AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.1.1

# Energy stores and systems

## Past-paper questions

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **124** |
| Available paper years | **2003–2025** |

## 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:** _____

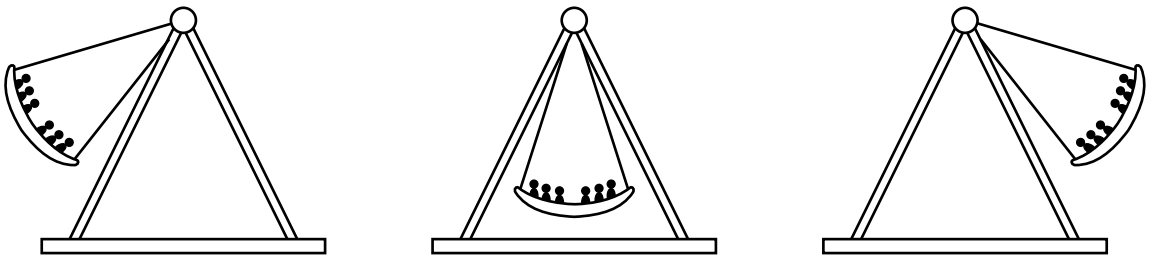
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

**4.1.1.1 Energy stores and systems**

**Question 01**

June 2003 | 3451H | Original Q13 | Legacy

**13** The Boat is a theme park ride. The Boat swings backwards and forwards. The diagrams show the Boat at the top and bottom of its swing.



**A** **B** **C**

(a) As the Boat swings from its position in **A** to its position in **B**, a child on the ride gains 5070 joules of kinetic energy. The child has a mass of 60 kg and is sitting at the centre.

(i) Write down the equation which links kinetic energy, mass and speed.

.....

*(1 mark)*

(ii) Calculate the speed of the child as the Boat passes through **B**. Show clearly how you work out your final answer.

.....

.....

.....

Speed = .....m/s

*(2 marks)*

4.1.1.1 Energy stores and systems

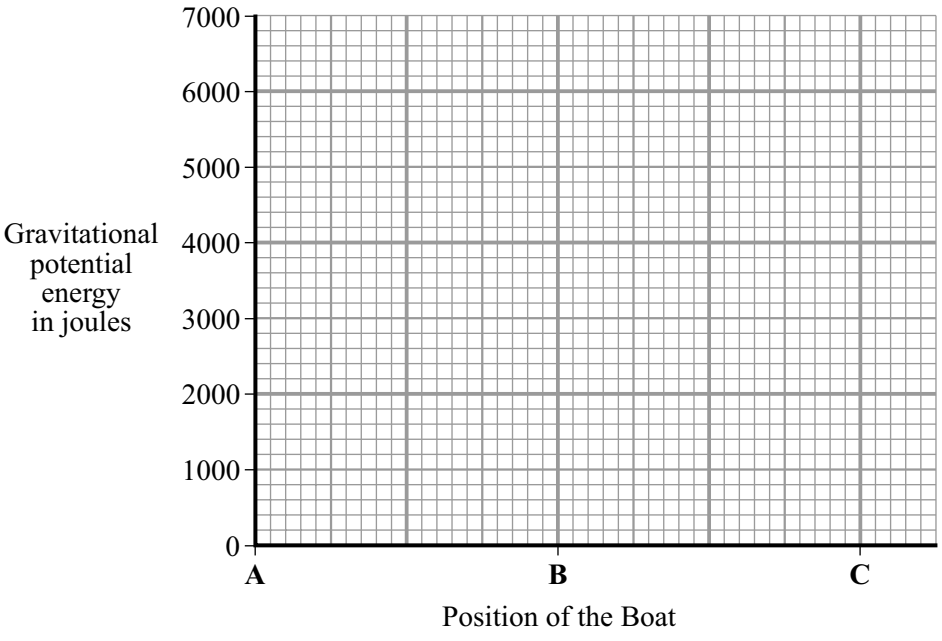
Question 01 · continued





MARGIN
BLANK

(b) Sketch a graph to show how the gravitational potential energy of the child changes as the Boat swings from **A** to **B** to **C**. The axes have been drawn for you.




*(2 marks)*

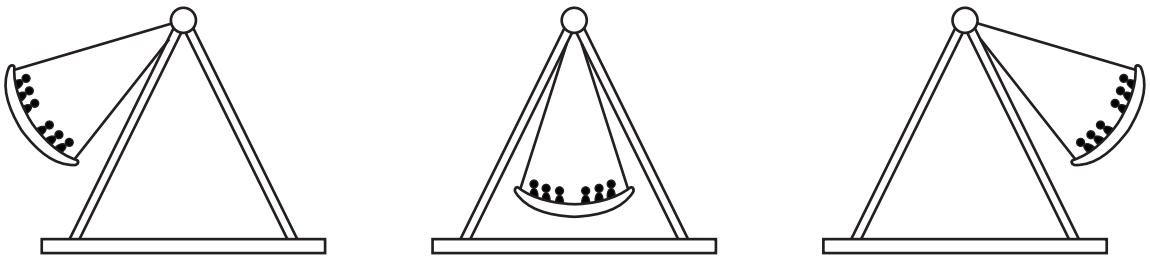
5

### 4.1.1.1 Energy stores and systems

**Question 02**

June 2003 | 3462H3 | Original Q11 | Legacy

**11** The Boat is a theme park ride. The Boat swings backwards and forwards. The diagrams show the Boat at the top and bottom of its swing.



**A** **B** **C**

(a) As the Boat swings from its position in **A** to its position in **B**, a child on the ride gains 5070 joules of kinetic energy. The child has a mass of 60 kg and is sitting at the centre.

(i) Write down the equation which links kinetic energy, mass and speed.

.....

*(1 mark)*

(ii) Calculate the speed of the child as the Boat passes through **B**. Show clearly how you work out your final answer.

.....

.....

.....

