

P1 Energy

Physics Paper 1 | AQA Combined Science Trilogy | Key ideas to remember

Energy → joules (J)

1 Energy stores and transfers



Gravitational store decreases

Kinetic store increases

Stores: kinetic (moving), gravitational, elastic (stretched), chemical, thermal, magnetic, electrostatic and nuclear.

Transfer pathways: mechanically, electrically, by heating or by radiation.

Conservation: energy cannot be created or destroyed.

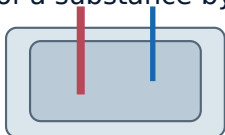
Wasted energy spreads to less useful stores, often thermal stores of the surroundings.

4 Heating and specific heat capacity

$$\Delta E = m \times c \times \Delta \theta$$

m in kg; c in J/kg °C; temperature change $\Delta \theta$ in °C. Energy in joules.

Specific heat capacity: energy to raise 1 kg of a substance by 1 °C.



Heater + thermometer

Insulate the block

Measure mass first

Practical: record starting temperature. Heat for a measured time at known power ($E = Pt$). Measure temperature rise; find $c = E / (m\Delta\theta)$. Higher conductivity → faster conduction. Thicker insulation → less heat loss.

Power → watts (W)

2 Three energy calculations

Kinetic: $E_k = \frac{1}{2}mv^2$

m = mass (kg); v = speed (m/s).

Greater mass/speed → more kinetic energy.

Gravitational: $E_p = mgh$

g = gravitational field strength (N/kg); h = height (m). Use the given g value.

Elastic: $E_e = \frac{1}{2}ke^2$

k = spring constant (N/m); e = extension (m). Valid below the limit of proportionality.

Worked example: 2 kg lifted 3 m, g = 10 N/kg:

$E_p = 2 \times 10 \times 3 = 60 \text{ J.}$

5 Efficiency and reducing waste

$$\text{Efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

Or use **useful power / total power**.

Multiply the fraction by 100 for a percentage. 40 J useful from 100 J input → **40%**.

Waste is transferred, not destroyed.

Friction increases thermal stores.

Lubrication: reduces friction.

Insulation: reduces unwanted heating.

HIGHER TIER

Explain how reducing unwanted transfers improves the intended energy transfer.

Energy is conserved

3 Work done and power

Work done = energy transferred.

$$W = F \times s$$

F = force (N); s = distance moved in the direction of the force (m). Work is in joules.

Example: 5 N through 2 m → **10 J**.

Power: energy transferred per second.

$$P = \frac{\text{energy transferred}}{\text{time}} = \frac{W}{t}$$

1 W = 1 J/s. Use time in seconds.

60 J in 3 s → **P = 20 W**.

More power means the same work is done in less time.

6 Energy resources

Renewable: replenished as used.

Solar, wind, hydroelectric, waves, tides, geothermal and biofuels.

Non-renewable: finite supplies.

Coal, oil, natural gas and nuclear fuels.

Fossil fuels: reliable on demand, but release CO₂ when burned.

Nuclear: reliable; no CO₂ from generating electricity, but radioactive waste.

Wind/solar: no fuel burned in use; output depends on conditions.

Compare: reliability, cost, environmental effects and the intended use. Biofuels are renewable but burning them releases CO₂.