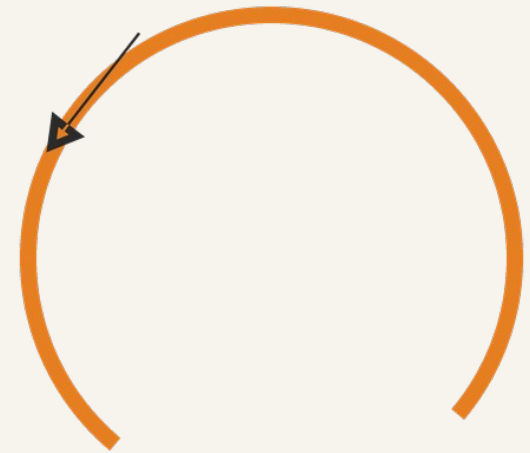


BOOKLET 2 • ENERGY AND EFFICIENCY

Conservation of Energy

Energy is never created and never destroyed. Follow where it goes.

National 5 Engineering Science



LEARNING INTENTION

To state the law of conservation of energy and describe energy transfers using block diagrams.

Daily Review

SHOW ME BOARDS

- 1 Name three forms of energy used in engineering.
- 2 Which four forms do we calculate at National 5?
- 3 An electric motor – name its useful output energy.
- 4 A filament bulb – name one form of wasted energy.
- 5 What is meant by input energy?

By the end of this lesson...

- 1 I can state the law of conservation of energy.
- 2 I can draw a block diagram for an engineered system.
- 3 I can show that useful energy plus wasted energy equals the input.
- 4 I can describe the transfer in a kettle, turbine, motor and torch.

The Law of Conservation of Energy

Three sentences that the rest of this booklet depends on.

- Energy cannot be created.
- Energy cannot be destroyed.
- Energy is only transferred or transformed.
- So the total energy in a system always stays the same.

Useful Plus Wasted Equals Input

If nothing is destroyed, the books must balance.

- Add up every useful joule and every wasted joule.
- The total is exactly the input energy. It always is.
- So if you know two of the three, you can find the third.
- This is the idea efficiency is built on.

Show Me – The Law

SHOW ME BOARDS

- 1 State the law of conservation of energy.
- 2 True or false: a motor destroys energy as heat.
- 3 A system takes in 500 J and gives 380 J useful. How much is wasted?
- 4 Can a system give out more energy than it takes in?
- 5 Where does the wasted energy from a drill actually go?