Speed = .....m/s

*(2 marks)*

4.1.1.1 Energy stores and systems

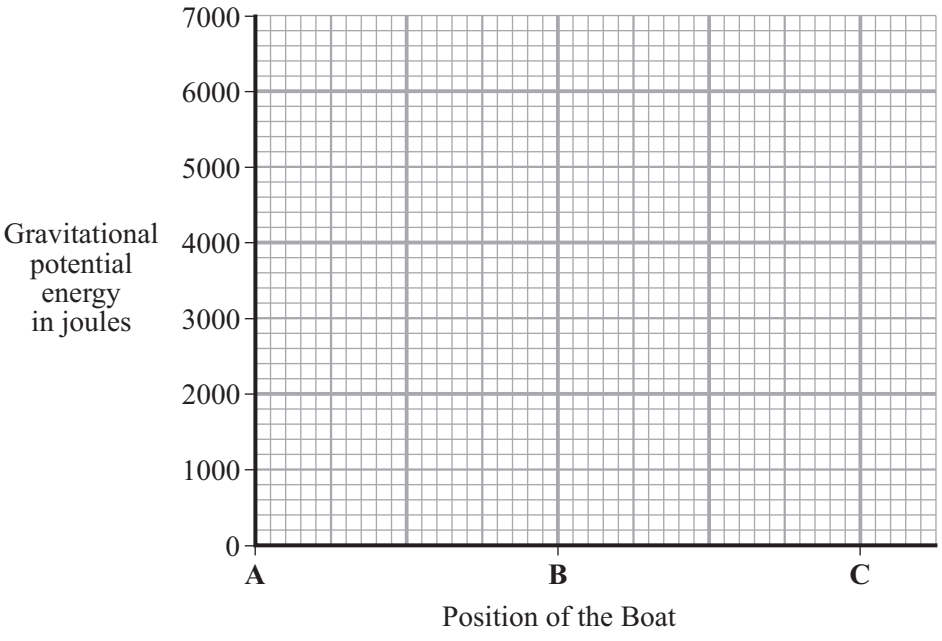
Question 02 · continued





MARGIN
BLANK

(b) Sketch a graph to show how the gravitational potential energy of the child changes as the Boat swings from **A** to **B** to **C**. The axes have been drawn for you.




*(2 marks)*

5

### 4.1.1.1 Energy stores and systems

**Question 03**

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;

.....

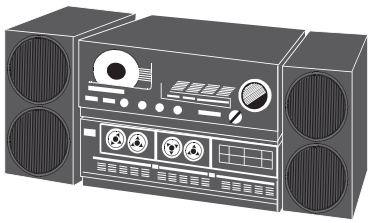
*(1 mark)*

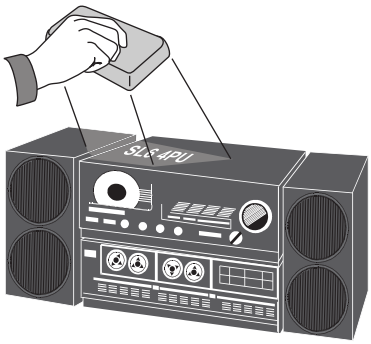
(ii) to send a signal to a TV from a remote control.

.....

*(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)*

**Question 03 · 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)*

9

### 4.1.1.1 Energy stores and systems

**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;

.....

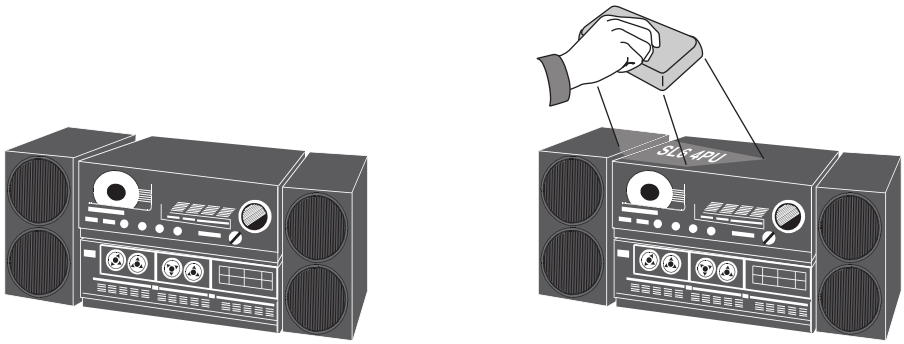
*(1 mark)*

(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)*

(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)*

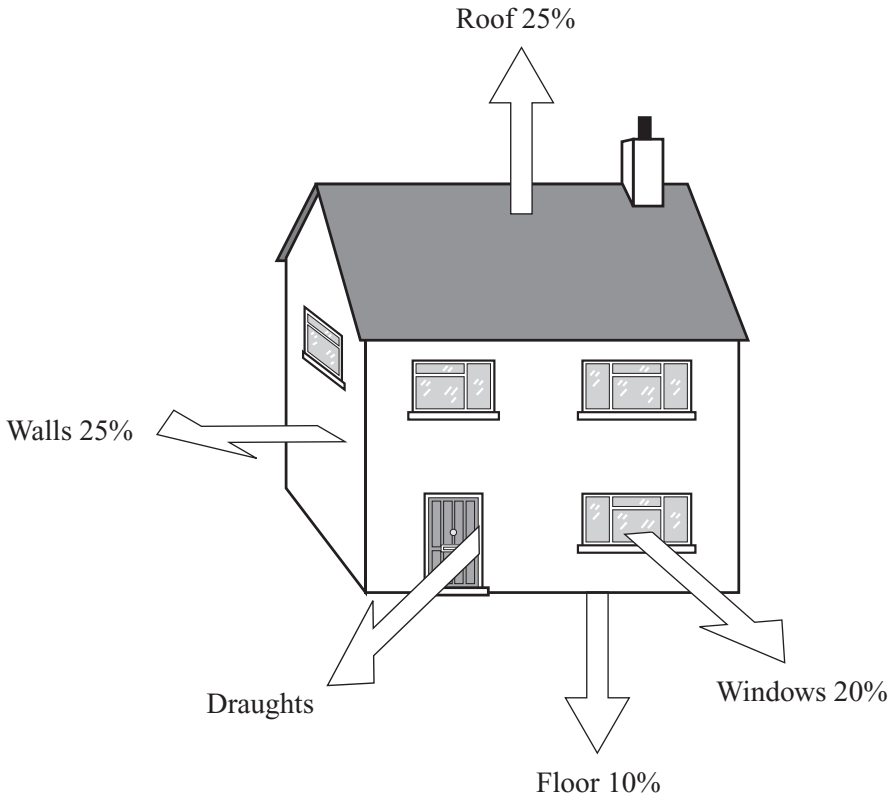
9

### 4.1.1.1 Energy stores and systems

**Question 05**

June 2005 | 3451 | Original Q3 | Legacy

**3** (a) The diagram shows the ways in which heat energy can be transferred from an old house.




(i) Calculate the percentage of energy transferred by draughts.

