Efficiency and reducing wasted energy

Name _____ Class _____ Date _____

No device is perfect. **Efficiency** tells you what fraction of the energy put in ends up where you want it.

KEY EQUATION

efficiency = useful output ÷ total input

Use energy (J) or power (W) for both.
Give it as a decimal (e.g. 0.75) or a percentage (75%).
It can never be more than 1 (100%).

WORKED EXAMPLE

A motor takes in 500 J and transfers 400 J usefully.
efficiency = 400 ÷ 500 = **0.8 (80%)**

Section A · Recall and calculate

Grade 4–5

1 What happens to energy that is not transferred usefully? [2]

It is dissipated (wasted),

usually to the thermal store of the surroundings.

2 A lamp is supplied with 100 J of energy electrically. It transfers 20 J usefully by light. Calculate its efficiency. [2]

Efficiency = 20 ÷ 100

= 0.2 (20%)

3 Give two ways of reducing unwanted energy transfers. [2]

Lubrication (reduces friction)

Thermal insulation (reduces the rate of energy transfer by heating)

Section B · Rearrange and apply

Grade 5–6

4 Complete the table. [4]

Total input	Useful output	Wasted	Efficiency
200 J	150 J	**50 J**	**0.75**
1000 W	**350 W**	650 W	**0.35**
400 J	100 J	**300 J**	0.25

5 A motor has an efficiency of 0.6 and a useful power output of 300 W. Calculate its input power. [3]

Input = useful output ÷ efficiency = 300 ÷ 0.6

Input = 500 W

6 Energy is transferred out of a warm house through its walls. Explain how the thickness and thermal conductivity of the walls affect the rate at which the house cools. [3]

The higher the thermal conductivity, the faster energy is transferred through the walls.

Thicker walls reduce the rate of energy transfer.

So thick walls with low thermal conductivity make the house cool more slowly.

Section C · Stretch

Grade 7+

7 Suggest three ways to increase the efficiency of an electric car. Explain each. (Higher) [3]

Streamline the body: less air resistance, so less energy dissipated.

Lubricate moving parts: less friction, so less heating.

Use lower-resistance wires: less heating in the circuits.

Exam-style question

AQA style

8 A filament lamp and an LED both produce 9 W of light. The filament lamp has an input power of 60 W. The LED has an efficiency of 0.75.

a Calculate the efficiency of the filament lamp. [2]

9 ÷ 60 = 0.15 (15%)

b Calculate the input power of the LED. [2]

9 ÷ 0.75 = 12 W

c Explain why replacing filament lamps with LEDs saves money. [2]

The LED needs much less input power for the same light,

so less energy is wasted and less electricity is bought.

Total: _____ / 25

How confident am I?

	Not yet	Nearly	Got it
I can calculate efficiency as a decimal and a percentage	☐	☐	☐
I can explain how insulation and lubrication reduce waste	☐	☐	☐
I can rearrange the efficiency equation	☐	☐	☐