

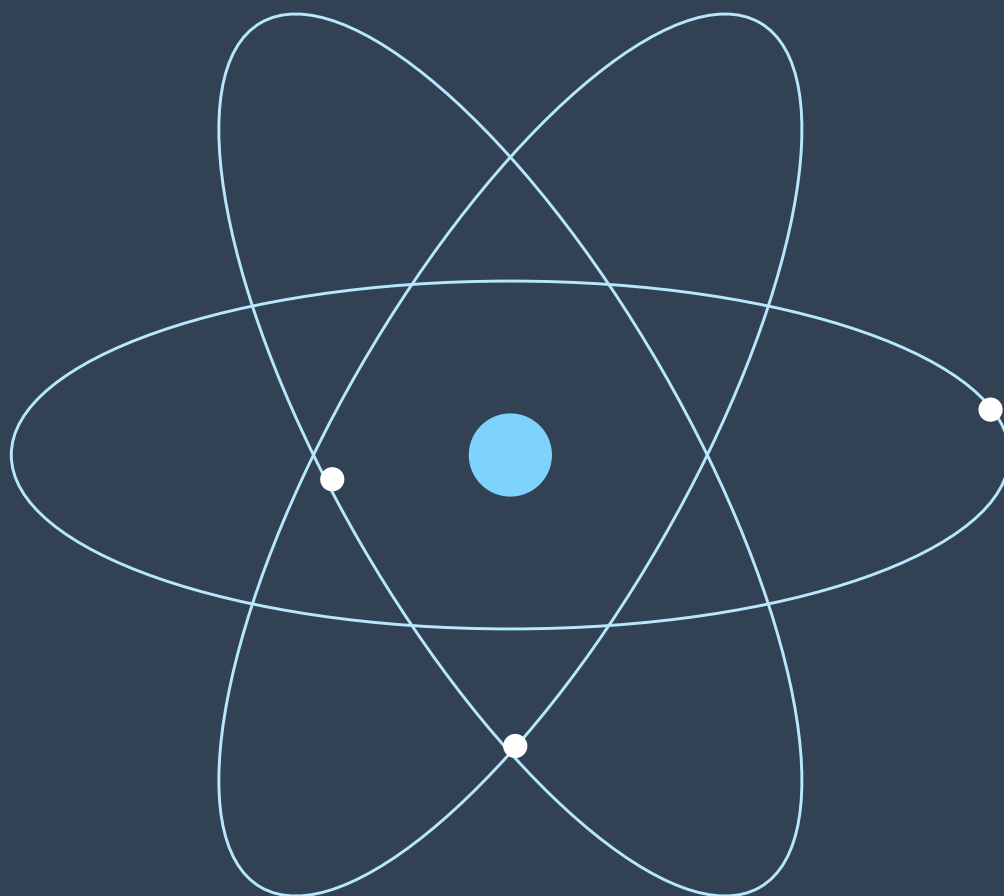
THE MATHS AND SCIENCE TUTOR

GCSE Physics Workbook

74 Exam Style Worksheets with Full Model Answers

Aligned to the GCSE Physics Specification 8463

Topic by Topic Practice for Grades 4 to 9



About this book

This workbook gathers **74 exam style physics worksheets** covering the whole GCSE Physics course, from energy and electricity to atomic structure, forces, waves, magnetism and space. Every worksheet has a matching set of full model answers at the back of the book.

How to use it

1. Choose a topic and work through the worksheets in order. Each one takes about 20 to 30 minutes.
2. Write your answers in the spaces provided and show all your working in calculations.
3. Mark your work using the model answers in Part 2, then go back over anything you missed.
4. Come back a week later and try the topic's mixed worksheet without notes.

Layout

Part 1 holds the worksheets and Part 2 holds the answers, both in the same topic order. The contents pages list the page numbers for each.