.....

% energy transferred by draughts = .....

*(1 mark)*

(ii) Complete the following sentence using **one** of the words from the box.

| | | |
|---|---|---|
| **conduction** | **convection** | **radiation** |

Draughts transfer heat energy by..... .

*(1 mark)*

(iii) State **one** way of reducing the heat transfer by draughts.

.....

*(1 mark)*

4.1.1.1 Energy stores and systems

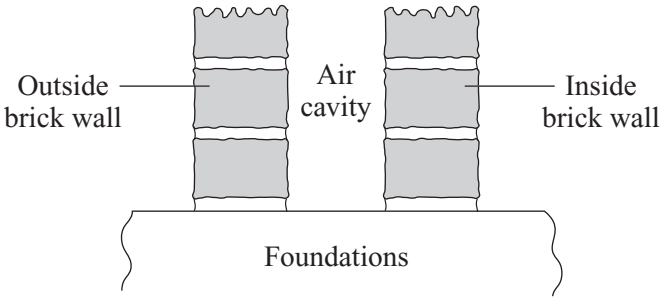
Question 05 · continued



I

MARGIN BLANK

(b) The diagram shows a section through the walls of a house built in 1930.




Explain how the air cavity between the two walls reduces the heat transfer from the house.

.....

.....

.....

.....

*(2 marks)*

(c) The table shows the installation costs and yearly savings on energy bills for different methods of insulating a house.

| Method of insulation | Installation cost in £ | Yearly saving on energy bills in £ |
|---|---|---|
| Double glazing | 4000 | 65 |
| Loft insulation | 240 | 60 |
| Cavity wall insulation | 600 | 80 |

(i) Give **one** reason why loft insulation is often fitted to an old house before double glazing or cavity wall insulation.

.....

.....

*(1 mark)*

(ii) The time it takes for the saving on energy bills to equal the cost of installing the insulation is called the pay-back time.

Calculate the pay-back time for loft insulation.

.....

Pay-back time = ..... years

*(1 mark)*

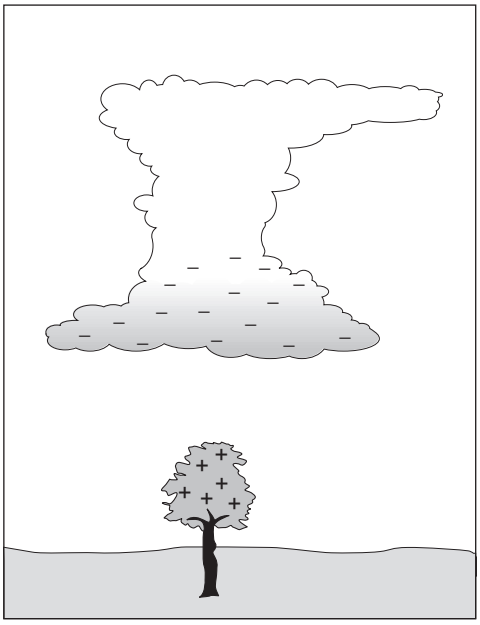
7

### 4.1.1.1 Energy stores and systems

**Question 06**

June 2005 | 3451 | Original Q11 | Legacy

**11** The diagram shows a charged thundercloud.



(a) Why does the tree below the thundercloud become positively charged?

.....

.....

*(1 mark)*

(b) The base of the cloud has a negative charge of 18 coulombs.
The potential difference between the base of the cloud and the ground is 1 200 000 kilovolts.

(i) Write down the equation that links charge, energy transferred and potential difference.

.....

*(1 mark)*

(ii) Calculate the maximum energy that could be transferred to the ground by a lightning strike. Show clearly how you work out your answer.

.....

.....

Maximum energy transferred = ..... joules

*(2 marks)*

4.1.1.1 Energy stores and systems

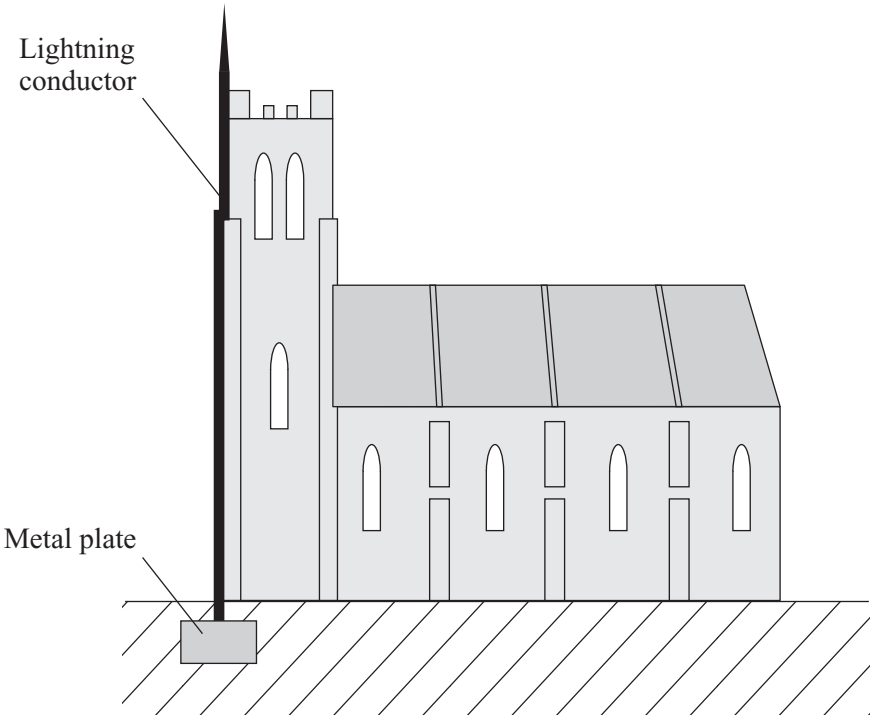
Question 06 · continued





MARGIN
BLANK

(c) A lightning conductor is usually attached to tall buildings. This reduces the risk of damage by a lightning strike.




