AQA GCSE Physics | 8463

SPECIFICATION POINT 4.2.4.2

Energy transfers in everyday appliances

Past-paper questions

Tier	**Higher**
Question groups	**106**
Available paper years	**2004–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.2.4.2 Energy transfers in everyday appliances

Question 01

June 2004 | 3451H | Original Q2 | Legacy

2 The diagram represents the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet	Visible light	Infra red	Microwaves	Radio waves

(a) Name the type of electromagnetic radiation that is used:

(i) to sterilise surgical instruments;

.....

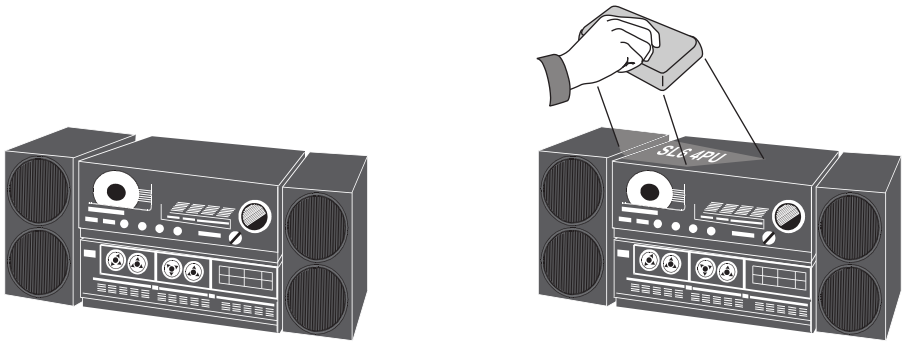
(1 mark)

(ii) to send a signal to a TV from a remote control.

.....

(1 mark)

(b) Valuable items can be security marked using special ink. The ink can only be seen in ultraviolet radiation.



Explain what happens to make the ink visible.

.....

.....

.....

.....

(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 01 · continued

MARGIN BLANK

(c) Explain why skin cells need to be protected from ultraviolet radiation.

.....

.....

.....

.....

(2 marks)

(d) The following information is from an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0.65 kW
Grill power	1.15 kW

(i) Name the **two** types of electromagnetic radiation that the oven can use to cook food.

..... and .....

(1 mark)

(ii) A joint of meat is cooked using both the microwave and the grill. Both are switched on at full power for half an hour.

Use the following equation to calculate the energy transferred, in kilowatt-hours, by the oven. Show clearly how you obtain your answer.

energy transferred = power × time

.....

.....

.....

energy transferred =.....kWh

(2 marks)

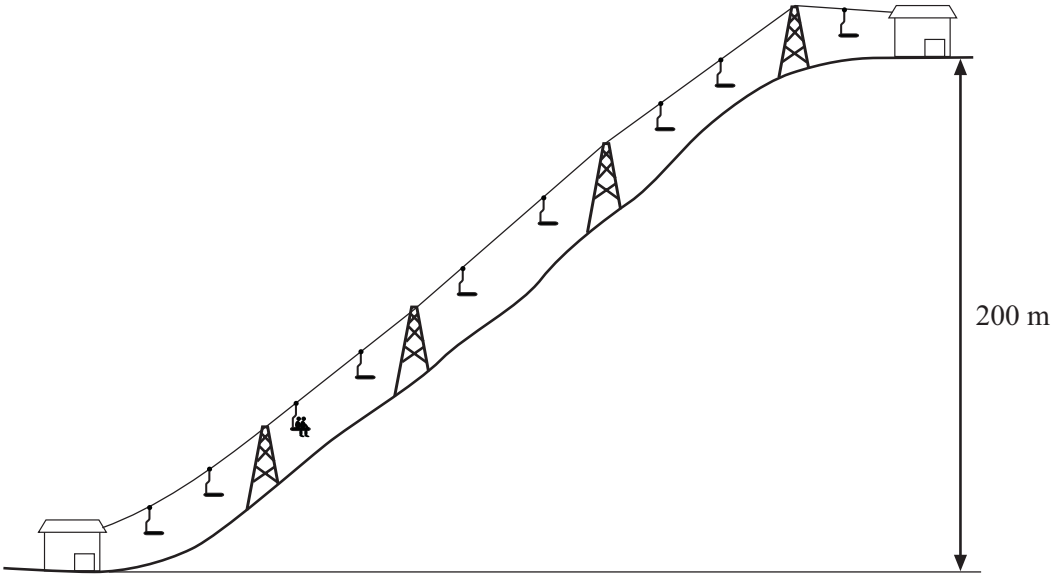
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4.2.4.2 Energy transfers in everyday appliances

Question 02

June 2004 | 3451H | Original Q6 | Legacy

6 (a) A chair lift carries two skiers, Greg and Jill, to the top of a ski slope. Greg weighs 700 N and Jill weighs 500 N.



(i) Write down the equation that links distance moved, force applied and work done.

.....

(1 mark)

(ii) Calculate the work done to lift Greg and Jill through a vertical height of 200 m.
Show clearly how you work out your answer and give the unit.

.....

.....

.....

work done =.....

(3 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 02 · continued

MARGIN BLANK

(b) The chair takes 5 minutes to move from the bottom to the top of the ski slope.

Use the following equation to calculate the power required to lift Greg and Jill to the top of the ski slope. Show clearly how you work out your answer.

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

.....

.....

power = ...watts

(2 marks)

(c) The chair lift is driven by an electric motor.

(i) Why would the power output of the electric motor need to be larger than your answer to part (b)?

.....

.....

(1 mark)

(ii) Complete the following sentence.

When the ski lift is working ..... energy supplied to the motor is usefully transferred as gravitational ..... energy. *(1 mark)*

8

4.2.4.2 Energy transfers in everyday appliances

Question 03

June 2004 | 3451H | Original Q10 | Legacy

10 (a) Nuclear power stations use the energy released by *nuclear fission* to generate electricity.

(i) Explain what is meant by *nuclear fission*.

.....

.....

.....

(2 marks)

(ii) How does nuclear fission lead to a chain reaction?

You may give your answer as a labelled diagram.

.....

.....

(1 mark)

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is expensive. Why?

.....

.....

(1 mark)

(c) The table compares the energy released from 1 kg of coal and 1 kg of uranium.

Coal	29 MJ
Uranium	580 000 MJ

1 MJ = 1 000 000 joules

State **one** benefit to the environment of using a concentrated fuel like uranium to generate electricity rather than using the energy from coal.

.....

.....

(1 mark)

5

4.2.4.2 Energy transfers in everyday appliances

Question 04

June 2004 | 3462H3 | Original Q2 | Legacy

2 The diagram represents the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet	Visible light	Infra red	Microwaves	Radio waves

(a) Name the type of electromagnetic radiation that is used:

(i) to sterilise surgical instruments;

.....

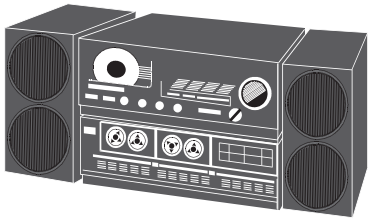
(1 mark)

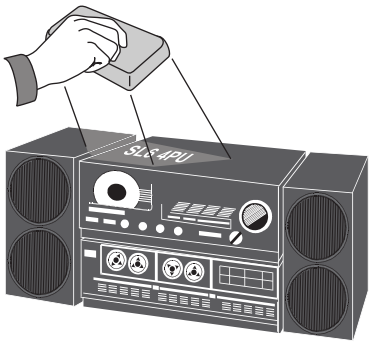
(ii) to send a signal to a TV from a remote control.

.....

(1 mark)

(b) Valuable items can be security marked using special ink. The ink can only be seen in ultraviolet radiation.





Explain what happens to make the ink visible.

.....

.....

.....

.....

(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 04 · continued

5

MARGIN BLANK

(c) Explain why skin cells need to be protected from ultraviolet radiation.

.....

.....

.....

.....

(2 marks)

(d) The following information is from an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0.65 kW
Grill power	1.15 kW

(i) Name the **two** types of electromagnetic radiation that the oven can use to cook food.

..... and .....

(1 mark)

(ii) A joint of meat is cooked using both the microwave and the grill. Both are switched on at full power for half an hour.

Use the following equation to calculate the energy transferred, in kilowatt-hours, by the oven. Show clearly how you obtain your answer.

energy transferred = power × time

.....

.....

.....

energy transferred =.....kWh

(2 marks)

9

4.2.4.2 Energy transfers in everyday appliances

Question 05

June 2004 | 3462H3 | Original Q8 | Legacy

8 (a) Nuclear power stations use the energy released by *nuclear fission* to generate electricity.

(i) Explain what is meant by *nuclear fission*.

.....

.....

.....

(2 marks)

(ii) How does nuclear fission lead to a chain reaction?

You may give your answer as a labelled diagram.

.....

.....

(1 mark)

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is expensive. Why?

.....

.....

(1 mark)

(c) The table compares the energy released from 1 kg of coal and 1 kg of uranium.

Coal	29 MJ
Uranium	580 000 MJ

1 MJ = 1 000 000 joules

State **one** benefit to the environment of using a concentrated fuel like uranium to generate electricity rather than using the energy from coal.

.....

.....

(1 mark)

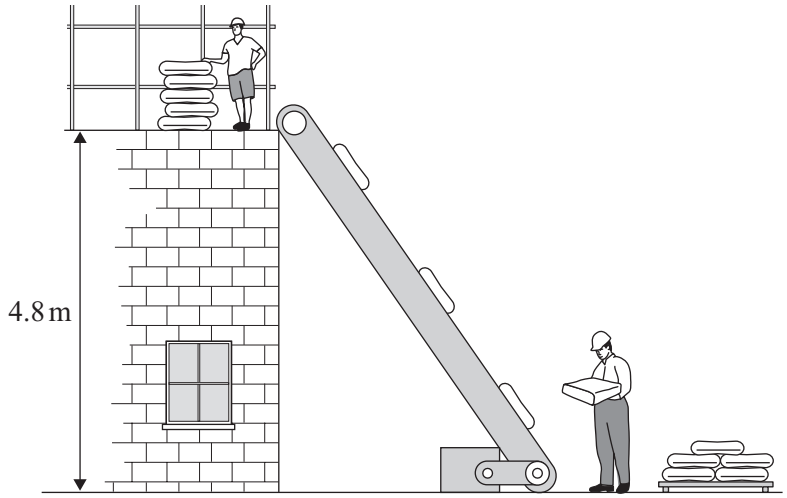
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4.2.4.2 Energy transfers in everyday appliances

Question 06

June 2005 | 3451 | Original Q13 | Legacy

13 A machine is used to lift materials on a building site.



(a) (i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

.....

(1 mark)

(ii) A 25 kg bag of cement is lifted from the ground to the top of the building.
Calculate the gain in the gravitational potential energy of the bag of cement.

(On Earth a 1 kg mass has a weight of 10 N.)

.....

.....

Change in gravitational potential energy = ... joules
(2 marks)

(b) The conveyor belt delivers six bags of cement each minute to the top of the building.

(i) Calculate the useful energy transferred by the machine each second.

.....

.....

.....

Useful energy transfer each second = ... J
(1 mark)

4.2.4.2 Energy transfers in everyday appliances

Question 06 · continued

MARGIN BLANK

(ii) The machine is 40 % efficient.
Use the following equation to calculate the total energy supplied to the machine each second. Show how you work out your answer.

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

.....

.....

Total energy supplied each second = ... J
(2 marks)

6

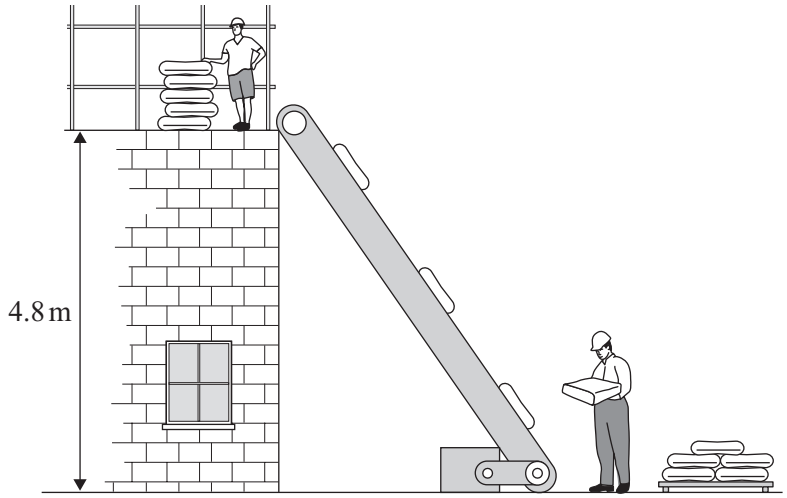
TURN OVER FOR THE NEXT QUESTION

4.2.4.2 Energy transfers in everyday appliances

Question 07

June 2005 | 3462 | Original Q10 | Legacy

10 A machine is used to lift materials on a building site.



(a) (i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

.....

(1 mark)

(ii) A 25 kg bag of cement is lifted from the ground to the top of the building.
Calculate the gain in the gravitational potential energy of the bag of cement.

(On Earth a 1 kg mass has a weight of 10 N.)

.....

.....

Change in gravitational potential energy = ... joules
(2 marks)

(b) The conveyor belt delivers six bags of cement each minute to the top of the building.

(i) Calculate the useful energy transferred by the machine each second.

.....

.....

.....

Useful energy transfer each second = ... J
(1 mark)

4.2.4.2 Energy transfers in everyday appliances

Question 07 · continued

MARGIN BLANK

(ii) The machine is 40 % efficient.
Use the following equation to calculate the total energy supplied to the machine each second. Show how you work out your answer.

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

.....

.....

Total energy supplied each second = ... J
(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

4.2.4.2 Energy transfers in everyday appliances

Question 08

June 2006 | 3451 | Original Q13 | Legacy

13 (a) Some people think that more electricity should be generated using nuclear fuels.

What reasons might they give for thinking this?

.....

.....

.....

.....

(2 marks)

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is high. Why?

.....

.....

(1 mark)

(c) Electricity can be generated using energy from the wind.

(i) On average a wind turbine produces only 24 % of the power it is capable of producing. Why?

.....

.....

(1 mark)

(ii) There is no fuel cost for a wind turbine. However, generating electricity from a wind farm costs more than generating the same power from a coal-burning power station. Why?

.....

.....

.....

.....

(2 marks)

6

4.2.4.2 Energy transfers in everyday appliances

Question 09

June 2006 | 3462 | Original Q11 | Legacy

11 (a) Some people think that more electricity should be generated using nuclear fuels.

What reasons might they give for thinking this?

.....

.....

.....

.....

(2 marks)

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is high. Why?

.....

.....

(1 mark)

(c) Electricity can be generated using energy from the wind.

(i) On average a wind turbine produces only 24 % of the power it is capable of producing. Why?

.....

.....

(1 mark)

(ii) There is no fuel cost for a wind turbine. However, generating electricity from a wind farm costs more than generating the same power from a coal-burning power station. Why?

.....

.....

.....

.....

(2 marks)

6

4.2.4.2 Energy transfers in everyday appliances

Question 10

November 2006 | PHY1A | Original Q2 | Legacy

QUESTION TWO

This question is about some of the energy sources that are used to generate electricity.

Match energy sources, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A coal

B hydroelectric

C nuclear

D wind

	Feature
1	has the highest decommissioning cost
2	causes noise pollution, and the supply is not constant
3	no fuel costs, and can be used to meet sudden demands for electricity
4	transformation of chemical energy to heat energy

4.2.4.2 Energy transfers in everyday appliances

Question 11

November 2006 | PHY1A | Original Q9 | Legacy

QUESTION NINE

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

A village is many kilometres away from a supply of mains electricity. The sun shines for at least a few hours nearly every day. The villagers want a supply of electricity for a radio receiver. The table shows the costs of two different ways of providing the electricity over a 20-year period.

Way of providing electricity	Equipment cost	Cost of a set of batteries	Number of sets of batteries needed
Solar cells and rechargeable batteries	£75.00	£12.50	4
'Throwaway' batteries	Zero	£2.75	80

9A What are the total costs over the 20-year period of the different ways of providing electricity?

	Solar cells and rechargeable batteries	'Throwaway' batteries
1	£87.50	£220.00
2	£87.50	£231.00
3	£125.00	£220.00
4	£125.00	£231.00

9B One disadvantage of using solar cells and rechargeable batteries is that . . .

1 new batteries are needed more often.

2 the radio could not be used at night.

3 they are more expensive in the long run.

4 they cost more in the first place.

Question 11 · continued

9C Another battery of solar cells has a maximum output of 1 kW. The battery, when used in the UK, produces, on average, 10 % of its maximum output. The battery costs £ 4000 and has an expected life of 200 000 hours. The cells have no maintenance costs.

What is the cost of each kilowatt-hour of electricity produced by the battery of solar cells when used in the UK?

1 20 p

2 25 p

3 40 p

4 50 p

9D Electricity from solar cells is more expensive than electricity generated in power stations.

Which of the following would make the cost of electricity from solar cells cheaper?

1 A decrease in the cost of fuel for normal types of power station.

2 Developing solar cells that are smaller.

3 Developing other alternative energy technologies.

4 Reducing the cost of solar cells by mass production.

END OF TEST

4.2.4.2 Energy transfers in everyday appliances

Question 12

March 2007 | PHY1A | Original Q3 | Legacy

QUESTION THREE

Electrical appliances usefully transform only part of the energy that is supplied to them. The rest of the energy is wasted.

Chefs often use electric mixers to combine ingredients.



3A A mixer **usefully** transforms electrical energy to . . .

1 kinetic energy.

2 light energy.

3 sound energy.

4 thermal energy.

4.2.4.2 Energy transfers in everyday appliances

Question 12 · continued

3B The energy that is **not** usefully transformed by the mixer is wasted as . . .

1 heat and sound.

2 heat only.

3 sound and kinetic energy.

4 sound only.

3C Which of the following statements is **false**?

1 The energy transformed by the mixer becomes difficult to use for other energy transformations.

2 The energy transformed by the mixer ends up making the surroundings a little warmer.

3 The energy transformed by the mixer ends up very spread out.

4 The energy transformed by the mixer no longer exists.

3D A second mixer transforms useful energy at the same rate as this one however, it wastes more energy.

This means that the second mixer . . .

1 costs less per minute to run.

2 is less efficient.

3 is more efficient.

4 transforms energy at a slower rate.

4.2.4.2 Energy transfers in everyday appliances

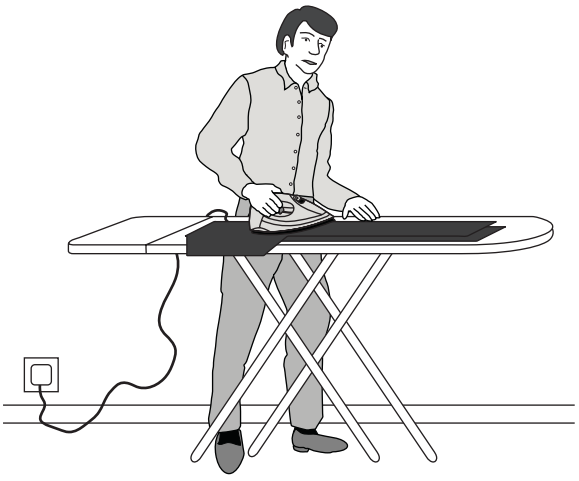
Question 13

March 2007 | PHY1A | Original Q7 | Legacy

QUESTION SEVEN

energy transferred (joule, J)	=	power (watt, W)	×	time (second, s)
energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

This question is about an electric iron. The power of the iron is 1.2 kW.



7A The base of the iron radiates energy.

It will radiate **least** energy when the base is . . .

1 at a high temperature and black.

2 at a high temperature and shiny.

3 at a low temperature and black.

4 at a low temperature and shiny.

4.2.4.2 Energy transfers in everyday appliances

Question 13 · continued

7B What is the maximum quantity of energy, in joules, that can be transformed by the iron in one hour?

1 72 J

2 4320 J

3 72 000 J

4 4 320 000 J

7C When the iron is used for one hour, less than the calculated maximum amount of energy is transformed.

Why is this?

1 Some energy is provided by the person doing the ironing.

2 Some energy is transferred to the surroundings.

3 The ironing board is covered with an insulator.

4 The iron switches off at times to keep it at the correct temperature.

7D Electricity costs 10 p per kilowatt-hour. In one week, the iron uses electricity for a total of 90 minutes.

Calculate the cost of this electricity.

1 £ 0.15

2 £ 0.18

3 £ 0.90

4 £ 1.08

4.2.4.2 Energy transfers in everyday appliances

Question 14

March 2007 | PHY1A | Original Q9 | Legacy

QUESTION NINE

The table gives the estimated costs, per kilowatt-hour, of generating electricity from four different energy sources.

Use the information in the table to help you to answer some of the questions.

Energy source	Building cost	Fuel cost	Operating cost	Decommissioning cost
Coal	2.0 p	0.6 p	0.9 p	0.1 p
Gas	2.3 p	1.4 p	0.3 p	0.1 p
Nuclear	4.2 p	0.4 p	0.7 p	2.5 p
Wind	4.8 p	zero	0.9 p	0.2 p

9A A power station must run continuously to meet a steady demand.

Ignoring the decommissioning and building costs, which power station would be economically best?

1 coal

2 gas

3 nuclear

4 wind

9B Which of the following is the correct order, cheapest first, for the **total** cost of producing each kWh of electricity?

1 coal, gas, wind, nuclear

2 gas, coal, nuclear, wind

3 nuclear, wind, gas, coal

4 wind, gas, coal, nuclear

Question 14 · continued

9C Which type of power station is the best for meeting short surges in demand for electricity?

1 coal

2 gas

3 nuclear

4 wind

9D Electricity produced from the wind costs more than electricity produced from fossil fuel power stations.

This is mainly because . . .

1 each wind turbine has a low output, so hundreds of them are needed to produce as much electricity as a fossil fuel power station.

2 wind turbines are usually erected on high ground and are unsightly, noisy and dependent on the weather conditions.

3 wind turbines have high decommissioning costs compared with fossil fuel power stations such as those using coal or oil.

4 wind turbines have high operating costs resulting from the high cost of maintaining a large number of them.

END OF TEST

4.2.4.2 Energy transfers in everyday appliances

Question 15

June 2007 | PHY1A | Original Q4 | Legacy

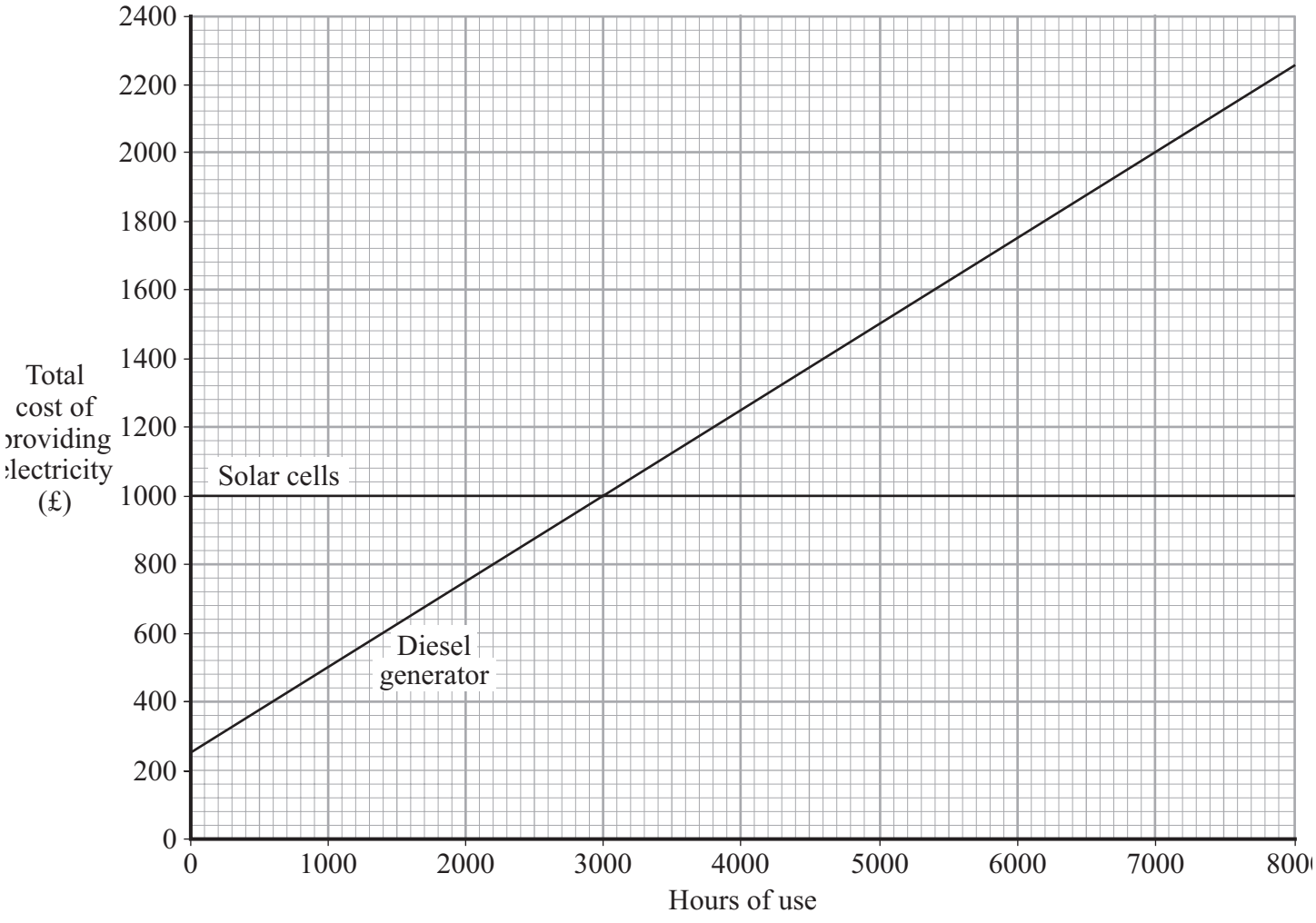
QUESTION FOUR

A remote village in South America is many kilometres from a mains electricity supply.

The villagers plan to pump water from the river and to use some of the water to irrigate fields.

They need an electricity supply to operate the pump.

The graph shows the total cost of two different ways of providing this electricity over time.



4A The graph shows that . . .

1 there are fuel costs but no maintenance costs for the solar cells.

2 there are maintenance costs but no fuel costs for the solar cells.

3 there are no fuel costs and no maintenance costs for the solar cells.

4 there are no fuel costs and no maintenance costs for the diesel generator.

4.2.4.2 Energy transfers in everyday appliances

Question 15 · continued

4B The price to buy the solar cells, compared with buying the diesel generator, is . . .

1 twice as much.

2 three times as much.

3 four times as much.

4 five times as much.

4C Providing electricity by diesel generator becomes more expensive than by solar cells after . . .

1 1000 hours of use.

2 2000 hours of use.

3 3000 hours of use.

4 4000 hours of use.

4D Maintenance of solar cells costs less than maintenance of the diesel generator mainly because . . .

1 solar cells have no moving parts.

2 solar cells do not produce exhaust gases.

3 solar cells operate at lower temperatures than diesel generators.

4 solar cells work only during the day.

4.2.4.2 Energy transfers in everyday appliances

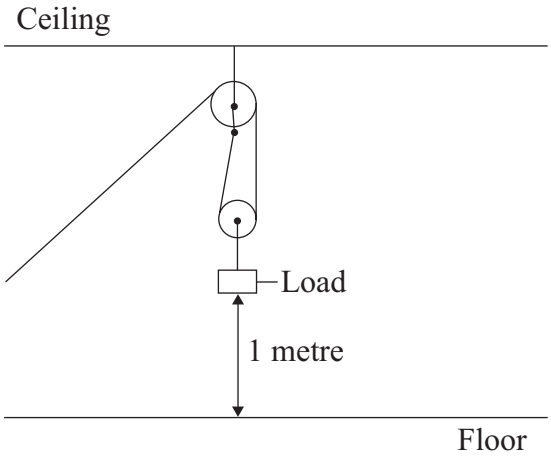
Question 16

June 2007 | PHY1A | Original Q6 | Legacy

QUESTION SIX

A student investigated a pulley system used to lift different loads. The student calculated the useful energy transferred by the pulley system for each load as it was lifted one metre. She then calculated the efficiency of the pulley system using the following equation.

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



The table shows the student's results.

Useful energy transferred by the pulley system (in J)	Total energy supplied to the pulley system (in J)	Calculated efficiency
1.00	3.33	0.30
2.00	4.16	0.48
3.00	5.00	
4.00	5.05	0.79
5.00	6.25	0.80

Question 16 · continued

6A What was the efficiency when the useful energy transferred by the pulley system was 3 J?

1 0.15

2 0.167

3 0.60

4 1.67

6B Which value of total energy supplied to the pulley system is probably anomalous?

1 3.33 J

2 4.16 J

3 5.05 J

4 6.25 J

6C Using both your knowledge and the data in the table, suggest what would happen to the efficiency of the pulley system if the energy supplied continued to increase.

The efficiency would eventually . . .

1 exceed 1.00.

2 reach a maximum.

3 begin to decrease.

4 increase, then begin to decrease.

6D The difference between the useful energy transferred by the pulley system and the total energy supplied to the pulley system is called the . . .

1 effective energy.

2 transferred energy.

3 transformed energy.

4 wasted energy.

4.2.4.2 Energy transfers in everyday appliances

Question 17

June 2007 | PHY1A | Original Q9 | Legacy

QUESTION NINE

The table shows the various costs, per kilowatt-hour, of electricity that is generated in four different ways.

Energy source	Capital cost	Running cost	Decommissioning cost
Nuclear	3.0 p	0.5 p	2.5 p
Gas	1.5 p	2.0 p	0.1 p
Coal	2.0 p	2.5 p	0.1 p
Wind	4.5 p	0.1 p	0.2 p

9A Considering only running cost, how much more does it cost to generate 1000 kilowatt-hours of electricity in a coal-fired power station than in a gas-fired power station?

1 £ 5

2 £ 15

3 £ 20

4 £ 25

9B It costs more to produce electricity from wind farms than from fuel-burning power stations.

This is mainly because wind generators . . .

1 have higher decommissioning costs.

2 have only very recently been developed.

3 have higher running costs.

4 use a dilute energy source.

4.2.4.2 Energy transfers in everyday appliances

Question 17 · continued

9C In the UK, most new power stations are gas-fired.

This is because, compared with all the other ways of generating electricity shown in the table, . . .

1 they cause less atmospheric pollution.

2 they are cheaper to build and cheaper overall.

3 they have lower running costs.

4 they use a renewable energy source.

9D Which one of the four ways of generating electricity is most suited to meeting short surges in the demand for electricity at any time of the day?

1 coal

2 gas

3 nuclear

4 wind

END OF TEST

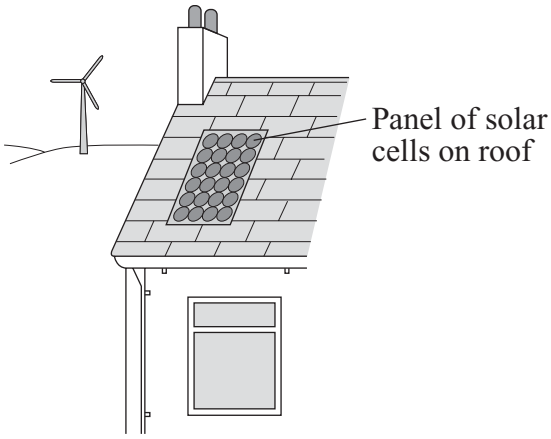
4.2.4.2 Energy transfers in everyday appliances

Question 18

November 2007 | PHY1A | Original Q5 | Legacy

QUESTION FIVE

A house on a Scottish island uses solar cells to produce some of the electricity needed for lights and for pumping water.



The panel of solar cells cost £300 and has a maximum output of 33 W.

On average, over 24 hours, it produces $\frac{1}{8}$ of its maximum output.

5A How many kilowatt-hours of electricity does the panel of solar cells produce, on average, each 24 hours?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 0.004125

2 0.099

3 0.792

4 356.4

5B The panel of solar cells has an expected life of 10 000 days.

What is the cost of the panel for each day of its life?

1 0.03 p

2 0.3 p

3 3.0 p

4 30 p

4.2.4.2 Energy transfers in everyday appliances

Question 18 · continued

5C Most of the electricity for the house is produced by a wind generator.

The solar cells are also used . . .

1 because they produce electricity at such a low cost per kilowatt-hour.

2 because they may produce electricity at times when there is no wind.

3 because they will produce electricity all the time.

4 because they produce electricity at times when it is most likely to be needed.

5D Which of the following sentences about solar cells is true?

1 Electricity from solar cells is used to heat water in panels on house roofs.

2 Solar cells use a **non**-renewable energy source.

3 Solar cells will **not** work on cloudy days.

4 Solar cells transform light energy to electrical energy.

4.2.4.2 Energy transfers in everyday appliances

Question 19

November 2007 | PHY1A | Original Q8 | Legacy

QUESTION EIGHT

Transformers are used in the National Grid.

8A Two types of transformer are used in various parts of the National Grid.

Which row in the table shows the correct locations of the two types of transformer?

	Between generators and power lines	Between power lines and substation	Between substation and people's homes
1	step-down	step-down	step-up
2	step-down	step-up	step-up
3	step-up	step-down	step-down
4	step-up	step-up	step-down

8B Transformers alter the potential difference across the power lines and the current through the power lines. These changes affect the efficiency of the power lines.

Which row in the table is correct?

	Potential difference across power lines	Current through power lines	Efficiency of transmission
1	decreased	decreased	decreased
2	decreased	increased	increased
3	increased	decreased	increased
4	increased	increased	increased

4.2.4.2 Energy transfers in everyday appliances

Question 19 · continued

8C The table shows the percentage of energy wasted as heat and sound by four different transformers.

Which transformer has the highest efficiency?

Transformer	Percentage of energy supplied to transformer which is wasted as sound	Percentage of energy supplied to transformer which is wasted as heat
1	1.1	7.4
2	1.2	4.7
3	1.3	5.4
4	1.4	6.9

8D The amount of electricity that a device transforms depends on the rate at which the device transforms energy and . . .

1 how long the device is switched on.

2 the current through the device.

