

## Using Energy

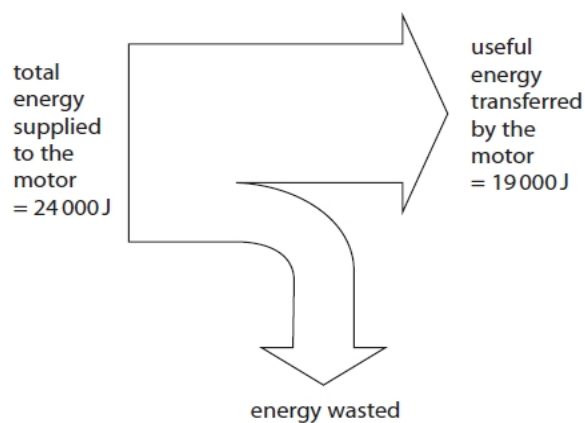
### Questions

**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.



**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:

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

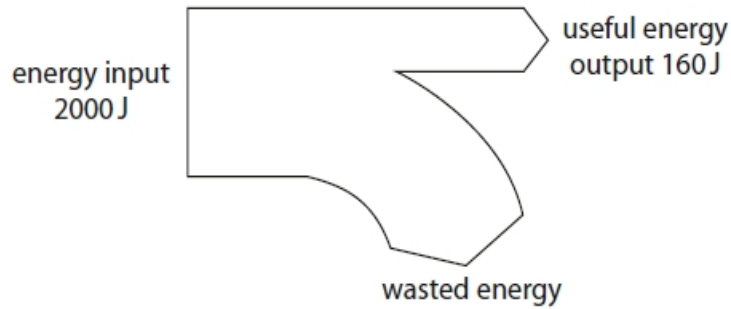
efficiency of electric motor = .....

**(Total for question = 3 marks)**

**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.



**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 .....

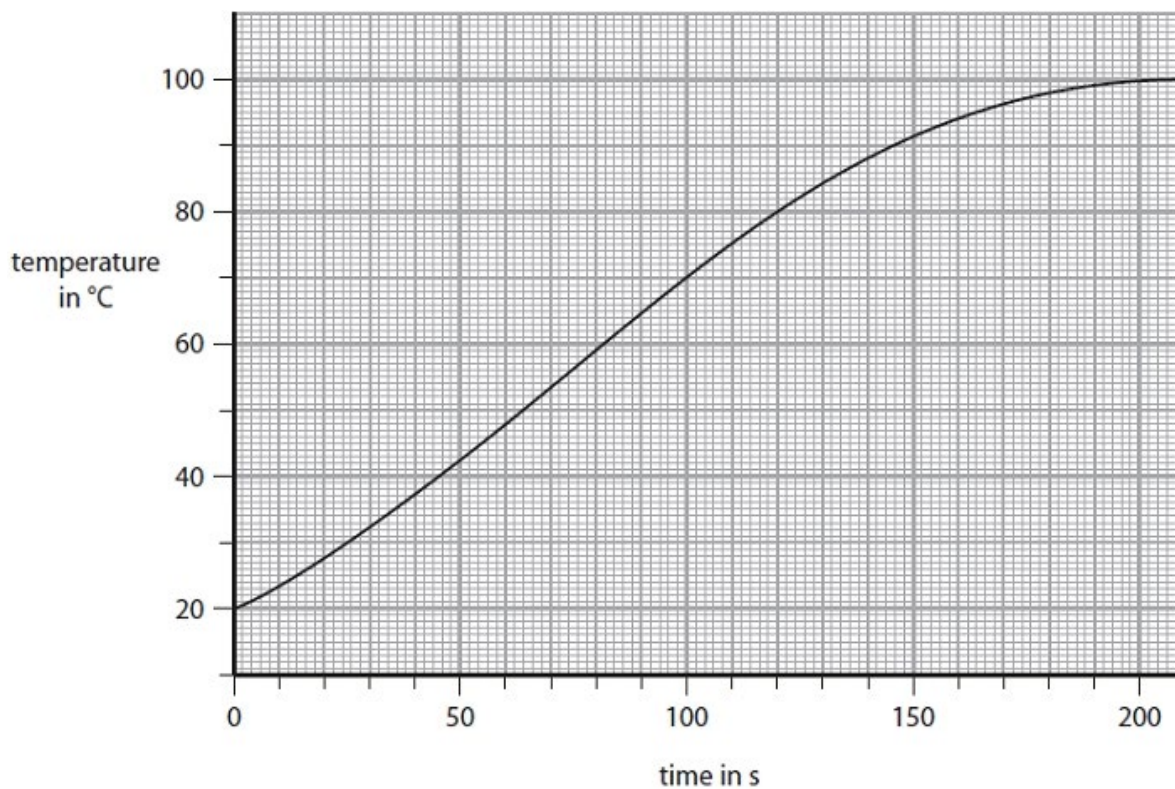
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**(Total for question = 6 marks)**