Explain why the lightning conductor is made of copper.

.....

.....

.....

.....

*(2 marks)*

6

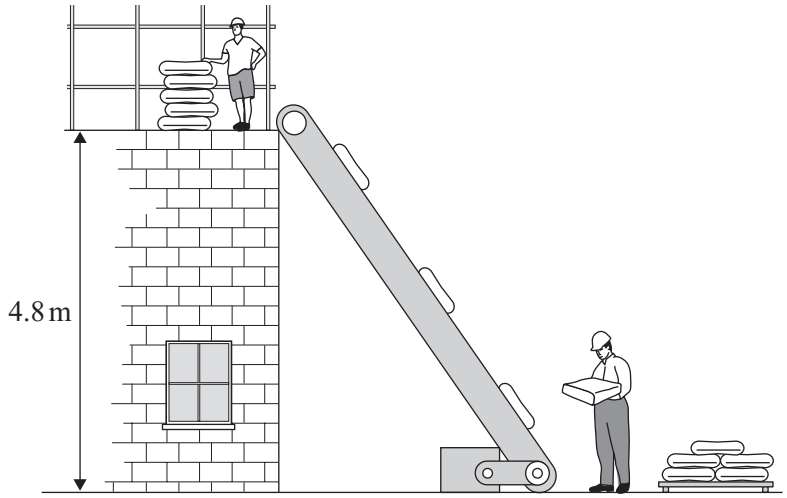
**TURN OVER FOR THE NEXT QUESTION**

### 4.1.1.1 Energy stores and systems

**Question 07**

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)*

**4.1.1.1 Energy stores and systems**

**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

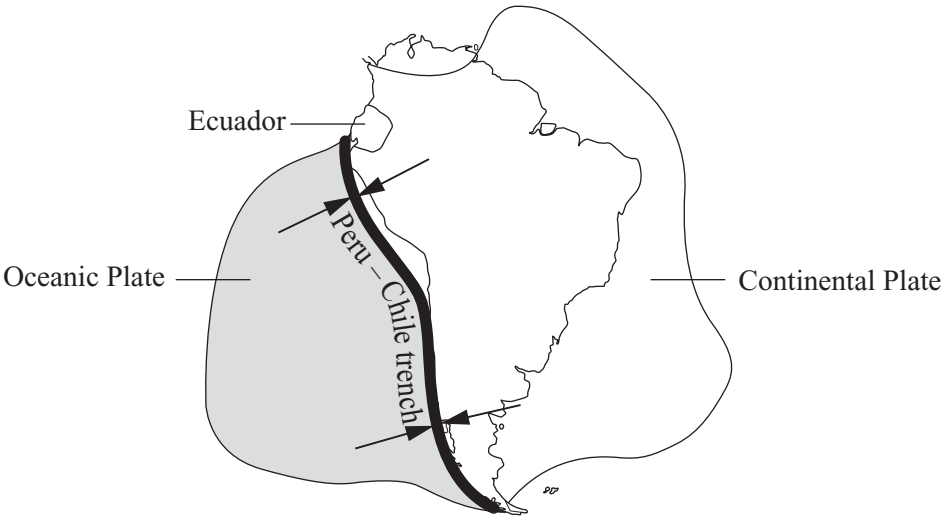
**TURN OVER FOR THE NEXT QUESTION**

### 4.1.1.1 Energy stores and systems

**Question 08**



**15** The Peru–Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.




*Source*: WITNEY, DROZDOWSKA AND MAILE, *AQA GCSE Physics* (Hodder & Stoughton) 2002. Adapted and reproduced by permission of Hodder & Stoughton.

(a) Explain what causes the tectonic plates to move.

.....

.....

.....

.....

*(2 marks)*

4.1.1.1 Energy stores and systems

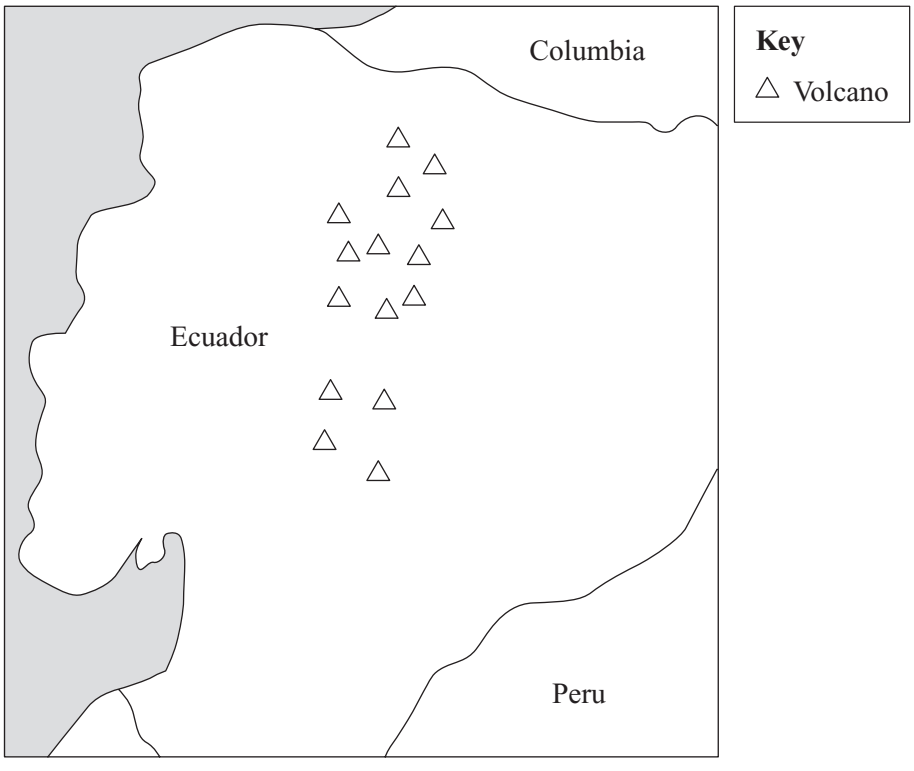
Question 08 · continued





MARGIN BLANK

(b) The map shows the location of some of the volcanoes in Ecuador. The volcanoes are all close to the Peru–Chile trench.