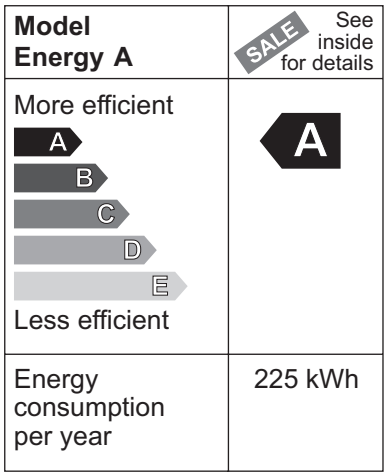
3 the potential difference across the device.

4 the power of the device.

4.2.4.2 Energy transfers in everyday appliances

Question 20

2 The diagram shows the label from a new freezer.



(a) An old freezer has an energy consumption per year of 350 kWh.

Use the equation in the box to calculate the extra cost of using the old freezer for one year compared with using a new 'A' rated freezer.

total cost = number of kilowatt-hours × cost per kilowatt-hour

Assume 1 kilowatt-hour (kWh) of energy costs 12 p.

Show clearly how you work out your answer.

.....

.....

Extra cost per year = £ .....

(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 20 · continued

BLANK

(b) The price of the new freezer was reduced in a sale.

Reducing the price reduces the payback time for replacing the old freezer from 12 years to 9 years.

Calculate, in pounds, how much the new freezer was reduced in the sale.

Show clearly how you work out your answer.

.....

.....

Price reduced by = £ .....

(2 marks)

(c) An advertisement in a shop claims that:

'Replacing an old freezer with a new 'A' rated freezer will benefit the environment.'

Do you agree that replacing the freezer will benefit the environment?

Answer yes or no. .....

Explain the reasons for your answer.

.....

.....

.....

.....

(2 marks)

6

4.2.4.2 Energy transfers in everyday appliances

Question 21

January 2008 | PHY1H | Original Q3 | Legacy

3 (a) In winter, energy is transferred from the warm air inside a house to the air outside.

(i) What effect will the energy transferred from the house have on the air outside?

.....

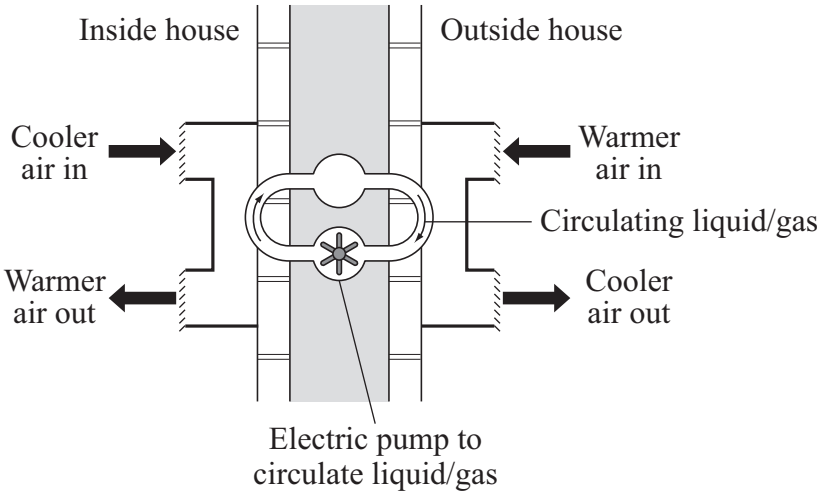
(1 mark)

(ii) What would happen to the energy transfer if the temperature inside the house were reduced? Assume the temperature outside the house does not change.

.....

(1 mark)

(b) To increase energy efficiency, a householder installs a heat exchanger to an outside wall of the house. The heat exchanger uses heat from the air outside to warm the inside of the house. The diagram shows the idea of the heat exchanger.



(i) Why does the heat exchanger cost money to run?

.....

(1 mark)

(ii) The heat exchanger is cost effective in reducing energy consumption. Explain why.

.....

.....

.....

.....

(2 marks)

5

4.2.4.2 Energy transfers in everyday appliances

Question 22

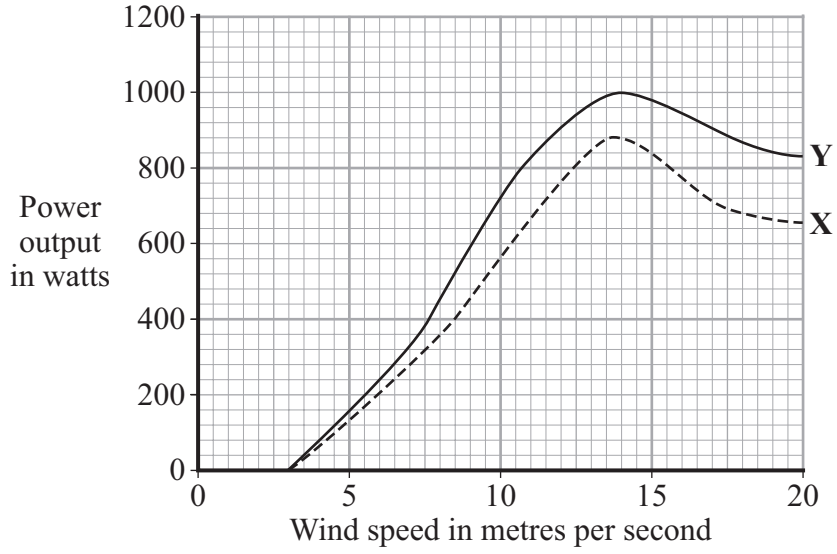
March 2008 | PHY1AP | Original Q4 | Legacy

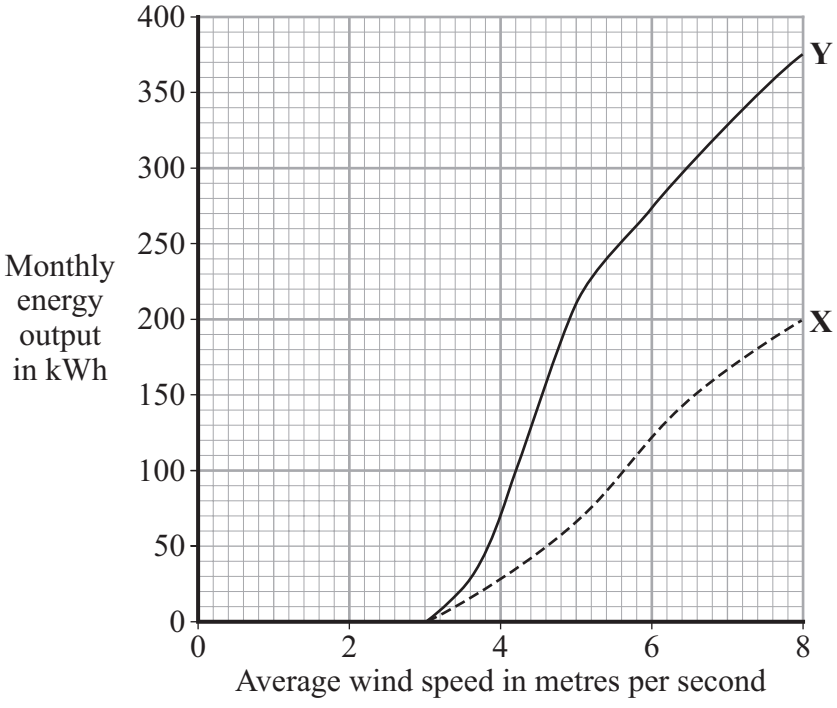
QUESTION FOUR

Many people are now installing wind turbines at their homes to produce electricity.

A customer has to decide which turbine to install.

The graphs show the performance of two models of wind turbine, **X** and **Y**.





4A How much greater is the maximum power produced by turbine **Y** than that produced by turbine **X**?

1 80 W

2 120 W

3 880 W

4 1000 W

4.2.4.2 Energy transfers in everyday appliances

Question 22 · continued March 2008 | PHY1AP | Original Q4 | Legacy

4B Which one of the following statements about the relationship between average wind speed and monthly energy output by turbine **X** is true?

1 An increase in average wind speed always causes an increase in monthly energy output.

2 As average wind speed doubles, monthly energy output doubles.

3 Above a certain average wind speed, monthly energy output falls.

4 At average wind speeds below 2 m/s, a 10 % increase in wind speed has no effect on monthly energy output.

4C Turbine **X** can be bought and installed for £750; turbine **Y** can be bought and installed for £1500.

A person lives in an area where the maximum wind speed is 10 m/s and the average annual wind speed is 3.5 m/s. A salesman advises the person to buy turbine **Y** because it produces more power.

Is the advice given by the salesman the best advice?

1 Yes, because turbine **Y** always produces more power than turbine **X**.

2 Yes, because as wind speed increases above 3 m/s, power output increases more rapidly from turbine **Y** than from turbine **X**.

3 No, because there is very little difference between the monthly energy output of the two turbines where the person lives.

4 No, because turbine **Y** will never pay for itself.

4D A neighbour objects to planning permission being given for the turbine.

The most likely reason for this objection is that the neighbour thinks that . . .

1 the turbine may cause a decrease in property prices in the area.

2 the turbine is a health risk.

3 the turbine will cause air pollution.

4 having a turbine is a status symbol.

4.2.4.2 Energy transfers in everyday appliances

Question 23

March 2008 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

An African village is in a remote location.

The Sun shines for at least a few hours nearly every day.

The villagers want a supply of electricity to pump up water from a well for a few hours each day.

The table shows the costs of two different ways of providing the electricity.

The capital cost is the cost of buying the equipment.

	Capital cost	Capital cost* (per kWh)	Fuel cost* (per kWh)	Maintenance cost* (per kWh)
Solar cells	£1000	20 p	zero	zero
Petrol generator	£250	5 p	20 p	10 p

[*These costs are averaged out over the 20 years that the equipment is expected to last.]

6A Which one of the following statements is true?

1 A petrol generator has a higher initial capital cost.

2 A petrol generator has a higher capital cost per kWh.

3 A petrol generator has a higher overall cost per kWh.

4 A petrol generator needs less maintenance.

6B An advantage of the petrol generator is that . . .

1 it will cause less air pollution.

2 it is cheaper to set up the system in the first place.

3 it has no moving parts.

4 it will cost less over a 20-year period.

4.2.4.2 Energy transfers in everyday appliances

Question 23 · continued

6C The main reason for choosing the solar cells for pumping water in the African village is that . . .

1 the low voltage from the solar cells is safer than high voltage power supplies.

2 solar cells are cheap to make.

3 solar cells provide a constant source of electricity.

4 the village is a long distance from mains electricity sources.

6D The main disadvantage of using the solar cells for pumping water in the African village is that . . .

1 they require no maintenance.

2 they will not work during the night.

3 they can work out cheaper over a 20-year period.

4 they have a high initial capital cost.

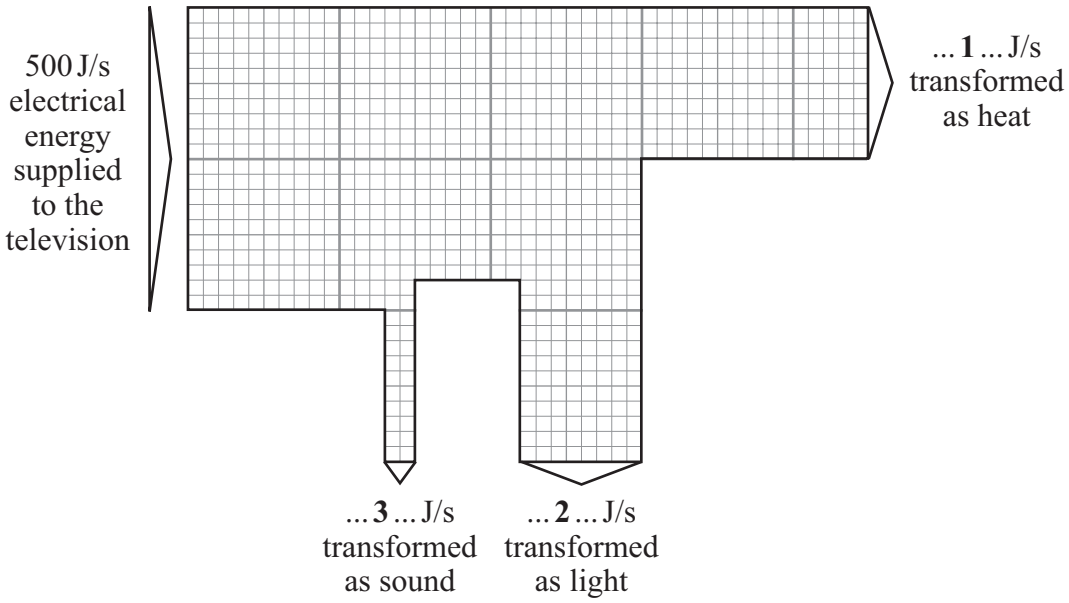
4.2.4.2 Energy transfers in everyday appliances

Question 24

June 2008 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The Sankey diagram shows the energy flow for a television.



The efficiency of the television is ... **4** ...

4.2.4.2 Energy transfers in everyday appliances

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

Match figures, **A**, **B**, **C** and **D**, with the numbers **1–4** on the diagram.

A 0.50

B 50

C 200

D 250

Turn over for the next question

4.2.4.2 Energy transfers in everyday appliances

Question 25

June 2008 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The table shows data about some energy sources used to generate electricity in the UK in 2004.

The figures in the table take into account the construction of the power station.

Energy source	Percentage of UK electricity generation	Carbon dioxide produced per kWh in grams	Construction cost in £ million	Generating cost in pence per kWh	Typical generating capacity in MW
Coal	33	1000	560	2.6	1600
Gas	40	500	300	2.2	650
Nuclear	19	5	1500	3.5	900
falling water (Hydroelectric)	1	10–30	140	3.5	55
Wind	0.4	4.6	1.3	3.3	3

4A An electricity company sells its electricity at 10 pence per kilowatt-hour (kWh).

Which energy source would the company prefer to use to make the biggest profit on its generating cost?

1 coal

2 gas

3 nuclear

4 hydroelectric

4B Which energy source has the greatest effect on global warming for every kilowatt-hour (kWh) of electricity produced?

1 coal

2 gas

3 nuclear

4 wind

4.2.4.2 Energy transfers in everyday appliances

Question 25 · continued

4C UK reserves of coal and gas are running out. Coal and gas can be provided from other countries.

Why might this be a good idea?

1 Transport costs for the fuel would be higher.

2 The UK would extend the life of its fossil fuel power stations.

3 The price of coal and gas would be out of the control of the UK.

4 The UK has the ability to develop hydroelectric and wind power stations.

4D The UK government wants to generate 10% of the country's electricity from renewable energy sources by 2010.

Which type of energy source that is renewable would you recommend in terms of generating cost?

1 gas

2 hydroelectric (falling water)

3 nuclear

4 wind

4.2.4.2 Energy transfers in everyday appliances

Question 26

June 2008 | PHY1AP | Original Q6 | Legacy

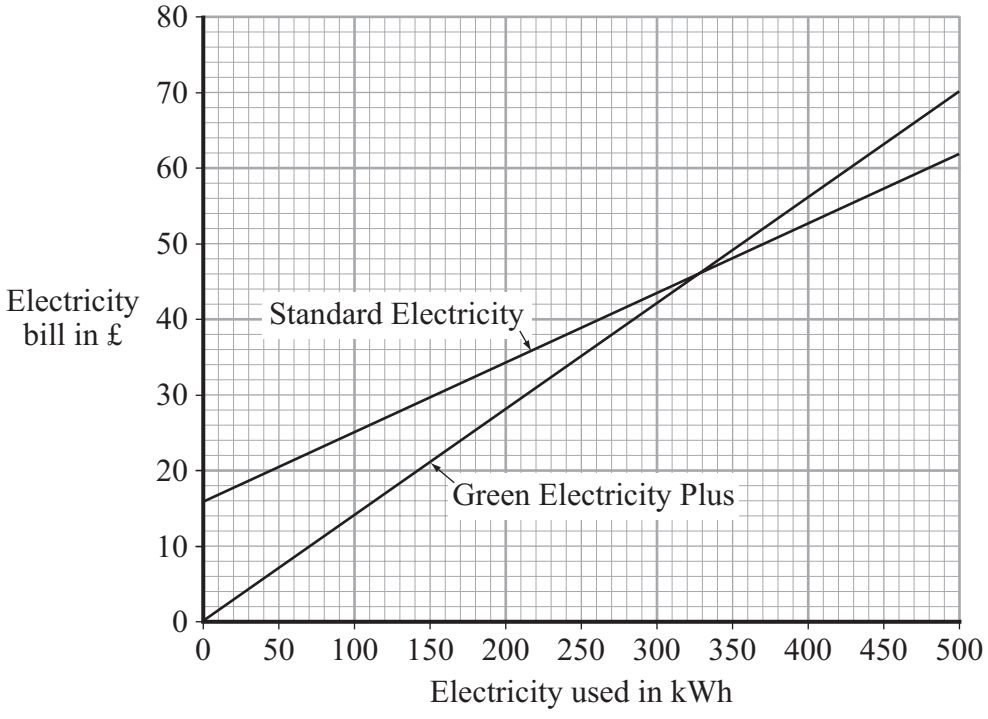
QUESTION SIX

An electricity company has two ways of charging for electricity – Standard Electricity and Green Electricity Plus.

The fixed charge is an additional charge added every three months to the bill sent to customers buying Standard Electricity.

Way of charging	Cost per kilowatt-hour	Fixed charge for three months
Standard Electricity	9 p	£16.25
Green Electricity Plus	14 p	£0

The graph shows how the electricity bill changes with the number of kilowatt-hours of electricity used in three months for the two ways of charging.



6A The graph shows that . . .

1 the Green Electricity Plus way is cheaper if the customer uses 400 kilowatt-hours.

2 the Standard Electricity way is cheaper if the customer uses 325 kilowatt-hours.

3 the Standard Electricity way is cheaper if the customer uses 200 kilowatt-hours.

4 the Green Electricity Plus way is cheaper if the customer uses 150 kilowatt-hours.

Question 26 · continued

6B The electricity company claims that electricity sold under the Green Electricity Plus payment plan is electricity that has been generated from non-polluting sources.

The electricity will be generated from . . .

1 renewable sources.

2 coal.

3 nuclear fuels.

4 oil.

6C The diagram shows part of a Green Electricity Plus bill.

Green Electricity Plus

First meter reading	Second meter reading	No. of kWh used
35785		

Cost per kWh – 14p TOTAL COST £19.04

total cost = number of kilowatt-hours × cost per kilowatt-hour

What is the second meter reading?

1 35649

2 35772

3 35798

4 35921

6D The Green Electricity Plus way is advertised as having *no fixed charge*. This may make a customer think that their electricity bills will be less.

To decide whether the bill will actually be smaller, the customer should . . .

1 trust the advertisement.

2 check on an independent website.

3 switch to the Green Plus way.

4 ask a company salesman.

4.2.4.2 Energy transfers in everyday appliances

Question 27

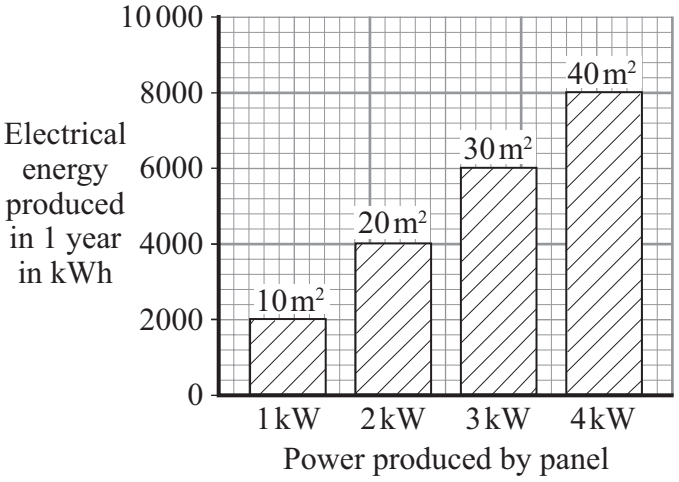
June 2008 | PHY1AP | Original Q8 | Legacy

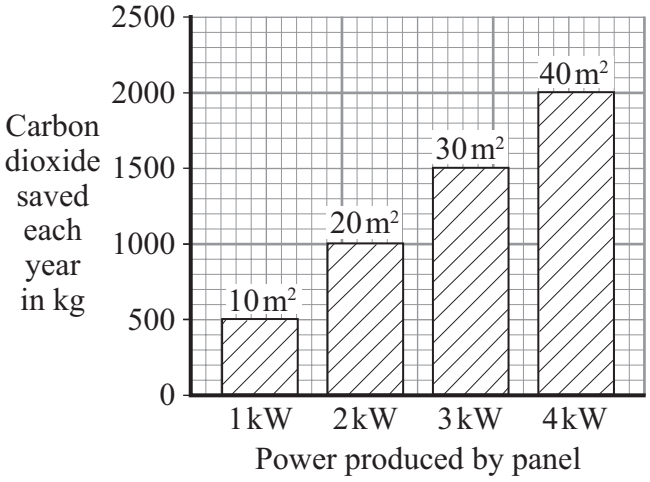
QUESTION EIGHT

The graphs in this question give information about solar cell panels used for producing electricity.

The graphs show:

- the area of the panels in m^2
- the power produced by the panels in kW
- the electrical energy produced each year by using the panels in kWh
- the mass of carbon dioxide saved each year by using the panels in kg.





8A Solar cells do not produce polluting gases.

How much carbon dioxide could be saved each year by using a 15 m^2 panel?

1 500 kg

2 750 kg

3 1 000 kg

4 1 750 kg

8B What area of panel would be needed to power a 2500 W heater?

1 20 m^2

2 25 m^2

3 30 m^2

4 35 m^2

Question 27 · continued

8C Electricity supplied from the National Grid costs 8 p per kilowatt-hour.

A householder is considering installing solar cell panels. The household uses 4000 kWh of electricity each year. The cost of installing a solar cell panel is £6400 per kW.

What is the payback time?

1 4 years

2 8 years

3 40 years

4 400 years

8D Senegal is a poor, developing country. It has no large power stations. Small, local schemes for generating power are used.

Solar cell panels are used to generate electricity for pumping water from wells in remote locations.

The main reason for using solar cell panels in such locations is that . . .

1 low voltage from the solar cells is safer than high voltage power supplies.

2 solar cells are cheap to make.

3 solar cells provide a constant supply of electricity.

4 the location is a long distance from other electricity supplies.

4.2.4.2 Energy transfers in everyday appliances

Question 28

June 2008 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

Electricity can be generated in various ways. Power stations use fossil fuels (coal, oil and gas) or nuclear fuels. No new nuclear power stations have been built in the UK for some years.

9A Which one of the following is a valid argument for using nuclear power stations?

1 For maximum efficiency, they have to be sited on the coast.

2 They have high decommissioning costs.

3 They use a renewable energy source.

4 They do **not** produce gases that pollute the atmosphere.

9B Some people argue that we should make more use of wind power instead of nuclear or fossil fuel power stations.

Which statement supports this view?

1 Fossil fuels and nuclear power stations are needed when the wind drops.

2 Large wind farms can be unsightly and noisy.

3 Wind farms have zero fuel costs.

4 Wind farms use large areas of land.

9C

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

Using 1 tonne of uranium in a nuclear power station produces 160 000 000 kWh of energy.

How long could 1 tonne of uranium keep a 2000 MW nuclear power station running?

(1 MW = 1000 kW)

1 0.0125 hours

2 12.5 hours

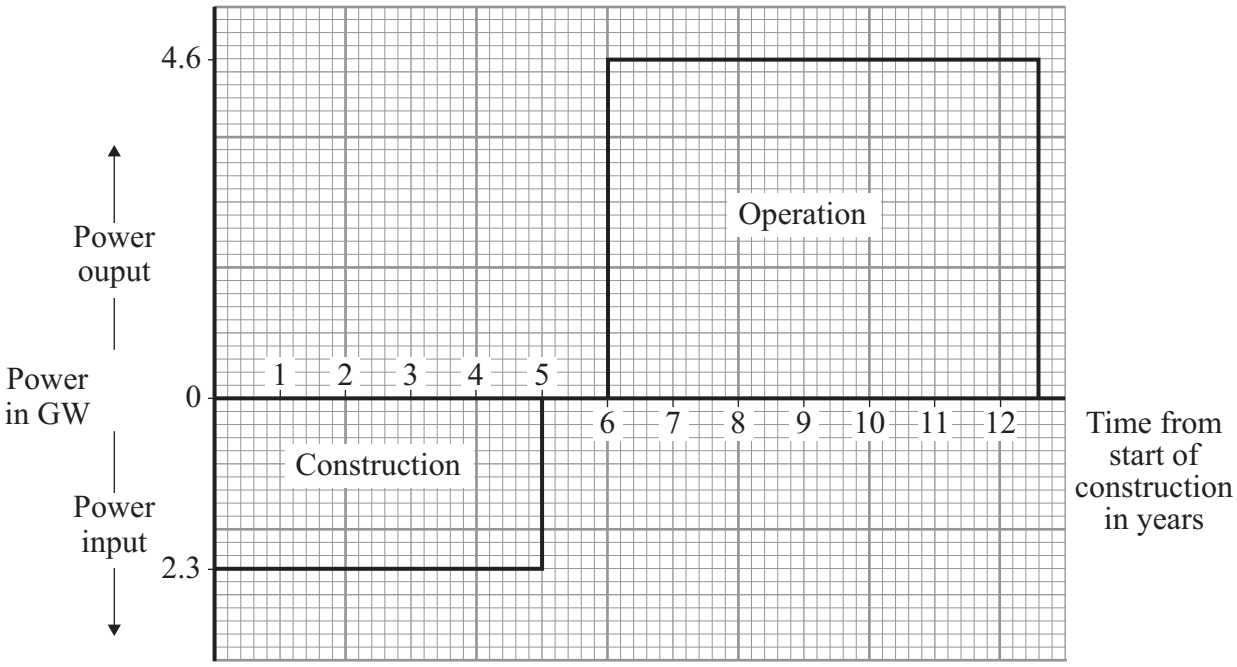
3 80 hours

4 80 000 hours

Question 28 · continued

9D Nuclear power stations take a long time to build. Power is used in their construction and initial fuel processing. This and the power produced by the station are shown in the graph.

The area under the graph represents the energy used or produced in GWh.



How many years from the start of construction will it be before the power station produces more energy than was used to build it?

1 2.5 years

2 7.5 years

3 8.0 years

4 8.5 years

END OF TEST

4.2.4.2 Energy transfers in everyday appliances

Question 29

June 2008 | PHY1H | Original Q4 | Legacy

4 (a) Solar energy is a *renewable* energy source that can be used to generate electricity.

4 (a) (i) What is meant by an energy source being *renewable*?

.....

(1 mark)

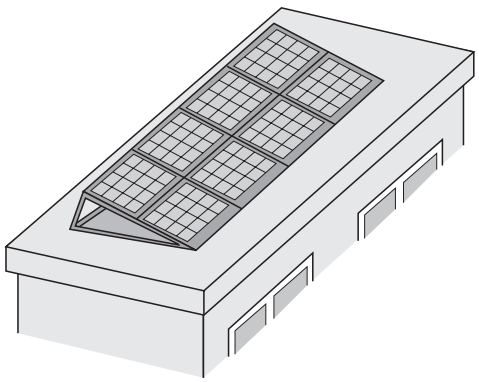
4 (a) (ii) Name **two** further renewable energy sources used to generate electricity.

1 .....

2 .....

(1 mark)

4 (b) A householder uses a bank of solar cells to generate electricity for his home.
The solar cells are tilted to receive the maximum energy input from the Sun.



4.2.4.2 Energy transfers in everyday appliances

Question 29 · continued

for mark

The data in the table gives the average energy input each second (in J/s), to a 1 m^2 area of solar cells for different angles of tilt and different months of the year.

Month	Angle of tilt			
	20°	30°	40°	50°
February	460	500	480	440
April	600	620	610	600
June	710	720	680	640
August	640	660	640	580
October	480	520	500	460
December	400	440	420	410

4 (b) (i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

.....

.....

.....

.....

(2 marks)

4 (b) (ii) The bank of solar cells used by the householder has an area of 8 m^2.

The efficiency of the solar cells is 0.15

Use the equation in the box to calculate the average **maximum** electrical energy available from the bank of solar cells each second in June.

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

Show clearly how you work out your answer.

.....

.....

Maximum energy = ... joules/second

(3 marks)

Question 4 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 29 · continued

for mark

4 (c) The graph shows how the householder's electrical energy needs change over one year.



Why would it be advisable for the householder to remain connected to the National Grid?

.....

.....

(1 mark)

8

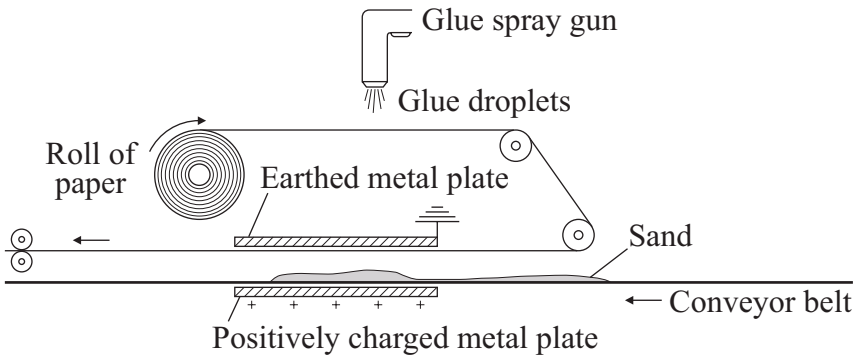
4.2.4.2 Energy transfers in everyday appliances

Question 30

June 2008 | PHY2H | Original Q6 | Legacy

6 Static electricity can be both useful and a nuisance.

6 (a) The diagram shows a method of producing sandpaper using static electricity.



Glue is sprayed onto a moving strip of paper. As the glue leaves the spray gun, the glue breaks up into tiny negatively charged droplets which coat the paper. The sticky paper passes between two metal plates. Sand moving on a conveyor belt also passes between the metal plates.

6 (a) (i) Explain the advantage of having all the droplets of glue negatively charged.

.....

.....

.....

.....

(2 marks)

6 (a) (ii) Explain why the sand moves towards the sticky paper.

.....

.....

.....

.....

(2 marks)

Question 6 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 30 · continued

for mark

6 (b) People often experience an electric shock when getting out of a car.
This happens because charge is generated as they move around on the car seats.

On a warm dry day, the potential difference between a driver and the car increases to 10 000 volts. As the driver goes to touch the car door, a spark jumps the air gap, transferring 20 joules of energy between the driver and the car.

Use the equation in the box to calculate the initial charge on the driver.

energy transformed = potential difference × charge

Show clearly how you work out your answer and give the unit.

.....

.....

Charge = ...

(3 marks)

7

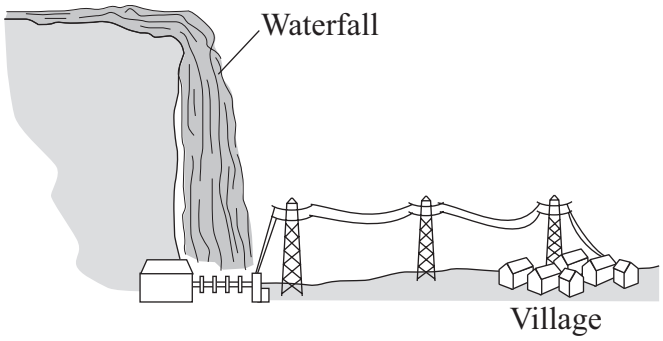
4.2.4.2 Energy transfers in everyday appliances

Question 31

November 2008 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

The diagram shows a hydroelectric scheme.



A small mountain village lies near a waterfall.

The energy of the falling water is used to generate electricity for the village.

The table gives some information about the village and the electrical supply.

Efficiency of generating system	0.12
Energy of water entering turbines per second	10 000 kJ
Population of the village	1200
Average number of people per household	4
Average electrical demand per household	3.0 kW

6A The reason why the energy transformation is so inefficient is that . . .

1 the waterfall is not high enough.

2 water is a poor conductor of electricity.

3 heat is produced in the turbines.

4 maintenance costs are high.

4.2.4.2 Energy transfers in everyday appliances

Question 31 · continued

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

6B The electrical energy available to the village is . . .

1 833 kJ

2 1 200 kJ

3 83 300 kJ

4 120 000 kJ

6C The average power demand for the whole village is . . .

1 900 kW

2 3 600 kW

3 4 800 kW

4 14 400 kW

6D The total energy used by the village each day is, on average, 21 600 kWh. The daily maintenance cost of running the hydroelectric scheme is £1200.

What is the price, in pence per kWh, which must be charged to cover the daily maintenance costs?

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

1 2.8 p

2 5.6 p

3 11.2 p

4 22.4 p

4.2.4.2 Energy transfers in everyday appliances

Question 32

November 2008 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

This question is about using electricity in the home.

9A When electricity is transmitted from a power station, it is stepped up from 25 kV to 300 kV.

This is done by a . . .

1 generator to decrease the current and make it safer.

2 generator to increase the current and make the electricity travel faster.

3 transformer to increase the current and reduce energy losses.

4 transformer to reduce the current and reduce energy losses.

The table shows the power ratings of four electrical appliances.

Fan heater	2 kW
Oven	3 kW
Kettle	2 kW
Microwave oven	0.75 kW

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

$$\text{energy transferred (kilowatt-hour, kWh)} = \text{power (kilowatt, kW)} \times \text{time (hour, h)}$$

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

The cost of electrical energy is 10 p per kilowatt-hour.

Question 32 · continued

9B The kettle is used for a total of 30 minutes a day. It has an efficiency of 0.9

What is the cost of the energy wasted by the kettle each day?

1 0.6 p

2 1.0 p

3 6.0 p

4 9.0 p

9C The fan heater has a heating element and a motor to turn the blades of the fan. The power rating of the heater is 1800 W. To cool a room in the summer, only the fan is used.

How much would it cost to use the fan to cool a room for 5 hours?

1 0.1 p

2 1.0 p

3 10.0 p

4 100.0 p

9D A bowl of cauliflower cheese is cooked in a microwave oven for 6 minutes on half power.

How much does it cost to cook the cauliflower cheese?

