# Using Energy

**Q1.**

A different cyclist uses a motorised bicycle.

The motorised bicycle is powered by an electric motor.

Figure 3 is an energy diagram for the motor.
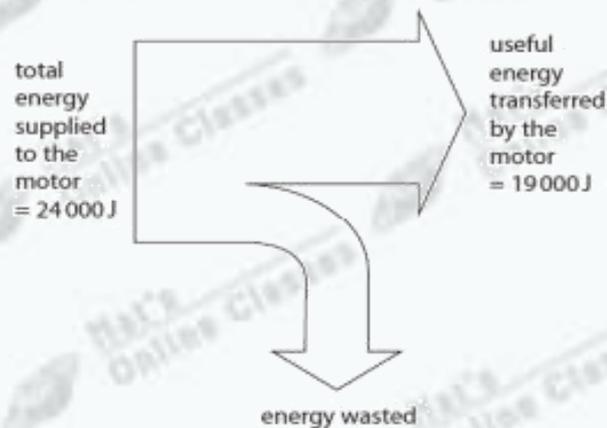
total energy supplied to the motor = 24 000 J

useful energy transferred by the motor = 19 000 J

energy wasted

**Figure 3**

(i) Calculate how much energy is wasted.

(1)

energy wasted = ........................................................ J

(ii) Calculate the efficiency of the electric motor.

(2)

Use the equation:

$$\text{efficiency} = \frac{\text{(useful energy transferred by the device)}}{\text{(total energy supplied to the device)}}$$

efficiency of electric motor = ...................................................................

## Q2.

Figure 2 shows an energy transfer diagram for a steam engine.

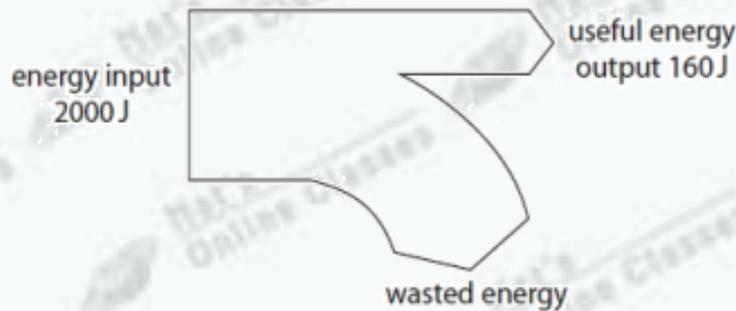The diagram shows the amounts of energy transferred each second by the steam engine.

energy input
2000 J

useful energy
output 160 J

wasted energy

**Figure 2**

(i) Calculate the amount of wasted energy.

(1)

wasted energy = ................................................................... J

(ii) Calculate the efficiency of the steam engine.

Use the equation

$$\text{efficiency} = \frac{\text{(useful energy transferred by the steam engine)}}{\text{(total energy supplied to the steam engine)}}$$

(2)

efficiency = ...........................................................

(iii) State what happens to the wasted energy.

(1)

........................................................................................................................

(iv) Coal is a fossil fuel that is burnt in some steam engines.

State **two** ways that the use of coal might be harmful to the environment.

(2)

1 .....................................................................................................................

........................................................................................................................

2 .....................................................................................................................

........................................................................................................................

**Q3.**

A kettle is used to heat water.