Explain how the volcanoes were formed.

.....

.....

.....

.....

.....

.....

*(3 marks)*

(c) The eruption of Mount St Helens in the USA is one of the few volcanic eruptions to have been accurately predicted by scientists. The scientists had been monitoring *seismic activity*, levels of sulphur dioxide and changes to the ground level.

(i) What is meant by *seismic activity*?

.....

*(1 mark)*

**QUESTION 15 CONTINUES ON THE NEXT PAGE**

Question 08 · continued





MARGIN BLANK

(ii) Suggest why scientists find it difficult to predict accurately when a volcano is going to erupt.

.....

.....

.....

.....

*(2 marks)*

(d) The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

*(1 mark)*

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....

.....

Kinetic energy = ..... joules
*(1 mark)*

(e) Read the information in the box and then answer the questions.

> Igneous rocks contain potassium-40. This is a radioactive isotope. It has a half-life of 1300 million years.
>
> Potassium-40 decays into argon-40 which is stable.
>
> Argon escapes from molten rock. Any argon found in an igneous rock must have been produced since the rock solidified.
>
> A sample of an igneous rock has one atom of potassium-40 for every three atoms of argon-40.

(i) What fraction of the potassium-40 has not yet decayed?

.....

*(1 mark)*

(ii) Calculate the age of the rock.

.....

Age of rock = ..... million years
*(1 mark)*

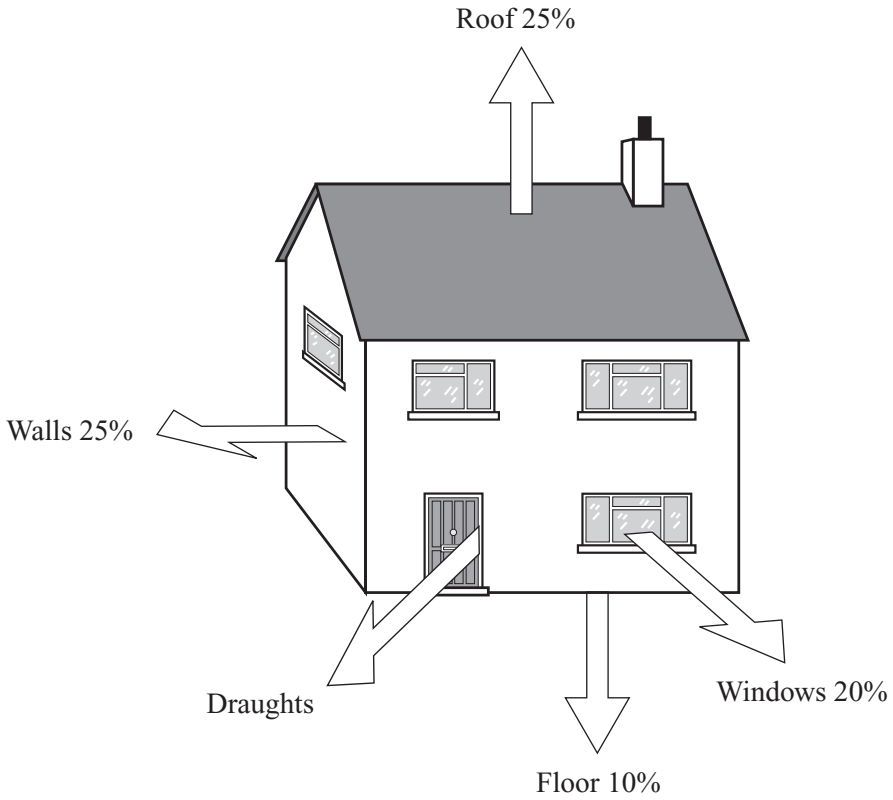
12

### 4.1.1.1 Energy stores and systems

**Question 09**

June 2005 | 3462 | Original Q3 | Legacy

**3** (a) The diagram shows the ways in which heat energy can be transferred from an old house.




(i) Calculate the percentage of energy transferred by draughts.

.....

% energy transferred by draughts = .....

*(1 mark)*

(ii) Complete the following sentence using **one** of the words from the box.

| | | |
|---|---|---|
| **conduction** | **convection** | **radiation** |

Draughts transfer heat energy by..... .

*(1 mark)*

(iii) State **one** way of reducing the heat transfer by draughts.

.....

*(1 mark)*

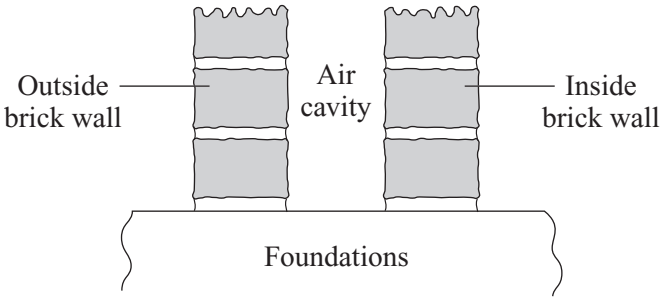
Question 09 · continued



I

MARGIN BLANK

(b) The diagram shows a section through the walls of a house built in 1930.




Explain how the air cavity between the two walls reduces the heat transfer from the house.

.....

.....

.....

.....

*(2 marks)*

(c) The table shows the installation costs and yearly savings on energy bills for different methods of insulating a house.

| Method of insulation | Installation cost in £ | Yearly saving on energy bills in £ |
|---|---|---|
| Double glazing | 4000 | 65 |
| Loft insulation | 240 | 60 |
| Cavity wall insulation | 600 | 80 |

(i) Give **one** reason why loft insulation is often fitted to an old house before double glazing or cavity wall insulation.

.....

.....

*(1 mark)*

(ii) The time it takes for the saving on energy bills to equal the cost of installing the insulation is called the pay-back time.

Calculate the pay-back time for loft insulation.

.....