1 0.375 p

2 0.750 p

3 1.500 p

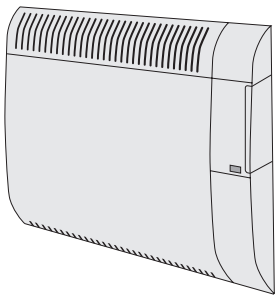
4 2.250 p

END OF TEST

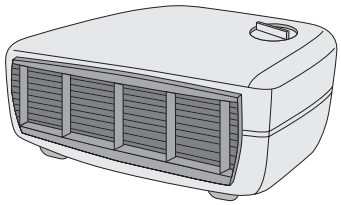
4.2.4.2 Energy transfers in everyday appliances

Question 33

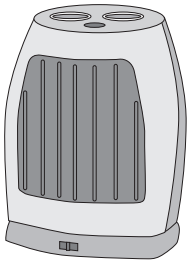
2 The pictures show three different types of electric heater.



400 W oil-filled panel heater (wall mounted)
- 3 heat settings
- Efficient background heat
- Safety overheat cut-out



3 kW fan heater
- 2 heat settings
- Power indicator light
- Cool air fan setting



1800 W ceramic heater
- 2 heat settings
- 8 hour timer
- Power indicator light
- Safety overheat cut-out

2 (a) The ceramic heater is run on full power for 5 hours.

Use the following equation to calculate, in kilowatt-hours, the amount of energy transferred from the mains to the heater.

energy transferred = power × time

Show clearly how you work out your answer.

.....

.....

Energy transferred = ... kilowatt-hours

(2 marks)

2 (b) Which heater will be the most expensive to run on its highest heat setting?

.....

(1 mark)

4.2.4.2 Energy transfers in everyday appliances

Question 33 · continued

for mark

2 (c) A heater is needed for a small office.

Comparing each type of heater with the other two, give **one** advantage of using each type of heater in the office.

oil-filled panel heater .....

.....

fan heater .....

.....

ceramic heater .....

.....

(3 marks)

6

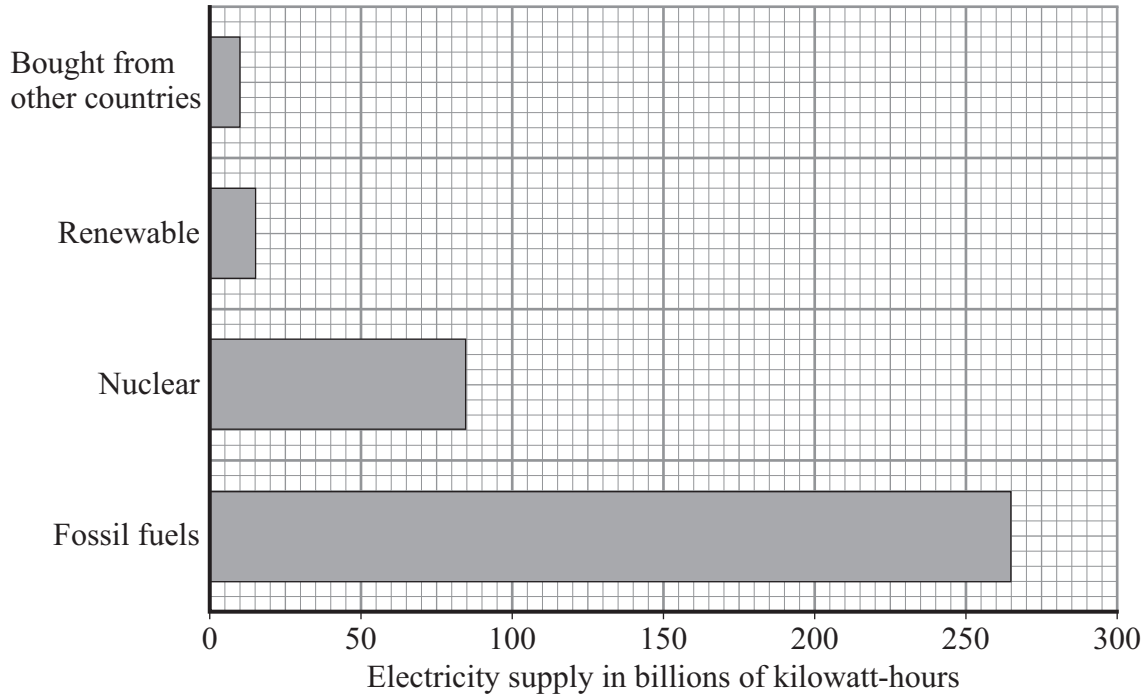
Turn over for the next question

4.2.4.2 Energy transfers in everyday appliances

Question 34

January 2009 | PHY1H | Original Q3 | Legacy

3 The bar chart shows how the UK's electricity demands in 2007 were met.



3 (a) What proportion of electricity was generated using renewable energy sources?

Show clearly how you work out your answer.

.....

.....

.....

.....

(2 marks)

Question 34 · continued

for mark

3 (b) By 2020, most of the UK's nuclear reactors and one-third of coal-fired power stations are due to close, yet the demand for electricity is expected to increase.

Four students, **A**, **B**, **C** and **D**, were asked how a demand of 380 billion kilowatt-hours could be met. They made the suggestions given in the table.

Student	Fossil fuels	Nuclear	Renewable	Bought from other countries
A	200	100	40	40
B	80	240	40	20
C	160	80	100	40
D	280	0	100	0

3 (b) (i) Which student has made the suggestion most likely to result in the lowest carbon dioxide emissions?

.....

Give a reason for your answer.

.....

.....

(2 marks)

3 (b) (ii) Suggest **one** realistic way in which a householder could help to reduce the annual electricity demand.

.....

.....

(1 mark)

Question 3 continues on the next page

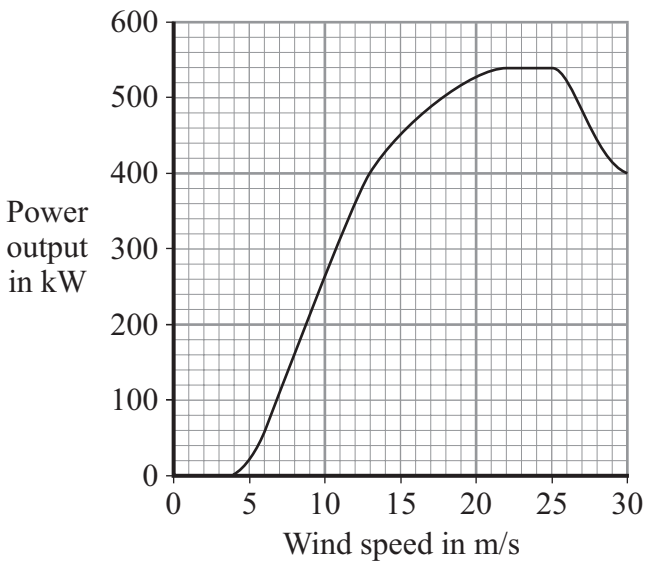
4.2.4.2 Energy transfers in everyday appliances

Question 34 · continued

for mark

3 (c) To increase the amount of electricity generated using renewable energy resources would probably involve erecting many new wind turbines.

The graph shows the power curve of a wind turbine.



3 (c) (i) Describe, in detail, how the power output of the turbine varies with the wind speed.

.....

.....

.....

.....

.....

.....

(3 marks)

3 (c) (ii) Give **one** disadvantage of using wind turbines to generate a high proportion of the electricity required in the UK.

.....

.....

(1 mark)

9

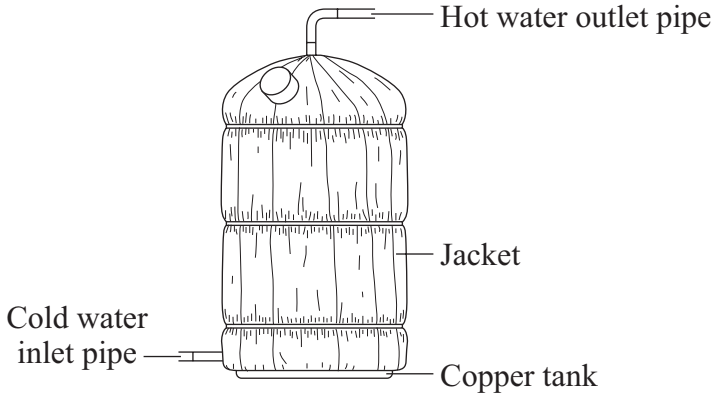
4.2.4.2 Energy transfers in everyday appliances

Question 35

March 2009 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The diagram shows a hot water cylinder. The cylinder contains an electric heater.



4A A jacket is wrapped round the cylinder to keep the water warm. The jacket contains trapped air.

Trapped air reduces heat loss by . . .

1 conduction only.

2 conduction and radiation.

3 conduction and convection.

4 conduction, convection and radiation.

4B If a jacket is not fitted, it would be best to have a shiny surface for the cylinder rather than a dark matt one.

This is because dark matt surfaces are . . .

1 good conductors.

2 poor conductors.

3 good radiators.

4 poor radiators.

4C The heater has a power of 3000 W. The heater is switched on for 6 hours.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

How many kilowatt-hours of energy does the heater use?

1 0.5

2 18

3 500

4 18 000

4D A household receives an electricity bill every 3 months. The total amount of electrical energy used during one 3-month period was 2000 kWh. Electricity costs 10 p per kWh.

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

How much was the bill?

1 £200

2 £600

3 £20 000

4 £60 000

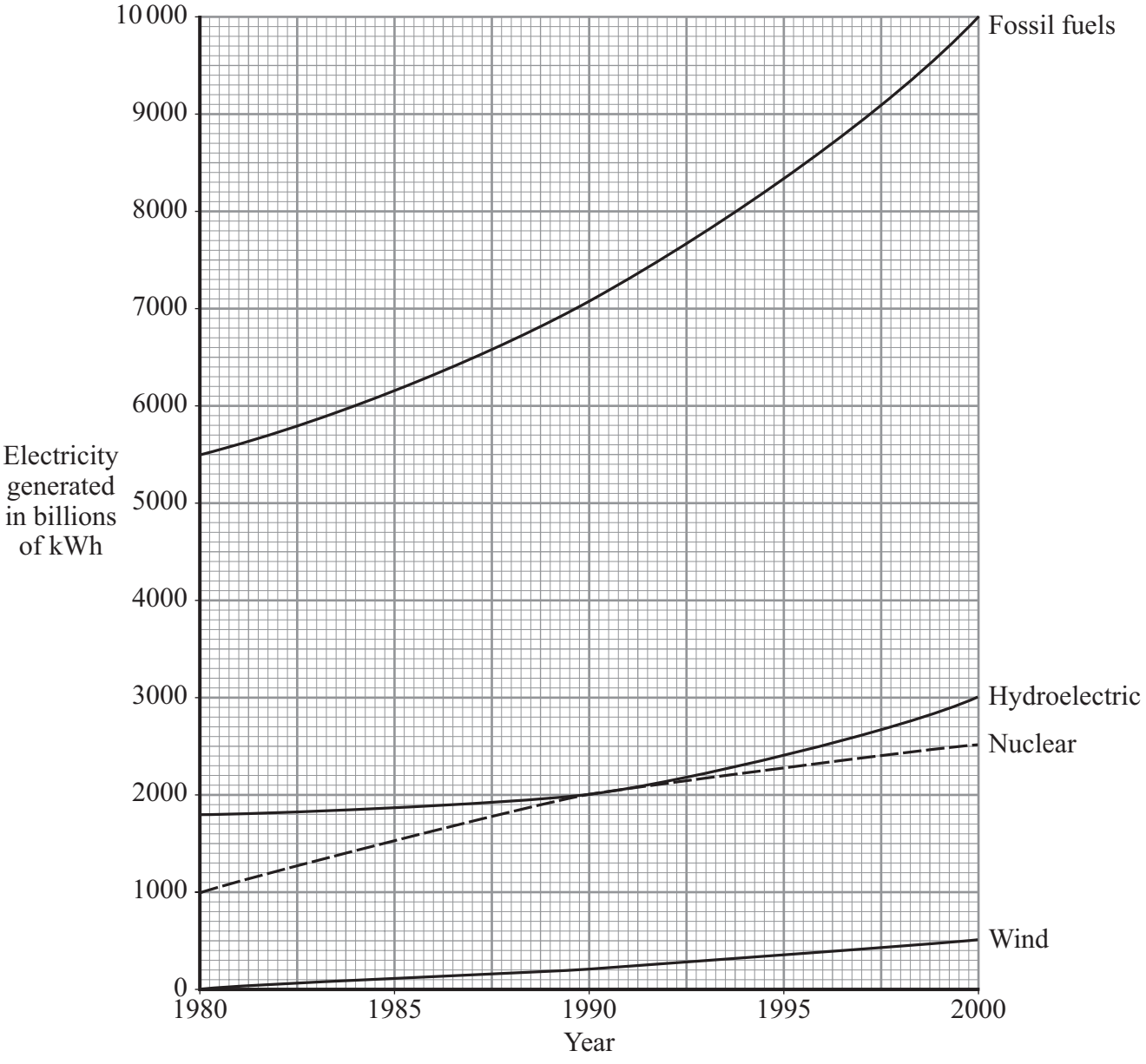
4.2.4.2 Energy transfers in everyday appliances

Question 36

March 2009 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The graph shows how much electricity has been generated worldwide from four different energy sources, from 1980 to 2000.



7A Which source has shown the smallest increase in electricity generation between 1990 and 2000?

1 fossil fuels

2 falling water (hydroelectric)

3 nuclear

4 wind

4.2.4.2 Energy transfers in everyday appliances

Question 36 · continued

7B In 2000, about what percentage of the total electricity was generated by hydroelectricity, nuclear and wind?

1 38 %

2 42 %

3 55 %

4 60 %

7C By 2030, the amount of electricity generated from hydroelectricity, nuclear and wind is likely to be 5 times greater than in 1990.

In 2030, the amount of electricity generated from these three sources, in billions of kWh, will be . . .

1 10 500.

2 11 000.

3 20 500.

4 21 000.

7D Some energy sources can be used to drive turbines directly.

Which two energy sources **cannot** be used to drive turbines directly?

1 nuclear and fossil fuel

2 hydroelectric and fossil fuel

3 nuclear and wind

4 hydroelectric and nuclear

4.2.4.2 Energy transfers in everyday appliances

Question 37

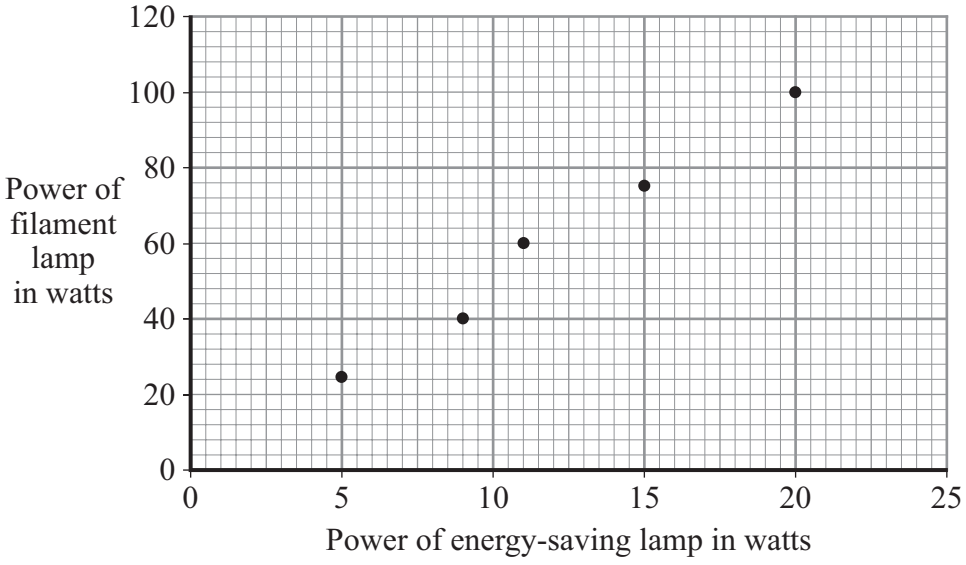
March 2009 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

A householder bought an energy-saving lamp. She found the following table printed on its packaging.

Power of energy-saving lamp in W	Equivalent power of filament lamp in W
5	25
9	40
11	60
15	75
20	100

The graph shows the data.



9A To see if the power of the filament lamp is directly proportional to the power of the energy-saving lamp, you should . . .

1 draw a line of best fit.

2 draw a straight line of best fit and see whether it passes through (0,0).

3 plot more points and see whether a straight line is produced.

4 produce a bar chart and see whether there is a positive relationship.

Question 37 · continued

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

9B A 25 W lamp transforms 25 joules of electrical energy each second.

The efficiency of a 25 W energy-saving lamp is 0.6

How much energy does it waste each second?

1 10.0 J

2 15.0 J

3 41.2 J

4 62.5 J

9C The efficiency of a 100 W filament lamp is 0.15

From the data in the table on page 30, what is the approximate efficiency of the 20 W energy-saving lamp?

1 0.03

2 0.15

3 0.30

4 0.75

9D The government has recommended that the sale of filament lamps should be stopped.

Why is this?

1 to give shops new products to sell

2 to use less fuel for generating electricity

3 to make electricity cheaper to buy

4 to give householders brighter lamps

END OF TEST

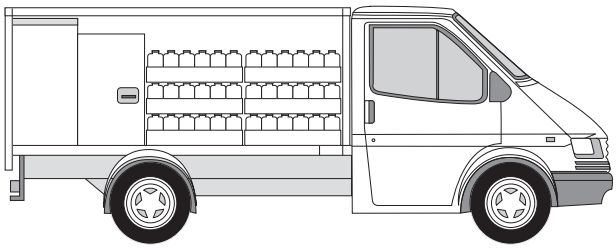
4.2.4.2 Energy transfers in everyday appliances

Question 38

June 2009 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The diagram shows an electrically powered milk float.



In a milk float, batteries drive an electric motor.
A milk float travels 40 km a day.
The batteries are recharged overnight.

4A When the milk float is travelling along the road, the batteries transform . . .

1 electrical energy to kinetic energy.

2 kinetic energy to chemical energy.

3 chemical energy to electrical energy.

4 kinetic energy to electrical energy.

4B When charging the batteries, the battery charger transfers 1.5 kW of power for 5 hours.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

The energy transferred to the batteries is . . .

1 0.3 kWh

2 3.3 kWh

3 7.5 kWh

4 75 kWh

4.2.4.2 Energy transfers in everyday appliances

Question 38 · continued

4C During a day, the electric motor usefully transfers 1600 kJ. The energy supplied to the electric motor is 4000 kJ.

What is the efficiency of the motor?

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

1 0.4

2 2.5

3 2400

4 5600

4D The milk float is said to be more 'environmentally friendly' than a petrol-driven vehicle.

This is because . . .

1 the batteries store energy.

2 it produces no harmful waste gases.

3 the batteries can be recharged many times.

4 the top speed is only 20 km/h.

4.2.4.2 Energy transfers in everyday appliances

Question 39

June 2009 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The table compares data for two types of lamp.

	Filament lamp	Compact fluorescent lamp (CFL)
Cost	80p	£3.00
Efficiency	0.2	0.8
Expected life	1000 hours	8000 hours

7A People may decide **not** to buy CFLs because CFLs are . . .

1 more expensive to buy.

2 more efficient.

3 cheaper to run.

4 longer lasting.

7B A filament lamp with a power rating of 100 W gives 2000 units of light.

What power rating would a CFL need to provide 2000 units of light?

1 8000 W

2 20 W

3 25 W

4 25 kW

4.2.4.2 Energy transfers in everyday appliances

Question 39 · continued

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

Electricity costs 15 p per kWh

7C What will be the cost of using a 100 W filament lamp during its expected life?

1 £1.50

2 £15.00

3 £150.00

4 £1500.00

7D In its lifetime, a security light is used for 15 000 hours.

How much would you expect to spend on buying CFLs for the security light in that time?

1 £5.63

2 £6.00

3 £12.00

4 £45.00

4.2.4.2 Energy transfers in everyday appliances

Question 40

June 2009 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

This question is about the energy available from various fuels.

The table shows the amount of energy that 1 kg of different fuels can produce when the fuel energy is transformed.

Fuel	Energy available in MJ per kg
Uranium	70 million
Hydrogen	115
Gas	50
Oil	45
Coal	20
Wood	15

1 MJ = 1 million joules

8A What mass of coal, in kg, would provide the same amount of energy as 1 kg of uranium?

1 0.29

2 3.5

3 0.29 million

4 3.5 million

8B Which three fuels are non-renewable?

1 coal, gas and wood

2 coal, gas and uranium

3 gas, oil and wood

4 gas, uranium and wood

4.2.4.2 Energy transfers in everyday appliances

Question 40 · continued

8C Coal is burned at a rate of 100 kg per second in a power station. The overall efficiency of the power station is 0.3.

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

What is the energy output per second, in MJ, of this power station?

1 600

2 1400

3 1500

4 6700

8D A factory gets all of its energy by burning oil.

Only half of the energy from burning oil is transformed into useful energy.

For a working day, the energy required to run the factory is 10 800 MJ.

What is the mass of oil, in kg, needed each day?

1 24

2 48

3 240

4 480

4.2.4.2 Energy transfers in everyday appliances

Question 41

June 2009 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

The following information is from a leaflet produced by a double-glazing company.

Change your single-glazed windows to our energy-efficient double glazed windows and save a massive £167 a year

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

9A The company assumes that energy costs 11p per kWh.

How much energy does the company claim would be saved each year by fitting its double-glazing?

1 15.2 kWh

2 1 520 kWh

3 1 837 kWh

4 183 700 kWh

9B Double glazing for a house costs £4000. A householder saves £200 in the first year after installing the double-glazing. Fuel prices rise steadily during that year.

The pay-back time is likely to be . . .

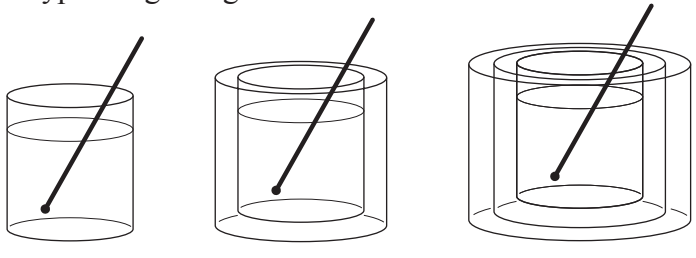
1 exactly 20 years.

2 more than 20 years if fuel prices continue to rise.

3 less than 20 years if fuel prices continue to rise.

4 less than 20 years if fuel prices fall steadily over the next few years.

9C Some students investigated the effectiveness of double and triple glazing. They let 100 cm^3 of boiling water cool in a glass beaker for 20 minutes. They repeated the cooling with the beaker placed inside another one and then inside two beakers. The students also looked up the U-value of different types of glazing on the Internet.



Single glazing | Double glazing | Triple glazing

Question 41 · continued

The results are shown in the table.

	Single glazing	Double glazing	Triple glazing
Temperature in °C after 20 minutes	68	81	88
U-value	1.0	0.5	0.3

Which of these conclusions should the students draw from their results?

1 Double glazing is more effective than triple glazing and a greater U-value means a larger heat loss.

2 Double glazing is more effective than triple glazing and a greater U-value means a smaller heat loss.

3 Triple glazing is more effective than double glazing and a smaller U-value means a larger heat loss.

4 Triple glazing is more effective than double glazing and a smaller U-value means a smaller heat loss.

9D One student stated that the investigation was not realistic. He said that:

- there is a difference between the area of a window and the surface area of the beakers
- the temperature difference across a window is different from the temperature difference across the beakers.

The table compares a window with the beakers in the experiment.

Which row in the table is correct?

	Surface area of window		Temperature difference across window	
	Compared with the beaker	**Effect on rate of heat transfer**	**Compared with the beaker**	**Effect on rate of heat transfer**
1	larger	slower	larger	slower
2	smaller	slower	larger	faster
3	larger	faster	smaller	slower
4	smaller	faster	smaller	faster

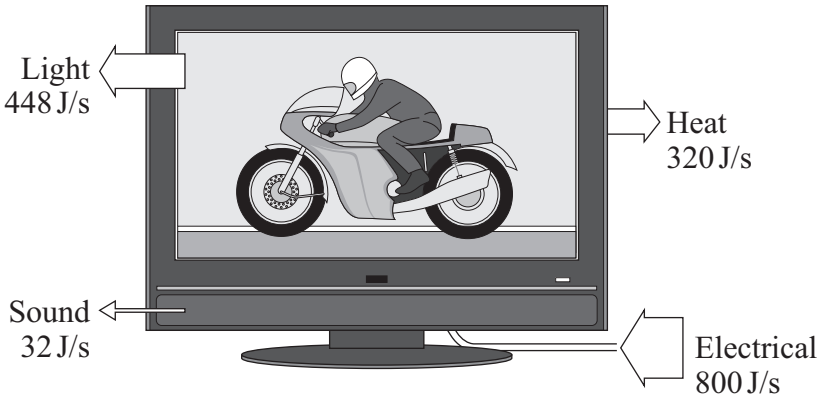
END OF TEST

4.2.4.2 Energy transfers in everyday appliances

Question 42

June 2009 | PHY1H | Original Q3 | Legacy

3 (a) The diagram shows the energy transformations produced by a TV.



3 (a) (i) Use the information in the diagram and the equation in the box to calculate the efficiency of the TV.

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

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2 marks)

3 (a) (ii) What eventually happens to the useful energy transferred by the TV?

.....

.....

(1 mark)

Question 3 continues on the next page

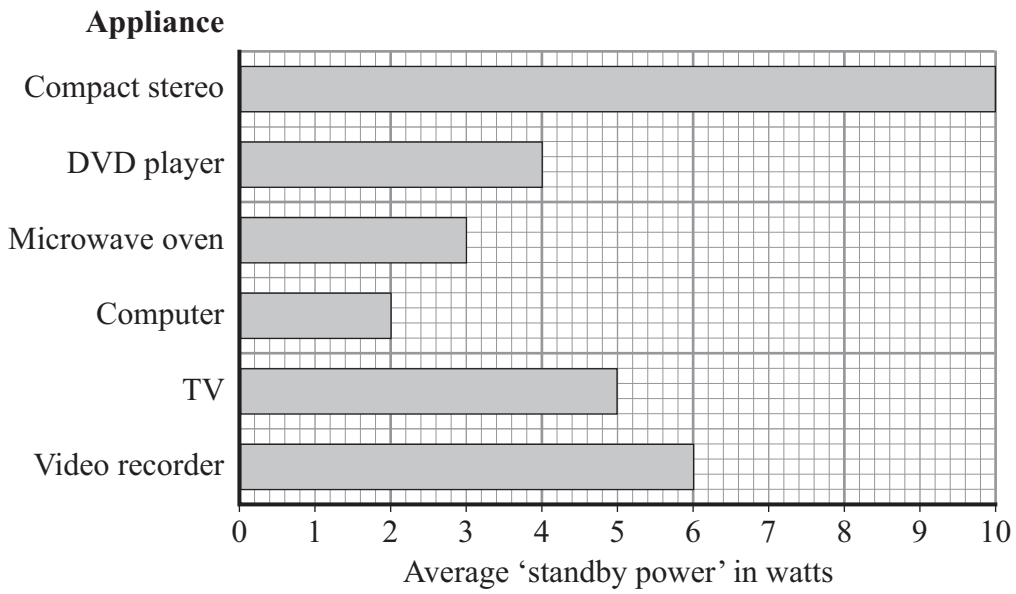
4.2.4.2 Energy transfers in everyday appliances

Question 42 · continued

for mark

3 (b) Electrical appliances left on standby use energy.

The bar chart shows the power for the appliances that one family leaves on standby when they go on holiday.



The family is on holiday for a total of 175 hours.

3 (b) (i) Use the information in the bar chart and the equation in the box to calculate the energy wasted by leaving the compact stereo on standby while the family is on holiday.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

Show clearly how you work out your answer.

.....

.....

Energy wasted = ... kilowatt-hours

(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 42 · continued

for mark

3 (b) (ii) Electricity costs 12 p per kilowatt-hour.

Use the equation in the box to calculate the cost of leaving the compact stereo on standby while the family is on holiday.

total cost = number of kilowatt-hours × cost per kilowatt-hours

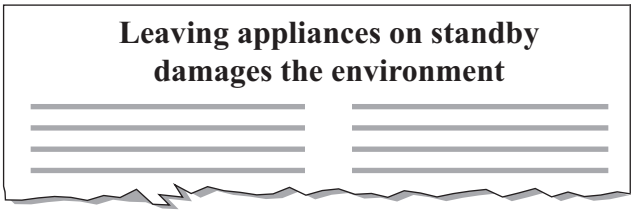
Show clearly how you work out your answer.

.....

Cost = ... p

(1 mark)

3 (c) A headline from a recent newspaper article is shown below.



Explain why leaving appliances on standby damages the environment.

.....

.....

.....

.....

(2 marks)

8

4.2.4.2 Energy transfers in everyday appliances

Question 43

November 2009 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

This question is about different ways of generating electricity.

7A Some types of power station heat water to produce steam. The steam then drives a turbine connected to an electrical generator.

Which types of power station produce steam?

1 biomass, coal and nuclear

2 biomass, wind and wave

3 coal, nuclear and wave

4 gas, wind and wave

The table gives data for the cost of generating electricity in different types of power station.

Type of power station	Building and operating costs in pence per kWh	Fuel costs in pence per kWh	Total cost in pence per kWh
Biomass	5.9	0.8	6.7
Coal	1.3	1.2	2.5
Gas	0.7	1.5	2.2
Nuclear	1.8	0.4	2.2
Wave	6.6	0.0	6.6
Wind	3.7	0.0	3.7

7B Which one of the following is correct?

1 Electricity generated from fossil fuels is always the cheapest.

2 The fuel cost for all renewable sources is zero.

3 The most expensive electricity comes from renewable sources.

4 Wind power stations produce the cheapest electricity.

4.2.4.2 Energy transfers in everyday appliances

Question 43 · continued

7C Fossil fuel power stations release polluting gases into the atmosphere. The government has suggested a carbon tax because of this. This tax would add 0.8 p/kWh to coal prices and 0.4 p/kWh to gas prices.

Which type of power station would produce the cheapest electricity if a carbon tax was added?

1 coal

2 gas

3 nuclear

4 wind

7D The total cost per kilowatt-hour of electricity from a wind-powered station is more than the total cost of electricity per kilowatt-hour from a gas-powered station.

By what percentage would the **fuel** cost of gas have to increase to make the **total** costs the same? (Assume that no carbon tax has been added.)

1 15 %

2 41 %

3 68 %

4 100 %

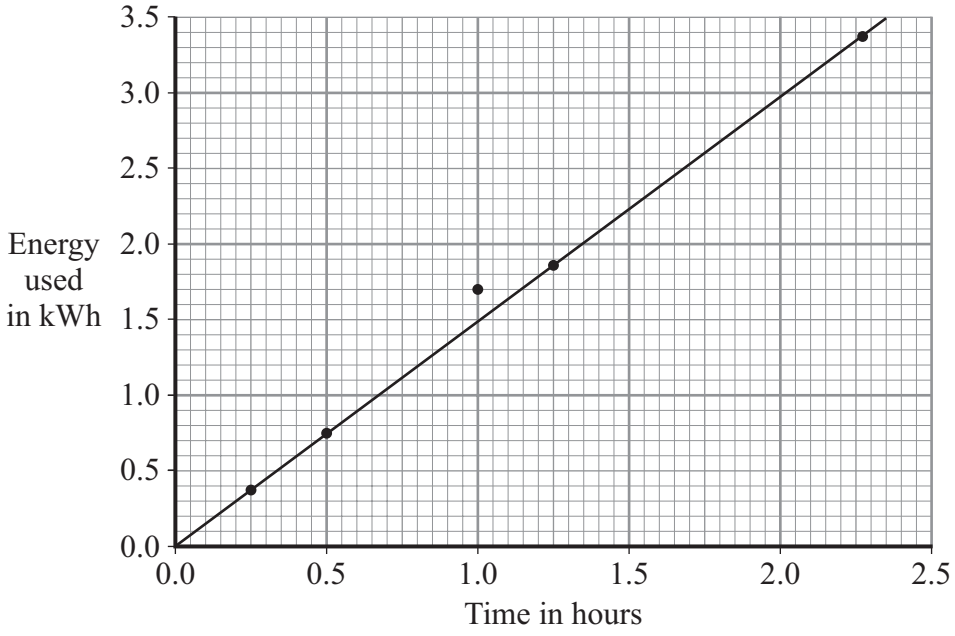
4.2.4.2 Energy transfers in everyday appliances

Question 44

November 2009 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The graph shows the amount of energy used by an electric fire plotted against the length of time it is switched on.



8A The unit of energy on the graph is the kilowatt-hour (kWh).

Energy is usually measured in . . .

1 joules.

2 joules per second.

3 watts.

4 watts per second.

8B The point on the graph at the time of one hour could be anomalous.

This means that the value of the energy . . .

1 was measured with too little precision.

2 was measured with too much precision.

3 does not fit the general pattern.

4 is subject to a systematic error.

4.2.4.2 Energy transfers in everyday appliances

Question 44 · continued

8C The graph shows that . . .

1 the energy used decreases with time.

2 the energy used is directly proportional to the time.

3 the energy used is inversely proportional to the time.

4 the energy used halves when the time is doubled.

8D What is the power of the electric fire?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 1.5 W

2 6.7 W

3 1500 W

4 6700 W

4.2.4.2 Energy transfers in everyday appliances

Question 45

November 2009 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

A notice in an office says:

Leaving your computer on standby overnight uses as much energy as microwaving six dinners

Switch it OFF

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

total cost = number of kilowatt-hours × cost per kilowatt-hour

Electricity costs 12 p per kilowatt-hour.

9A The instructions on a frozen cottage pie say: 'Cook in an 850 W microwave oven for 6 minutes'.

Approximately how much would it cost to cook 6 cottage pies, if they are cooked one at a time?

1 6 p

2 £1.02

3 £3.66

4 £36.72

9B A computer monitor in an office has a power rating of 300 W. Normal office hours are 9 am to 5 pm.

A sensible estimate of the energy wasted if it is left on overnight at full power is . . .

1 4.8 kWh

2 7.2 kWh

3 4800 kWh

4 7200 kWh

Question 45 · continued

9C The 300 W computer monitor can be switched to standby. The standby power is 3 W.

How much money is saved each hour by switching the monitor from full power to standby?

1 less than 1 p

2 3.6 p

3 33 p

4 36 p

9D It is estimated that in Britain 15 million televisions are left on standby for 20 hours per day. The European Parliament has passed a law to help to reduce this problem.

Suggest which of the following would have been included in the law.

