Exercise walk-through

1.6
Efficiency (4.1.2.2)

AQA · GCSE · Physics

Calculating energy changes

- E_k is **kinetic energy** in J; m is mass in kg; v is speed in m/s.
- E_p is **gravitational potential energy** in J; h is the change in height in m; g is the **gravitational field strength** in N/kg (9.8 N/kg on Earth).
- E_e is **elastic potential energy** in J; k is the **spring constant** in N/m; e is the **extension** in m.

$$E_k = \frac{1}{2}mv^2 \qquad E_p = mgh \qquad E_e = \frac{1}{2}ke^2$$

Specific heat capacity

- When a substance is heated, the energy in its thermal store increases and its temperature rises:
- ΔE is the change in thermal energy in J, m the mass in kg and $\Delta\theta$ the temperature change in °C.
- The **specific heat capacity** c is the energy needed to raise the temperature of 1 kg of a substance by 1 °C, in J/kg °C.
- This equation is on the equations sheet.

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

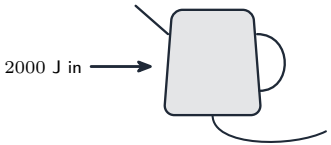
Power

- **Power** is the rate at which energy is transferred, or the rate at which work is done.
- A more **powerful** motor lifts the same load through the same height in less time.
- P is **power** in watts, E energy transferred in J, W the **work done** in J and t the time in s.
- A transfer of 1 J per second is a power of 1 **watt** (W).

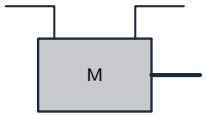
$$P = \frac{E}{t} \qquad P = \frac{W}{t}$$

Exercises 2.1·2.2

2.1 A kettle is supplied with 2000 J. 1800 J heats the water. Calculate the efficiency of the kettle. [2]

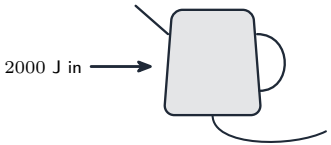


2.2 A motor is 75% efficient. It is supplied with 400 J. Calculate the useful energy output. [2]



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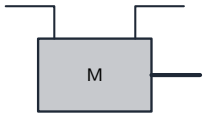
2.1 A kettle is supplied with 2000 J. 1800 J heats the water. Calculate the efficiency of the kettle. [2]



2.1

- $1800 \div 2000 = \mathbf{0.90}$, or 90%

2.2 A motor is 75% efficient. It is supplied with 400 J. Calculate the useful energy output. [2]



2.2

- $0.75 \times 400 = \mathbf{300}$ J

Exercise 3.1

3.1 An LED lamp uses 4.0 W and a filament lamp uses 40 W. Both give out 2.0 W of light. Calculate the efficiency of each lamp, and explain why the LED is better. [3]



LED, 4.0 W



filament, 40 W

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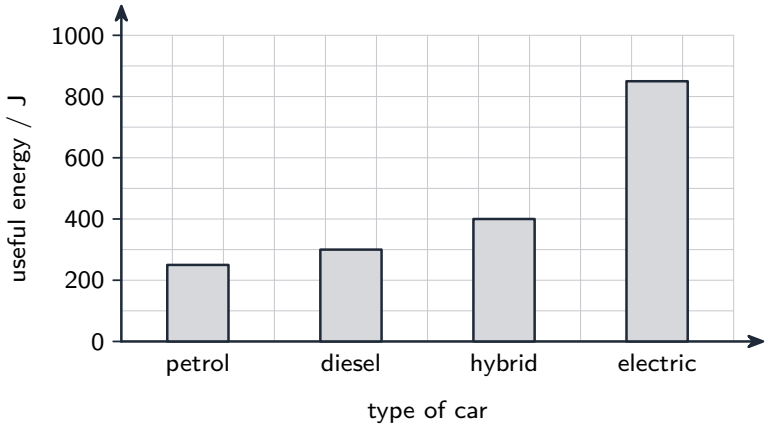
3.1

- LED: $2.0 \div 4.0 = 0.50$, or 50%
- filament: $2.0 \div 40 = 0.050$, or 5%
- the LED wastes much less energy by heating, so it costs less to run

Exercise 3.2 (a)

3.2 The chart shows the useful kinetic energy that four types of car get from every 1000 J of energy supplied.

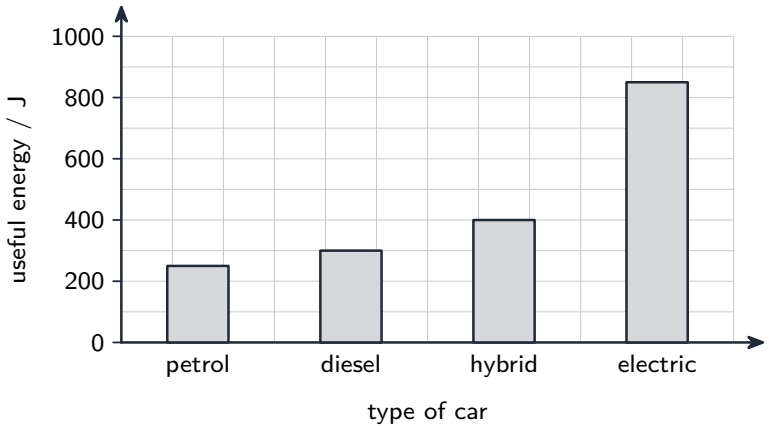
(a) Calculate the efficiency of the diesel car. [2]



Exercise 3.2 (a)

3.2 The chart shows the useful kinetic energy that four types of car get from every 1000 J of energy supplied.

(a) Calculate the efficiency of the diesel car. [2]



(a) $300 \div 1000 = \mathbf{0.30}$, or 30%

Exercise 3.2 (b)

3.2 The chart shows the useful kinetic energy that four types of car get from every 1000 J of energy supplied.

(b) Calculate the wasted energy for the petrol car and for the electric car. How many times more energy does the petrol car waste? [3]

Exercise 3.2 (b)

3.2 The chart shows the useful kinetic energy that four types of car get from every 1000 J of energy supplied.

(b) Calculate the wasted energy for the petrol car and for the electric car. How many times more energy does the petrol car waste? [3]

(b) petrol: $1000 - 250 = 750$ J; electric: $1000 - 850 = 150$ J; $750 \div 150 = \mathbf{5}$ times

Exercise 3.2 (c)

3.2 The chart shows the useful kinetic energy that four types of car get from every 1000 J of energy supplied.

(c) Describe where the wasted energy goes in a petrol car. [2]

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(c) Describe where the wasted energy goes in a petrol car. [2]

(c) it heats the engine and the surroundings; some is transferred by sound, or wasted doing work against friction

Exercise 3.2 (d)

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(d) Evaluate the use of electric cars instead of petrol cars. [6]

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(d) Evaluate the use of electric cars instead of petrol cars. [6]

(d) points to include:

- electric cars are much more efficient, so they waste less energy
- they give out no exhaust gases where they are used, so the air in towns is cleaner
- but much electricity is made in power stations that burn fossil fuels, which give out carbon dioxide
- power stations are only about 35–50% efficient, so the overall saving is smaller
- batteries are costly, need rare metals and take a long time to charge; the range can be short
- a conclusion that weighs these points

Levels: **5–6** a full, logical answer with correct physics and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.