Pay-back time = ..... years

*(1 mark)*

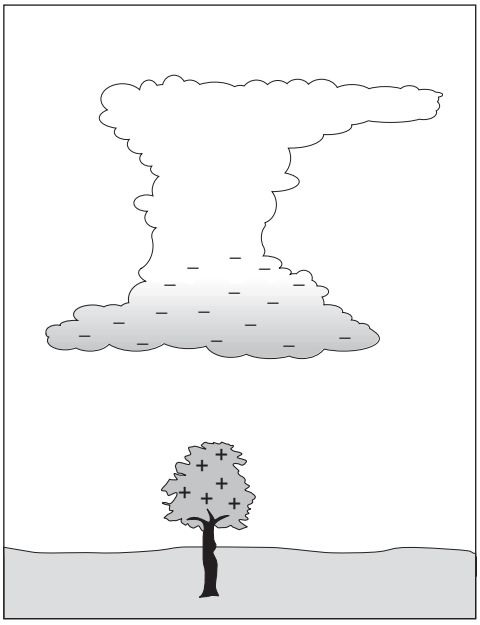
7

### 4.1.1.1 Energy stores and systems

**Question 10**

June 2005 | 3462 | Original Q9 | Legacy

**9** The diagram shows a charged thundercloud.



(a) Why does the tree below the thundercloud become positively charged?

.....

.....

*(1 mark)*

(b) The base of the cloud has a negative charge of 18 coulombs.
The potential difference between the base of the cloud and the ground is 1 200 000 kilovolts.

(i) Write down the equation that links charge, energy transferred and potential difference.

.....

*(1 mark)*

(ii) Calculate the maximum energy that could be transferred to the ground by a lightning strike. Show clearly how you work out your answer.

.....

.....

Maximum energy transferred = ..... joules

*(2 marks)*

**4.1.1.1 Energy stores and systems**

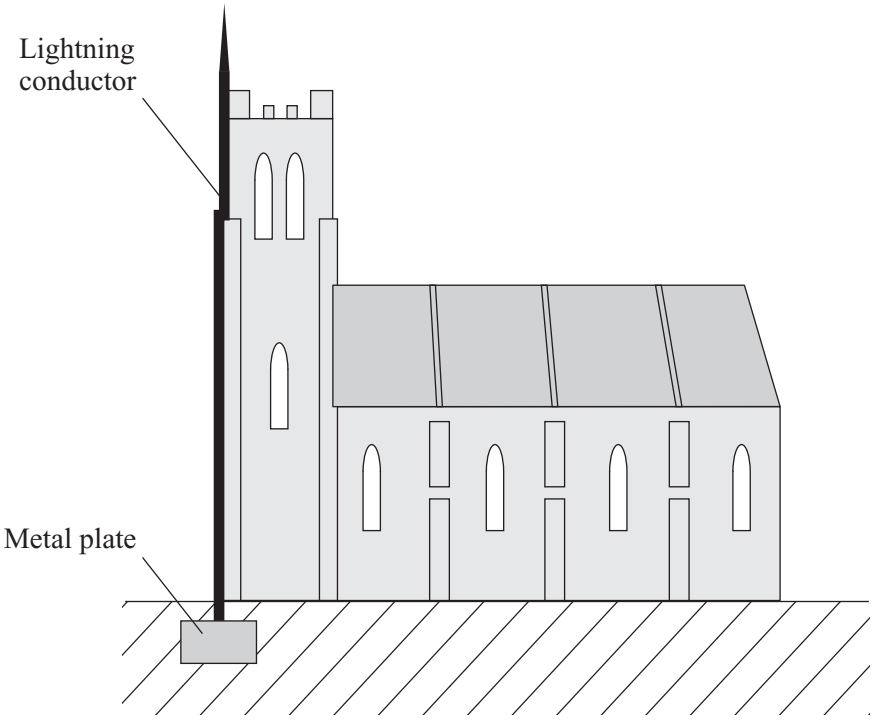
**Question 10 · continued**



1 /

MARGIN BLANK

(c) A lightning conductor is usually attached to tall buildings. This reduces the risk of damage by a lightning strike.




Explain why the lightning conductor is made of copper.

.....

.....

.....

.....

