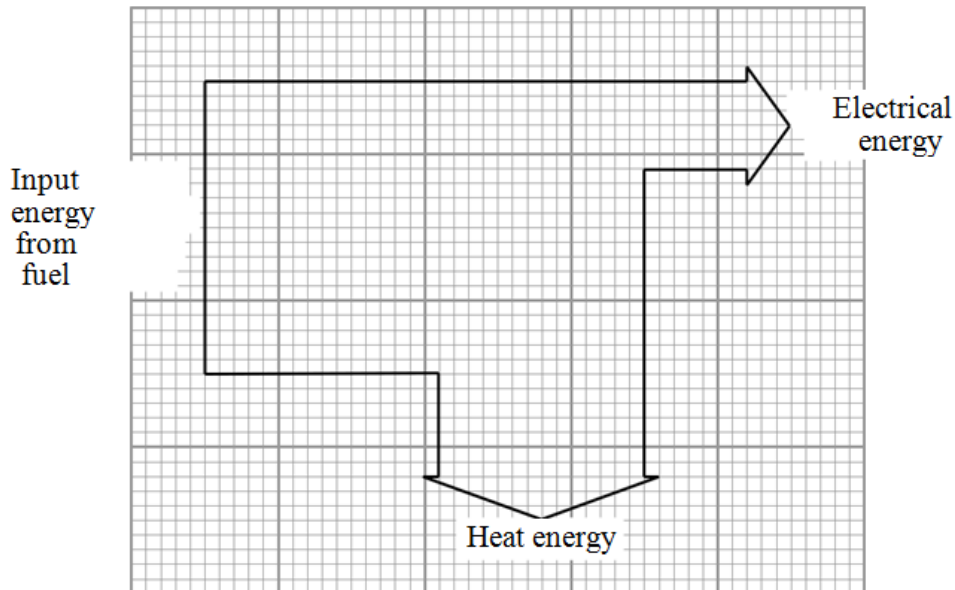


Efficiency and Reducing Unwanted Energy Transfers 1

Q:1 (a) The diagram shows the energy transformations in a fuel burning power station.



(i) Name one fuel that is burned to provide the energy source for a power station.

.....

(1 mark)

(ii) Use the diagram and the equation in the box to calculate the efficiency of the power station.

efficiency=

useful energy transferred by the device

total energy supplied to the device

Show clearly how you work out your answer.

Efficiency = _____

(2 marks)

(iii) Name the process by which a nuclear fuel provides the energy needed to generate electricity in a nuclear power station.

(1 mark)

(b) Electricity is distributed from power stations to consumers along the National Grid.

(i) Transformers are part of the National Grid. Transformers are efficient devices. What is meant by a device being efficient?

(1 mark)

(ii) When electricity flows through a cable, some energy is transformed into heat. Explain how the National Grid system reduces the amount of energy lost as heat.

(2 marks)

(c) Read this information taken from a recent newspaper article.

Researchers have found that children living close to overhead power cables are more likely to develop leukaemia.

The researchers studied two groups of children. One group had developed leukaemia, the other group was healthy.

Although the researchers found a link, they are unable to explain why it happened.

They say that the results may have happened by chance.

Other factors that have not been investigated, such as the environment, the geographical area or the children's genes, could be important.

A cancer research charity said that childhood leukaemia was most likely to be caused by factors that parents were unable to control.

(i) Why did the researchers study a group of healthy children?

(1 mark)

(ii) The information does not say how many children were studied. Why should this data have been included in the article?

(1 mark)

(iii) The researchers could not be certain that the overhead power cables were responsible for the increased chance of children developing leukaemia.

Explain why.

(2 marks)

(iv) The results of the research carried out by scientists may worry some people. What do you think scientists should do?

Put a tick () in the box next to your choice.

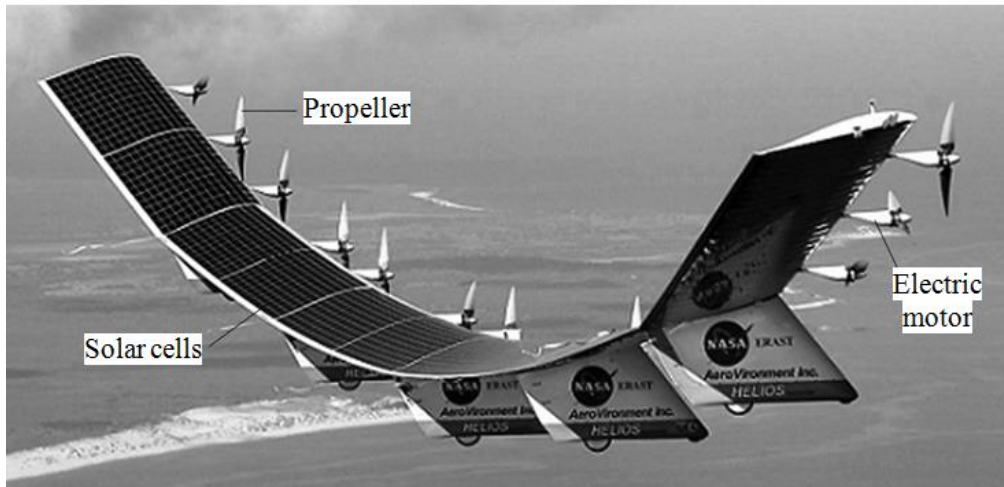
Scientists should publish their research findings straight away.

Scientists should not publish their research findings until they have found out as many facts as possible.

Give a reason for your choice.