1 decrease the price of televisions

2 make it compulsory for television owners to switch off their television sets when not in use

3 set a 1 W limit on standby power for all televisions

4 set a 1 W limit on standby power for all new televisions

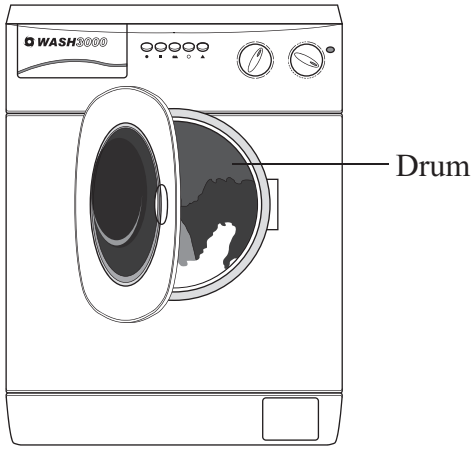
END OF TEST

4.2.4.2 Energy transfers in everyday appliances

Question 46

January 2010 | PHY1H | Original Q2 | Legacy

2 The picture shows a new washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



2 (a) Complete the following sentences.

2 (a) (i) An electric motor is designed to transform electrical energy into

..... energy.

(1 mark)

2 (a) (ii) Some of the electrical energy supplied to the motor is wasted as

..... energy and ..... energy.

(1 mark)

2 (b) What happens to the energy wasted by the electric motor?

.....

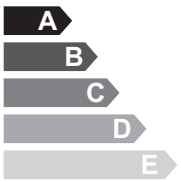
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(1 mark)

Question 46 · continued

for mark

2 (c) The diagram shows the label from the new washing machine.

Model – Wash 3000 **Energy A**	
More efficient  Less efficient	
Energy consumption kWh/wash cycle (based on 40 °C wash)	1.1

An 'A' rated washing machine is *more energy efficient* than a 'C' rated washing machine.

Explain what being *more energy efficient* means.

.....

.....

.....

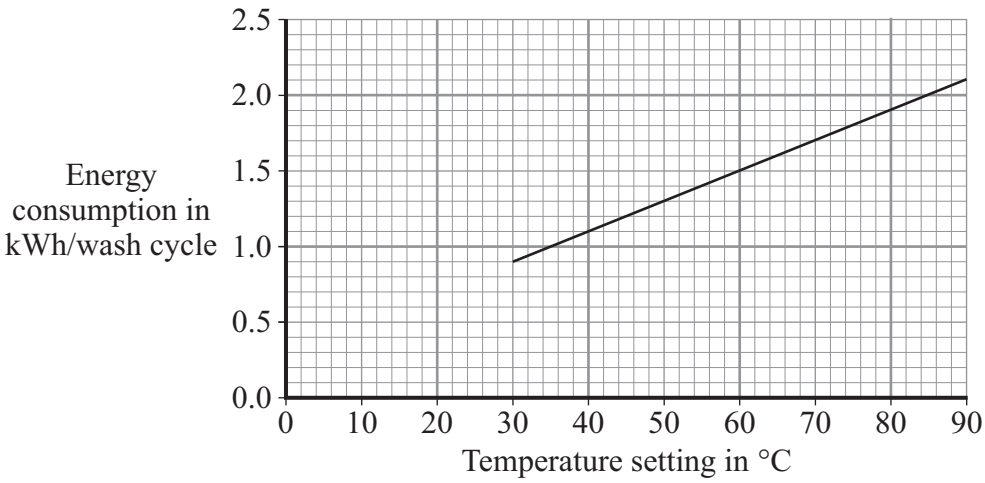
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(2 marks)

Question 2 continues on the next page

for mark

2 (d) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



2 (d) (i) Electricity costs 12 p per kilowatt-hour (kWh).
The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

Money saved = ... p

(2 marks)

2 (d) (ii) Suggest why reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

.....

.....

(1 mark)

8

4.2.4.2 Energy transfers in everyday appliances

Question 47

5 Over the next 15 years, some of the older nuclear power stations will be closed down, and the process of *decommissioning* will start. In the same period, several countries plan to build a number of new nuclear power stations.

5 (a) (i) What does it mean to *decommission* a nuclear power station?

.....

.....

(1 mark)

5 (a) (ii) How does *decommissioning* affect the overall cost of electricity generated using nuclear fuels?

.....

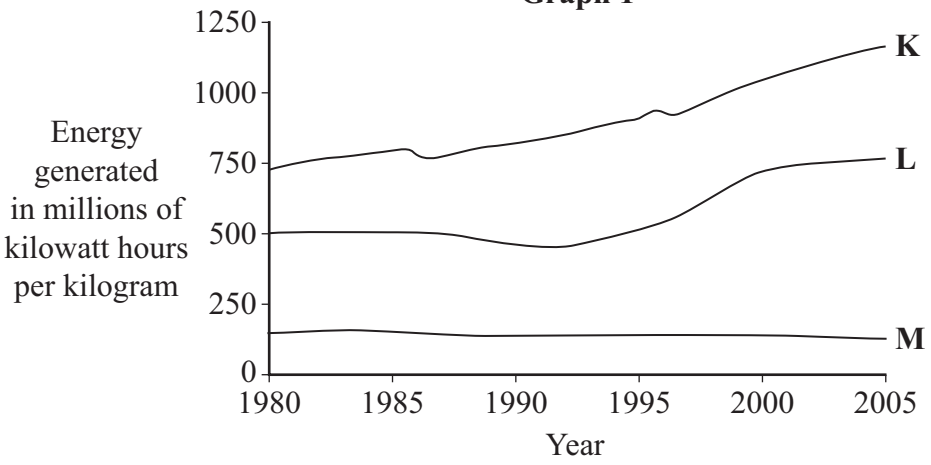
.....

(1 mark)

5 (b) Uranium is a fuel used in nuclear power stations to generate electricity.

Graph 1 compares how the electricity generated from one kilogram of nuclear fuel changed between 1980 and 2005 in three different types of nuclear power station.

Graph 1



5 (b) (i) Compare the efficiency of the three types of power station, **K**, **L** and **M**, between 1980 and 2005.

.....

.....

.....

.....

(2 marks)

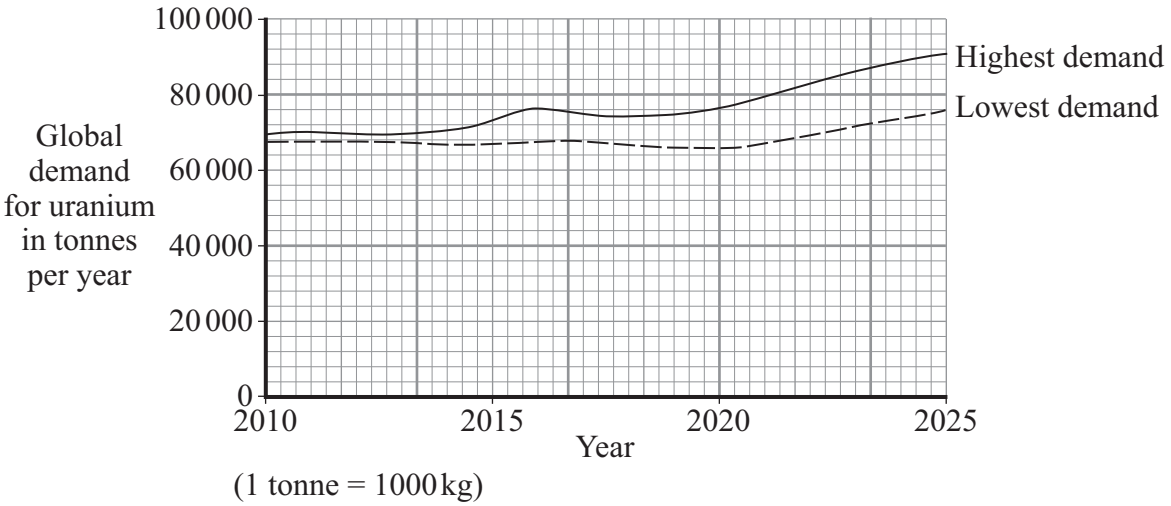
4.2.4.2 Energy transfers in everyday appliances

Question 47 · continued

for mark

Graph 2 shows two different predictions for the global growth in uranium demand over the next 15 years.

Graph 2



(1 tonne = 1000 kg)

5 (b) (ii) Suggest reasons why it is **not** possible to predict accurately how much uranium will be needed in 2025.

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.....

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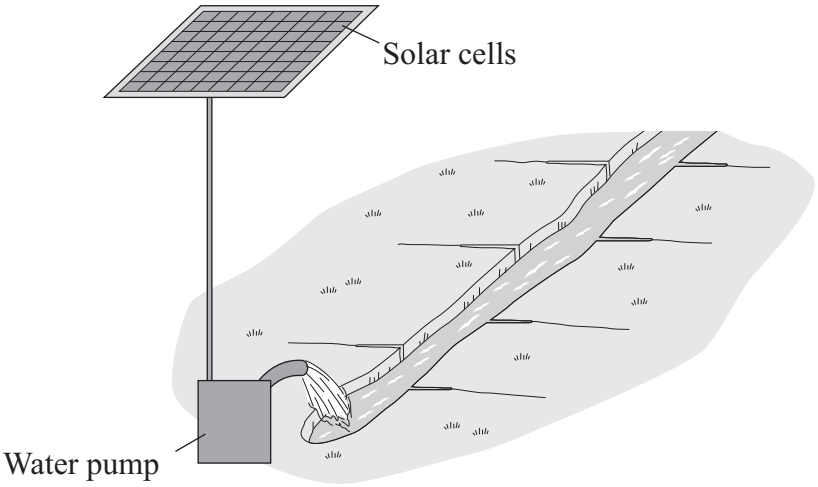
(2 marks)

6

4.2.4.2 Energy transfers in everyday appliances

Question 48

7 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

7 (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)

7 (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)

4.2.4.2 Energy transfers in everyday appliances

Question 48 · continued

for mark

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

.....

.....

(1 mark)

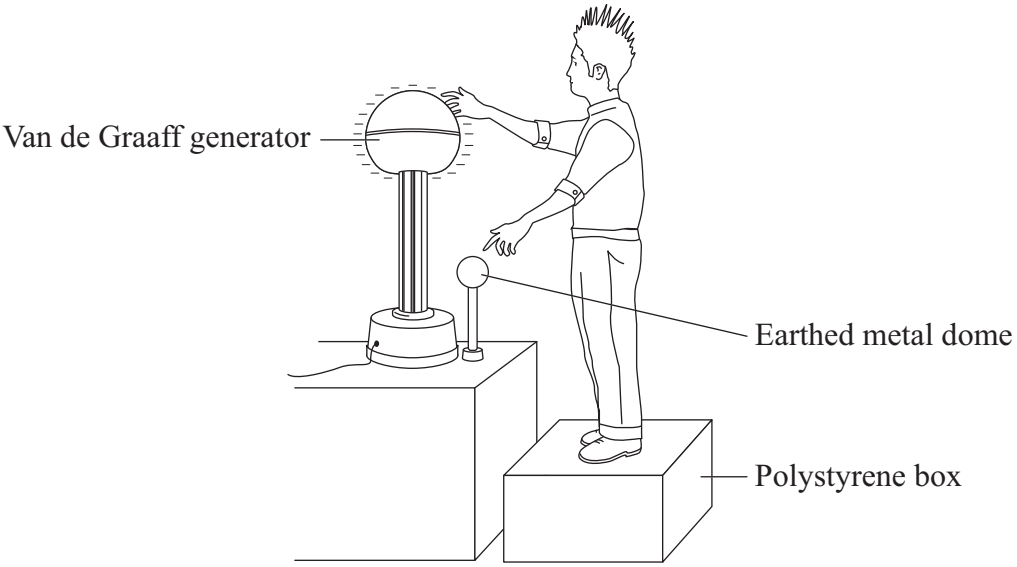
4

4.2.4.2 Energy transfers in everyday appliances

Question 49

January 2010 | PHY2H | Original Q5 | Legacy

5 (a) The diagram shows a student touching the metal dome of a Van de Graaff generator. When the generator is switched on, the metal dome becomes negatively charged.



Explain why the student's hair stands on end when the generator is switched on.

.....

.....

.....

(2 marks)

5 (b) When the potential difference between the student and a nearby earthed metal dome reached 15 kV, a spark jumped between the student and the earthed dome. The spark transformed 30 mJ of energy into heat, light and sound. (1 mJ = 0.001 J)

Use the equation in the box to calculate the charge carried by the spark.

energy transformed = potential difference × charge

.....

.....

Charge transferred = ... coulombs

(2 marks)

5 (c) What name is given to the rate of flow of charge?

.....

(1 mark)

5

4.2.4.2 Energy transfers in everyday appliances

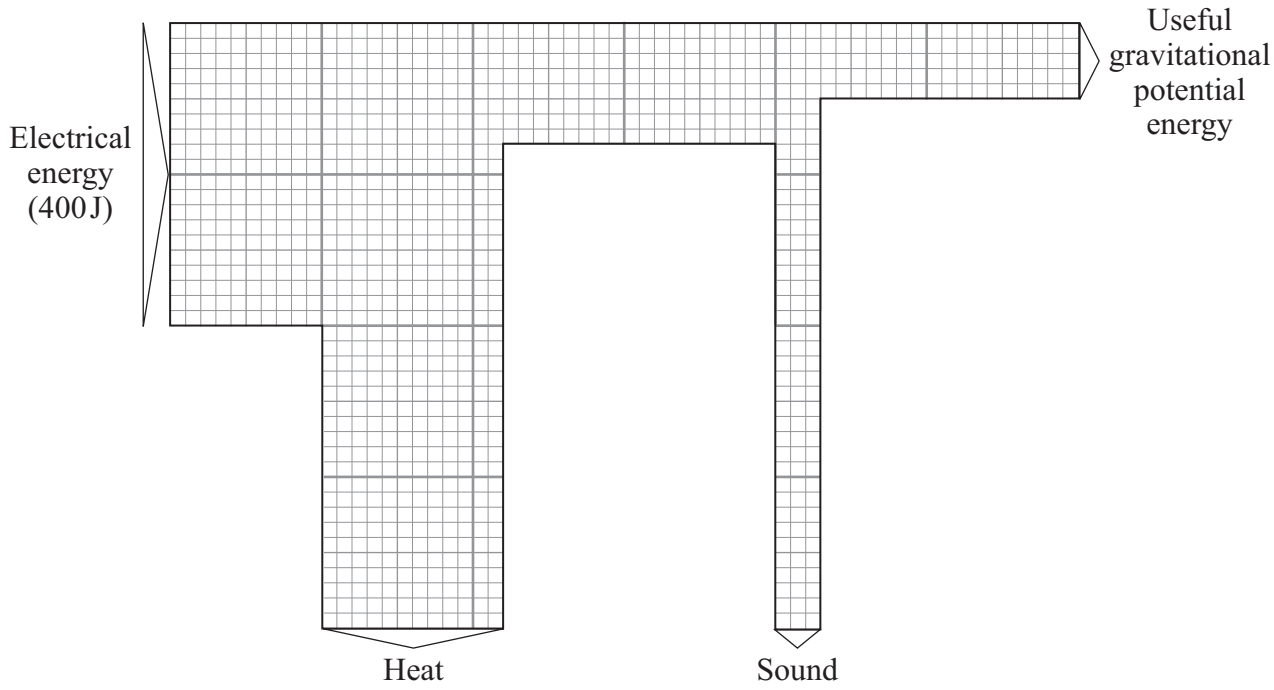
Question 50

March 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

An electric motor is used to lift a weight.

The Sankey diagram shows the energy transformations that take place each second in the electric motor.



Match figures, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A 0.25

B 60

C 100

D 240

4.2.4.2 Energy transfers in everyday appliances

Question 50 · continued

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

The useful gravitational potential energy gained each second is . . . **1** . . . J.

The heat (thermal energy) produced each second is . . . **2** . . . J.

The sound energy produced each second is . . . **3** . . . J.

The total energy wasted each second is 300 J. The efficiency of the electric motor is . . . **4** . . . .

4.2.4.2 Energy transfers in everyday appliances

Question 51

March 2010 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about useful energy transformations by different electrical devices.

Match devices, **A**, **B**, **C** and **D**, with the useful energy transformations **1–4** in the table.

A computer monitor

B loudspeaker

C microphone

D solar cell

	Useful energy transformations
1	electrical energy into light energy
2	sound energy into electrical energy
3	electrical energy into sound energy
4	light energy into electrical energy

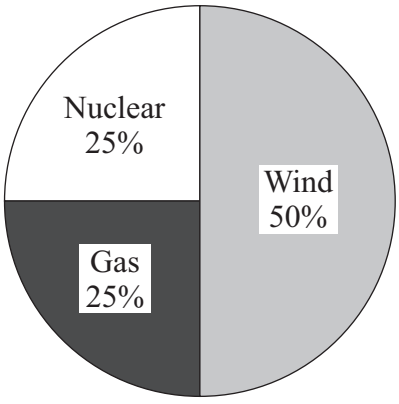
4.2.4.2 Energy transfers in everyday appliances

Question 52

March 2010 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

An electricity company claims to generate its electricity from environmentally friendly energy sources. Its sources are shown below.



The table shows the cost of generating one kilowatt-hour of electricity using each energy source.

Energy source	Cost in pence per kilowatt-hour
Gas	2.2
Nuclear	2.2
Wind	3.6

8A The average cost per kilowatt-hour for the electricity company is . . .

1 2.5p

2 2.7p

3 2.9p

4 3.1p

8B How much of the company's electricity is produced by sources that do not release polluting gases?

1 25%

2 50%

3 75%

4 100%

4.2.4.2 Energy transfers in everyday appliances

Question 52 · continued

8C Pumped storage hydroelectric power stations have two reservoirs of water. One reservoir is at a high level, the other at a low level. Water can be released from the high reservoir to flow through turbines to the low reservoir. The turbines drive electrical generators. At night, when demand for electricity is low, water is pumped back to the high reservoir.

The electricity company buys a pumped storage hydroelectric power station.

When is the company likely to use this power station to generate electricity?

1 when the demand for electricity is low

2 when there is a sudden increase in demand for electricity

3 when the wind is blowing at a steady speed

4 when a constant increase in generating capacity is needed

8D The government wants 20% of all electricity to be generated from renewable sources by 2020. It is considering building more wind farms, tidal and wave-powered generators and nuclear power stations.

Why would a scientist consider this statement to be wrong?

1 Coal will continue to be available for another 200 years.

2 Nuclear energy should not be included as a renewable source.

3 The decision should be made by scientists, not politicians.

4 These renewable energy sources are not reliable.

4.2.4.2 Energy transfers in everyday appliances

Question 53

June 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The table gives data for some energy sources used to generate electricity in the UK.

	Energy source	Generating cost in pence per kWh	Number of grams of carbon dioxide produced per kWh
A	Coal	2.6	1000
B	Gas	2.2	500
C	Hydroelectric (falling water)	3.4	20
D	Nuclear	3.5	5

Use the data in the table above to match energy sources, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table below.

1	produces the cheapest electricity
2	is renewable
3	contributes least to global warming
4	contributes most to global warming

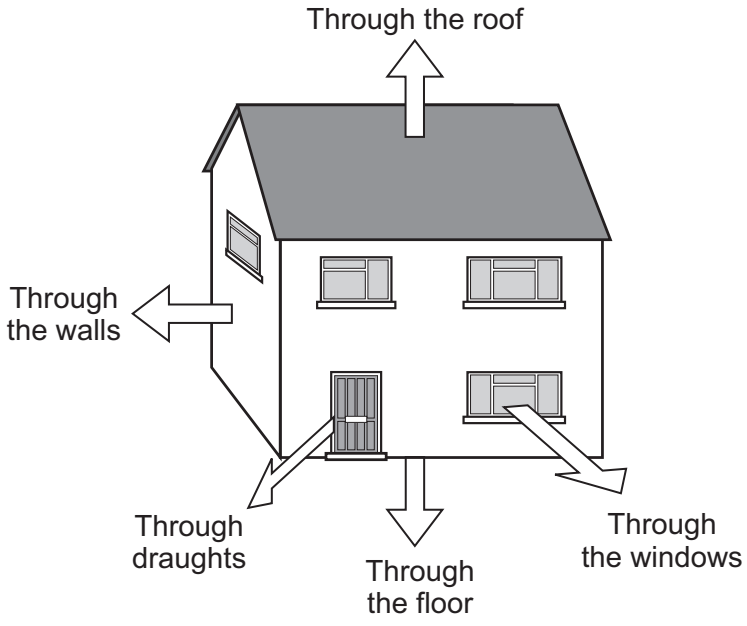
4.2.4.2 Energy transfers in everyday appliances

Question 54

June 2010 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

The diagram shows the ways in which energy can be lost from a house.



5A This house is losing heat at a rate of 30 kW.

What power must be supplied by the central heating system to maintain a steady temperature?

1 less than 30 kW

2 30 kW

3 60 kW

4 more than 60 kW

5B One day, the central heating boiler uses 10 kWh of energy.

The efficiency of the central heating boiler is 0.9

How much of the energy from the fuel is usefully transferred?

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

1 1 kWh

2 9 kWh

3 10 kWh

4 11kWh

4.2.4.2 Energy transfers in everyday appliances

Question 54 · continued

5C What happens to the energy that is **not** usefully transferred?

1 It is stored in the boiler until needed.

2 It is turned mainly into sound energy.

3 It warms the air surrounding the house.

4 It leaves the house in the form of light energy.

5D In the UK, the government has ruled that central heating boilers must have an efficiency of at least 0.9

Why might the government wish to raise this figure above 0.9?

Because . . .

1 householders would have to pay more for their energy supplies.

2 it would help to conserve energy supplies.

3 it would help to protect the ozone layer.

4 more polluting gases would be produced.

4.2.4.2 Energy transfers in everyday appliances

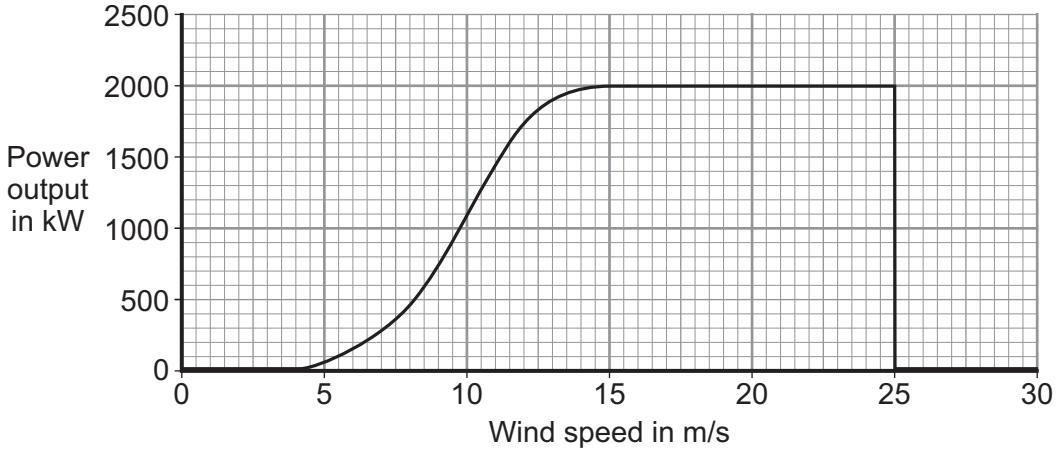
Question 55

June 2010 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

A wind turbine can be used to produce electricity.

The graph shows how the power output of a particular turbine varies with wind speed.



The turbine is designed to operate best at a minimum wind speed of 15 m/s. This is called the rated wind speed.

7A How much energy would be transferred if the turbine operated at its rated wind speed for 2 hours?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 2 kWh

2 4 kWh

3 2000 kWh

4 4000 kWh

7B The turbine will work only when the wind speed is above a value called the cut-in wind speed. The turbine shuts down when the wind speed reaches a certain value.

Which row in the table gives the correct wind speeds?

	Cut-in wind speed	Shut-down wind speed
1	4 m/s	15 m/s
2	9 m/s	20 m/s
3	4 m/s	25 m/s
4	13 m/s	25 m/s

4.2.4.2 Energy transfers in everyday appliances

Question 55 · continued

7C What happens to the energy of the wind at speeds lower than the cut-in speed and higher than the shut-down speed?

1 It will all be transformed into heat.

2 It will all be transformed into sound.

3 It will be stored in the turbine for future use.

4 It will stay as kinetic energy of moving air.

7D The efficiency of this turbine is 0.7

How many kilowatt-hours of wind energy would be needed to produce 10 kilowatt-hours of electrical energy?

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

1 7.0

2 9.3

3 10.7

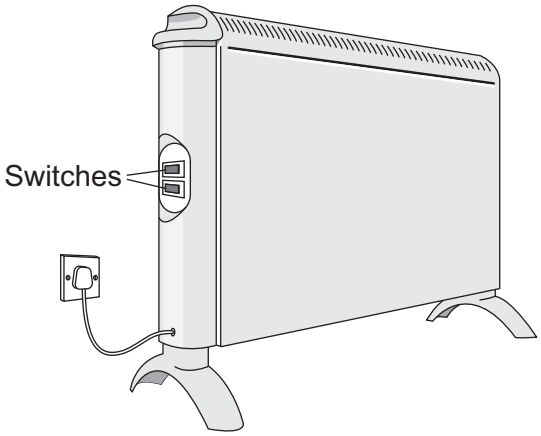
4 14.3

4.2.4.2 Energy transfers in everyday appliances

Question 56

June 2010 | PHY1H | Original Q3 | Legacy

3 (a) The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.



Setting	Power in watts
Low	700
Medium	1400
High	

3 (a) (i) When both switches are on, the heater works at the high power setting.

What is the power of the heater, in kilowatts, when it is switched to the **high** power setting?

.....

Power = ... kilowatts
(1 mark)

3 (a) (ii) The heater is used on the **high** power setting. It is switched on for $1\frac{1}{2}$ hours.

Use the equation in the box to work out the energy transferred from the mains to the heater in $1\frac{1}{2}$ hours.

energy transferred = power × time

Show clearly how you work out your answer and give the unit.

.....

.....

.....

Energy transferred = ...
(3 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 56 · continued

3 (a) (iii) This type of heater is a very efficient device.

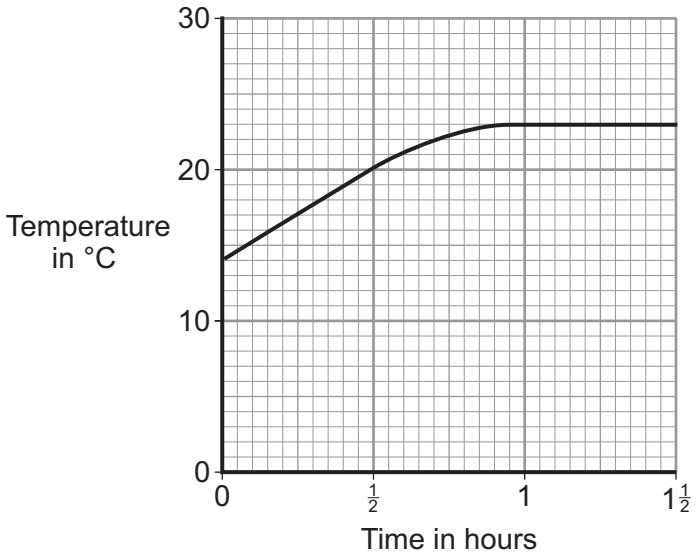
What is meant by a device being very efficient?

.....

.....

(1 mark)

3 (b) The graph shows how the temperature of a room changes during the $1\frac{1}{2}$ hours that the heater is used.



After 1 hour, the temperature of the room has become constant, even though the heater is still switched on.

Explain why.

.....

.....

.....

.....

(2 marks)

7

4.2.4.2 Energy transfers in everyday appliances

Question 57

June 2010 | PHY2H | Original Q7 | Legacy

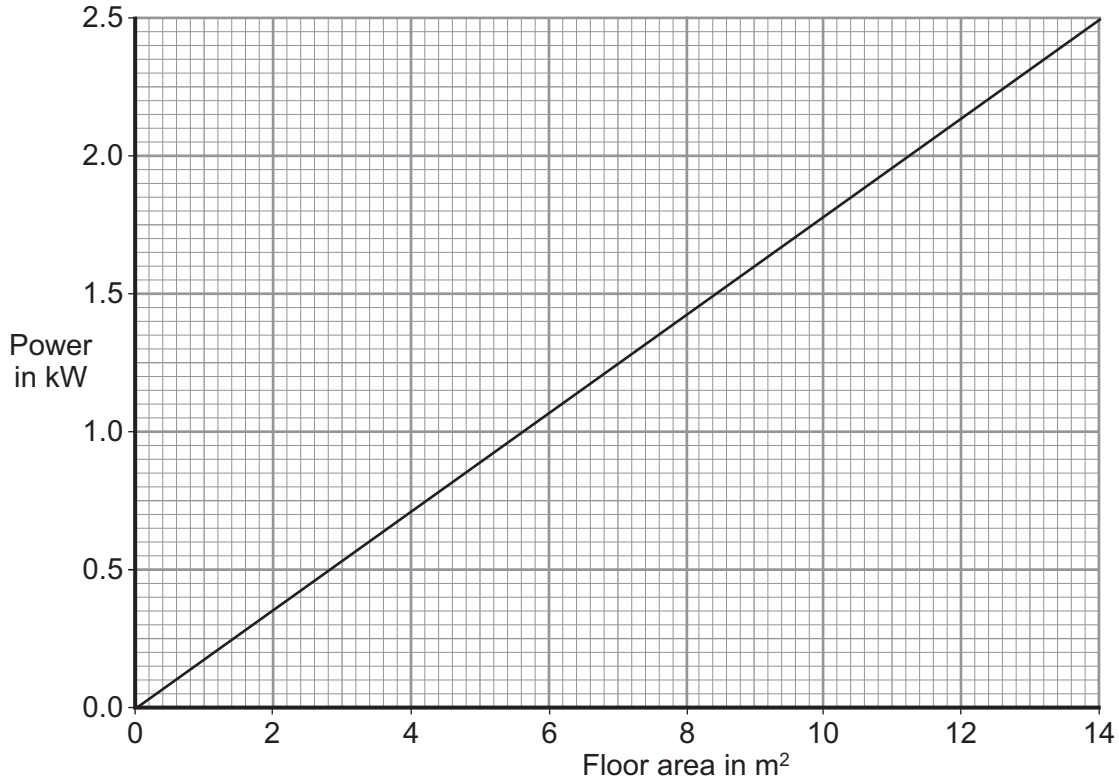
7 A homeowner has installed electric underfloor heating in the kitchen. When the heating is switched on, an electric current flows through wires running under the tiled floor surface.

7 (a) What is an electric current?

.....

(1 mark)

7 (b) The graph shows how the power output of an underfloor heating system depends on the area of the floor that is heated.



The area of the homeowner's kitchen floor is 9.0 m^2.

Use the graph and the equation in the box to calculate the current drawn from the 230 V mains supply by the heating system.

power = current × potential difference

Show clearly how you work out your answer and give the unit.

.....

.....

.....

.....

Current = ...

(4 marks)

5

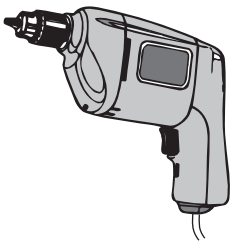
4.2.4.2 Energy transfers in everyday appliances

Question 58

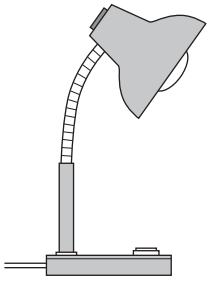
November 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

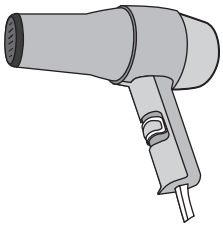
The diagrams show four electrical devices. The Sankey diagrams show the energy transformations involved in the four electrical devices.



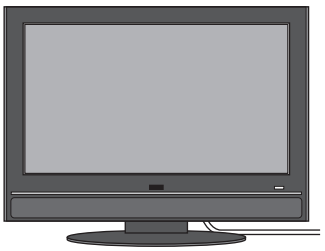
A
Electric drill



B
Desk lamp



C
Hair dryer



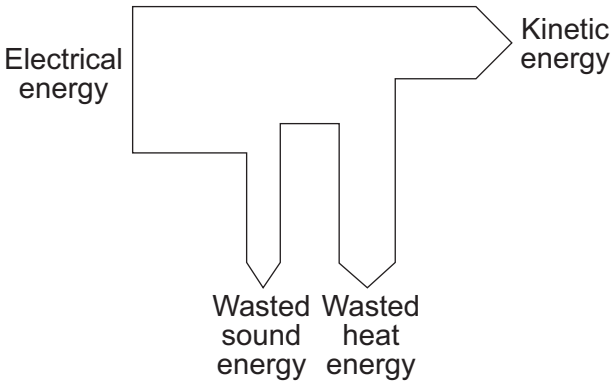
D
Television

Match devices, **A**, **B**, **C** and **D**, with the Sankey diagrams **1**–**4**.