**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

**(Total for question = 3 marks)**

**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

**(Total for question = 2 marks)**

**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)

.....

.....

**(Total for question = 5 marks)**

**Q6.**State **two** non-renewable energy sources.

(2)

1 .....

2 .....

**(Total for question = 2 marks)****Q7.**

Which of these is a non-renewable source of energy?

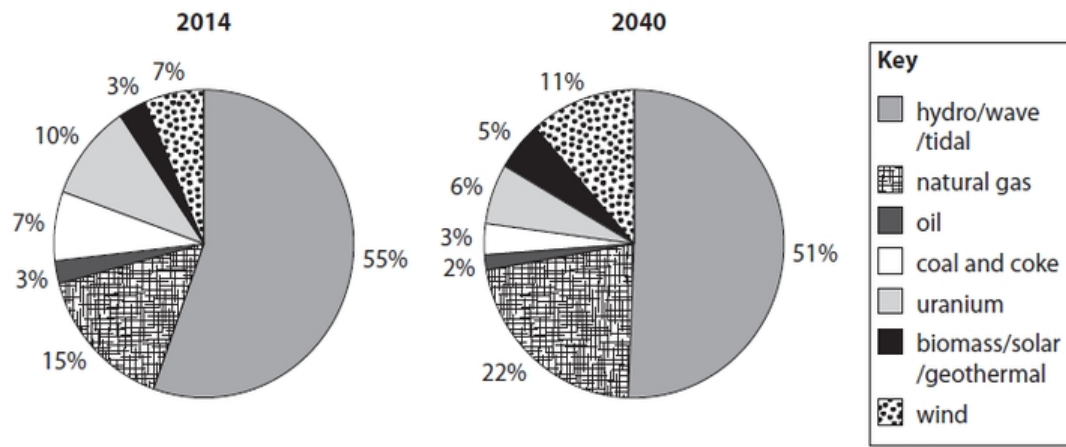
(1)

- A** geothermal
- B** natural gas
- C** tidal
- D** solar

**(Total for question = 1 mark)**

**Q8.**

Figure 10 shows all the energy sources used in Canada in 2014 and a prediction for 2040.



**Figure 10**

Discuss the effects on the environment of two predicted changes between 2014 and 2040.

(4)

change 1

.....

.....

effect on the environment

.....

.....

change 2

.....

.....

effect on the environment

.....

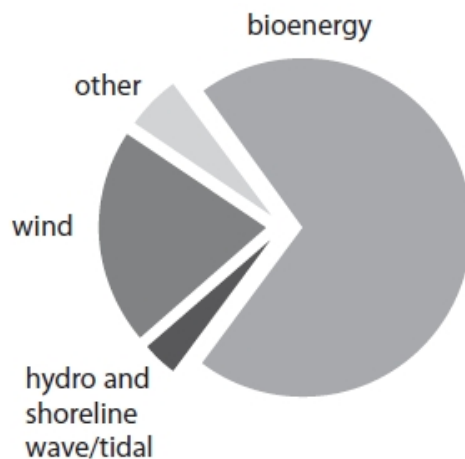
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**(Total for question = 4 marks)**

**Q9.**

Figure 9 shows the renewable energy sources used in the UK in 2015.