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GCSE Physics Workbook

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Part 1: Worksheets

Energy

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2	Elastic Potential Energy ($E_e = \frac{1}{2}ke^2$)	9
3	National and Global Energy Resources	11
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Core Equation:

$$\text{Efficiency} = \frac{\text{Useful energy transfer}}{\text{Total energy transfer}} \quad (\text{often expressed as a percentage: } \text{Efficiency} = \frac{\text{Useful energy transfer}}{\text{Total energy transfer}} \times 100\%)$$

Rearranged Forms:

$$\text{Useful energy transfer} = \text{Efficiency} \times \text{Total energy transfer}$$

$$\text{Total energy transfer} = \frac{\text{Useful energy transfer}}{\text{Efficiency}}$$

Units:

Useful output energy: **Joules (J)**

Total input energy: **Joules (J)**

Efficiency: **No units** (or %)

Section A: Formula Recall, Rearrangement & Units

1. Complete the following statements about efficiency:

- Efficiency is a measure of how much of the _____ energy input is converted into _____ energy output.
- Efficiency has _____ when expressed as a decimal, but can also be given as a _____.

2. Rearrange the efficiency formula to make the following the subject:

- Useful energy transfer: _____
- Total energy transfer: _____

3. Convert the following energy values to Joules (J) or power values to Watts (W):

- 15 kJ = _____
- 0.25 MJ = _____
- 500 W = _____
- 2.5 kW = _____
- 3 minutes = _____
- 0.5 hours = _____

Section B: Practice Calculations

4. Answer the following questions, showing your working clearly and stating appropriate units.

- An electric motor is supplied with 500 J of electrical energy and produces 400 J of useful kinetic energy. Calculate the efficiency of the motor as a decimal.

- A light bulb has an efficiency of 0.15. If it is supplied with 200 J of electrical energy, how much useful light energy does it produce?

- c) A car engine is 35% efficient. If it produces 70 kJ of useful kinetic energy, calculate the total energy supplied to the engine from the fuel. Give your answer in Joules.

- d) A solar panel receives 1.2 MJ of energy from the Sun. If its efficiency is 20%, how much useful electrical energy does it generate? Give your answer in Joules.

Section C: Challenge Context

5. An electric kettle is used to heat water. It has a power rating of 2.2 kW and is switched on for 3.0 minutes. During this time, 356.4 kJ of thermal energy is usefully transferred to the water.

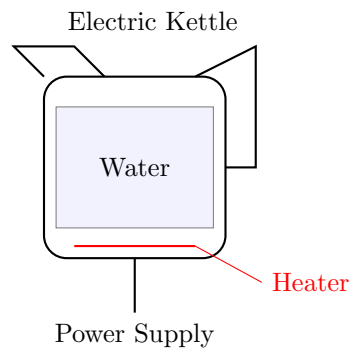


Figure 1: Electric Kettle

- a) Calculate the efficiency of the electric kettle. Give your answer as a percentage to 3 significant figures. Show your working clearly.

- b) Explain why the efficiency of the kettle is not 100%. In your answer, refer to energy transfers and the principle of conservation of energy.

Core Equation:

$$\text{Efficiency} = \frac{\text{Useful energy transfer}}{\text{Total energy transfer}} \quad (\text{often expressed as a percentage: } \text{Efficiency} = \frac{\text{Useful energy transfer}}{\text{Total energy transfer}} \times 100\%)$$

Rearranged Forms:

$$\text{Useful energy transfer} = \text{Efficiency} \times \text{Total energy transfer}$$

$$\text{Total energy transfer} = \frac{\text{Useful energy transfer}}{\text{Efficiency}}$$

Units:Useful output energy: **Joules (J)**Total input energy: **Joules (J)**Efficiency: **No units** (or %)**Section A: Formula Recall, Rearrangement & Units**

1. Complete the following statements about efficiency:

- a) Efficiency is a measure of how much of the **total** energy input is converted into **useful** energy output.
- b) Efficiency has **no units** when expressed as a decimal, but can also be given as a **percentage**.

2. Rearrange the efficiency formula to make the following the subject:

- a) Useful energy transfer: **Useful energy transfer = Efficiency × Total energy transfer**
- b) Total energy transfer: **Total energy transfer = $\frac{\text{Useful energy transfer}}{\text{Efficiency}}$**

3. Convert the following energy values to Joules (J) or power values to Watts (W):

- a) 15 kJ = **15000 J**
- b) 0.25 MJ = **250000 J**
- c) 500 W = **0.5 kW**
- d) 2.5 kW = **2500 W**
- e) 3 minutes = **180 seconds**
- f) 0.5 hours = **1800 seconds**

Section B: Practice Calculations

4. Answer the following questions, showing your working clearly and stating appropriate units.

- a) An electric motor is supplied with 500 J of electrical energy and produces 400 J of useful kinetic energy. Calculate the efficiency of the motor as a decimal.