Figure 11 shows a graph of temperature against time for the water in the kettle.
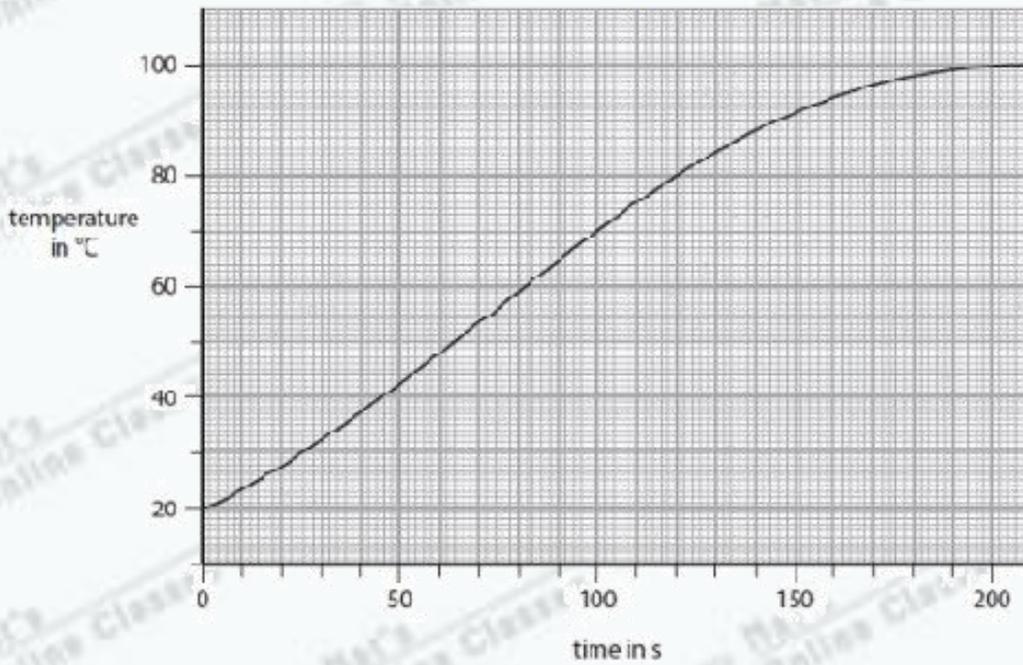


**Figure 11**

Calculate the rate of increase in temperature at a time of 150 s, by drawing a tangent to the curve in Figure 11 at a time of 150 s.

(3)

........................................................................ °C / s

**Q4.**

A kettle is used to heat water.

The kettle has an efficiency of 91% in supplying energy to the water.
The thermal energy of the water increases by $3.3 \times 10^5$ J in 200 s.

Calculate the total amount of energy supplied to the kettle in the 200 s.

Use the equation

$$\text{efficiency} = \frac{\text{(useful energy transferred by the device)}}{\text{(total energy supplied to the device)}}$$

(2)

total amount of energy supplied = ................................................................. J

**Q5.**

Figure 13 shows wind turbines, used to generate electricity for the National Grid.



(Source: © MarcelClemens/Shutterstock)

**Figure 13**

The wind turns the turbine blades.

The wind is a renewable source of energy.

(i) State **two** other renewable sources of energy.

(2)

1 .................................................................................................................

2 .................................................................................................................

(ii) For one turbine

- the energy input per second from the wind is 6.2 kJ
- the energy output per second to the National Grid is 2.2 kJ.

Calculate the efficiency of this turbine.

(2)

efficiency = ..................................................

(iii) Suggest a reason why it is impossible for the turbine to use all the kinetic energy of the wind.

(1)

..................................................................................................................................

..................................................................................................................................

## Q6.

State **two** non-renewable energy sources.

(2)

1 ..............................................................................................................................

2 ..............................................................................................................................

# Mark Scheme – Using Energy

**Q1.**

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (i) | 5000(J) | 24 000 – 19 000 | (1) AO2 |

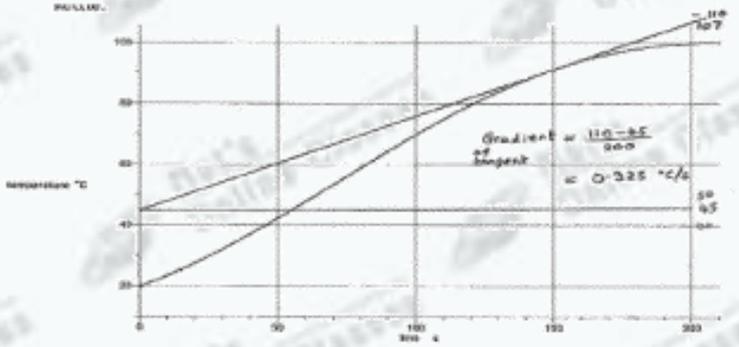| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (ii) | substitution (1)<br><br>(efficiency =)$\dfrac{19000}{24000}$ (x100%)<br><br>evaluation(1)<br>0.79 or 79% | allow 0.8<br>do not award 79<br>without percentage<br><br>award full marks for correct answer without working. | (2) AO2 |