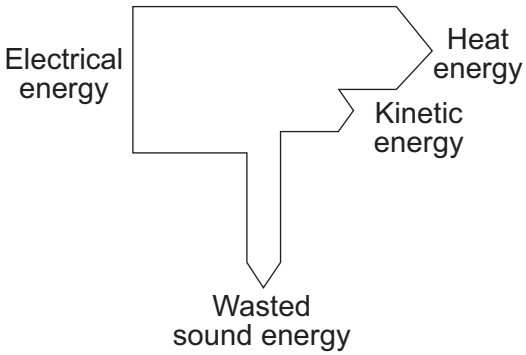
4.2.4.2 Energy transfers in everyday appliances

Question 58 · continued

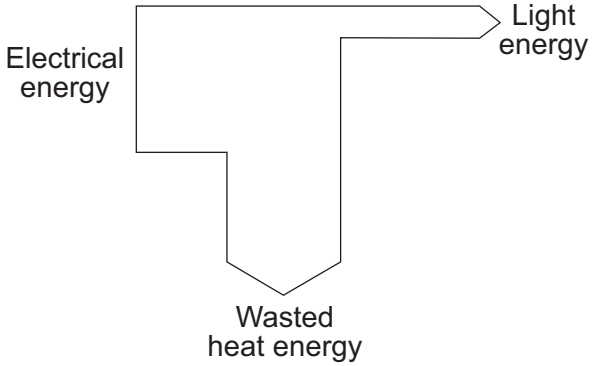
1



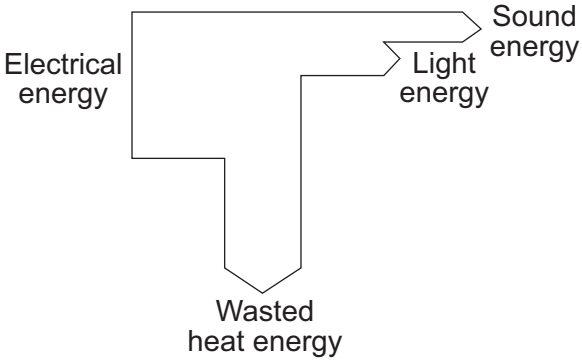
2



3



4



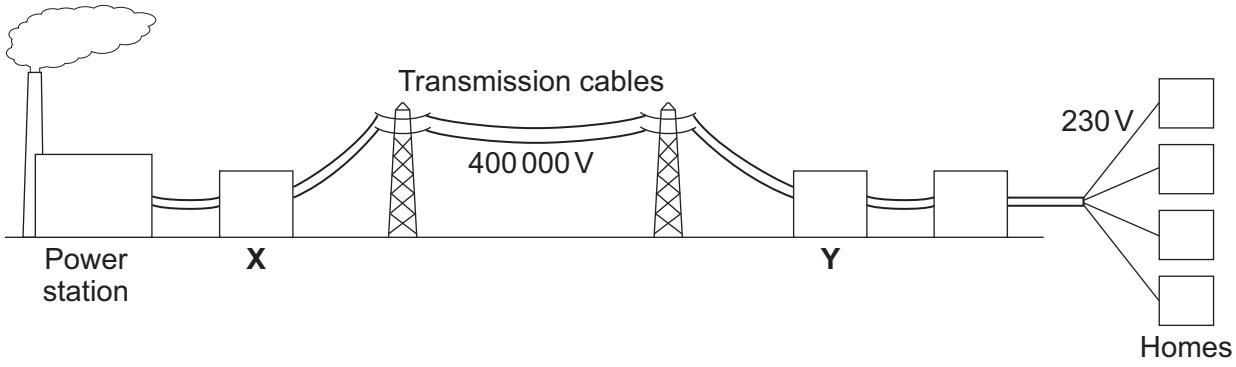
4.2.4.2 Energy transfers in everyday appliances

Question 59

November 2010 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows a power station connected to the National Grid. The National Grid distributes the electrical energy to homes.



7A Which row in the table correctly describes the transformers **X** and **Y**?

	X	Y
1	step-down	step-down
2	step-down	step-up
3	step-up	step-down
4	step-up	step-up

7B Why is the voltage (potential difference) across the transmission cables of the National Grid very high?

1 so that the electricity travels faster

2 so that the electric current is large

3 to make the transmission of electricity safe

4 to reduce energy loss from the cables

7C A transformer changes both the voltage and the current.

Which row in the table correctly describes the changes of current in transformers **X** and **Y**?

	X	Y
1	decrease	decrease
2	decrease	increase
3	increase	decrease
4	increase	increase

4.2.4.2 Energy transfers in everyday appliances

Question 59 · continued

7D In the power station, the boiler has an efficiency of 0.75. The turbine and generator system have an efficiency of 0.80.

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

For every 1000 J of energy supplied to the boiler, what is the useful output energy from the turbine and generator system?

1 600 J

2 750 J

3 800 J

4 1670 J

Turn over for the next question

4.2.4.2 Energy transfers in everyday appliances

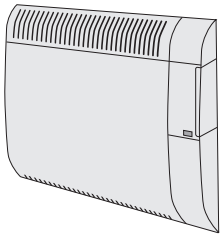
Question 60

November 2010 | PHY1AP | Original Q9 | Legacy

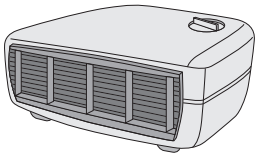
QUESTION NINE

The pictures show three different types of electric heater.

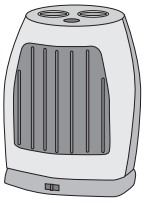
400 W oil-filled panel heater
- 3 heat settings
- Efficient background heat
- Safety overheat cut-out



3 kW fan heater
- 2 heat settings
- Power indicator light
- Cool air fan setting



1800 W ceramic heater
- 2 heat settings
- 8 hour timer
- Power indicator light
- Safety overheat cut-out



9A Two 400 W oil-filled panel heaters are both switched on in an office.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

How much energy, in kWh, is transferred from the mains to the heaters in 12 hours?

1 4.8

2 9.6

3 2400

4 4800

9B The cost of using the ceramic heater during one week was £6.00. During this week, the heater transferred 40 kWh.

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

What was the cost per kWh of the electricity?

1 1.50p

2 6.67p

3 £0.15

4 £6.67

4.2.4.2 Energy transfers in everyday appliances

Question 60 · continued

9C When the fan heater is working at less than full power, 2 kilojoules of energy are usefully transferred every second. The efficiency of the fan heater at this power is 0.95.

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

How many joules of electrical energy are supplied to the fan heater each second?

1 0.000475

2 0.475

3 2.1

4 2105

9D The fan heater cannot be 100% efficient.

Why is this?

1 The fan heater is the most powerful of the four heaters.

2 The fan heater does not have a safety overheat cut-out.

3 The fan heater makes a noise.

4 The fan heater's case becomes warm during use.

END OF TEST

4.2.4.2 Energy transfers in everyday appliances

Question 61

6 (a) The table gives information about some ways of reducing the energy consumption in a house.

Method of reducing energy consumption	Installation cost in £	Annual saving on energy bills in £
Cavity wall insulation	250	115
Jacket for hot water tank	12	35
Upgraded central heating controls	310	80

Show that over 5 years, the most cost-effective method of reducing energy consumption is to install cavity wall insulation.

.....

.....

.....

.....

(2 marks)

6 (b) Any device that transforms energy will waste energy.

Why must the total energy input to such a device always equal the total energy output from the device?

.....

.....

(1 mark)

4.2.4.2 Energy transfers in everyday appliances

Question 61 · continued

6 (c) A holiday cottage has a pre-payment electricity meter. The electricity is charged at the rate of 20 p per kWh. A £2 coin is put into the meter and a 2.5 kW fire switched on.

Use the equations in the box to work out how many hours it will be before £2 runs out. Assume that no other electrical device is switched on.

energy transferred = power × time
total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

.....

.....

Time = ... hours

(2 marks)

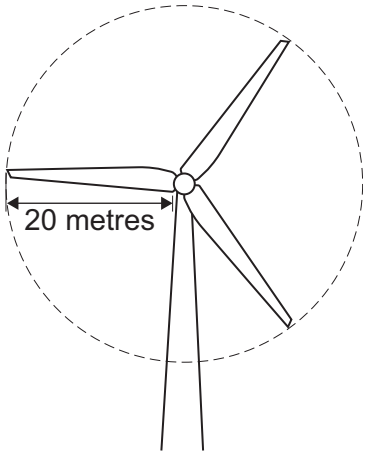
5

4.2.4.2 Energy transfers in everyday appliances

Question 62

January 2011 | PHY2H | Original Q4 | Legacy

4 The diagram shows a wind turbine.



4 (a) The blades of the turbine are 20 metres long. On average, 15 000 kg of air, moving at a speed of 12 m/s, hit the blades every second.

Use the equation in the box to calculate the kinetic energy of the air hitting the blades every second.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

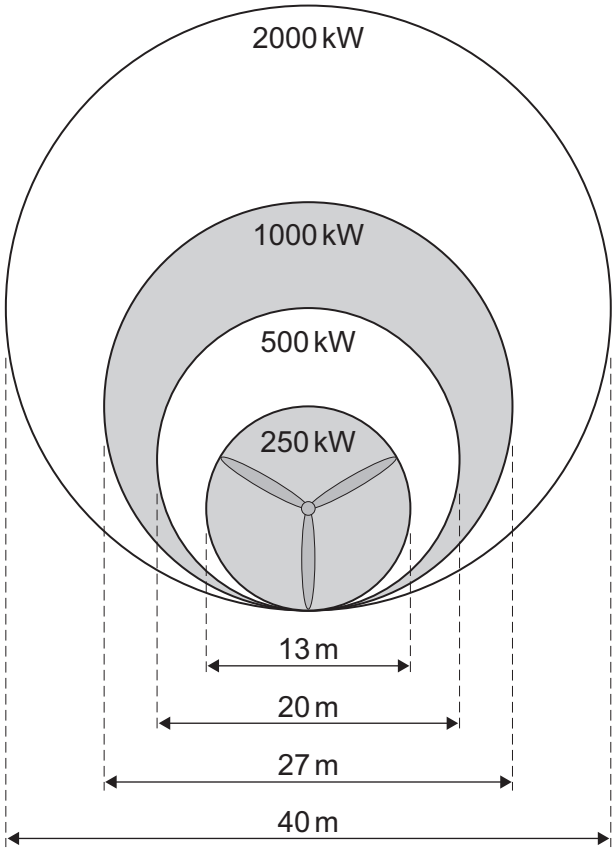
Kinetic energy = ... J

(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 62 · continued

4 (b) Part of the kinetic energy of the wind is transformed into electrical energy.
The diagram shows that, for the same wind speed, the power output of a turbine, in kilowatts, depends on the length of the turbine blades.



Give a reason why doubling the diameter of the blades more than doubles the power output of a turbine.

.....

.....

(1 mark)

3

4.2.4.2 Energy transfers in everyday appliances

Question 63

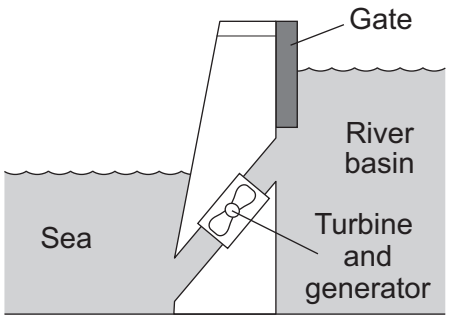
March 2011 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

It is estimated that the total energy available from the world's tides could provide about 5 % of the electricity generated worldwide.

One method of using the energy of tides is to build a barrage across a river.

The diagram shows a tidal barrage.



Tide going out

- As the tide rises, the gate is opened to let seawater into the river basin.
- At high tide the gate is closed, trapping water in the river basin.
- As the tide goes out, the gate is opened and water flows through the turbine.

3A Which energy transformations take place as the water flows from the river basin through the turbine and the generator to the sea?

1 gravitational potential to electrical to kinetic

2 gravitational potential to kinetic to electrical

3 kinetic to electrical to gravitational potential

4 kinetic to gravitational potential to electrical

4.2.4.2 Energy transfers in everyday appliances

Question 63 · continued March 2011 | PHY1AP | Original Q3 | Legacy

3B From the information above, one of the advantages of a tidal barrage over a wind farm is that it . . .

1 can be built anywhere.

2 generates electricity all the time.

3 has low building costs.

4 uses a predictable energy source.

3C Environmentalists claim that one of the **disadvantages** of tidal power stations is that they . . .

1 cause noise pollution.

2 destroy the habitat of wading birds.

3 produce gases that pollute the atmosphere.

4 produce radioactive waste.

3D A cheaper way to use tidal energy is to use underwater currents to drive turbines. This is the same idea as a wind farm, but it works under water.

One report states that electricity generated by underwater currents would be four times as expensive as electricity generated by a wind farm.

The cost of electricity, from cheapest to most expensive, would be . . .

1 tidal barrage, underwater current, wind farm.

2 underwater current, wind farm, tidal barrage.

3 wind farm, tidal barrage, underwater current.

4 wind farm, underwater current, tidal barrage.

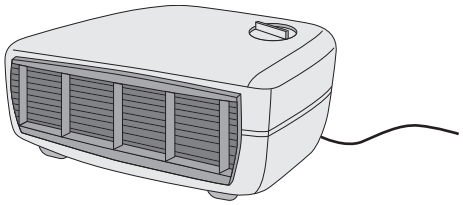
4.2.4.2 Energy transfers in everyday appliances

Question 64

March 2011 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

A fan heater is used to heat air and to move it around a room.



Fan heater

4A The fan heater usefully transforms electrical energy to . . .

1 kinetic and sound energy.

2 light and thermal energy.

3 sound and light energy.

4 thermal and kinetic energy.

4B Energy that is not usefully transformed by the fan heater is wasted as . . .

1 chemical energy.

2 kinetic energy.

3 sound energy.

4 thermal energy.

4C The fan heater moves hot air around the room.

This method of heat transfer is sometimes called forced . . .

1 conduction.

2 convection.

3 evaporation.

4 radiation.

4D The fan heater transfers 3 kWh of energy as it warms a room.

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

Electricity costs 15p per kWh

What is the cost of this energy?

1 5p

2 45p

3 £5

4 £45

Turn over for the next question

4.2.4.2 Energy transfers in everyday appliances

Question 65

March 2011 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

A 'hybrid' car can run on petrol stored in a tank or on electricity stored in a rechargeable battery.

5A When the battery is completely 'flat', it has no energy stored in it. The battery of car **X** is connected to the mains electrical supply and receives energy at a rate of 2000 W. It takes 6 hours to fully charge the battery.

How much electrical energy is needed to fully charge the battery of car **X**?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 3 kWh

2 12 kWh

3 333 kWh

4 12 000 kWh

5B A different hybrid car, **Y**, needs a different amount of electrical energy to charge its battery. The total cost of this electrical energy is £3.

Mains electricity costs 15 pence per kWh.

How much electrical energy is needed to fully charge the battery of car **Y**?

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

1 0.2 kWh

2 12 kWh

3 20 kWh

4 45 kWh

5C When the battery of car **Y** is fully charged, it can travel 100 km using the energy stored in its battery. Travelling the same distance using its petrol engine would require five times as much energy.

What does this tell you about the efficiency of the two methods of propelling car **Y**?

1 The electric motor is more efficient than the petrol engine.

2 The petrol engine is more efficient than the electric motor.

3 The petrol engine and the electric motor have the same efficiency.

4 It is impossible to compare the efficiency.

4.2.4.2 Energy transfers in everyday appliances

Question 65 · continued

5D Some cars are all electric and have no petrol engine fitted.

Which statement about these cars is true?

1 They are not responsible for producing any atmospheric pollution.

2 They produce more atmospheric pollution than petrol-engine cars.

3 They produce no atmospheric pollution while being driven.

4 They produce no atmospheric pollution but a lot of noise pollution.

Turn over for the next question

4.2.4.2 Energy transfers in everyday appliances

Question 66

March 2011 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The table is taken from an advert for low-energy lamps.

Save up to 80 % of your electricity bill by switching to low-energy lamps		
Filament lamp	**Equivalent low-energy lamp**	**Power saving**
60 W	12 W	80 %
60 W	15 W	
100 W	20 W	80 %
100 W	24 W	76 %

7A A householder changes from using a 60 W filament lamp to using a 15 W low-energy lamp.

What is the percentage power saving made?

1 20 %

2 45 %

3 75 %

4 80 %

A 20 W low-energy lamp provides the same amount of light each second as a 100 W filament lamp.

7B The efficiency of a 100 W filament lamp is 0.15.

What is the efficiency of the 20 W low-energy lamp?

1 0.03

2 0.15

3 0.30

4 0.75

4.2.4.2 Energy transfers in everyday appliances

Question 66 · continued

7C How much money is saved over 200 hours by replacing a 100 W filament lamp with a 20 W low-energy lamp?

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

Electricity costs 15p per kWh

1 48p

2 60p

3 £2.40

4 £3.00

7D A householder is considering changing all her filament lamps for low-energy lamps. However, she says that the table in the advert does not contain enough information for her to know how much money she will save.

She needs to know . . .

1 how much each lamp costs and how long it lasts.

2 how long each lamp lasts and how much electricity costs per kWh.

3 how much electricity costs per kWh and how much each lamp costs.

4 how much each lamp costs, how long each lamp lasts and how much electricity costs per kWh.

4.2.4.2 Energy transfers in everyday appliances

Question 67

June 2011 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about four electrical devices.

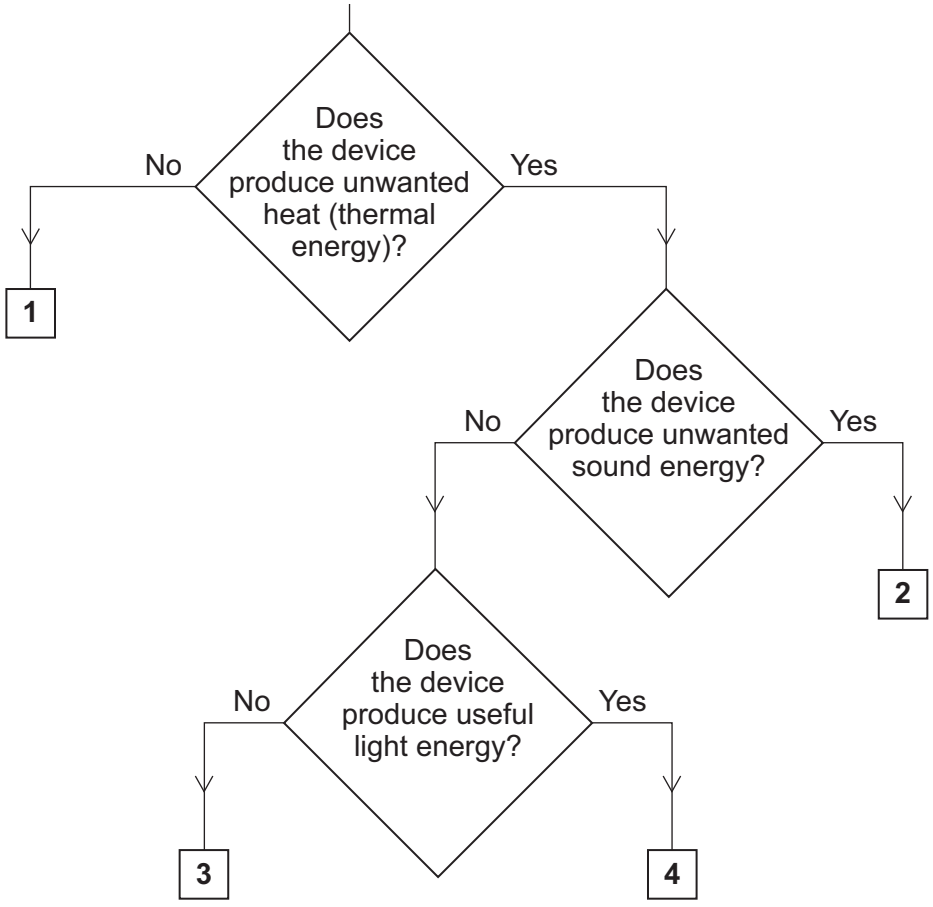
Match the devices, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the flow chart.

A food mixer

B iron

C radio

D television



4.2.4.2 Energy transfers in everyday appliances

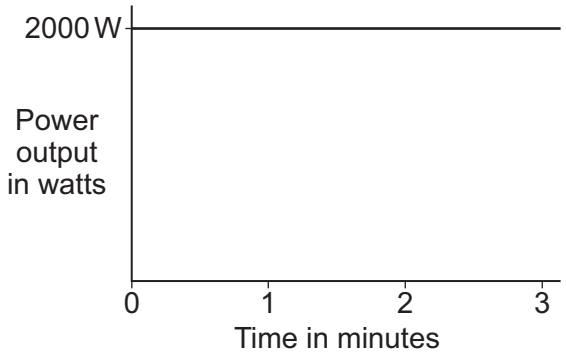
Question 68

June 2011 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

An electric kettle has a power rating of 2000 W. It can boil 1 litre of water in 3 minutes.

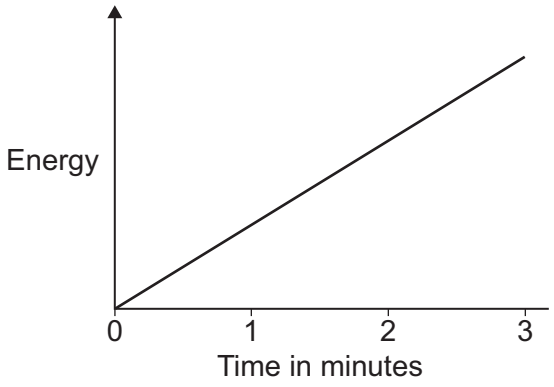
The graph shows how the power output of the kettle varies with time.



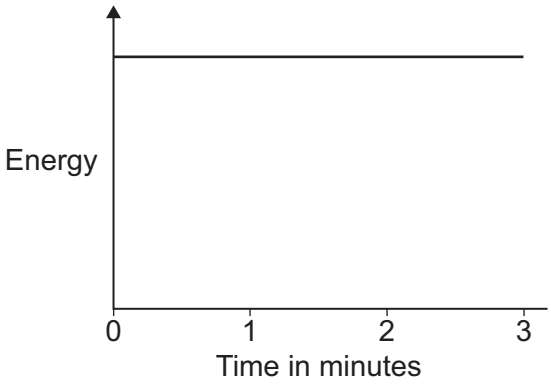
energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

5A Which graph shows how the energy transferred by the kettle varies with time?

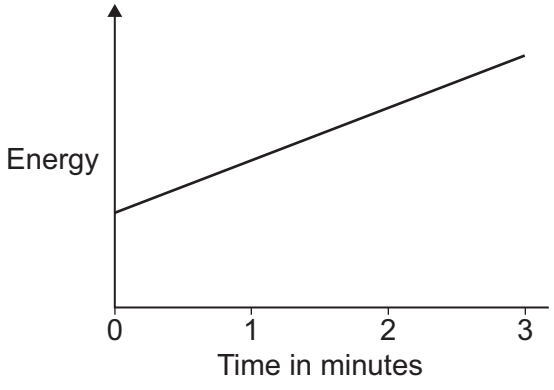
1



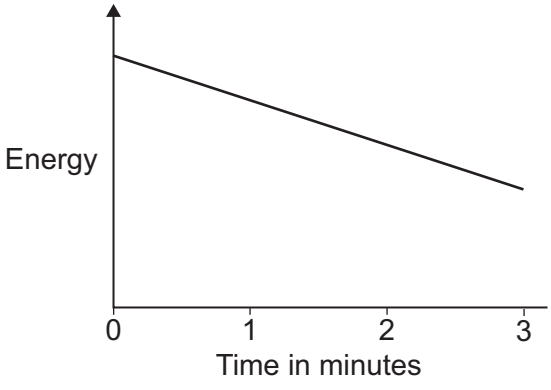
2



3



4



4.2.4.2 Energy transfers in everyday appliances

Question 68 · continued

5B The energy transferred to boil the water is . . .

1 0.1 kWh

2 0.5 kWh

3 0.6 kWh

4 0.8 kWh

5C The 2000 W kettle is replaced by a 1000 W kettle. This second kettle is used to boil 1 litre of water.

Which row in the table shows what happens when a 1000 W kettle is used instead of a 2000 W kettle?

	Energy used to boil the water	Time taken to boil the water
1	stays the same	increases
2	stays the same	decreases
3	increases	stays the same
4	decreases	increases

5D It costs £7.50 to use the 1000 W kettle for 3 months. During this time, 50 kWh of electrical energy are transferred by the kettle.

total cost = number of kilowatt-hours × cost per kilowatt-hour

What is the cost per kilowatt-hour of electrical energy?

1 3.75 p

2 7.00 p

3 11.25 p

4 15.00 p

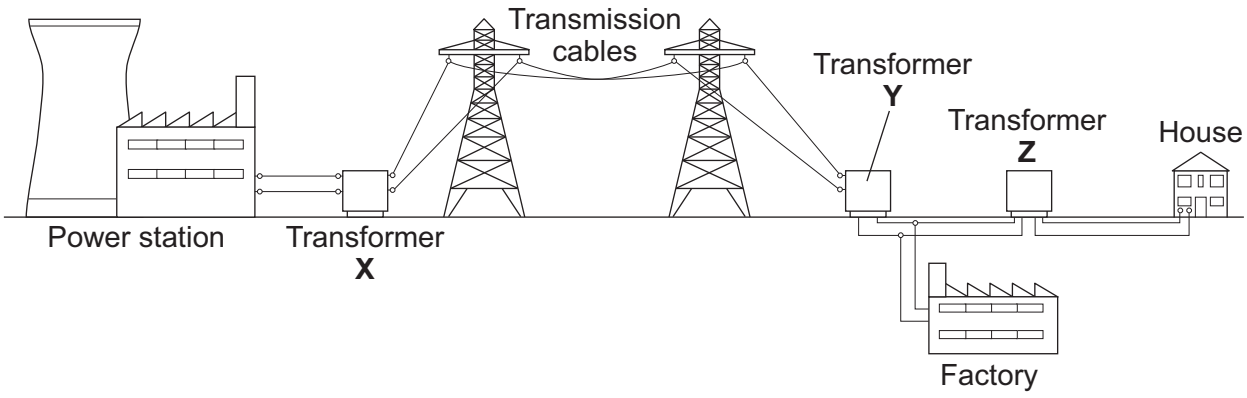
4.2.4.2 Energy transfers in everyday appliances

Question 69

June 2011 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

Transformers are used in the National Grid.



7A Both step-up transformers and step-down transformers are used in the National Grid.

Which row in the table shows the correct types of transformer?

	Transformer X	Transformer Y	Transformer Z
1	step-up	step-down	step-up
2	step-up	step-up	step-up
3	step-up	step-down	step-down
4	step-up	step-up	step-down

7B Transformer **X** changes the voltage between the power station and the transmission cables. It also changes the current. These changes affect the efficiency of the transmission cables.

Which row in the table correctly describes the changes produced by transformer **X**?

	Voltage	Current	Efficiency of transmission
1	decreased	decreased	decreased
2	decreased	increased	increased
3	increased	decreased	increased
4	increased	increased	increased

4.2.4.2 Energy transfers in everyday appliances

Question 69 · continued

7C The table shows the percentage of energy wasted as heat and sound by four different transformers.

Which transformer has the highest efficiency?

Transformer	Percentage of energy supplied to transformer which is wasted as sound	Percentage of energy supplied to transformer which is wasted as heat
1	1.1	7.4
2	1.2	4.7
3	1.3	5.4
4	1.4	6.9

7D The amount of electricity that a device uses depends on the rate at which the device transforms energy and . . .

1 how long the device is switched on.

2 the current through the device.

3 the potential difference across the device.

4 the power of the device.

4.2.4.2 Energy transfers in everyday appliances

Question 70

June 2011 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

Solar cells are used to produce electricity on a large scale in places such as Australia and California. They are not used on a large scale in the UK.

9A Which of the following statements about solar cells being used to produce electricity on a large scale is correct?

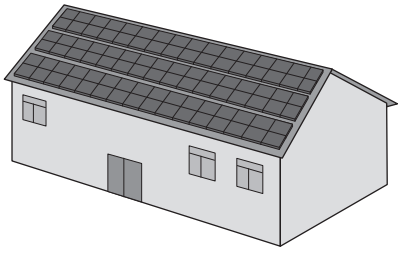
1 Solar cells need a large area of land because solar cells are not very efficient.

2 Solar cells need a large area of land because the Sun does not shine at night.

3 Solar cells need a small area of land because the Sun shines every day.

4 Solar cells need a small area of land because solar cells are very efficient.

9B The drawing shows an array of solar cells on the roof of a new village hall.



The solar cells produce more electricity than is needed by the hall.

The surplus electricity . . .

1 can be stored in the hall until it is needed.

2 can be stored in the solar cells until it is needed.

3 can be sold and transmitted by the National Grid.

4 is wasted energy and spreads out.

The amount of electricity produced each year by an array of solar cells depends on:

- the area of the array
- the angle of tilt of the array
- the direction that the array faces
- which part of the country the array is in.

Question 70 · continued

The map shows how much solar radiation, in kWh / m^2, falls on different parts of the UK each year.

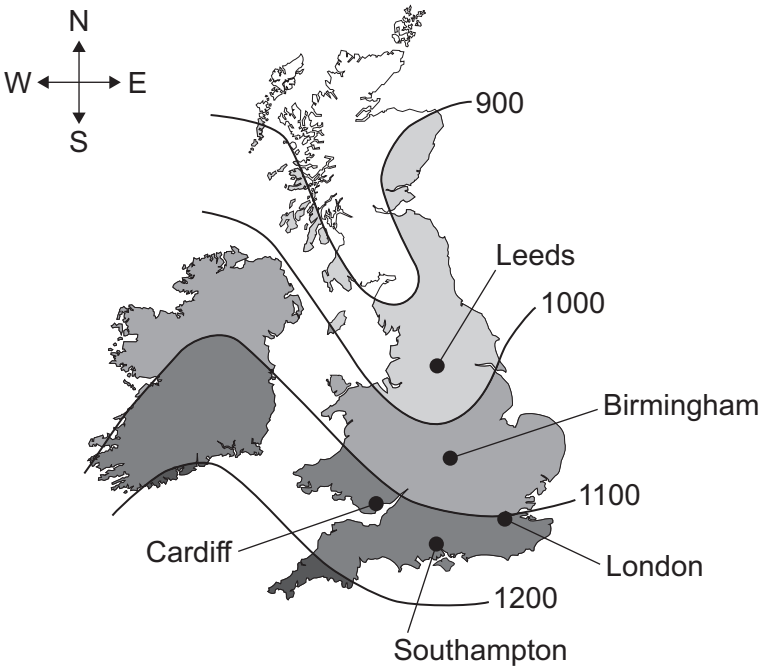


Table 1 gives figures for the annual solar radiation, in kWh / m^2, for London. The table also gives data for various angles of tilt and for various directions that an array faces.

Table 1

Angle of tilt of array to the horizontal	Direction that the array faces				
	South	South-west	West	North-west	North
30°	1042	997	886	762	709
45°	1023	968	829	666	621
60°	960	900	753	580	485
Vertical	724	684	565	427	360

9C Which row in **Table 2** gives the biggest amount of solar radiation?

Table 2

	Location	Angle of tilt in degrees	Direction that the array faces
1	Birmingham	30	South
2	Southampton	30	West
3	Leeds	60	West
4	Cardiff	30	South

Question 9 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 70 · continued

9D An array with an area of 20 m^2 is installed on a roof in London at an angle of 60°. The array faces south-west. The efficiency of the array is 0.2

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

What is the annual amount of electrical energy produced by the array?

1 3600 kWh

2 4500 kWh

3 18000 kWh

4 90000 kWh

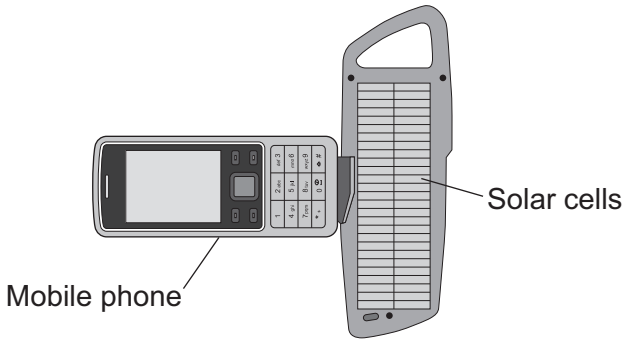
END OF TEST

4.2.4.2 Energy transfers in everyday appliances

Question 71

June 2011 | PHY1H | Original Q4 | Legacy

4 (a) The diagram shows a solar powered device being used to recharge a mobile phone.



On average, the solar cells produce 0.6 joules of electrical energy each second.
The solar cells have an efficiency of 0.15.

4 (a) (i) Use the following equation to calculate the average energy input each second to the device.

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

Show clearly how you work out your answer.

.....

.....

Average energy input each second = ... J/s

(2 marks)

4 (a) (ii) Draw a labelled Sankey diagram for the solar cells.
The diagram does **not** need to be drawn to scale.

(1 mark)

4.2.4.2 Energy transfers in everyday appliances

Question 71 · continued

4 (a) (iii) Energy from the Sun is stored by a rechargeable battery inside the device.

Suggest **one** factor that would affect the time it takes to fully charge the battery.

Give a reason for your answer.

.....

.....

.....

.....

(2 marks)

4 (b) Scientists have developed a new type of solar cell with an efficiency of over 40 %. The efficiency of the solar cell was confirmed independently by other scientists.

Suggest why it was important to confirm the efficiency independently.

.....

.....

(1 mark)

4 (c) The electricity used in homes in the UK is normally generated in a fossil fuel power station.

Outline some of the advantages of using solar cells to generate this electricity.

.....

.....

.....

.....

(2 marks)

8

4.2.4.2 Energy transfers in everyday appliances

Question 72

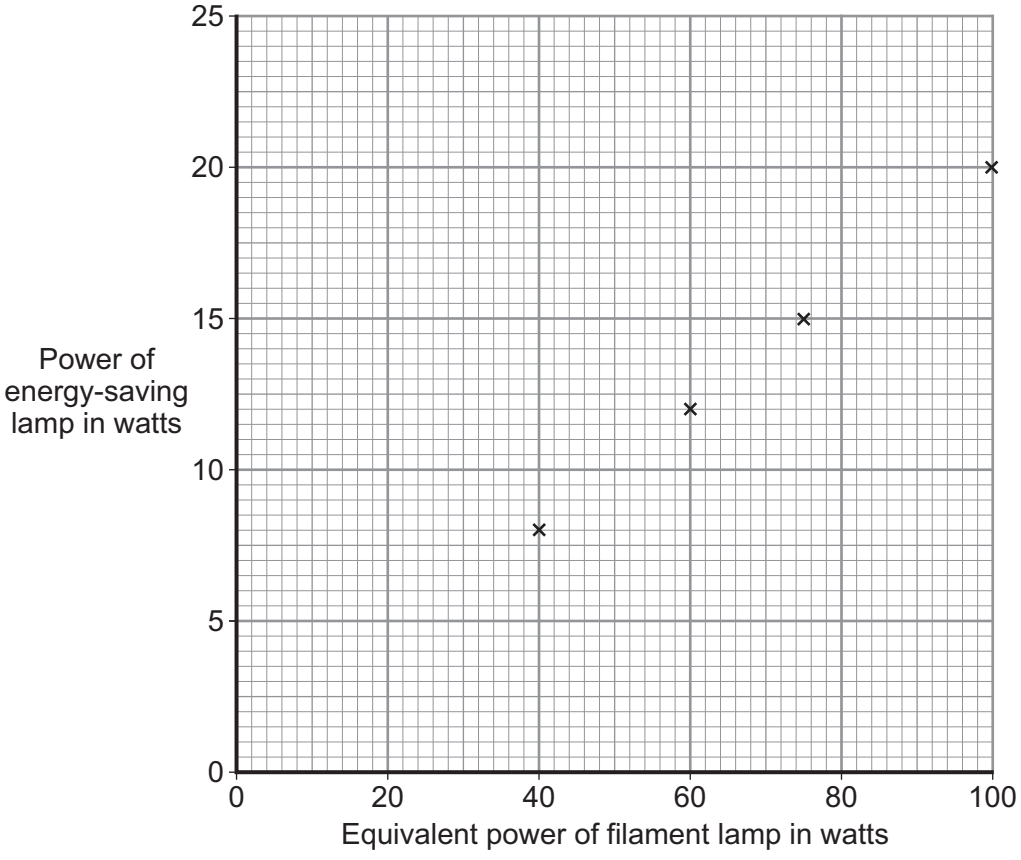
November 2011 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

A householder bought an energy-saving lamp. The following table was printed on the box.