Show Me – The Law Again

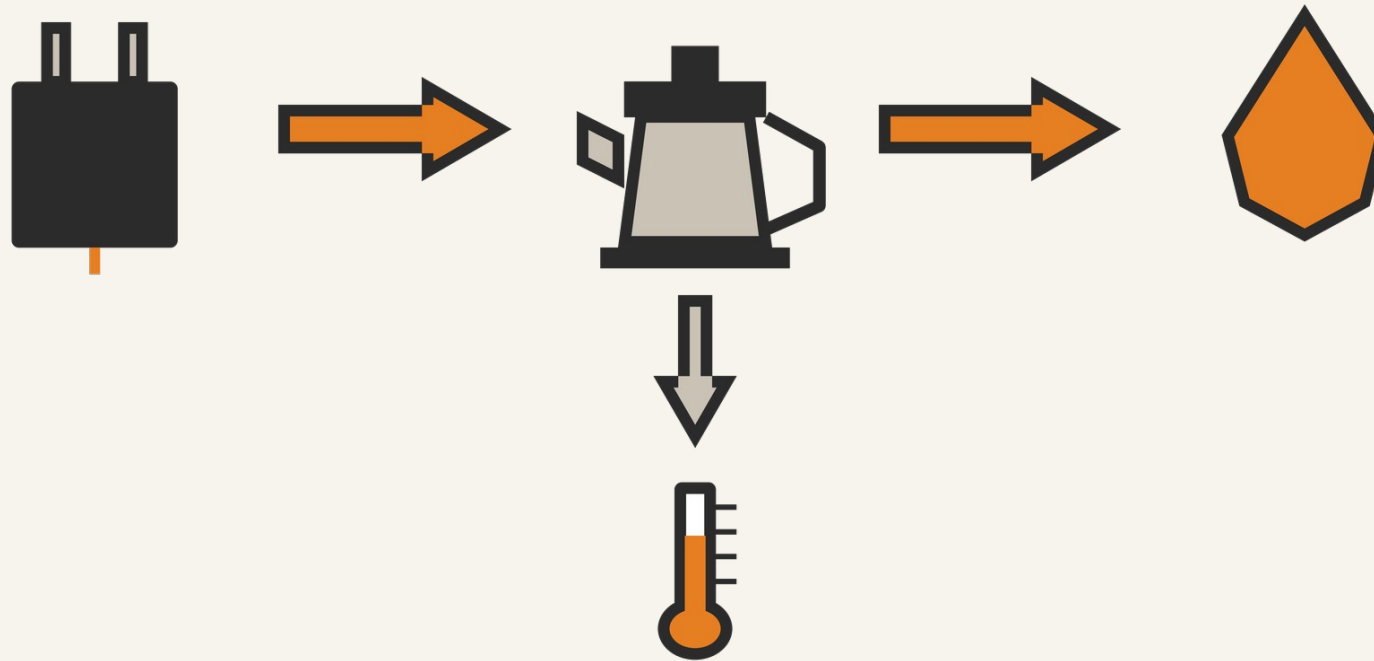
SHOW ME BOARDS

EXTRA PRACTICE

- 1 Finish the sentence: energy cannot be created or...
- 2 A lamp takes in 60 J and gives 6 J of light. How much is wasted?
- 3 True or false: wasted energy has been destroyed.
- 4 A system wastes 250 J from an input of 1 000 J. Find the useful output.
- 5 Name the two things energy can do, according to the law.

Block Diagrams – The Electric Kettle

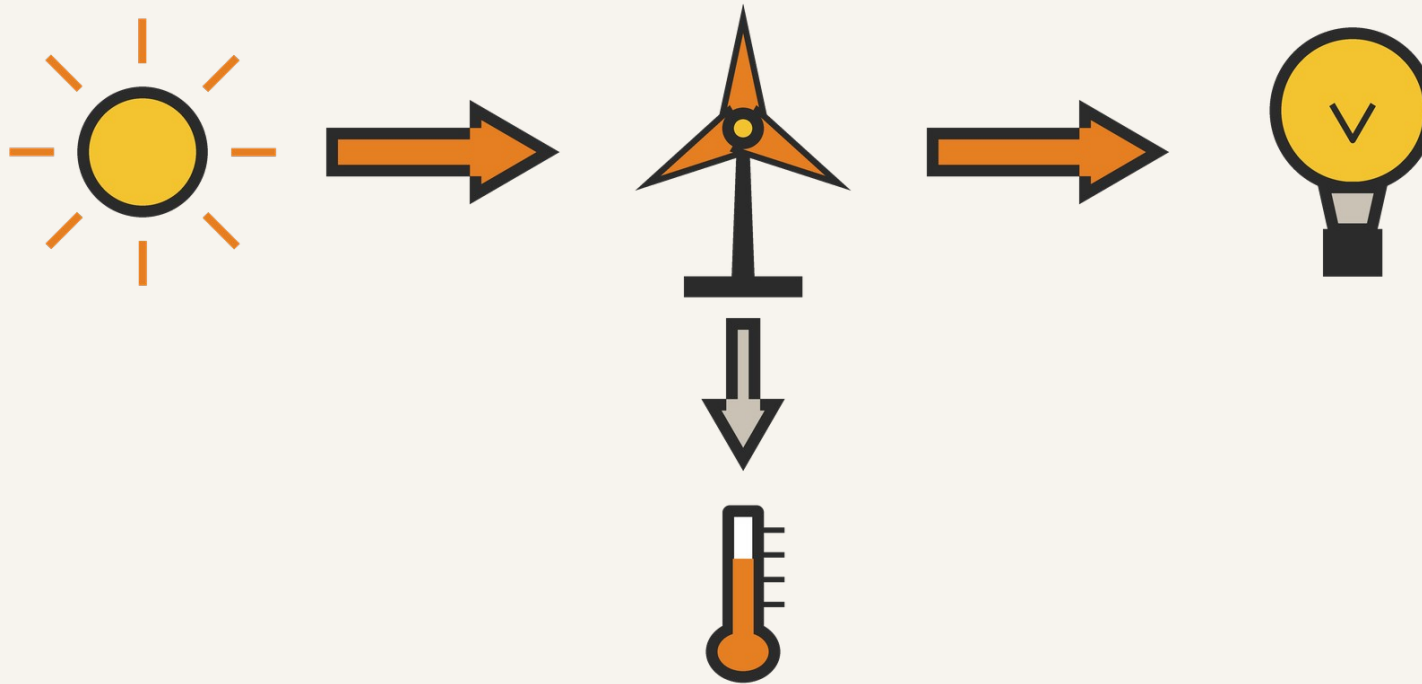
Engineers draw the chain so they can see every transfer at once.