Figure 9 is to scale.



**Figure 9**

(i) State the energy source that gave the greatest amount of renewable energy for the UK in 2015.

(1)

.....

(ii) Justify your choice of energy source in part (i).

(1)

.....

.....

(iii) State which of these energy sources gave about 20% of the energy from renewable sources for the UK in 2015.

(1)

.....

**(Total for question = 3 marks)**



**Q10.**

Explain why renewable sources provide an increasing fraction of the electricity supply for many countries.

(2)

.....

.....

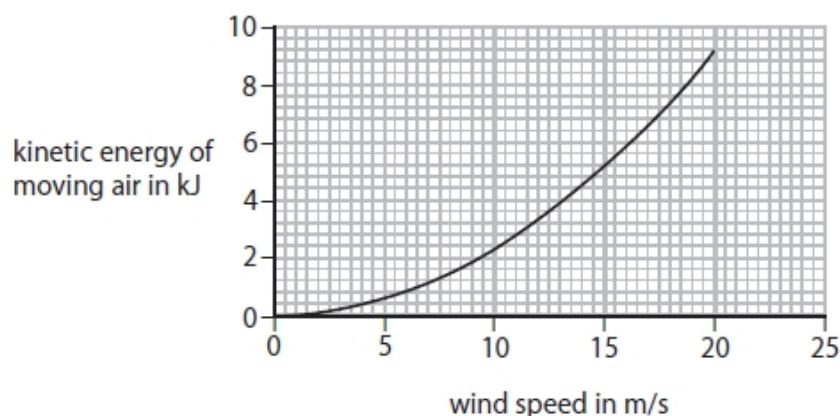
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**(Total for question = 2 marks)****Q11.**

Moving air can be used to generate electricity using a wind turbine.

Figure 8 is a graph of kinetic energy against wind speed for a mass of moving air.

**Figure 8**

Just before the air reaches a wind turbine it has a wind speed of 15 m/s.

When the air has gone through the turbine it has a wind speed of 13 m/s.

As the air moves through the turbine some of its kinetic energy is transferred to the turbine.

Use the graph to determine the percentage of the kinetic energy transferred to the turbine from the air.

(3)

percentage of kinetic energy transferred from the air = .....%

**(Total for question = 3 marks)**

## 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) (efficiency =) $\frac{19000}{24000} \times 100\%$  evaluation(1) 0.79 or 79%	allow 0.8 do not award 79 without percentage  award full marks for correct answer without working.	(2) AO2

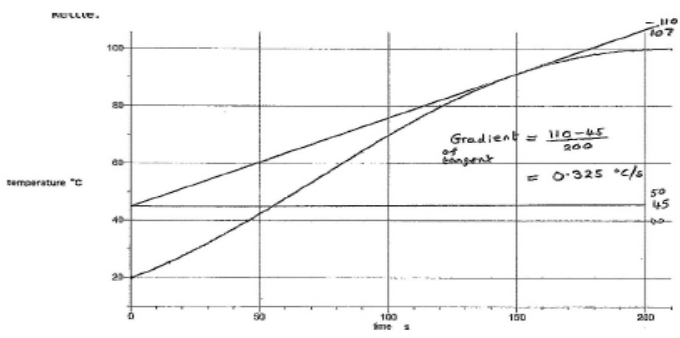
Q2.

Question Number	Answer	Additional guidance	Mark
(i)	1840 (J)                    (1)		(1)
Question Number	Answer	Additional guidance	Mark
(ii)	substitution            (1) (efficiency =) $\frac{160}{2000}$  evaluation                (1) 0.08 OR 8 (%)	Ignore any units  award full marks for the correct answer without working	(2)

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

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

Q3.