Power of energy-saving lamp in W	Equivalent power of filament lamp in W
8	40
12	60
15	75
20	100

5A The graph shows the data given in the table.



To see if the power of the filament lamp is directly proportional to the power of the energy-saving lamp, you should . . .

1 draw a line of best fit and see if it passes through (0,0).

2 change the watts to kilowatts.

3 produce a bar chart.

4 use a different scale.

4.2.4.2 Energy transfers in everyday appliances

Question 72 · continued

5B Assume that the power of the filament lamp is directly proportional to the power of the energy-saving lamp.

What is the power of an energy-saving lamp that is equivalent to a 150 W filament lamp?

1 8 W

2 18 W

3 30 W

4 35 W

5C The efficiency of a 100 W filament lamp is 0.15.

What is the efficiency of a 20 W energy-saving lamp?

1 0.03

2 0.15

3 0.30

4 0.75

5D The government has decided to stop the sale of filament lamps. This is to save on the amount of fuel needed for making electricity.

Most energy-saving lamps contain toxic chemicals. Safety campaigners say that energy-saving lamps must be disposed of carefully.

Which row in the table correctly describes the types of issue given above that concern the government and safety campaigners?

	The Government	Safety campaigners
1	environmental	economic
2	economic	environmental
3	ethical	social
4	social	ethical

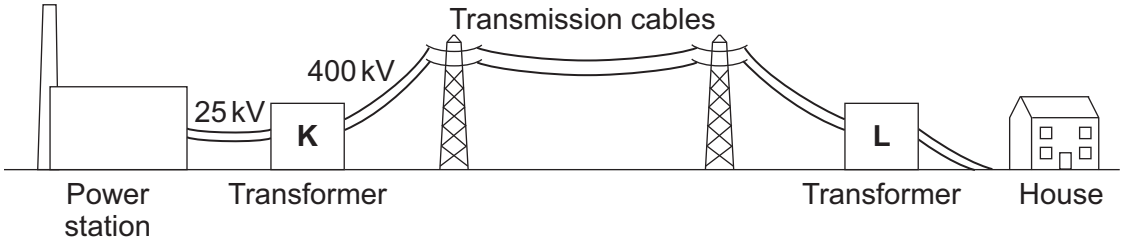
4.2.4.2 Energy transfers in everyday appliances

Question 73

November 2011 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

Electricity is transmitted around the country through the National Grid.



6A The voltage from the power station is stepped up from 25 kV to 400 kV in transformer **K** so that . . .

1 the current decreases.

2 the current increases.

3 the current travels faster.

4 the current travels more slowly.

6B Increasing the voltage also . . .

1 increases energy losses from the cables.

2 makes the National Grid more efficient.

3 makes the National Grid safer.

4 means a step-down transformer is not needed.

6C Which row of the table shows what happens in transformer **L**?

	Current	Voltage
1	decreases	decreases
2	decreases	increases
3	increases	decreases
4	increases	increases

4.2.4.2 Energy transfers in everyday appliances

Question 73 · continued

6D The amount of electrical energy that a device transfers depends on . . .

1 the current flowing through the device only.

2 for how long the device is switched on only.

3 the power of the device only.

4 the power of the device and for how long it is switched on.

Turn over for the next question

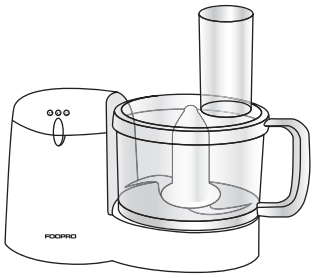
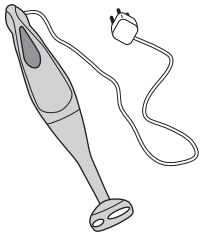
4.2.4.2 Energy transfers in everyday appliances

Question 74

November 2011 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

A food mixer and a hand-held blender can both be used for making soup. The ingredients are cooked and then processed to produce a smooth soup. Processing is done by metal blades spinning in the soup.

	Food mixer	Hand-held blender
		
Power rating	500 W	300 W
Volume of soup	300–500 cm^3	Up to 2000 cm^3
Feature	Lid	No lid

7A Which one of the following describes advantages of using the hand-held blender rather than the food mixer for making soup?

1 The hand-held blender can mix smaller volumes of soup and does not splash.

2 The hand-held blender uses more power and may splash hot soup on the user.

3 The hand-held blender can mix larger volumes of soup and does not splash.

4 The hand-held blender uses less power and can mix larger volumes of soup.

7B How much more does it cost to use the food mixer for 1 hour rather than the hand-held blender?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

Electricity costs 15 p per kilowatt-hour

1 3 p

2 4.5 p

3 7.5 p

4 30 p

7C As the soup is being processed, it cools down.

Which soup will probably cool down the quickest?

1 the soup processed by the food mixer, because it has a lid that stops convection

2 the soup processed by the food mixer, because the container is made of plastic

3 the soup processed by the hand-held blender, because there is no lid to stop convection

4 the soup processed by the hand-held blender, because the soup is not as hot

7D The processed soup is put into a saucepan and reheated.

Heat is transferred through the soup because the soup at the bottom of the saucepan . . .

1 contracts, becomes less dense and falls.

2 expands, becomes more dense and falls.

3 contracts, becomes more dense and rises.

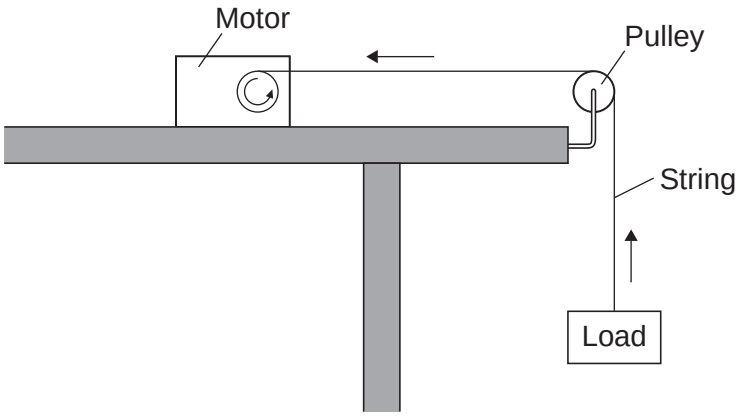
4 expands, becomes less dense and rises.

4.2.4.2 Energy transfers in everyday appliances

Question 75

June 2012 | PH1HP | Original Q2 | Legacy

2 A student uses an electric motor to lift a load.



In the motor, the electrical energy is transferred into other types of energy. Some of this energy is useful and the rest of the energy is wasted.

2 (a) (i) Name the useful energy output from the electric motor.

.....

(1 mark)

2 (a) (ii) What eventually happens to the wasted energy?

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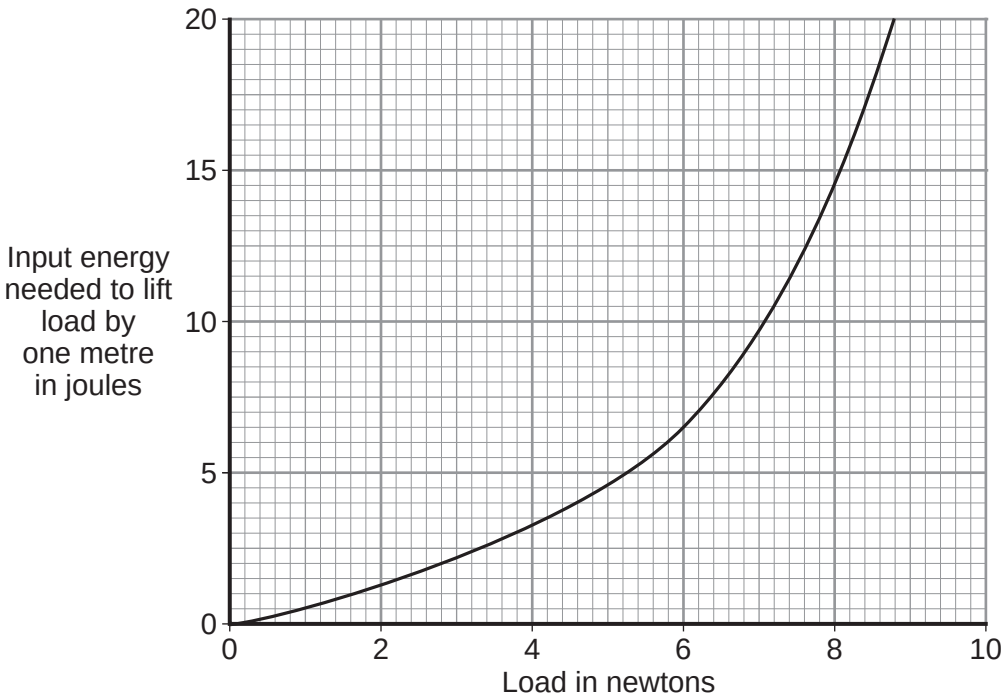
(1 mark)

Question 2 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 75 · continued

2 (b) The graph shows the input energy the motor needs to lift different loads by one metre.



What can you conclude from the graph about the relationship between the load lifted and the input energy needed?

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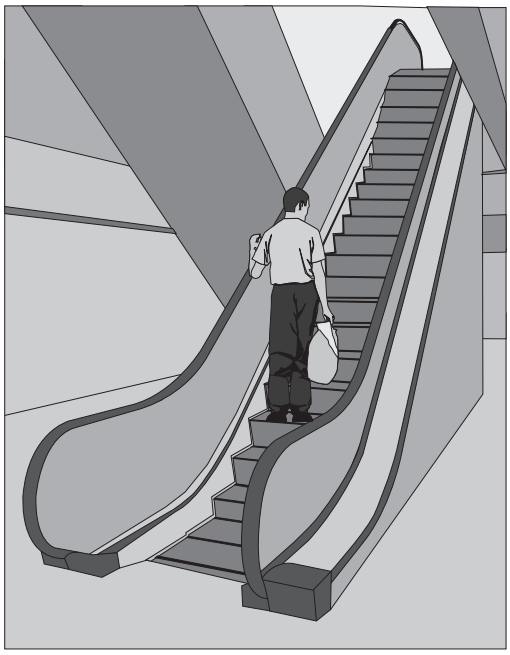
.....

(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 75 · continued

2 (c) A shop uses escalators to lift customers to different floor levels. The escalators use electric motors. When the shop is not busy some escalators are turned off.
A sign tells the customers that the escalators are turned off to save energy.



2 (c) (i) Each escalator has one motor with an average power of 4000 W. The motor is turned on for an average of 8 hours each day, 6 days each week. Electricity costs 15 pence per kilowatt-hour.

Calculate the cost of the electricity used in an average week to run **one** escalator.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Cost = ... pence
(3 marks)

2 (c) (ii) Give **one** environmental advantage to turning off electrical appliances when they are not being used.

.....

.....
(1 mark)

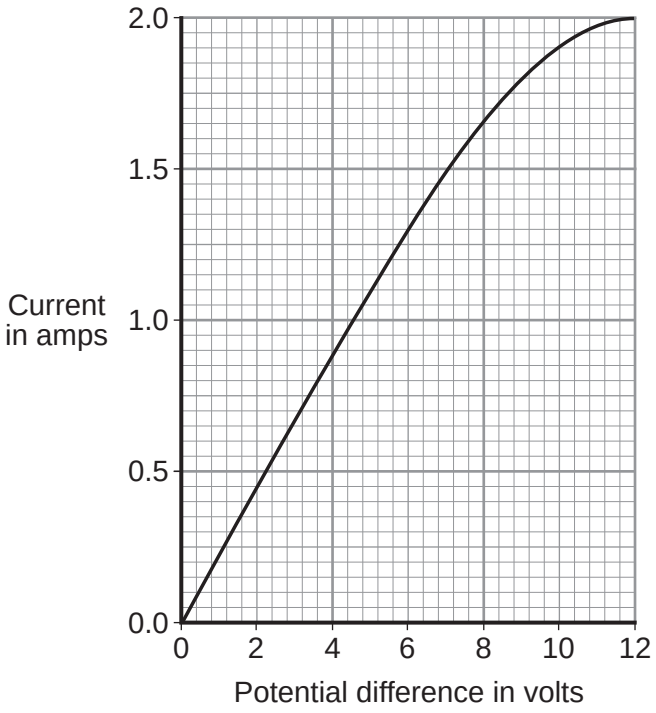
8

4.2.4.2 Energy transfers in everyday appliances

Question 76

June 2012 | PH2HP | Original Q5 | Legacy

5 The graph shows how the electric current through a 12 V filament bulb varies with the potential difference across the bulb.



5 (a) What is the meaning of the following terms?

electric current

.....

.....

potential difference

.....

.....

(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 76 · continued

5 (b) The resistance of the metal filament inside the bulb increases as the potential difference across the bulb increases.

Explain why.

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(3 marks)

5 (c) Use data from the graph to calculate the rate at which the filament bulb transfers energy, when the potential difference across the bulb is 6 V.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Rate of energy transfer = ... W

(2 marks)

7

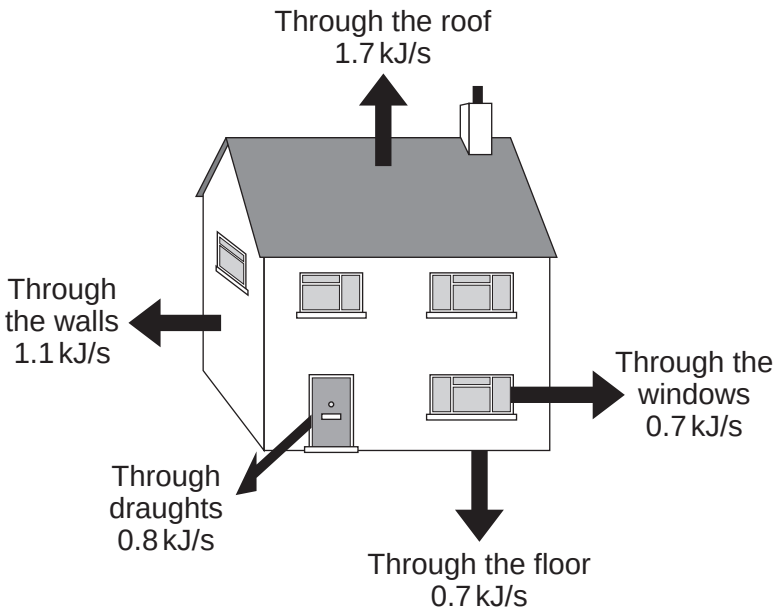
4.2.4.2 Energy transfers in everyday appliances

Question 77

January 2013 | PH1HP | Original Q1 | Legacy

1 **Diagram 1** shows the energy transferred per second from a badly insulated house on a cold day in winter.

Diagram 1



1 (a) (i) When the inside of the house is at a constant temperature, the energy transferred from the heating system to the inside of the house equals the energy transferred from the house to the outside.

Calculate, in kilowatts, the power of the heating system used to keep the inside of the house in **Diagram 1** at a constant temperature.

1 kilowatt (kW) = 1 kilojoule per second (kJ/s)

.....

Power of the heating system = ... kW

(1 mark)

4.2.4.2 Energy transfers in everyday appliances

Question 77 · continued

1 (a) (ii) In the winter, the heating system is switched on for a total of 7 hours each day.

Calculate, in kilowatt-hours, the energy transferred each day from the heating system to the inside of the house.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Energy transferred each day = ... kWh

(2 marks)

1 (a) (iii) Energy costs 15 p per kilowatt-hour.

Calculate the cost of heating the house for one day.

.....

Cost = ...

(1 mark)

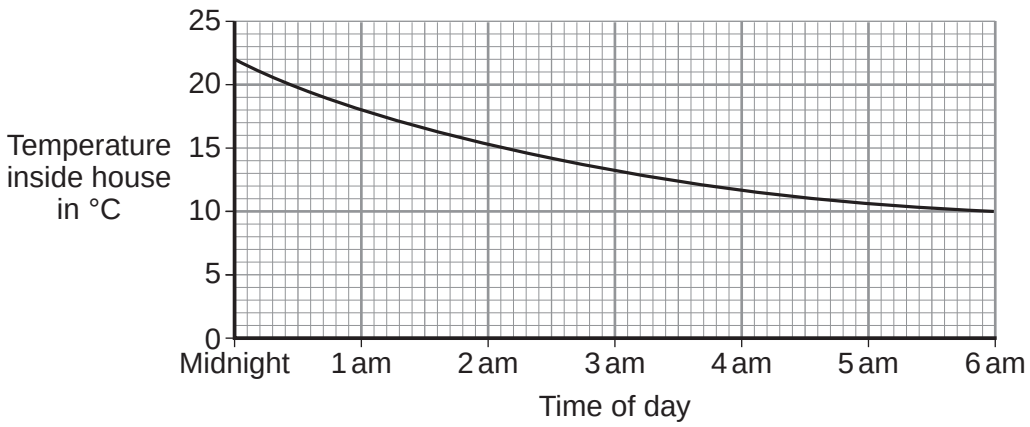
Question 1 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 77 · continued

1 (a) (iv) The heating system is switched off at midnight.

The graph shows how the temperature inside the house changes after the heating system has been switched off.



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

Between midnight and 6 am the rate of energy transfer from

the house

decreases.
decreases then stays constant.
increases.

Give the reason for your answer.

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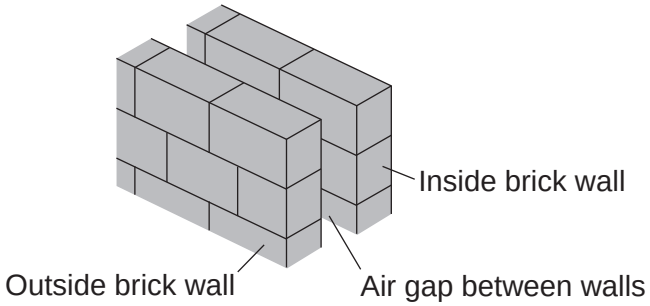
(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 77 · continued

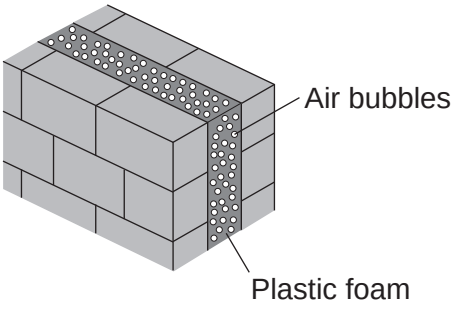
1 (b) **Diagram 2** shows how the walls of the house are constructed.
Diagram 3 shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

Diagram 2



U-value of the wall = 0.7

Diagram 3



U-value of the wall = 0.3

1 (b) (i) The plastic foam reduces energy transfer by convection.

Explain why.

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(2 marks)

1 (b) (ii) Filling the air gap with plastic foam reduces the U-value of the wall.

What is meant by the term *U-value*?

.....

.....

(1 mark)

Question 1 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 77 · continued

1 (c) A homeowner has part of the outside wall of her house removed and replaced with double-glazed glass doors.

U-value of the wall = 0.3
U-value of glass doors = 1.8

Explain the effect of replacing part of the outside wall with glass doors on the rate of energy transfer from the house.

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(2 marks)

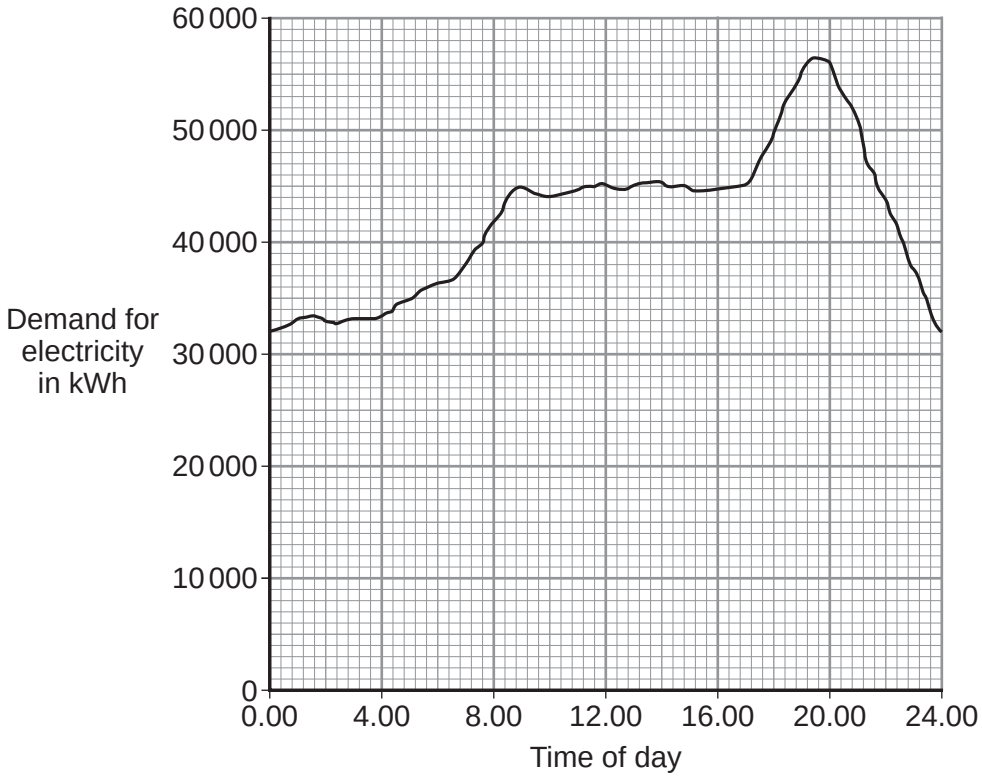
11

4.2.4.2 Energy transfers in everyday appliances

Question 78

January 2013 | PH1HP | Original Q3 | Legacy

3 (a) The graph shows how the demand for electricity in the UK changes during one 24-hour period.



The table gives the start-up times for two types of power station.

Type of power station	Start-up time
Gas	A few minutes
Nuclear	Several days

How would these two types of power station be used to meet the demand for electricity during this 24-hour period?

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(3 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 78 · continued

3 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

A farmer plans to generate all the electricity needed on her farm, using either a biogas generator or a small wind turbine.

The biogas generator would burn methane gas. The methane gas would come from rotting the animal waste produced on the farm. When burnt, methane produces carbon dioxide.

The biogas generator would cost £18 000 to buy and install. The wind turbine would cost £25 000 to buy and install.

The average power output from the wind turbine would be the same as the continuous output from the biogas generator.

Evaluate the advantages and disadvantages of the two methods of generating electricity.

Conclude, with a reason, which system would be better for the farmer to buy and install.

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(6 marks)

9

4.2.4.2 Energy transfers in everyday appliances

Question 79

June 2013 | PH1HP | Original Q3 | Legacy

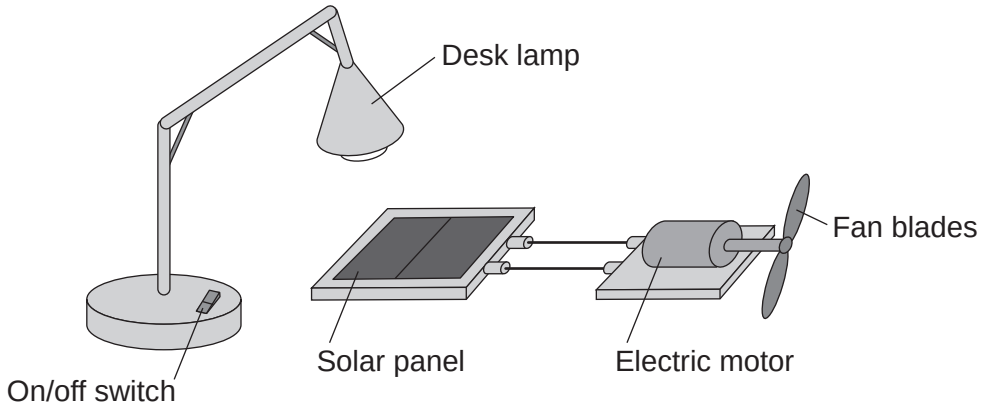
3 (a) Light waves transfer energy.

3 (a) (i) Complete the following sentence.

The oscillations producing a light wave are ..... to the direction of the energy transfer by the light wave.

(1 mark)

3 (a) (ii) The apparatus in the diagram shows that light waves transfer energy.



Describe how switching the desk lamp on and off shows that light waves transfer energy.

You do **not** need to describe the energy transfers.

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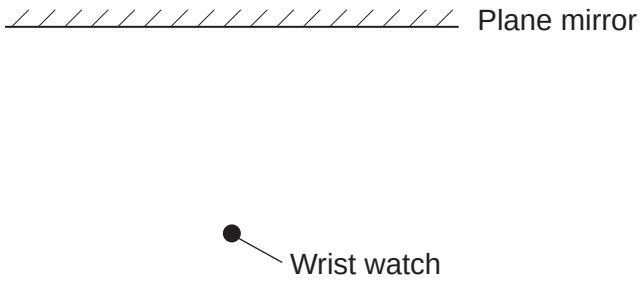
(2 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 79 · continued

3 (b) A student holds a wrist watch in front of a plane mirror. The student can see an image of the wrist watch in the mirror.

The diagram shows the position of the wrist watch and the mirror.



Draw a ray diagram showing how the image of the wrist watch is formed.

Mark the position of the image.

(4 marks)

3 (c) The image of the wrist watch seen by the student is virtual.

What is a virtual image?

.....

.....

(1 mark)

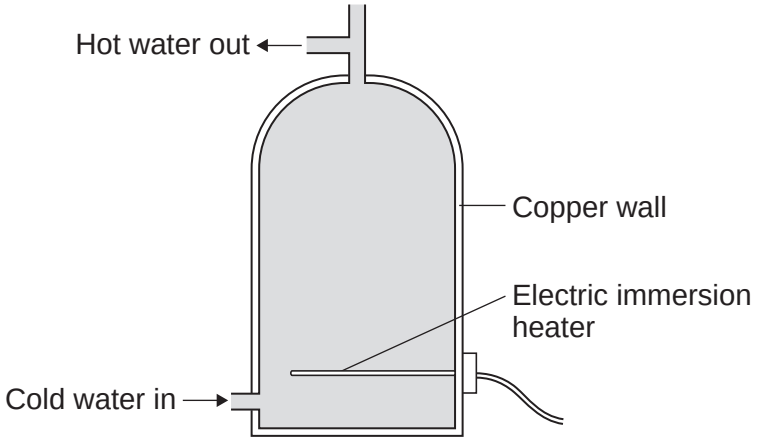
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4.2.4.2 Energy transfers in everyday appliances

Question 80

June 2013 | PH1HP | Original Q5 | Legacy

5 An electric immersion heater is used to heat the water in a domestic hot water tank. When the immersion heater is switched on the water at the bottom of the tank gets hot.



5 (a) Energy is transferred by the process of convection from the hot water at the bottom of the tank to the cooler water at the top.

Explain how.

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(4 marks)

5 (b) Complete the following sentence.

The main way the energy is transferred through the copper wall of the water tank is by the process of ..... .

(1 mark)

Question 5 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

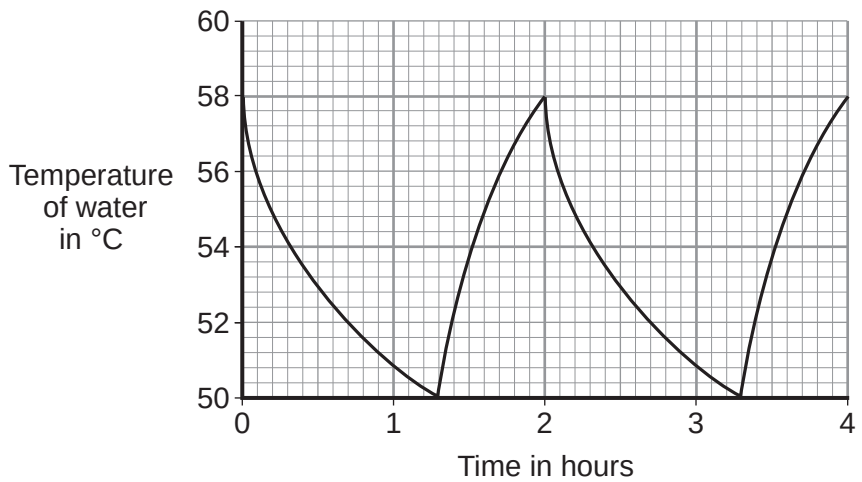
Question 80 · continued

5 (c) The immersion heater has a thermostat to control the water temperature.

When the temperature of the water inside the tank reaches 58°C the thermostat switches the heater off. The thermostat switches the heater back on when the temperature of the water falls to 50°C.

Graph A shows how the temperature of the water inside a hot water tank changes with time. The tank is **not** insulated.

Graph A (no insulation)



5 (c) (i) The temperature of the water falls at the fastest rate just after the heater switches off.

Explain why.

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(2 marks)

5 (c) (ii) To heat the water in the tank from 50°C to 58°C the immersion heater transfers 4032 kJ of energy to the water.

Calculate the mass of water in the tank.

Specific heat capacity of water = 4200 J/kg°C
Use the correct equation from the Physics Equations Sheet.

.....

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.....

Mass = ... kg

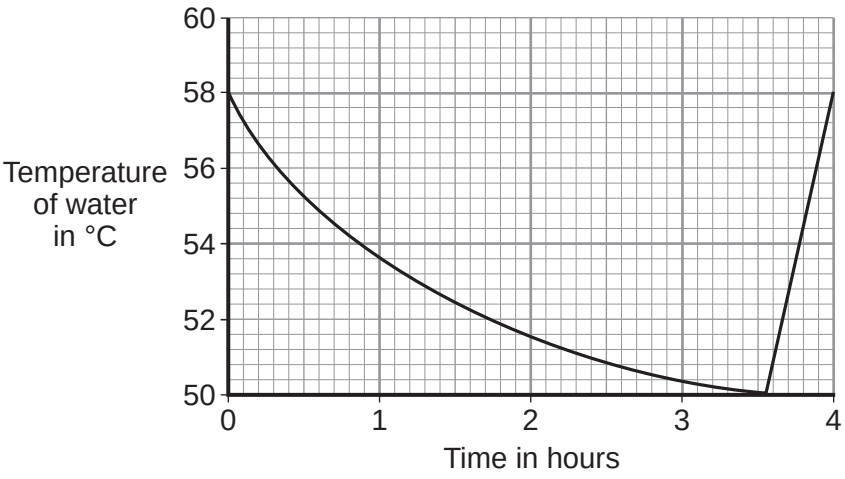
(3 marks)

Question 80 · continued

5 (c) (iii) An insulating jacket is fitted to the hot water tank.

Graph B shows how the temperature of the water inside the insulated hot water tank changes with time.

Graph B



An insulating jacket only costs £12.

By comparing **Graph A** with **Graph B**, explain why fitting an insulating jacket to a hot water tank saves money.

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(3 marks)

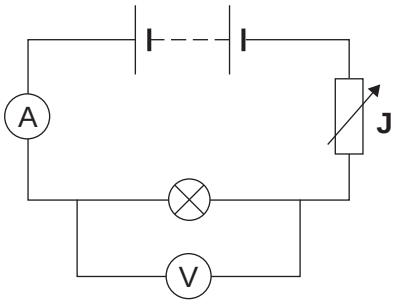
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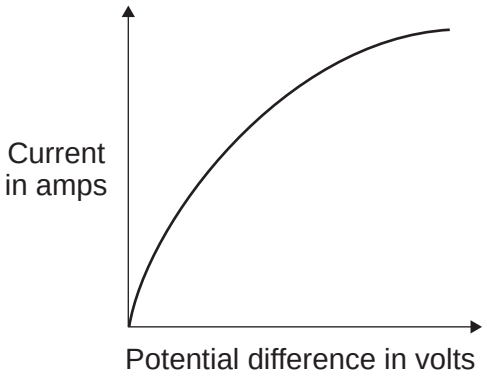
4.2.4.2 Energy transfers in everyday appliances

Question 81

June 2013 | PH2HP | Original Q2 | Legacy

2 (a) The diagram shows the circuit used to obtain the data needed to plot the current–potential difference graph for a filament bulb.





2 (a) (i) Why is the component labelled '**J**' included in the circuit?

.....

.....

(1 mark)

2 (a) (ii) The resistance of the bulb increases as the potential difference across the bulb increases. Why?

.....

.....

(1 mark)

2 (a) (iii) The bulb is at full brightness when the potential difference across the bulb is 12 V. The current through the bulb is then 3 A.

Calculate the power of the bulb when it is at full brightness and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Power = ...

(3 marks)

4.2.4.2 Energy transfers in everyday appliances

Question 81 · continued

2 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The table gives data about two types of light bulb people may use in their homes.

Type of light bulb	Energy efficiency	Cost of one light bulb	Average lifetime in hours
Halogen	10%	£1.95	2 000
Light Emitting Diode (LED)	32%	£11.70	36 000

Both types of light bulb produce the same amount of light.

Evaluate, in terms of cost and energy efficiency, the use of the two types of light bulb.

To gain full marks you must compare both types of light bulb and conclude which light bulb would be the best to use.

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(6 marks)

11

4.2.4.2 Energy transfers in everyday appliances

Question 82

June 2014 | PH1HP | Original Q1 | Legacy

1 Electricity can be generated using various energy sources.

1 (a) Give **one** advantage and **one** disadvantage of using nuclear power stations rather than gas-fired power stations to generate electricity.

[2 marks]

Advantage .....

.....

Disadvantage .....

.....

1 (b) (i) A single wind turbine has a maximum power output of 2 000 000 W.

The wind turbine operated continuously at maximum power for 6 hours.

Calculate the energy output in kilowatt-hours of the wind turbine.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Energy output = ... kWh

1 (b) (ii) Why, on average, do wind turbines operate at maximum power output for only 30% of the time?