**Q2.**

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (i) | 1840 (J)　　　(1) | | (1) |

| Question Number | Answer | | Mark |
|---|---|---|---|
| (ii) | substitution　(1)<br><br>(efficiency =) $\dfrac{160}{2000}$<br><br>evaluation　(1)<br><br>0.08 OR 8 (%) | Ignore any units<br><br>award full marks for the correct answer without working | (2) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (iii) | reference to :<br><br>thermal (energy)    (1)<br><br>OR<br><br>(lost to) environment /surroundings/dissipated (1)<br><br><br>OR<br><br>transferred/changed to another form of energy (1) | IGNORE gets re-used / recycled<br><br>heat<br>OR<br><br>(to) atmosphere / (to) the air /sky/ steam<br><br><br>accept named form of energy | (1) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (iv) | an answer that makes reference to **any two from** | IGNORE unqualified pollutes/pollution<br>IGNORE ozone layer<br><br>IGNORE non-renewable<br>IGNORE 'fumes' | (2) |
| | produces/ releases/makes/gives off carbon dioxide / $CO_2$ /greenhouse gases (1) | (causes) greenhouse effect OR contributes to global warming/climate change allow CO2 | |
| | produces carbon monoxide / CO (1) | causes carbon monoxide poisoning | |
| | produces air pollution (1) | accept (harmful) particles /dust | |
| | produces sulphur dioxide/ $SO_2$ (1) | causes <u>acid rain</u> | |
| | produces soot /smoke (1) | blackens/ stains buildings/statues | |
| | mining coal (1) | slag heaps/ mining damages the landscape/habitats/ecosystem OR ground needs to be dug up | |

**Q3.**

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| | | | (3) |
| |  | | |
| | drawing tangent attempt (1) | | |
| | correct data points from graph (1) | accept other data from the graph | |
| | 60,60   and    150,92 | | |
| | evaluation (1) | award full marks for the correct answer without working | |
| | 0.33±0.07 (°C / s) | | |

**Q4.**

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| | rearrangement and substitution (1)<br><br>energy supplied = $\dfrac{\text{useful energy}}{\text{efficiency}}$<br><br>$= \dfrac{3.3 \times 10^{3}}{0.91}$<br><br>evaluation (1)<br><br>$3.6 \times 10^{3}$ (J) | | (2) |
| | | $(3.626 \times 10^{3})$<br>number that rounds to<br>$3.6 \times 10^{3}$ (J)<br><br>3600 or 3626 scores 1 mark<br><br>award full marks for the correct answer without working<br><br>no marks for 91% of $3.3 \times 10^{3} = 3.0 \times 10^{3}$ (J) | |

**Q5.**

|  | Answer | Additional guidance | Mark |
|---|---|---|---|
| i | **Two** from:<br><br>falling water/hydro (1)<br>tides (1)<br>sun/solar (1)<br>geothermal (1)<br>biomass (1) |  | (2)<br>AO1 |

|  | Answer | Additional guidance | Mark |
|---|---|---|---|
| (ii) | recall and substitution (1)<br><br>(%) efficiency = $\dfrac{2.2\ (\times\ 100)}{6.2}$<br><br>evaluation (1)<br><br>0.35 (1) | allow numbers that round to 0.35 e.g. 0.3548<br><br>accept 35(%) for full marks<br><br>award full marks for correct answer without working. | (2)<br>AO2 |

| | Answer | Additional guidance | Mark |
|---|---|---|---|
| (iii) | **One** from:<br><br>air (has to be) moving on the other side of the blades (1)<br><br>not all of the air hits the blade (1)<br><br>friction within the turbine/generator (1)<br><br>some energy (always) transferred to thermal (1)<br><br>it is fitted with a speed limiter (1) | | (1)<br>AO3 |

**Q6.**

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| | any two sources from:<br><br>• oil<br><br>• (natural) gas<br>• coal<br>• nuclear/uranium | accept petrol /diesel for oil<br><br><br>accept fossil fuel(s) for any of the first three i.e. fossil fuel and oil or coal or gas scores 1 mark but fossil fuel and nuclear scores 2 marks | (2)<br>AO 1 1 |

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