Question number	Answer	Additional guidance	Mark
	 <p>drawing tangent attempt (1)</p> <p>correct data points from graph (1) 60,60 and 150,92</p> <p>evaluation (1) <math>0.33 \pm 0.07</math> (<math>^{\circ}\text{C} / \text{s}</math>)</p>	<p>accept other data from the graph</p> <p>award full marks for the correct answer without working</p>	(3)

Q4.

Question number	Answer	Additional guidance	Mark
	<p>rearrangement and substitution (1)</p> <p>energy supplied = <math>\frac{\text{useful energy}}{\text{efficiency}}</math></p> <p>= <math>\frac{3.3 \times 10^5}{0.91}</math></p> <p>evaluation (1)</p> <p><math>3.6 \times 10^5</math> (J)</p>	<p>(<math>3.626 \times 10^5</math>) number that rounds to <math>3.6 \times 10^5</math> (J)</p> <p>3600 or 3626 scores 1 mark</p> <p>award full marks for the correct answer without working</p> <p>no marks for 91% of <math>3.3 \times 10^5 = 3.0 \times 10^5</math> (J)</p>	(2)

Q5.

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

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

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

Q6.

Question Number	Answer	Additional guidance	Mark
	any two sources from: <ul style="list-style-type: none"> <li>• oil</li> <li>• (natural) gas</li> <li>• coal</li> <li>• nuclear/uranium</li> </ul>	accept petrol /diesel for oil  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	<b>(2)</b> AO 1 1

Q7.

Question Number	Answer	Mark
	<b>B natural gas is the only correct answer</b> <i>A geothermal is not a non-renewable source of energy</i> <i>C tidal is not a non-renewable source of energy</i> <i>D solar is not a non-renewable source of energy</i>	<b>(1)</b> AO 1 1

Q8.

Question Number	Answer	Additional guidance	Mark
	<p>discussion to involve two points each giving change and effect (max 4 marks)</p> <p>some examples:</p> <p>change: biomass-solar-geothermal (fraction) increases (1) effect: e.g. reduces greenhouse gas / CO<sub>2</sub> emissions (1)</p> <p>change: 'wind' (fraction) increases (1) effect: e.g. visual/noise pollution arguments (1)</p> <p>change: 'natural gas' (fraction) increases (1) effect: e.g. contributes to global warming (1)</p> <p>change: 'uranium' (fraction) decreases (1) effect: e.g. less radioactive waste (1)</p>	<p>ignore vague responses such as 'environmentally friendly', less pollution etc.</p> <p>candidates may give positive or negative effects</p> <p>for this change (and for oil) allow decreases (with a correct accompanying effect for 2 marks)</p> <p>accept conserves non-renewables but not just 'more renewable'</p>	<p><b>(4)</b></p> <p>AO 3 2a</p> <p>AO 3 2b</p>

Q9.

Question Number	Answer	Additional guidance	Mark
(i)	bioenergy	biofuel / biomass	(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
(ii)	largest area / fraction / percentage (idea)	<b>must be referring to the chart</b> , not just repeating 4bi stem- can't have greatest/ largest amount by itself	(1) AO 3 1b

Question Number	Answer	Additional guidance	Mark
(iii)	wind		(1) AO 3 1b

Q10.

Question Number	Answer	Additional guidance	Mark
	an explanation linking:  increased use of renewables/decrease use of nonrenewables (1)  reason (1)	accept "them" as renewable accept reason why renewables are beneficial  accept reason why non-renewable(s) are not beneficial	(2) AO 1 1



Q11.

Question Number	Answer	Additional guidance	Mark
	reading energies from graph (1) 5.2 and 3.9 (kJ)  substitution (1) e.g. $\frac{1.3 \times (100)}{5.2}$  evaluation (1) 25(%)	accept 5.0 to 5.4 and 3.7 to 4.1   0.18 to 0.32   18 to 32 (%) award full marks for the correct answer with no working	<b>(3)</b> AO 2 1