[1 mark]

.....

.....

1 (c) An on-shore wind farm is made up of many individual wind turbines.

They are connected to the National Grid using underground power cables.

Give **one** advantage of using underground power cables rather than overhead power cables.

[1 mark]

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6

4.2.4.2 Energy transfers in everyday appliances

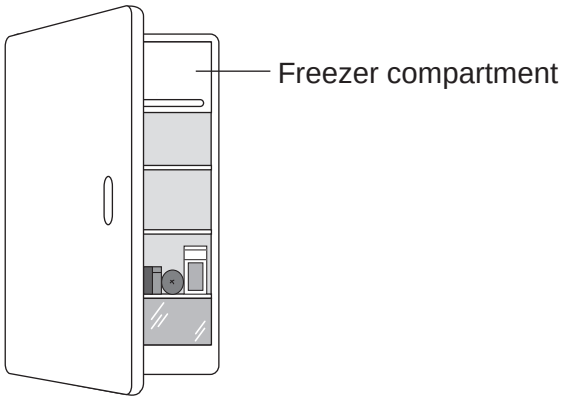
Question 83

June 2014 | PH1HP | Original Q6 | Legacy

6 (a) **Figure 6** shows a fridge with a freezer compartment.

The temperature of the air inside the freezer compartment is –5 °C.

Figure 6



The air inside the fridge forms a convection current when the fridge door is closed.
Explain why.

[4 marks]

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4.2.4.2 Energy transfers in everyday appliances

Question 83 · continued

6 (b) **Table 1** shows information about four fridges.

Table 1

Fridge	Volume in litres	Energy used in one year in kWh
A	250	300
B	375	480
C	500	630
D	750	750

A householder concludes that the energy used in one year is directly proportional to the volume of the fridge.

Explain why her conclusion is **not** correct.

Use data from the table in your answer.

[2 marks]

.....

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.....

6 (c) New fridges are more efficient than fridges made twenty years ago.

Give **one** advantage and **one** disadvantage of replacing an old fridge with a new fridge.

Ignore the cost of buying a new fridge.

[2 marks]

Advantage .....

.....

Disadvantage .....

.....

8

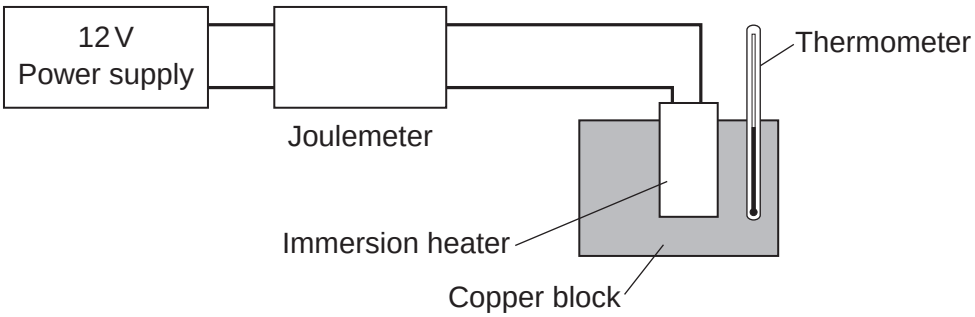
4.2.4.2 Energy transfers in everyday appliances

Question 84

June 2014 | PH1HP | Original Q7 | Legacy

7 A student used the apparatus in **Figure 7** to obtain the data needed to calculate the specific heat capacity of copper.

Figure 7



The initial temperature of the copper block was measured.

The power supply was switched on.

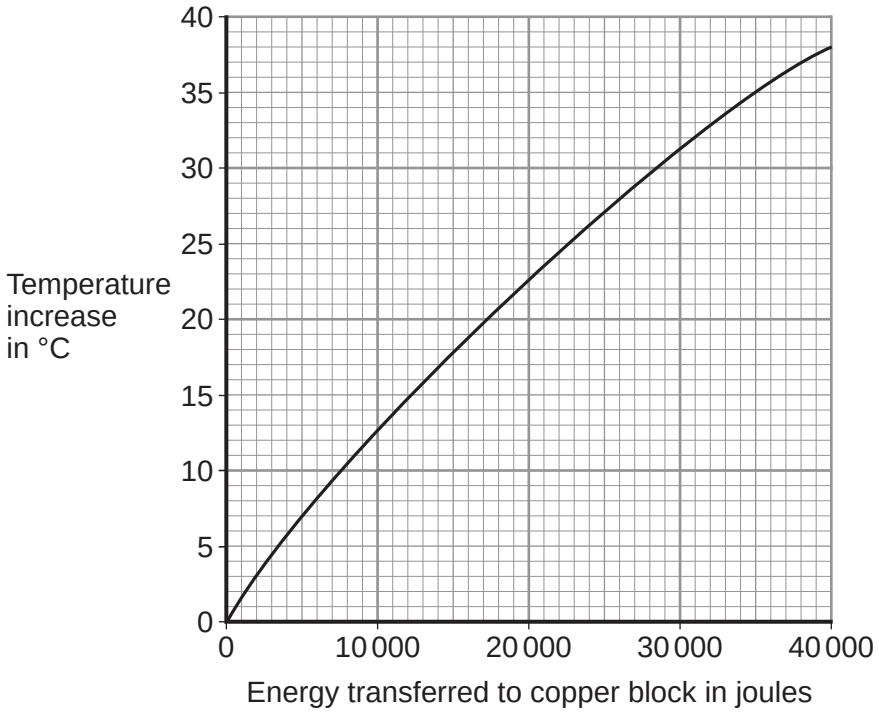
The energy transferred by the heater to the block was measured using the joulemeter.

The temperature of the block was recorded every minute.

The temperature increase was calculated.

Figure 8 shows the student's results.

Figure 8



4.2.4.2 Energy transfers in everyday appliances

Question 84 · continued

7 (a) Energy is transferred through the copper block.

What is the name of the process by which the energy is transferred?

Tick (✓) **one** box.

[1 mark]

Conduction ☐

Convection ☐

Radiation ☐

7 (b) Use **Figure 8** to determine how much energy was needed to increase the temperature of the copper block by 35 °C.

[1 mark]

..... joules

7 (c) The copper block has a mass of 2 kg.

Use your answer to part **(b)** to calculate the value given by this experiment for the specific heat capacity of copper. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

.....

Specific heat capacity = ...

7 (d) This experiment does **not** give the correct value for the specific heat of copper.

Suggest **one** reason why.

[1 mark]

.....

.....

6

4.2.4.2 Energy transfers in everyday appliances

Question 85

June 2014 | PH1HP | Original Q8 | Legacy

8 **Table 2** shows information about different light bulbs.

The bulbs all have the same brightness.

Table 2

Type of bulb	Input power in watts	Efficiency
Halogen	40	0.15
Compact fluorescent (CFL)	14	0.42
LED	7	0.85

8 (a) (i) Calculate the useful power output of the CFL bulb.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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.....

Useful power output = ... watts

8 (a) (ii) Use your answer to part **(a)(i)** to calculate the waste energy produced each second by a CFL bulb.

[1 mark]

.....

Waste energy per second = ... joules

Question 8 continues on the next page

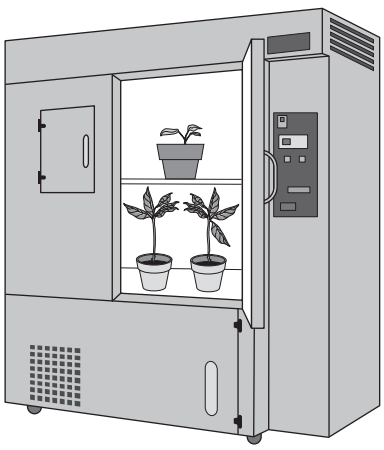
4.2.4.2 Energy transfers in everyday appliances

Question 85 · continued

8 (b) (i) A growth cabinet is used to investigate the effect of light on the rate of growth of plants.

Figure 9 shows a growth cabinet.

Figure 9



In the cabinet the factors that affect growth can be controlled.

A cooler unit is used to keep the temperature in the cabinet constant. The cooler unit is programmed to operate when the temperature rises above 20 °C.

The growth cabinet is lit using 50 halogen bulbs.

Changing from using halogen bulbs to LED bulbs would reduce the cost of running the growth cabinet.

Explain why.

[4 marks]

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4.2.4.2 Energy transfers in everyday appliances

Question 85 · continued

8 (b) (ii) A scientist measured the rate of growth of plants for different intensities of light.

What type of graph should be drawn to present the results?

[1 mark]

.....

Give a reason for your answer.

.....

.....

8 (c) **Table 3** gives further information about both a halogen bulb and an LED bulb.

Table 3

Type of bulb	Cost to buy	Lifetime in hours	Operating cost over the lifetime of one bulb
Halogen	£1.50	2 000	£16.00
LED	£30.00	48 000	£67.20

A householder needs to replace a broken halogen light bulb.

Compare the cost efficiency of buying and using halogen bulbs rather than an LED bulb over a time span of 48 000 hours of use.

Your comparison must include calculations.

[4 marks]

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12

4.2.4.2 Energy transfers in everyday appliances

Question 86

June 2015 | PH1HP | Original Q1 | Legacy

1 **Figure 1** shows a man using a leaf blower to move leaves.

Figure 1



The leaf blower is powered by an electric motor connected to a battery.

1 (a) Energy transfers take place when the leaf blower is being used.

Complete the following sentences.

[3 marks]

The battery stores ..... energy which is transferred into electrical energy.

The electric motor transfers electrical energy usefully into ..... energy.

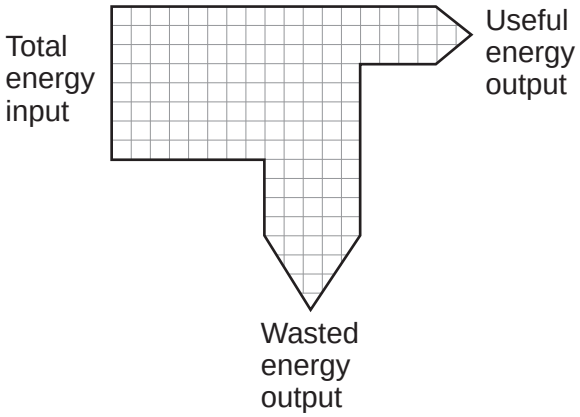
The motor wastes energy as ..... and as energy that heats the surroundings.

4.2.4.2 Energy transfers in everyday appliances

Question 86 · continued

1 (b) **Figure 2** shows a Sankey diagram for the leaf blower.

Figure 2



Use **Figure 2** to calculate the efficiency of the leaf blower.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Efficiency = ...

5

4.2.4.2 Energy transfers in everyday appliances

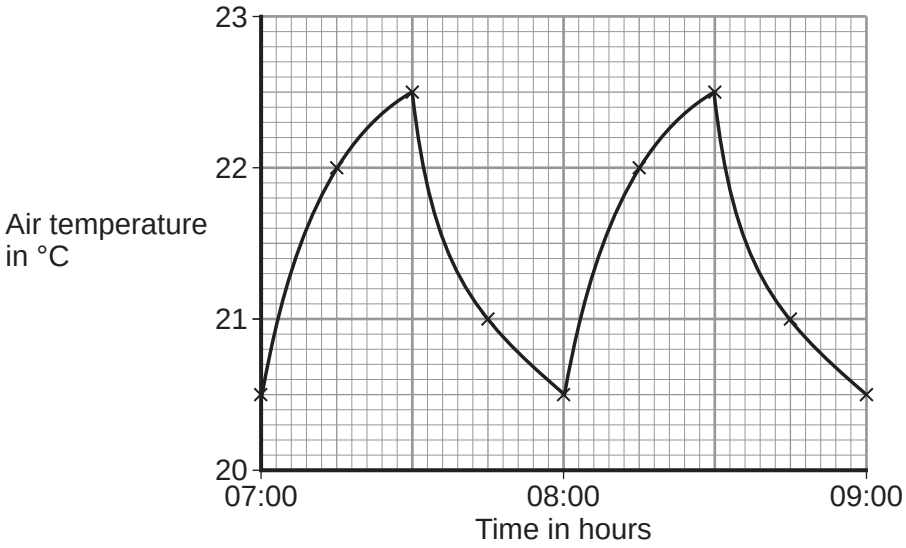
Question 87

June 2015 | PH1HP | Original Q3 | Legacy

3 A householder monitored how the air temperature inside his house changed over a 2-hour period. The householder measured the temperature every 15 minutes.

Figure 3 shows how the temperature changed with time.

Figure 3



3 (a) (i) The householder used a digital thermometer to measure the temperature.

What would be an appropriate resolution for the digital thermometer?

[1 mark]

Draw a ring around your answer.

0.5 °C **1 °C** **5 °C**

3 (a) (ii) The householder's results are shown on a line graph in **Figure 3**.

Why would it **not** be appropriate to use the results to plot a bar chart?

[1 mark]

.....

.....

4.2.4.2 Energy transfers in everyday appliances

Question 87 · continued

3 (b) The householder's heating is controlled by a thermostat. The thermostat switches the heating on when the temperature decreases below a certain temperature.

3 (b) (i) At what temperature does the thermostat switch the heating on?

[1 mark]

..... °C

3 (b) (ii) Use **Figure 3** to determine the number of minutes that the householder's heating was switched on between 07:00 and 09:00.

[1 mark]

.....

.....

Time = ... minutes

Question 3 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 87 · continued

3 (c) The householder read the following extract from a newspaper article about reducing energy use in the home.

> . . . decreasing the temperature setting on your thermostat by 1 °C will reduce your heating bill by 10% . . .

On Monday, the householder set his thermostat at 20.0 °C and recorded the energy, in kWh, used to heat his house.

On Tuesday, the householder set his thermostat at 19.0 °C and recorded the energy, in kWh, used to heat his house.

Table 2 shows the results of the householder's investigation.

Table 2

Thermostat setting in °C	Energy in kWh
20.0	8.0
19.0	7.2

3 (c) (i) The outside temperature was the same on both days.

Give **one** reason why this was important.

[1 mark]

.....

.....

3 (c) (ii) Explain how the results shown in **Table 2** support the extract from the newspaper article.

Justify your answer with a calculation.

[2 marks]

.....

.....

.....

.....

4.2.4.2 Energy transfers in everyday appliances

Question 87 · continued

3 (c) (iii) The statement in the extract is **not** valid for all situations.
Suggest why.

[2 marks]

.....

.....

.....

.....

9

Turn over for the next question

4.2.4.2 Energy transfers in everyday appliances

Question 88

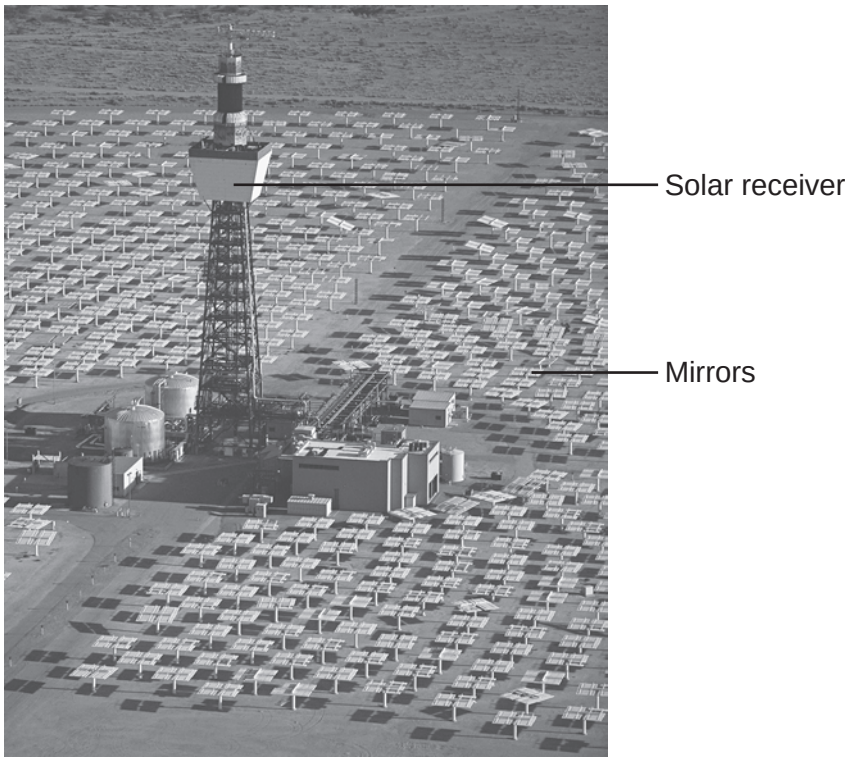
June 2015 | PH1HP | Original Q5 | Legacy

5 **Figure 5** shows a solar thermal power station that has been built in a hot desert.

The power station uses energy from the Sun to heat water to generate electricity.

Energy from the Sun is reflected towards a solar receiver using many mirrors.

Figure 5



5 (a) (i) Which part of the electromagnetic spectrum provides most of the energy to heat the water in a solar thermal power station?

[1 mark]

.....

4.2.4.2 Energy transfers in everyday appliances

Question 88 · continued

5 (a) (ii) Describe how heated water is used to generate electricity by this solar thermal power station.
The process is the same as in a fossil fuel power station.

[3 marks]

.....

.....

.....

.....

.....

.....

5 (b) A new type of solar power station, called a solar storage power station, is able to store energy from the Sun by heating molten chemical salts.
The stored energy can be used to generate electricity at night.

5 (b) (i) It is important that the molten chemical salts have a high specific heat capacity.
Suggest **one** reason why.

[1 mark]

.....

.....

5 (b) (ii) The solar storage power station can store a maximum of 2 200 000 kWh of energy.
The solar storage power station can supply a town with a maximum electrical power of 140 000 kW.

Calculate for how many hours the energy stored by the solar storage power station can supply the town with electrical power.

Give your answer to 2 significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Time = ... hours

Question 5 continues on the next page

Question 88 · continued

5 (b) (iii) **Table 3** gives information about the place where the solar storage power station has been built.

Table 3

Season	Mean number of daylight hours	Mean power received from the Sun per square metre in kW
Spring	11.5	0.90
Summer	13.5	1.10
Autumn	12.0	0.95
Winter	10.5	0.71

The solar storage power station does not operate at the maximum possible electrical output every day of the year.

Suggest why.

[2 marks]

.....

.....

.....

.....

5 (c) Power stations do not work at maximum possible electrical output all the time.
The 'capacity factor' of a power station is calculated using the equation:

$$\text{Capacity factor} = \frac{\text{actual electrical output per year}}{\text{maximum possible electrical output per year}}$$

4.2.4.2 Energy transfers in everyday appliances

Question 88 · continued

Table 4 shows capacity factors for different types of power station.

Table 4

Type of power station	Renewable energy source	Capacity factor
Coal	No	0.41
Natural gas	No	0.48
Nuclear	No	0.66
Solar thermal	Yes	0.33
Tidal	Yes	0.26
Wind turbine	Yes	0.30

5 (c) (i) Compare the capacity factors of the renewable power stations with those of the non-renewable power stations in **Table 4**.
Explain the reason for the difference between the capacity factors.

[3 marks]

.....

.....

.....

.....

.....

.....

5 (c) (ii) The capacity factor of a solar storage power station is higher than for all other renewable power stations.
Suggest **one** reason why.

[1 mark]

.....

.....

14

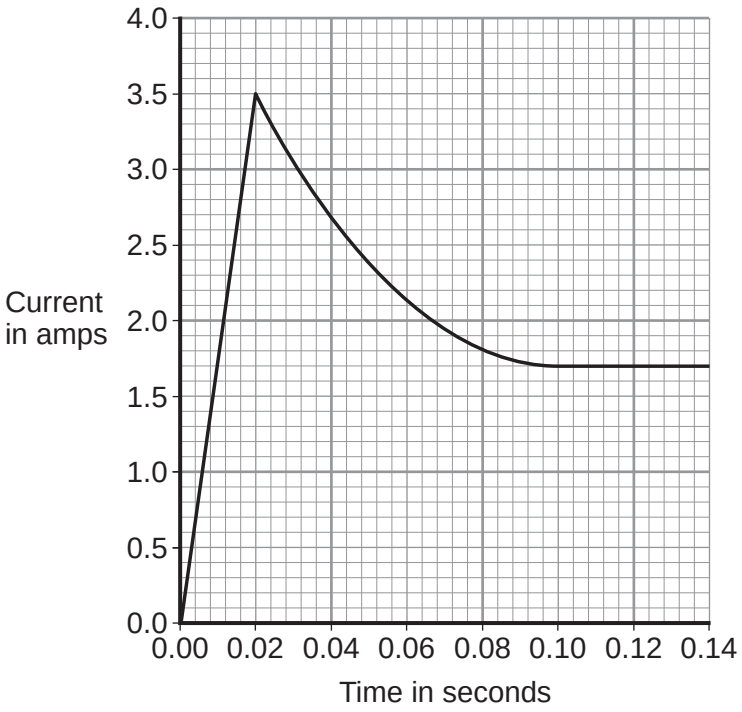
4.2.4.2 Energy transfers in everyday appliances

Question 89

June 2015 | PH2HP | Original Q5 | Legacy

5 A 12 V filament bulb is connected to a 12 V power supply.
Figure 6 shows how the current changes after the bulb is switched on.

Figure 6



5 (a) (i) After 0.10 seconds, the bulb works at its normal brightness.

What is the current through the bulb when it is working at normal brightness?

[1 mark]

Current = ... A

5 (a) (ii) The bulb works at normal brightness for 30 seconds before it is switched off.

Calculate the charge that flows through the bulb in the 30 seconds before it is switched off. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Charge = ... unit .....

4.2.4.2 Energy transfers in everyday appliances

Question 89 · continued

5 (a) (iii) Calculate the energy transferred by the 12 V bulb when it is working at normal brightness for 30 seconds.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

Energy transferred = ... J

5 (b) Between 0.02 seconds and 0.08 seconds, there is an increase in both the resistance and the temperature of the metal filament inside the bulb.

Explain, in terms of the electrons and ions inside the filament, why both the temperature and the resistance increase.

[2 marks]

.....

.....

.....

.....

.....

.....

8

4.2.4.2 Energy transfers in everyday appliances

Question 90

June 2016 | PH1HP | Original Q6 | Legacy

6 All European Union countries are expected to generate 20% of their electricity using renewable energy sources by 2020.

The estimated cost of generating electricity in the year 2020 using different energy sources is shown in **Table 1**.

Table 1

Energy source	Estimated cost (in the year 2020) in pence per kWh
Nuclear	7.8
Solar	25.3
Tidal	18.8
Wind	10.0

France generated 542 billion kWh of electricity using nuclear power stations in 2011. France used 478 billion kWh of electricity and sold the rest of the electricity to other countries in 2011.

6 (a) France may continue generating large amounts of electricity using nuclear power stations instead of using renewable energy resources.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

4.2.4.2 Energy transfers in everyday appliances

Question 90 · continued

6 (b) Give **two** disadvantages of generating electricity using nuclear power stations.

[2 marks]

1 _____

_____

2 _____

_____

6 (c) A panel of solar cells has an efficiency of 0.15.

The total power input to the panel of solar cells is 3.2 kW.

Calculate the useful power output of this panel of solar cells in kW.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

_____

Useful power output = _____ kW

Question 6 continues on the next page

Question 90 · continued

6 (d) **Table 2** shows the manufacturing cost and efficiency of different types of panels of solar cells.

Table 2

Type of Solar Panel	Cost to manufacture a 1 m^2 solar panel in £	Efficiency in %
A	40.00	20
B	22.50	15
C	5.00	10

Some scientists think that having a low manufacturing cost is more important than improving the efficiency of solar cells.

Use information from **Table 2** to suggest why.

[2 marks]

8

4.2.4.2 Energy transfers in everyday appliances

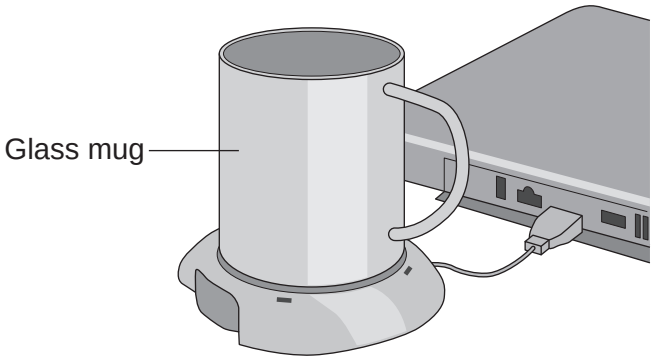
Question 91

June 2016 | PH1HP | Original Q8 | Legacy

8 A heater uses energy from a laptop computer to keep a mug of coffee hot.

Figure 9 shows the heater connected to a laptop computer.

Figure 9



8 (a) Give **two** factors, other than the material of the mug, that would affect the rate of energy transfer to the coffee.

[2 marks]

1 _____

2 _____

8 (b) Energy is conducted slowly through the base of the glass mug.

Explain how energy is conducted through the base of the glass mug.

[2 marks]

_____

_____

_____

_____

4.2.4.2 Energy transfers in everyday appliances

Question 91 · continued

8 (c) Energy is transferred to the coffee at the bottom of the mug.

Explain how a convection current is set up in the coffee.

[4 marks]

8

4.2.4.2 Energy transfers in everyday appliances

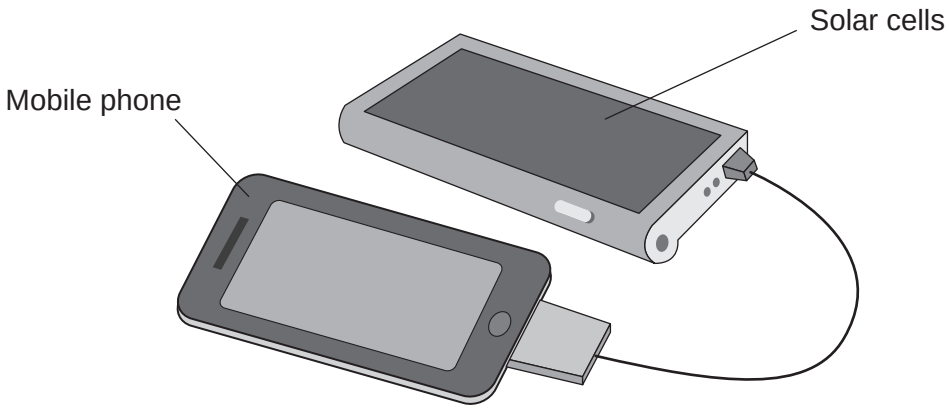
Question 92

June 2017 | PH1HP | Original Q6 | Legacy

6 **Figure 6** shows a mobile phone battery being charged using solar cells.

The useful power output of the solar cells is 2.5 W

Figure 6



6 (a) The efficiency of the solar cells is 40%.

Calculate the total power input to the solar cells.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Total power input = _____ W

6 (b) The mobile phone battery can store 36 kJ of energy and was initially uncharged.

Calculate the minimum time, in hours, it would take to fully charge the mobile phone battery using these solar cells.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Time = _____ hours

4.2.4.2 Energy transfers in everyday appliances

Question 92 · continued

6 (c) Explain why the power **output** of the solar cells may be lower than 2.5 W

[2 marks]

6 (d) Explain why the time taken to recharge this mobile phone battery using these solar cells depends on whether the phone is switched on or off.

[2 marks]

9

4.2.4.2 Energy transfers in everyday appliances

Question 93

June 2017 | PH2HP | Original Q5 | Legacy

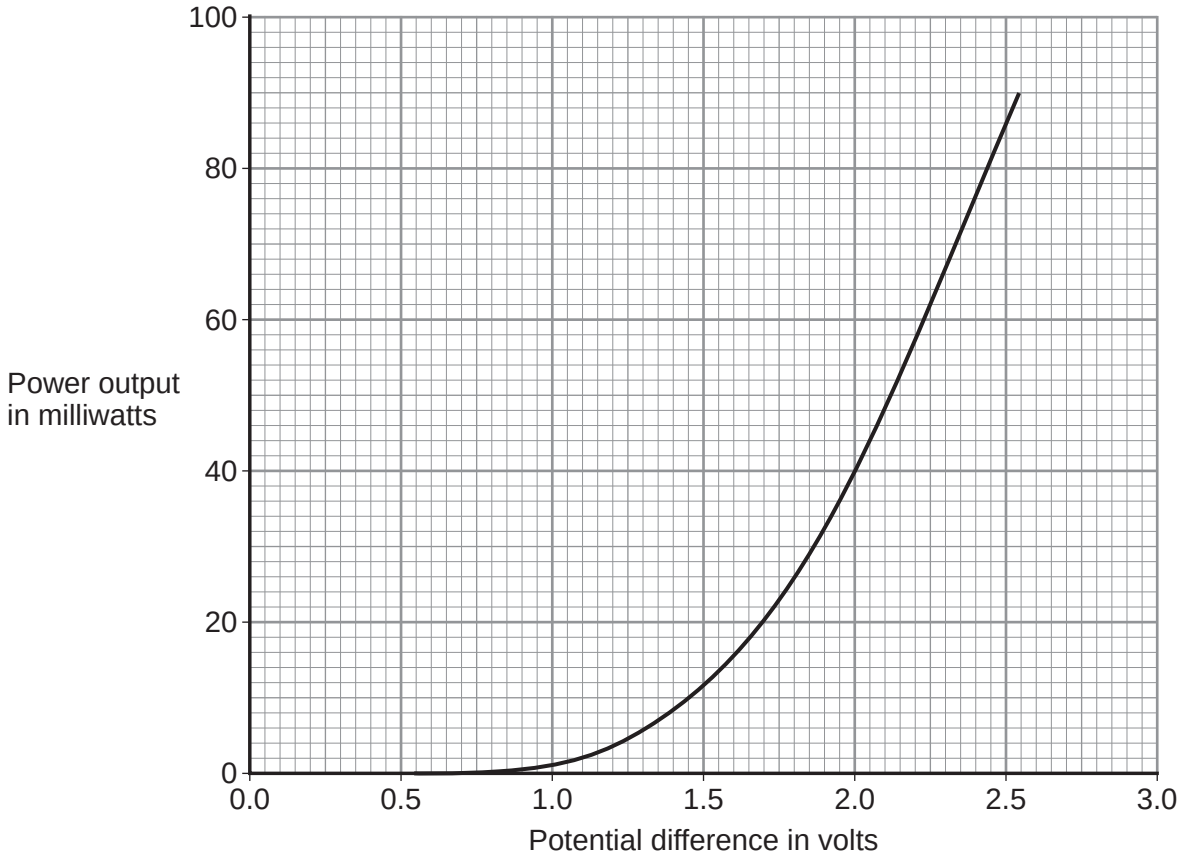
5 The lighting in a home may be provided by LED bulbs, filament bulbs or halogen bulbs.

5 (a) (i) In the box below, draw the circuit symbol for an LED.

[1 mark]

5 (a) (ii) **Figure 6** shows how the power output from one type of LED varies with the potential difference across the LED.

Figure 6



1 milliwatt = 0.001 W

4.2.4.2 Energy transfers in everyday appliances

Question 93 · continued

The LED is connected in series with a battery and resistor.
The potential difference across the LED is 2.0 V

Use data from **Figure 6** to calculate the energy transferred by the LED in 5 minutes.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Energy transferred = _____ J

5 (b) The resistance of a filament bulb increases as the temperature of the filament increases.

Explain, in terms of the electrons and ions inside the filament, why the resistance increases.

[2 marks]

5 (c) Why are LED bulbs cheaper to use than filament bulbs or halogen bulbs that produce the same brightness of light?

[1 mark]

4.2.4.2 Energy transfers in everyday appliances

Question 94

June 2019 | 8463/1H | Original Q1

0 1 Light bulbs are labelled with a power input.

0 1 . 1 What does power input mean?

[1 mark]

Tick (✓) **one** box.

- The charge transferred each second by the bulb. ☐
- The current through the bulb. ☐
- The energy transferred each second to the bulb. ☐
- The potential difference across the bulb. ☐

0 1 . 2 Write down the equation which links current, potential difference and power.

[1 mark]

_____

0 1 . 3 A light bulb has a power input of 40 W

The mains potential difference is 230 V

Calculate the current in the light bulb.

[3 marks]

_____

_____

_____

Current = _____ A

4.2.4.2 Energy transfers in everyday appliances

Question 94 · continued

Table 1 shows information about three different light bulbs.

Table 1

Light bulb	Total power input in watts	Useful power output in watts	Efficiency
P	6.0	5.4	0.90
Q	40	2.0	0.05
R	9.0	**X**	0.30

0 1 . 4 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 1 . 5 Calculate the value of **X** in **Table 1**.

[3 marks]

X = _____ W

0 1 . 6 In addition to power input, light bulbs should also be labelled with the rate at which they emit visible light.

Suggest why.

[2 marks]

11

4.2.4.2 Energy transfers in everyday appliances

Question 95

June 2019 | 8463/1H | Original Q6

0 6 **Figure 7** shows a person using an electric lawn mower.

Figure 7



0 6 . 1 The lawn mower is connected to the mains electricity supply.

What is the frequency of the mains electricity supply in the UK?

[2 marks]

Frequency = _____ Unit _____

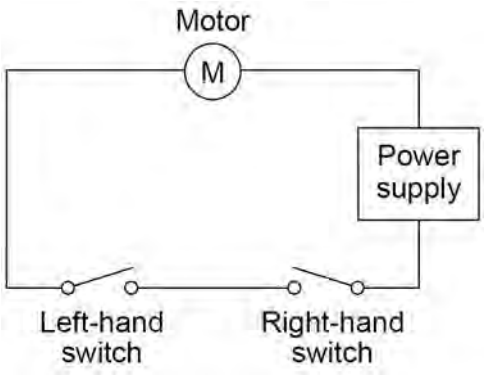
4.2.4.2 Energy transfers in everyday appliances

Question 95 · continued

The lawn mower has a switch on each side of the handle.

Figure 8 shows the circuit diagram for the lawn mower.

Figure 8



0 6 . 2 The motor in the lawn mower can only be turned on when the person using it holds the handle of the lawn mower with both hands.

Explain why.

[2 marks]

0 6 . 3 The power input to the motor is 1.8 kW

The resistance of the motor is 32 Ω

Calculate the current in the motor.

[3 marks]

Current = _____ A

4.2.4.2 Energy transfers in everyday appliances

Question 95 · continued

June 2019 | 8463/1H | Original Q6

0 6 . 4 The useful power output from the motor is 1.5 kW

Calculate the time it takes for the motor to transfer 450 000 J of useful energy.