*(2 marks)*

6

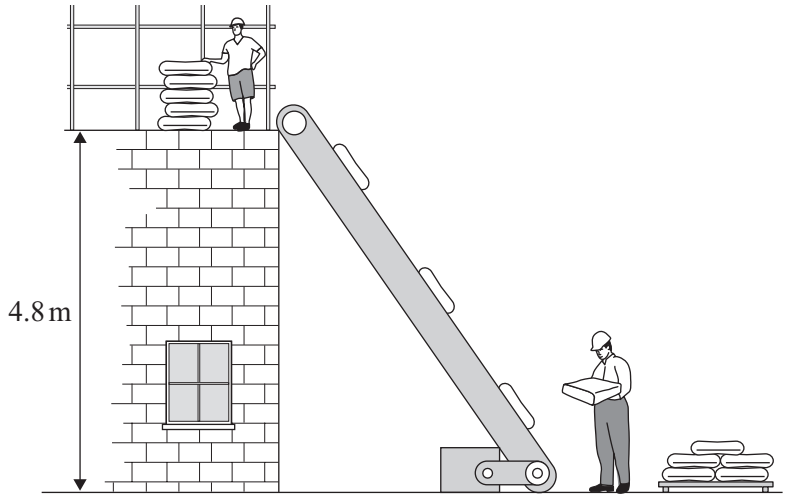
**TURN OVER FOR THE NEXT QUESTION**

### 4.1.1.1 Energy stores and systems

**Question 11**

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)*

4.1.1.1 Energy stores and systems

Question 11 · 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

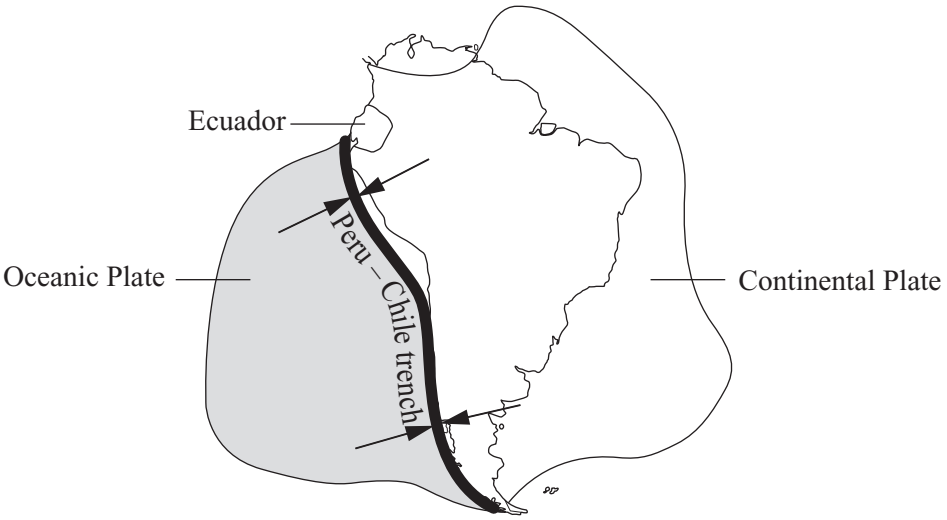
**TURN OVER FOR THE NEXT QUESTION**

### 4.1.1.1 Energy stores and systems

**Question 12**

June 2005 | 3462 | Original Q11 | Legacy

**11** The Peru–Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.




*Source*: WITNEY, DROZDOWSKA AND MAILE, *AQA GCSE Physics* (Hodder & Stoughton) 2002. Adapted and reproduced by permission of Hodder & Stoughton.

(a) Explain what causes the tectonic plates to move.

.....

.....

.....

.....

*(2 marks)*

**4.1.1.1 Energy stores and systems**

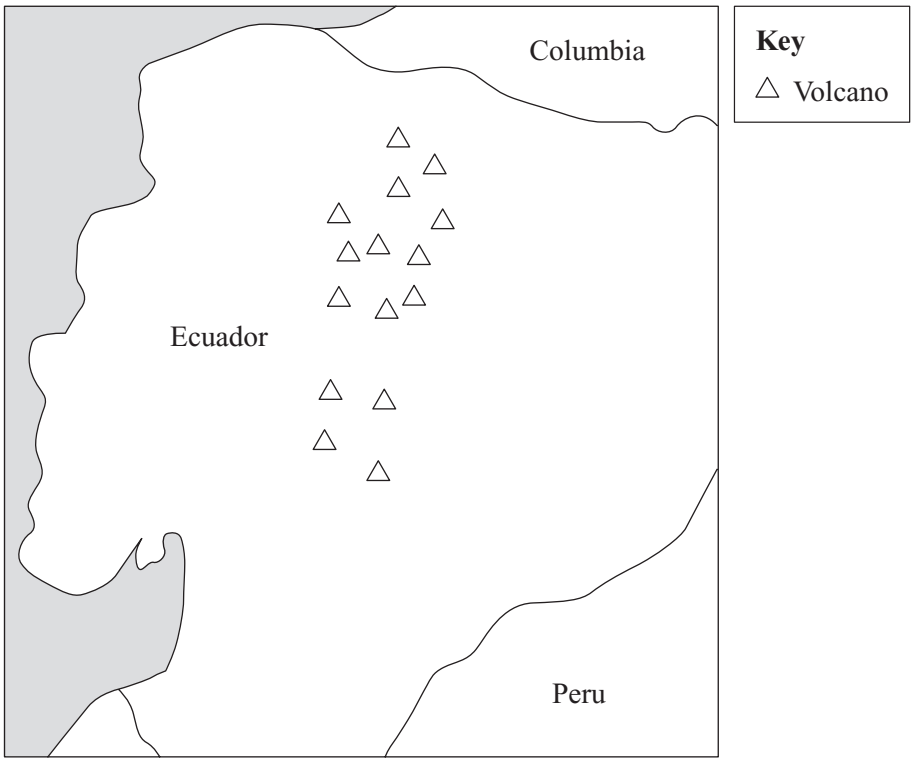
**Question 12 · continued**





MARGIN
BLANK

(b) The map shows the location of some of the volcanoes in Ecuador. The volcanoes are all close to the Peru–Chile trench.




Explain how the volcanoes were formed.

.....

.....

.....

.....

.....

.....

*(3 marks)*

(c) The eruption of Mount St Helens in the USA is one of the few volcanic eruptions to have been accurately predicted by scientists. The scientists had been monitoring *seismic activity*, levels of sulphur dioxide and changes to the ground level.

(i) What is meant by *seismic activity*?

.....

*(1 mark)*

**QUESTION 11 CONTINUES ON THE NEXT PAGE**

**Question 12 · continued**



(ii) Suggest why scientists find it difficult to predict accurately when a volcano is going to erupt.

.....

.....

.....

.....

*(2 marks)*

(d) The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

*(1 mark)*

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....

.....

Kinetic energy = ..... joules
*(1 mark)*

(e) Read the information in the box and then answer the questions.

> Igneous rocks contain potassium-40. This is a radioactive isotope. It has a half-life of 1300 million years.
>
> Potassium-40 decays into argon-40 which is stable.
>
> Argon escapes from molten rock. Any argon found in an igneous rock must have been produced since the rock solidified.
>
> A sample of an igneous rock has one atom of potassium-40 for every three atoms of argon-40.

(i) What fraction of the potassium-40 has not yet decayed?

.....

*(1 mark)*

(ii) Calculate the age of the rock.

.....

