

Topic 1: Energy

AQA GCSE Physics 8463 · spec 4.1 · sheets 1.1–1.7

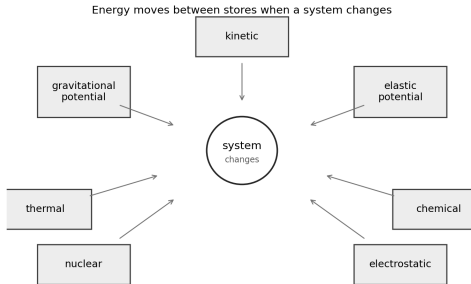
Energy runs through the whole course

- Paper 1 and Paper 2 both use energy ideas.
- The Physics Equations Sheet is enclosed with every paper.
- Your marks are for choosing, converting and rearranging.

One mark for the equation itself

- "Write down the equation which links E , P and t " is a real 1-mark question.
- Learn each equation in words and in symbols.
- Give answers to 2 or 3 significant figures with a unit.

Name the store that fills and the store that empties



- A system is an object or group of objects you choose.
- Seven stores to name: kinetic, gravitational potential, elastic potential, thermal, chemical, nuclear, electrostatic.
- The exam accepts words or symbols.

Five situations the specification names

Rising and falling

Describing a change: an object projected upwards trades kinetic for gravitational potential.

A vehicle slowing down empties kinetic and fills the thermal store of the brakes.

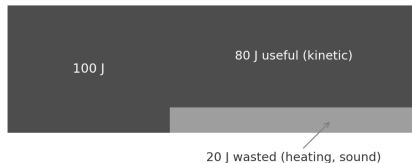
Collisions and currents

A moving object hitting an obstacle: kinetic empties, thermal stores fill.

A kettle: electrical work fills the thermal store of the water.

Sankey diagrams show energy to scale

Sankey diagram: arrow width shows the energy



- Arrow width is proportional to energy.
- Widths out always add up to the width in.
- Wasted energy is not destroyed; it is stored less usefully.

Three equations, three stores

- Kinetic: $E_k = \frac{1}{2}mv^2$.
- Elastic: $E_e = \frac{1}{2}ke^2$, below the limit of proportionality.
- Gravitational: $E_p = mgh$, with g given.

Your turn: launch speed

- A spring with $k = 50 \text{ N/m}$ is stretched by 0.12 m and launches a 0.020 kg toy plane.
- Find the maximum possible launch speed before the answer appears.

A worked chain from spring to speed

- 1 Known** $k = 50 \text{ N/m}$, $e = 0.12 \text{ m}$, $m = 0.020 \text{ kg}$; all base units.
- 2 Store** $E_e = \frac{1}{2}ke^2 = \frac{1}{2} \times 50 \times 0.12^2 = 0.36 \text{ J}$.
- 3 Transfer** at release all E_e becomes E_k .
- 4 Rearrange** $v = \sqrt{2E_k/m} = \sqrt{2 \times 0.36/0.020}$.
- 5 Answer** $v = 6.0 \text{ m/s}$, 2 s.f., unit from $\sqrt{\text{J/kg}}$.

Two cords double the energy

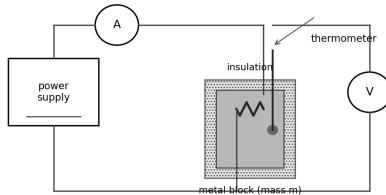
- Two identical cords store twice one cord's energy.
- Set the total equal to mgh and solve for height.
- The real height is lower — the next section explains why.

Specific heat capacity links energy and temperature

- $\Delta E = mc\Delta\theta$ with $\Delta\theta$ a change, not a reading.
- c is the energy for one kilogram to rise one degree Celsius.
- Convert kilojoules to joules before substituting.

RP1 from memory

RP1: the heater transfers energy; $\Delta E = V I t$ raises the thermal store



- Block, heater, thermometer, insulation, supply, meters, stopwatch, balance.
- Energy in is $E = VIt$; then $c = \Delta E / (m\Delta\theta)$.
- Insulating reduces loss to the surroundings.

Power divides energy by time

- $P = E/t$ and $P = W/t$; one joule per second is one watt.
- Time in seconds, always.
- A rate given per second is already a power.

Your turn: stairs power

- A 60.0 kg athlete climbs 175 cm of stairs in 1.40 s; g is 9.8 N/kg.
- Find her useful power output before the answer appears.

The stairs question, start to finish

- 1 **Known** $m = 60.0 \text{ kg}$, $h = 175 \text{ cm} = 1.75 \text{ m}$, $t = 1.40 \text{ s}$, $g = 9.8 \text{ N/kg}$.
- 2 **Energy** $E_p = mgh = 60.0 \times 9.8 \times 1.75 = 1029 \text{ J}$.
- 3 **Power** $P = E_p/t = 1029/1.40$.
- 4 **Answer** $P = 735 \text{ W}$.
- 5 **Check** her total power is higher: her body also heats and pushes air.

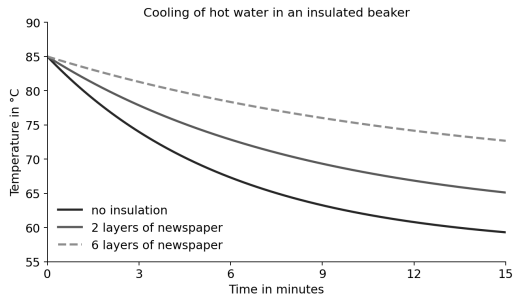
Dissipated energy still exists

- Energy is transferred usefully, stored, or dissipated — never created or destroyed.
- Explaining a "lower than calculated" answer takes three steps.
- Cause, then where the energy went, then the smaller useful store.

Lubrication and insulation cut the losses

- Lubrication reduces friction between moving parts.
- Thermal insulation slows transfer by heating.
- Higher thermal conductivity means faster transfer through a wall.

RP2 compares insulators



- Same water volume, same start temperature, same beaker and lid.
- Variable is the material, or its thickness.
- Smallest temperature fall is the best insulator.

Efficiency as a decimal or a percentage

- Useful output over total input, for energy or for power.
- A decimal is between 0 and 1; a percentage between 0 and 100.
- Percentage wasted is one hundred minus percentage useful.

Your turn: two heaters

- Both heaters take 2000 W; A delivers 1700 W, B delivers 1500 W.
- Compute both efficiencies before the answer appears.

A comparison question wants calculations

- 1 **A** $1700/2000 = 0.85 = 85\%$.
- 2 **B** $1500/2000 = 0.75 = 75\%$.
- 3 **Gap** ten percentage points, one-eighth of B's efficiency.
- 4 **Conclusion** A delivers more of its input usefully; both stay useful heaters.

Nine resources, three uses

- Renewable means replenished as it is used.
- Compare resources for transport, electricity generation and heating.
- You do not need how electricity generation works.

The ending the scheme pays for

- Reliability means output when needed.
- Environmental points: carbon dioxide, waste, habitats.
- Science identifies the problems; political, social, ethical and economic factors decide.

Check yourself

- Checklist before you call this topic done.
- Name both stores, convert first, rearrange before substituting.
- RP1 and RP2 methods with controls, from memory.