(1 mark)

Q:2 The picture shows a solar-powered aircraft. The aircraft has no pilot.



(a) Use words from the box to complete the following sentence.

electrical heat light sound

Solar cells are designed to transform _____ energy into

_____ energy.

(2 marks)

(b) On a summer day, 175 000 joules of energy are supplied to the aircraft's solar cells every second. The useful energy transferred by the solar cells is 35 000 joules every second.

(b)(i) Use the equation in the box to calculate the efficiency of the solar cells.

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

Show clearly how you work out your answer.

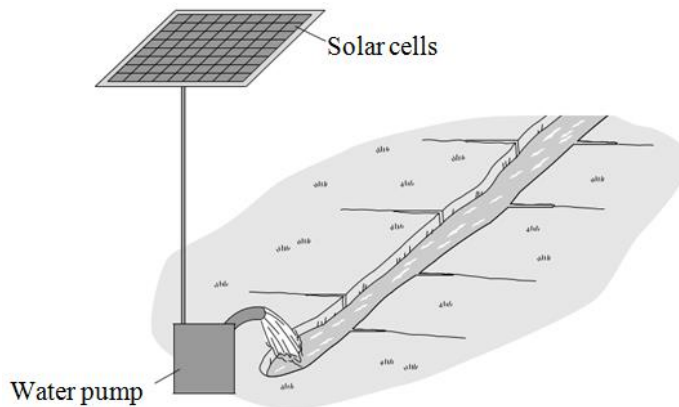
Efficiency = _____

(2 marks)

(b)(ii) What happens to the energy that is not usefully transferred by the solar cells?

(1 mark)

Q:3 The farmers in a village in India use solar powered water pumps to irrigate the fields.



On average, a one square metre panel of solar cells receives 5 kWh of energy from the Sun each day.

The solar cells have an efficiency of 0.15

(a)(i) Use the following equation to calculate the electrical energy available from a one square metre panel of solar cells.

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

Show clearly how you work out your answer.

Electrical energy = _____ kWh

(2 marks)

(a)(ii) On average, each solar water pump uses 1.5 kWh of energy each day. Calculate the area of solar cells required by one solar water pump.

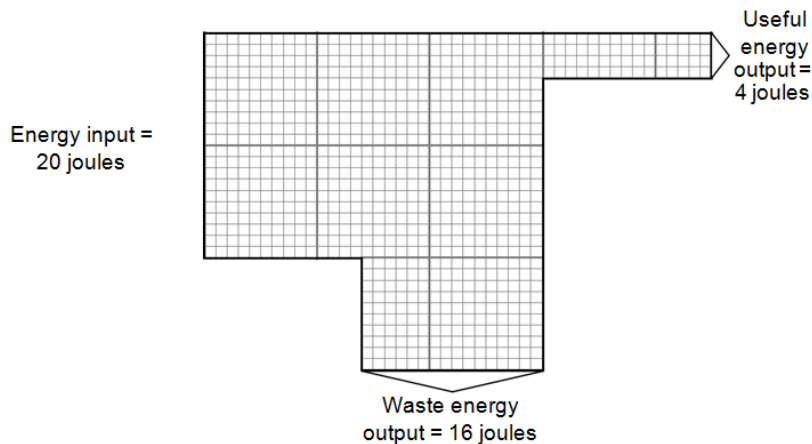
Area = _____ square metres

(1 mark)

(b) Give one reason why the area of solar cells needed will probably be greater than the answer to part (a)(ii).

(1 mark)

Q:4 The Sankey diagram for a low energy light bulb, known as a CFL, is shown below.



(a) (i) What is the useful energy output that the CFL is designed to produce?

(1 mark)

(a) (ii) What effect does the waste energy output have on the surrounding air?

(1 mark)

(a) (iii) Use the information in the diagram to calculate the efficiency of the CFL. Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Efficiency = _____

(2 marks)

(a) (iv) CFLs contain mercury. Mercury is a poisonous substance. It is important that old CFLs are sent for recycling and not thrown into a rubbish bin. Suggest one reason why.

(1 mark)

(b) A new type of low energy bulb uses light emitting diodes (LEDs).

Draw a ring around the correct answer in the box to complete the sentence.

LED bulbs are more efficient than CFLs. This means that LED bulbs waste
proportion of the input energy compared to CFLs.

a smaller
the same
Bigger

(1 mark)

Q:5 The table gives data about two types of low energy bulb.

Type of bulb	Power input in watts	Efficiency	Lifetime in hours	Cost of one bulb
Compact Fluorescent Lamp (CFL)	8	20 %	10 000	£3.10
Light Emitting Diode (LED)	5		50 000	£29.85

(a) Both types of bulb produce the same useful power output.

(a) (i) Calculate the useful power output of the CFL. Use the correct equation from the Physics Equations Sheet. Show clearly how you work out your answer.

Useful power output = _____ W

(2 marks)

(a) (ii) Calculate the efficiency of the LED bulb.

Use the correct equation from the Physics Equations Sheet. Show clearly how you work out your answer.

Efficiency = _____

(1 mark)

(b) Sketch and label a Sankey diagram for the CFL.

(2 marks)

(c) LED bulbs are expensive. This is because of the large number of individual electronic LED chips needed to produce sufficient light from each bulb.

(c) (i) Use the data in the table to evaluate the cost-effectiveness of an LED bulb compared to a CFL.

(2 marks)

(c) (ii) Scientists are developing brighter and more efficient LED chips than those currently used in LED bulbs.

Suggest one benefit of developing brighter and more efficient LED chips.

(1 mark)

TOTAL MARKS=35