[3 marks]

Time = _____ seconds

1

4.2.4.2 Energy transfers in everyday appliances

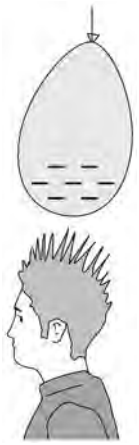
Question 96

June 2019 | 8463/1H | Original Q10

1 0 **Figure 12** shows a student after rubbing a balloon on his hair.

The balloon and hair have become charged.

Figure 12



1 0 . 1 Describe the force that acts on the student's hair in **Figure 12**.

[2 marks]

1 0 . 2 An earthed conductor was brought near the charged student.
A spark jumped between the conductor and the student.

The potential difference between the conductor and the student was 2.5 kV
The energy transferred by the spark was 0.0050 J

Calculate the charge transferred by the spark.

[3 marks]

Charge = _____ C

4.2.4.2 Energy transfers in everyday appliances

Question 96 · continued

1 0 . 3 A defibrillator can transfer a charge to regulate a person's heartbeat.

Figure 13 shows a defibrillator.

Figure 13



When the defibrillator is in use, a potential difference of 4800 V is applied across the person's chest.

A charge of 0.16 coulombs passes through the person's chest in 4.0 ms

Calculate the resistance of the person's chest.

[5 marks]

Resistance = _____ Ω

10

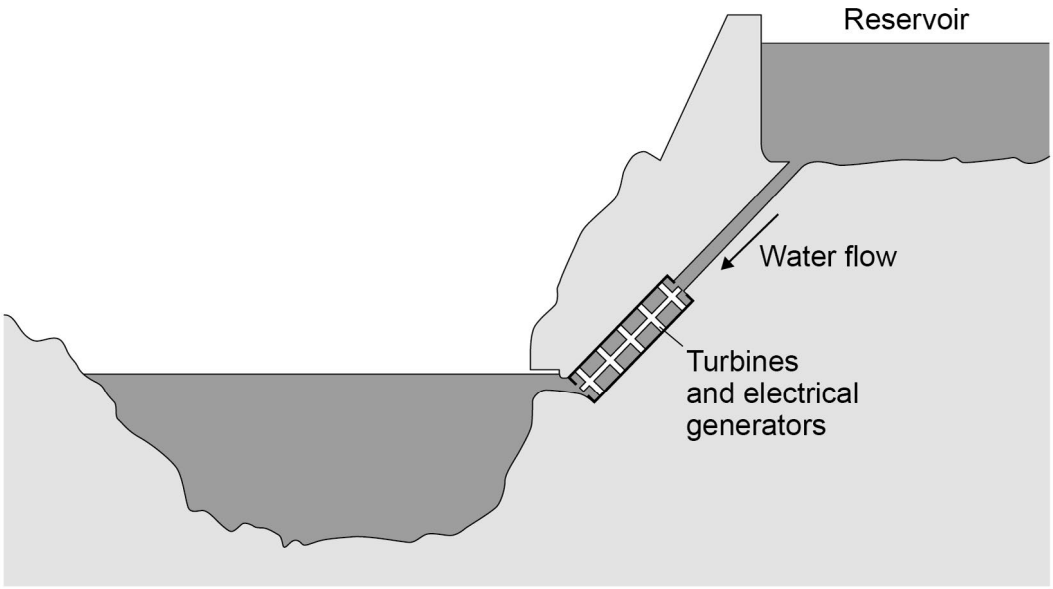
4.2.4.2 Energy transfers in everyday appliances

Question 97

November 2020 | 8463/1H | Original Q3

0 3 **Figure 4** shows a hydroelectric power station.

Figure 4



Electricity is generated when water from the reservoir flows through the turbines.

0 3 . 1 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

0 3 . 2 The reservoir stores 6 500 000 m^3 of water.

The density of the water is 998 kg/m^3.

Calculate the mass of water in the reservoir.

Give your answer in standard form.

[4 marks]

Mass (in standard form) = _____ kg

4.2.4.2 Energy transfers in everyday appliances

Question 97 · continued

0 3 . 3 Write down the equation which links energy transferred (E), power (P) and time (t).

[1 mark]

0 3 . 4 The electrical generators can provide 1.5×10^9 W of power for a maximum of 5 hours.

Calculate the maximum energy that can be transferred by the electrical generators.

[3 marks]

Energy transferred = _____ J

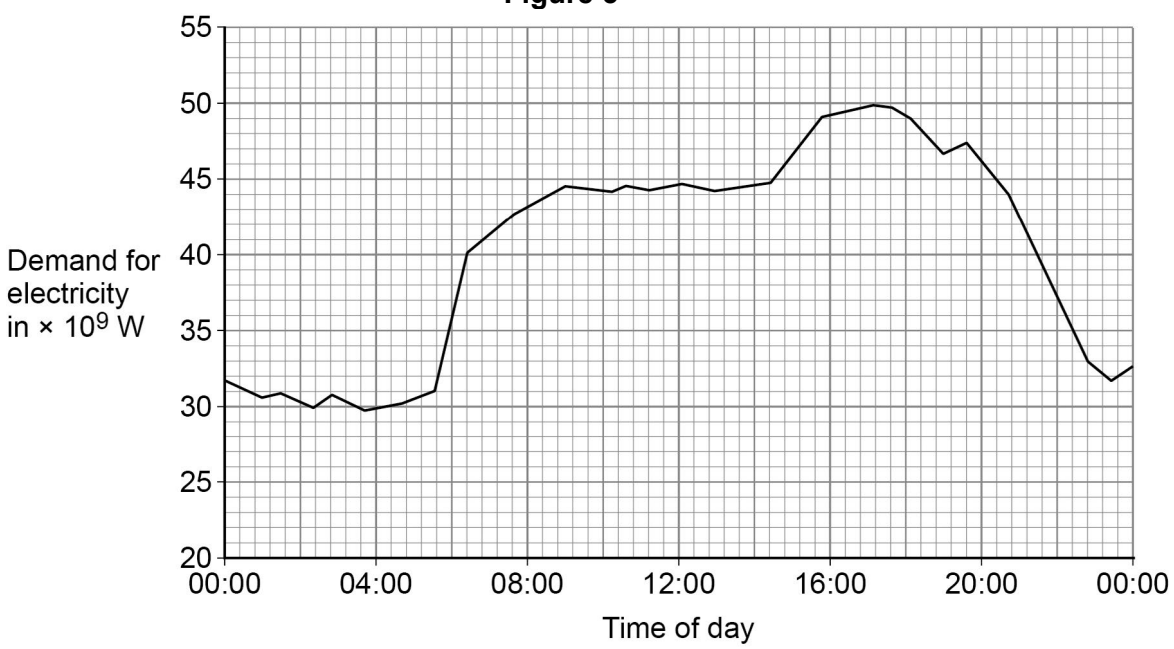
Question 3 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 97 · continued

0 3 . 5 **Figure 5** shows how the UK demand for electricity increases and decreases during one day.

Figure 5



The hydroelectric power station in **Figure 4** can provide 1.5×10^9 W of power for a maximum of 5 hours.

Give **two** reasons why this hydroelectric power station is not able to meet the increase in demand shown between 04:00 and 16:00 in **Figure 5**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

11

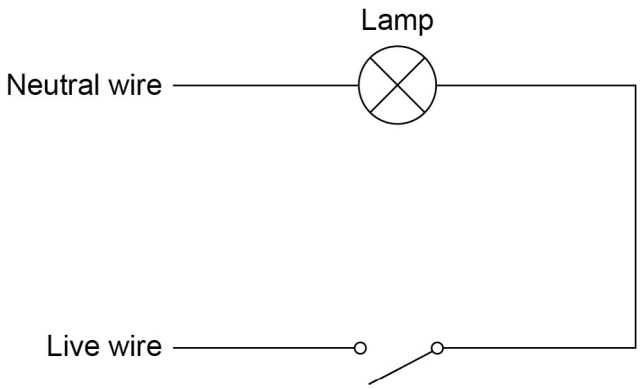
4.2.4.2 Energy transfers in everyday appliances

Question 98

November 2020 | 8463/1H | Original Q9

0 9 **Figure 13** shows part of a mains electricity lighting circuit in a house.

Figure 13



0 9 . 1 A fault in the switch caused a householder to receive a mild electric shock before a safety device switched the circuit off.

The mean power transfer to the person was 5.75 W.

The potential difference across the person was 230 V.

Calculate the resistance of the person.

[5 marks]

Resistance = _____ Ω

4.2.4.2 Energy transfers in everyday appliances

Question 98 · continued

0 9 . 2 An electrician replaced the switch.

The electrician would have received an electric shock unless the circuit was disconnected from the mains supply.

Explain why.

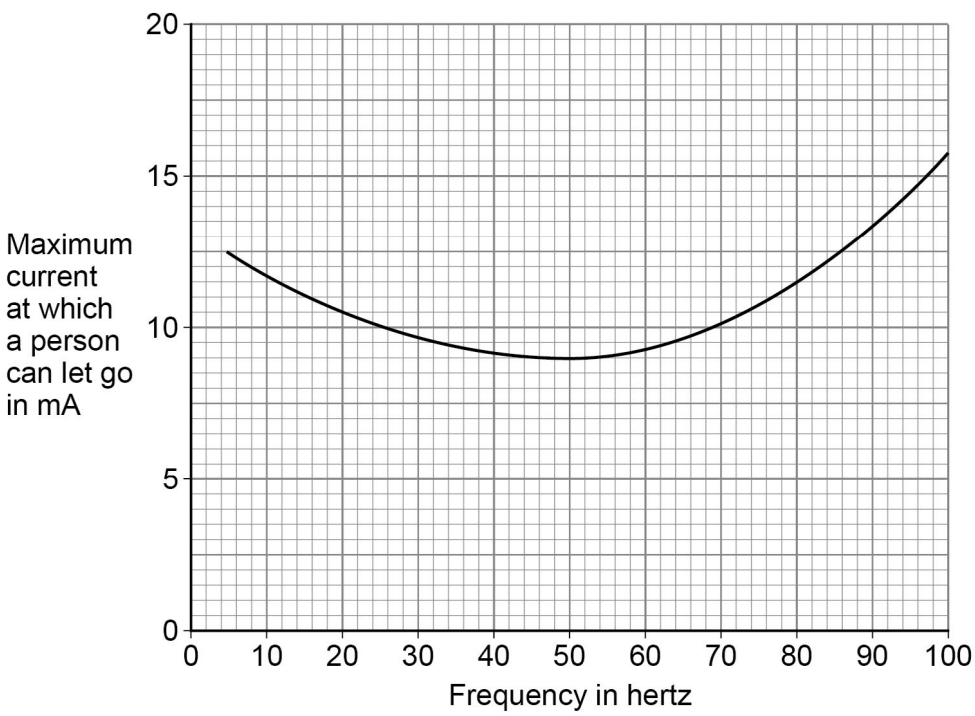
[3 marks]

Question 9 continues on the next page

0 9 . 3 The current from an electric shock causes a person's muscles to contract. The person cannot let go of the electrical circuit if the current is too high.

Figure 14 shows how the maximum current at which a person can let go depends on the frequency of the electricity supply.

Figure 14



The UK mains frequency is 50 Hz.

Explain why it would be safer if the UK mains frequency was **not** 50 Hz.

[2 marks]

10

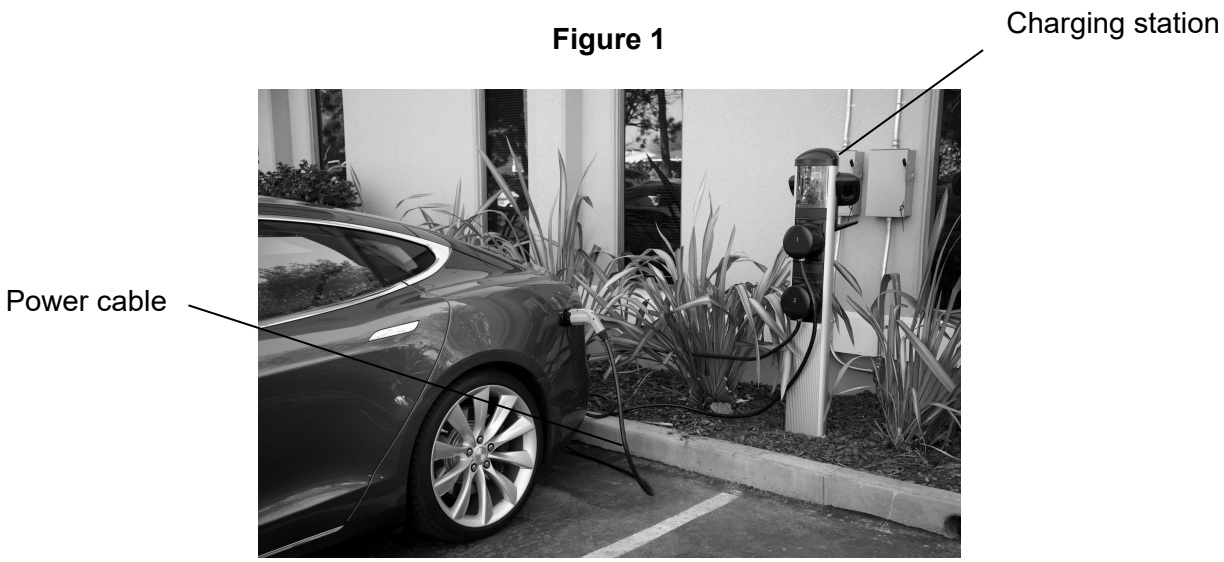
4.2.4.2 Energy transfers in everyday appliances

Question 99

November 2021 | 8463/1H | Original Q1

0 1 **Figure 1** shows an electric car being recharged.

Figure 1



0 1 . 1 The charging station applies a direct potential difference across the battery of the car.

What does 'direct potential difference' mean?

[1 mark]

Question 1 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 99 · continued

0 1 . 2 Which equation links energy transferred (E), power (P) and time (t)?

[1 mark]

Tick (✓) **one** box.

energy transferred = $\frac{\text{power}}{\text{time}}$ ☐

energy transferred = $\frac{\text{time}}{\text{power}}$ ☐

energy transferred = power × time ☐

energy transferred = power^2 × time ☐

0 1 . 3 The battery in the electric car can store 162 000 000 J of energy.

The charging station has a power output of 7200 W.

Calculate the time taken to fully recharge the battery from zero.

[3 marks]

Time taken = _____ s

4.2.4.2 Energy transfers in everyday appliances

Question 99 · continued

0 1 . 4 Which equation links current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$I = V \times R$ ☐

$I = V^2 \times R$ ☐

$R = I \times V$ ☐

$V = I \times R$ ☐

0 1 . 5 The potential difference across the battery is 480 V.

There is a current of 15 A in the circuit connecting the battery to the motor of the electric car.

Calculate the resistance of the motor.

[3 marks]

Resistance = _____ Ω

Question 1 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 99 · continued

0 1 . 6 Different charging systems use different electrical currents.

- Charging system **A** has a current of 13 A.
- Charging system **B** has a current of 26 A.
- The potential difference of both charging systems is 230 V.

How does the time taken to recharge a battery using charging system **A** compare with the time taken using charging system **B**?

[1 mark]

Tick (✓) **one** box.

Time taken using system **A** is half the time of system **B** ☐

Time taken using system **A** is the same as system **B** ☐

Time taken using system **A** is double the time of system **B** ☐

10

4.2.4.2 Energy transfers in everyday appliances

Question 100

November 2021 | 8463/1H | Original Q5

0 5 . 1 During one year, 1.25×10^{18} J of energy was transferred from the National Grid.

number of seconds in 1 year = 3.16×10^{7}

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

[2 marks]

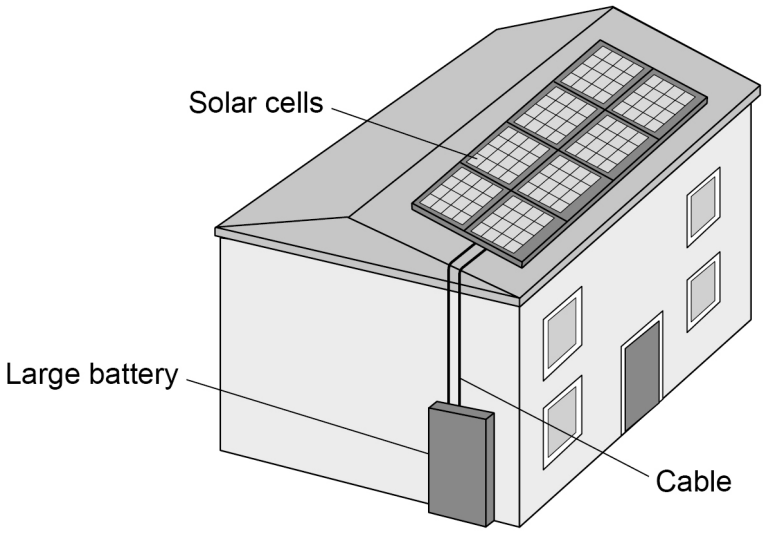
Energy each second (3 significant figures) = _____ J

Figure 5 shows a house with a solar power system.

The solar cells generate electricity.

When the electricity generated by the solar cells is not needed, the energy is stored in a large battery.

Figure 5



4.2.4.2 Energy transfers in everyday appliances

Question 100 · continued

0 5 . 2 The charge flow through the cable between the solar cells and the battery in 24 hours was 27 000 coulombs.

Calculate the mean current in the cable.

[4 marks]

Mean current = _____ A

0 5 . 3 At one time, the total power input to the solar cells was 7.8 kW.

The efficiency of the solar cells was 0.15

Calculate the useful power output of the solar cells.

[3 marks]

Useful power output = _____ W

Question 5 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 100 · continued

November 2021 | 8463/1H | Original Q5

0 5 . 4 It is unlikely that **all** of the electricity that the UK needs can be generated by solar power systems.

Explain why.

[2 marks]

11

4.2.4.2 Energy transfers in everyday appliances

Question 101

June 2022 | 8463/1H | Original Q3

0 3 An engineering company has invented pavement tiles that generate electricity as people walk on them.

Figure 3 shows someone walking on the pavement tiles.

Figure 3



Use the Physics Equations Sheet to answer questions **03.1** and **03.2**.

0 3 . 1 What equation links current (I), potential difference (V) and power (P)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{V}{I}$ ☐

$P = V \times I$ ☐

$I = P \times V$ ☐

$V = I^2 \times P$ ☐

4.2.4.2 Energy transfers in everyday appliances

Question 101 · continued

0 3 . 2 When a person walks on a tile, a potential difference of 40 V is induced across the tile.

The power output of the tile is 4.4 W.

Calculate the current in the tile.

[3 marks]

Current = _____ A

Question 3 continues on the next page

4.2.4.2 Energy transfers in everyday appliances

Question 101 · continued

Use the Physics Equations Sheet to answer questions **03.3** and **03.4**.

0 3 . 3 What equation links efficiency, total power input and useful power output?

[1 mark]

Tick (✓) **one** box.

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

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

Efficiency = useful power output × total power input ☐

0 3 . 4 The tiles are used to power LED lights in the pavement.

An LED light has a total power input of 4.0 W.

The efficiency of the LED light is 0.85

Calculate the useful power output of the LED light.

[3 marks]

Useful power output = _____ W

8

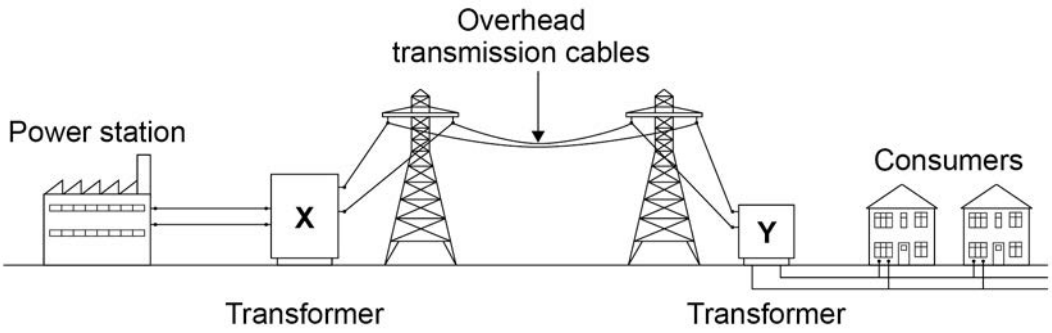
4.2.4.2 Energy transfers in everyday appliances

Question 102

June 2022 | 8463/1H | Original Q6

0 6 **Figure 8** shows how electricity is supplied to consumers by the National Grid.

Figure 8



0 6 . 1 Explain why transformer **X** is used in the National Grid.

[4 marks]

0 6 . 2 Explain why transformer **Y** is used in the National Grid.

[2 marks]

4.2.4.2 Energy transfers in everyday appliances

Question 102 · continued

0 6 . 3 The town of Hornsdale in Australia has electricity supplied by a huge battery.

On one day the battery transferred 3.24×10^{11} J of energy to the town.

The potential difference of the town's electricity supply is 230 V.

Calculate the charge flow to the town on this day.

Use the Physics Equations Sheet.

Give your answer to **3** significant figures.

[4 marks]

Charge flow (3 significant figures) = _____ C

10

4.2.4.2 Energy transfers in everyday appliances

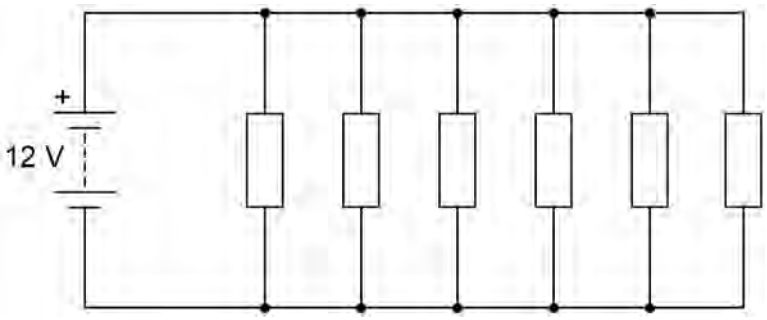
Question 103

June 2023 | 8463/1H | Original Q3

0 3 **Figure 4** shows an electrical circuit used to heat the windscreen of a car.

Each resistor in the circuit represents a heating element.

Figure 4



0 3 . 1 The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'?

[1 mark]

Use the Physics Equations Sheet to answer questions **03.2** and **03.3**.

0 3 . 2 Which equation links charge flow (Q), energy (E) and potential difference (V)?

[1 mark]

Tick (✓) **one** box.

$E = \frac{V}{Q}$ ☐

$E = QV$ ☐

$E = \frac{Q}{V}$ ☐

$E = \frac{V^2}{Q}$ ☐

4.2.4.2 Energy transfers in everyday appliances

Question 103 · continued

0 3 . 3 Calculate the charge flow through the 12 V battery when the battery transfers 5010 J of energy.

[3 marks]

Charge flow = _____ C

0 3 . 4 Ice forms on the windscreen at a temperature of 0 °C.

The electrical circuit transfers 5010 J of energy to the ice.

A mass of 0.015 kg of ice melts.

Calculate the specific latent heat of fusion of water.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of fusion of water = _____ J/kg

4.2.4.2 Energy transfers in everyday appliances

Question 103 · continued

0 3 . 5 The electrical circuit was left switched on while the ice changed from a solid to a liquid and increased in temperature to 5 °C.

Explain the changes in the arrangement **and** movement of the particles as the ice melted and the temperature increased to 5 °C.

[6 marks]

14

4.2.4.2 Energy transfers in everyday appliances

Question 104

June 2023 | 8463/1H | Original Q4

0 4 A remote village in the UK uses a hydroelectric generator to provide electricity.

0 4 . 1 In one day, 2 500 000 kg of water passes through the hydroelectric generator.

The change in gravitational potential energy of the water is 367.5 MJ.

gravitational field strength = 9.8 N/kg

Calculate the mean change in vertical height of the water as it moves through the hydroelectric generator.

Use the Physics Equations Sheet.

[4 marks]

Mean change in vertical height = _____ m

4.2.4.2 Energy transfers in everyday appliances

Question 104 · continued

0 4 . 2 The generator transfers 3.0 kW of electrical power.

Calculate the time taken for the generator to transfer 2.16×10^7 J of energy.

Use the Physics Equations Sheet.

Give your answer in standard form.

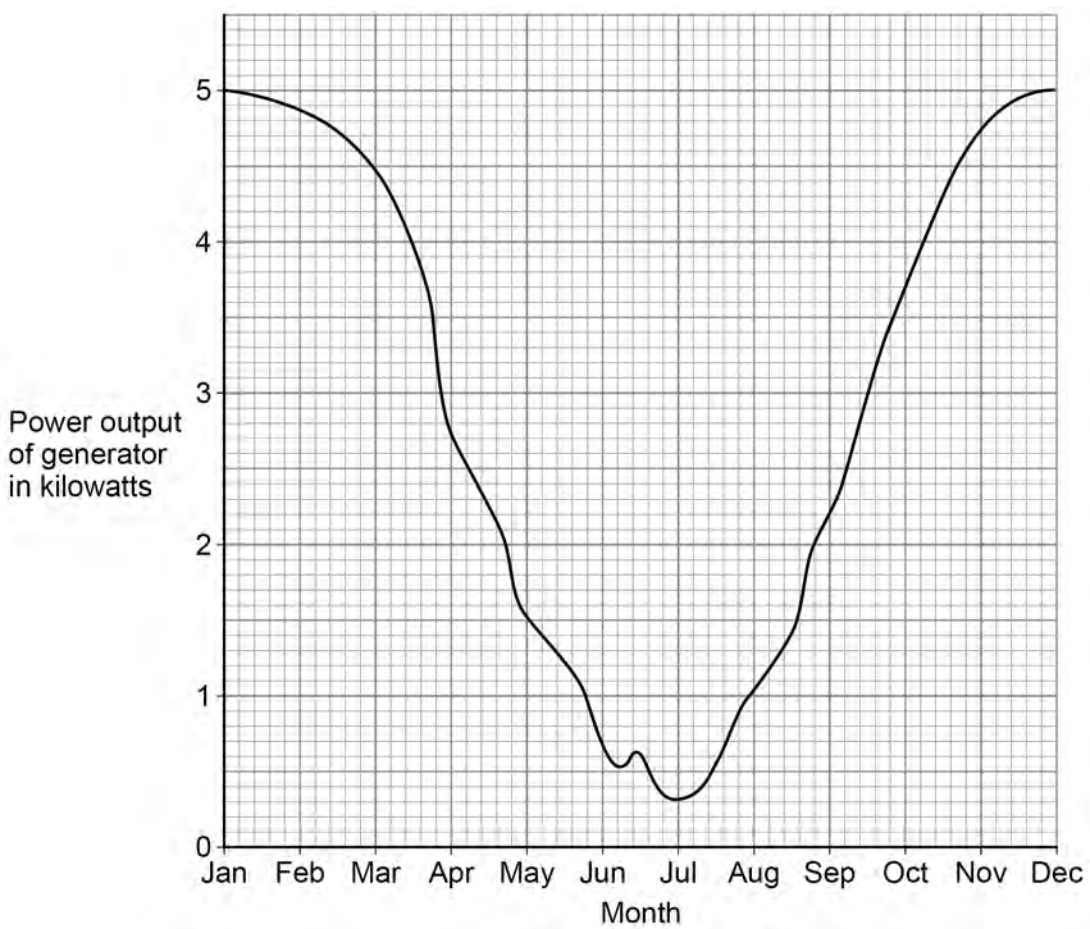
[5 marks]

Time taken (in standard form) = _____ s

Question 4 continues on the next page

0 4 . 3 **Figure 5** shows how the power output of the generator varied during one year.

Figure 5



A solar power system is installed in the remote village in addition to the hydroelectric generator.

Explain why this improves the reliability of the electricity supply to the village.

Use information from **Figure 5**.

[2 marks]

11

4.2.4.2 Energy transfers in everyday appliances

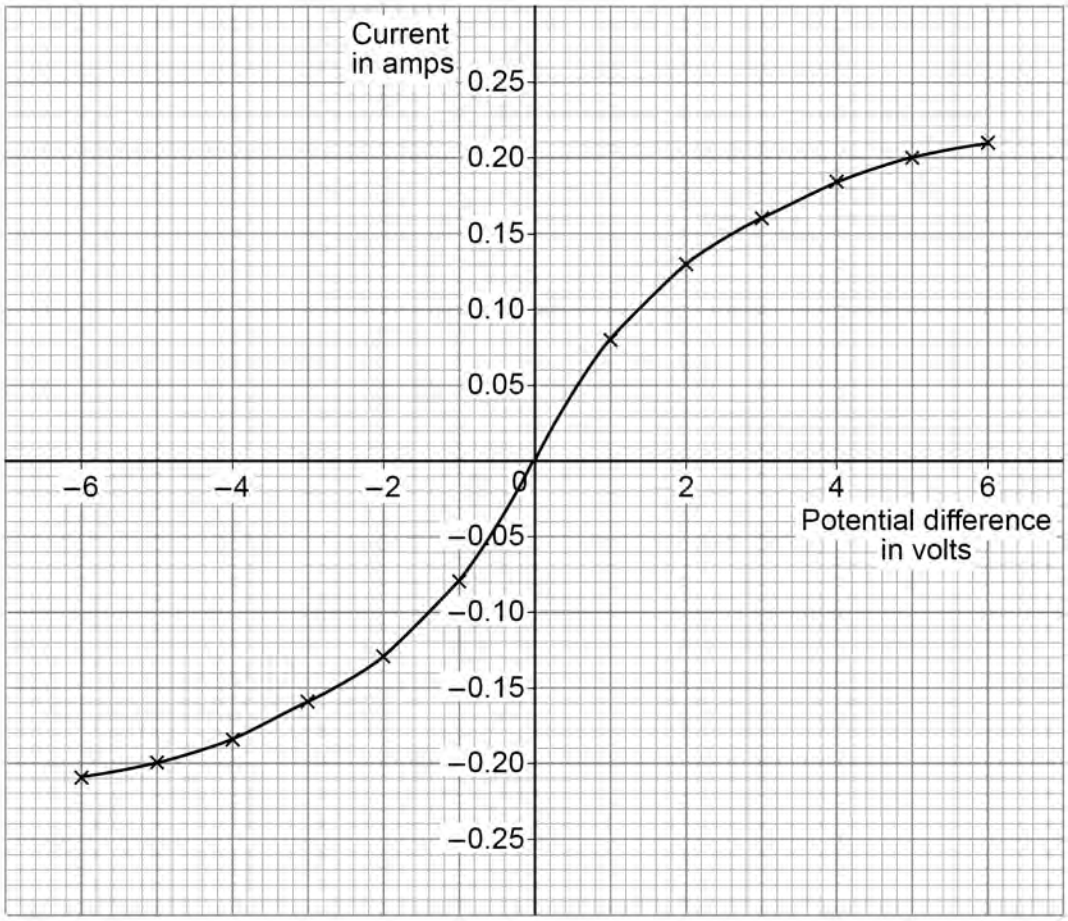
Question 105

June 2023 | 8463/1H | Original Q6

0 6 A student investigated how the current in a filament lamp varies with the potential difference across the filament lamp.

Figure 6 shows the results.

Figure 6



4.2.4.2 Energy transfers in everyday appliances

Question 105 · continued

June 2023 | 8463/1H | Original Q6

0 6 . 1 Describe a method the student could use to obtain these results.

You should include a circuit diagram.

[6 marks]

4.2.4.2 Energy transfers in everyday appliances

Question 105 · continued

0 6 . 2 Determine the resistance of the filament lamp when the potential difference across it is +3.0 V.

Use the Physics Equations Sheet.

Use **Figure 6** on page 18.

[3 marks]

Resistance = _____ Ω

0 6 . 3 The current in the lamp is 0.21 A when the potential difference across the lamp is 6.0 V.

Calculate the energy transferred by the filament lamp in 30 minutes.

Use the Physics Equations Sheet.

[5 marks]

Energy transferred = _____ J

4.2.4.2 Energy transfers in everyday appliances

Question 105 · continued

0 6 . 4 The power output of the lamp is 1.0 W when the potential difference across the lamp is 5.0 V.

A student predicts that the power output would be 4.0 W if the potential difference was doubled.

Explain why the student is **not** correct.

[2 marks]

16

Turn over for the next question

4.2.4.2 Energy transfers in everyday appliances

Question 106

June 2025 | 8463/1H | Original Q6

0 6 **Figure 8** shows a battery-powered hand warmer that contains a heating pad.

The battery transfers energy to increase the temperature of the heating pad.

Figure 8



0 6 . 1 The heating pad has a mass of 0.20 kg.

When the hand warmer was switched on, the energy transferred to the heating pad was 8000 J.

specific heat capacity of heating pad = 1600 J/kg °C

Calculate the temperature increase of the heating pad.

Use the Physics Equations Sheet.

[3 marks]

Temperature increase = _____ °C

4.2.4.2 Energy transfers in everyday appliances

Question 106 · continued

0 6 . 2 The hand warmer was powered by a 5.0 V battery.

The battery transferred 180 kJ of energy to the heating pad.

Calculate the charge flow through the battery.

Use the Physics Equations Sheet.

[4 marks]

Charge flow = _____ C

Question 6 continues on the next page

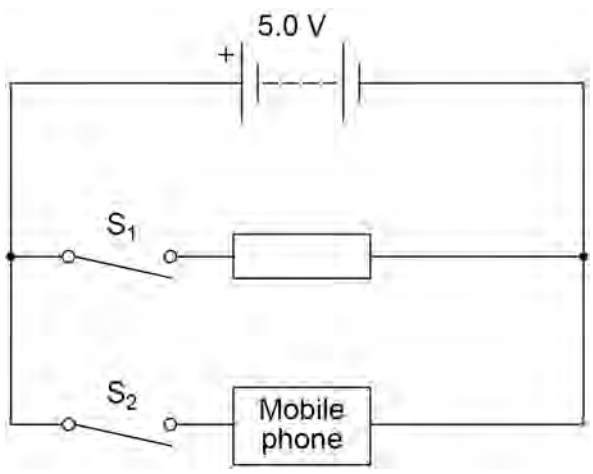
Question 106 · continued

0 6 . 3 The circuit inside the hand warmer can be connected to a mobile phone to recharge the mobile phone.

Figure 9 shows the circuit diagram when the hand warmer is connected to a mobile phone.

The heating pad of the hand warmer is represented by the resistor symbol.

Figure 9



Explain how closing both switches S_1 and S_2 affects the power output of the battery compared with only closing switch S_1.

[3 marks]

10