Model Answer:

$$\text{Efficiency} = \frac{\text{Useful energy}}{\text{Total energy}} = \frac{400 \text{ J}}{500 \text{ J}} = 0.8$$

- b) A light bulb has an efficiency of 0.15. If it is supplied with 200 J of electrical energy, how much useful light energy does it produce?

Model Answer:

$$\text{Useful energy} = \text{Efficiency} \times \text{Total energy} = 0.15 \times 200 \text{ J} = 30 \text{ J}$$

- c) A car engine is 35% efficient. If it produces 70 kJ of useful kinetic energy, calculate the total energy supplied to the engine from the fuel. Give your answer in Joules.

Model Answer:

First, convert efficiency to a decimal: $35\% = 0.35$.

Then, convert useful energy to Joules: $70 \text{ kJ} = 70000 \text{ J}$.

$$\text{Total energy} = \frac{\text{Useful energy}}{\text{Efficiency}} = \frac{70000 \text{ J}}{0.35} = 200000 \text{ J}$$

- d) A solar panel receives 1.2 MJ of energy from the Sun. If its efficiency is 20%, how much useful electrical energy does it generate? Give your answer in Joules.

Model Answer:

First, convert efficiency to a decimal: $20\% = 0.20$.

Then, convert total energy to Joules: $1.2 \text{ MJ} = 1200000 \text{ J}$.

$$\text{Useful energy} = \text{Efficiency} \times \text{Total energy} = 0.20 \times 1200000 \text{ J} = 240000 \text{ J}$$

Section C: Challenge Context

5. An electric kettle is used to heat water. It has a power rating of 2.2 kW and is switched on for 3.0 minutes. During this time, 356.4 kJ of thermal energy is usefully transferred to the water.

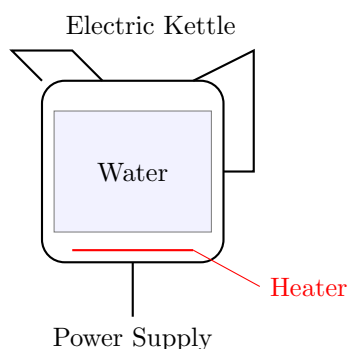


Figure 1: Electric Kettle

- a) Calculate the efficiency of the electric kettle. Give your answer as a percentage to 3 significant figures. Show your working clearly.

Model Answer:

1. Convert power to Watts: $P = 2.2 \text{ kW} = 2200 \text{ W}$.

2. Convert time to seconds: $t = 3.0 \text{ minutes} = 3.0 \times 60 = 180 \text{ s}$.

3. Calculate total energy input: $E_{\text{total}} = P \times t = 2200 \text{ W} \times 180 \text{ s} = 396000 \text{ J}$.

4. Convert useful energy to Joules: $E_{\text{useful}} = 356.4 \text{ kJ} = 356400 \text{ J}$.

5. Calculate efficiency: $\text{Efficiency} = \frac{E_{\text{useful}}}{E_{\text{total}}} = \frac{356400 \text{ J}}{396000 \text{ J}} = 0.90$.

6. Convert to percentage and round to 3 SF: $0.90 \times 100\% = 90.0\%$.

- b) Explain why the efficiency of the kettle is not 100%. In your answer, refer to energy transfers and the principle of conservation of energy.

Model Answer:

The efficiency of the kettle is not 100% because some of the total electrical energy input is transferred to unwanted (wasted) energy stores, primarily the thermal energy store of the surroundings. For example, the kettle itself heats up, and some heat is lost to the air through convection and radiation, and to the countertop through conduction. According to the principle of conservation of energy, energy cannot be created or destroyed, only transferred from one store to another. Therefore, the total energy input must equal the total energy output (useful + wasted). Since some energy is always wasted, the useful energy output will always be less than the total energy input, making the efficiency less than 100%.