electrical energy in · heat energy in the water · heat and sound lost to the surroundings

Block Diagrams – The Wind Turbine

Same idea, a different chain – and the input is free.



kinetic energy of the wind · kinetic energy of the blades · electrical energy out

Show Me — Complete the Chain

SHOW ME BOARDS

- 1 An electric motor: electrical energy in, and what useful output?
- 2 A generator: what goes in, and what comes out?
- 3 A battery torch: name the input energy.
- 4 A hairdryer: name its two useful outputs.
- 5 A loudspeaker: electrical energy in, and what out?

Show Me — More Chains

SHOW ME BOARDS

EXTRA PRACTICE

- 1 A petrol engine: name the input energy.
- 2 A solar panel: what goes in, and what comes out?
- 3 An electric heater: name the useful output.
- 4 A hydro turbine: name the input energy.
- 5 A buzzer: electrical energy in, and what out?

Task 1 – Energy Transfer Diagrams

Four systems, four chains to complete.
Every arrow needs a form of energy written on it.
Do not forget the wasted energy branch.

Booklet – “Energy Transfer Diagrams”

Watch Out – Energy Is Never “Used Up”

THE MISTAKE

- “The motor uses up the electrical energy.”
- “The energy runs out and disappears.”
- “The wasted energy is gone for good.”

THE CORRECT ANSWER

- It transfers it – into movement, heat and sound.
- It changes form. The total never changes.
- It is still there, just spread out and not useful.

Task 2 – Forms of Energy

Ten questions, in full sentences, in your jotter.
Q8 and Q10 are “explain” questions – give a reason.
17 marks in total, printed beside each question.

Booklet – “PRACTICE: Forms of Energy”

Checkpoint

- 1 State the law of conservation of energy.
- 2 A system takes in 900 J and wastes 240 J. How much is useful?
- 3 What + why: a turbine gives out less electrical energy than the wind's kinetic energy. Where did the rest go?

Exam Practice — Past Papers

2024 Q5(b) — wind turbine transformation diagram (1)

2022 Q2(a) — system diagram for a hairdryer (1)

2023 Q1(a) — system diagram for a doorbell (1)

Name the form exactly — “energy” alone scores nothing.

Find the relationship in the data booklet

LOOKING AHEAD

Work Done

Next: putting numbers on energy, with the first formula.

Plenary – Prove Your I Can... Statements

SHOW ME BOARDS

- 1 State the law of conservation of energy.
- 2 Useful energy plus wasted energy equals what?
- 3 A kettle: name the input and the useful output.
- 4 A wind turbine: name the input energy.
- 5 True or false: energy can be destroyed if you waste enough of it.

Plenary – More Quick Checks

SHOW ME BOARDS

EXTRA PRACTICE

- 1 Input 400 J, wasted 90 J – how much is useful?
- 2 A torch: name the useful output energy.
- 3 Name one form energy is usually wasted as.
- 4 Input 2 000 J, useful 1 600 J – how much is wasted?
- 5 Complete: energy is only transferred or...

Extension — If You Finish Early

- 1 Draw the full chain for a hydro dam, from stored water to the grid.
- 2 That dam has three stages. Where is energy wasted at each one?
- 3 What + why: why can no chain ever deliver all of its input?

Extension — More Challenges

EXTRA PRACTICE

- 1 Draw the chain for an electric car, from battery to movement.
- 2 Add the wasted energy branch at every stage of that chain.
- 3 What + why: a petrol car wastes far more than an electric one. Why?