Age of rock = ..... million years
*(1 mark)*

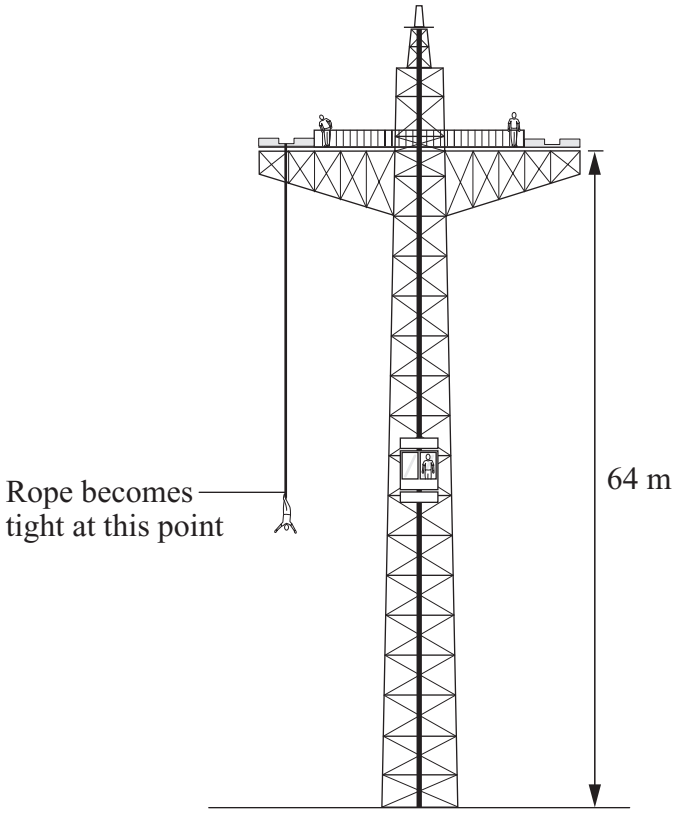
12

4.1.1.1 Energy stores and systems

Question 13

June 2006 | 3451 | Original Q14 | Legacy

**14** The diagram shows a tower used for bungee jumping.




(a) A lift takes a person of mass 55 kg, to a platform 64 metres above the ground.

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

.....

*(1 mark)*

(ii) Calculate the increase in the gravitational potential energy of the person when going from the ground to the platform.

Show clearly how you work out your final answer.
(Gravitational field strength = 10 N/kg)

.....

.....

.....

Increase in gravitational potential energy = ..... joules

*(2 marks)*

4.1.1.1 Energy stores and systems

Question 13 · continued



BLANK

(b) The falling bungee jumper reaches a maximum speed when 15 840 joules of gravitational potential energy have been transferred into kinetic energy.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

*(1 mark)*

(ii) Calculate the maximum speed of the falling bungee jumper.

Show clearly how you work out your final answer.

.....

.....

.....

Speed = ..... m/s

*(3 marks)*

(c) As the rope stretches the bungee jumper slows down.

Describe fully the energy transfer that happens as the bungee jumper continues to fall towards the ground.

*To gain full marks in this question you should write you ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

.....

.....

.....

.....

*(3 marks)*

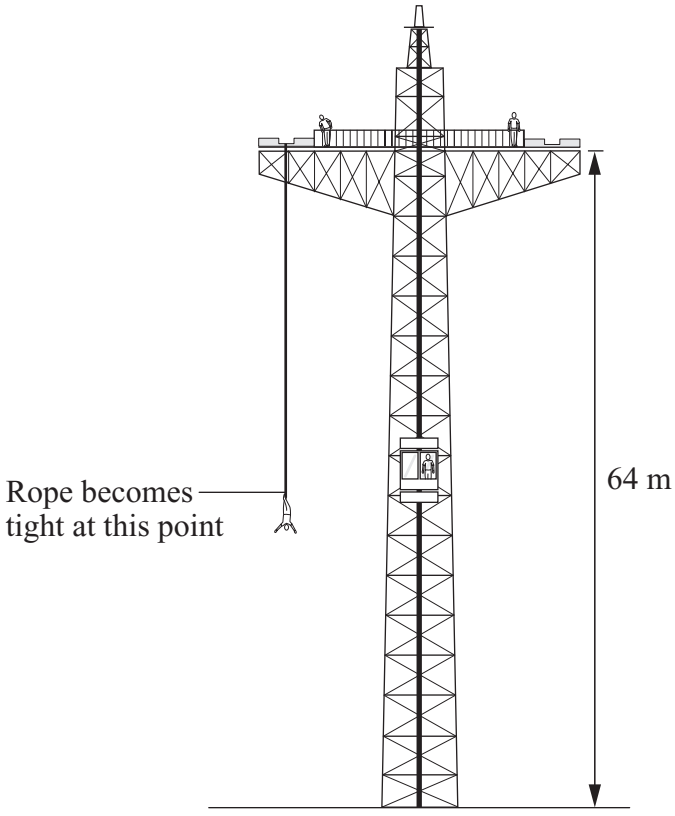
10

4.1.1.1 Energy stores and systems

Question 14

June 2006 | 3462 | Original Q12 | Legacy

**12** The diagram shows a tower used for bungee jumping.




(a) A lift takes a person of mass 55 kg, to a platform 64 metres above the ground.

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

.....

*(1 mark)*

(ii) Calculate the increase in the gravitational potential energy of the person when going from the ground to the platform.

Show clearly how you work out your final answer.
(Gravitational field strength = 10 N/kg)

.....

.....

.....

Increase in gravitational potential energy = ..... joules

*(2 marks)*

4.1.1.1 Energy stores and systems

Question 14 · continued



BLANK

(b) The falling bungee jumper reaches a maximum speed when 15 840 joules of gravitational potential energy have been transferred into kinetic energy.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

*(1 mark)*

(ii) Calculate the maximum speed of the falling bungee jumper.

Show clearly how you work out your final answer.

.....

.....

.....

Speed = ..... m/s

*(3 marks)*

(c) As the rope stretches the bungee jumper slows down.

Describe fully the energy transfer that happens as the bungee jumper continues to fall towards the ground.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

.....

.....

.....

.....

*(3 marks)*

10

4.1.1.1 Energy stores and systems

Question 15

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 15 · 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**

4.1.1.1 Energy stores and systems

Question 16

March 2007 | PHY1A | Original Q2 | Legacy

**QUESTION TWO**

Thermal energy can be transferred in several ways.

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

**A** free electrons

**B** ions

**C** particles

**D** waves

Convection currents in liquids and gases are the result of expansion caused by . . . **1** . . . moving faster in hotter regions.

Thermal radiation is energy transfer by . . . **2** . . . .

The hotter a metal is, the greater the kinetic energy of the vibrating . . . **3** . . . in the metal structure.

Kinetic energy is transferred to cooler parts of the metal by . . . **4** . . . diffusing through it.

4.1.1.1 Energy stores and systems

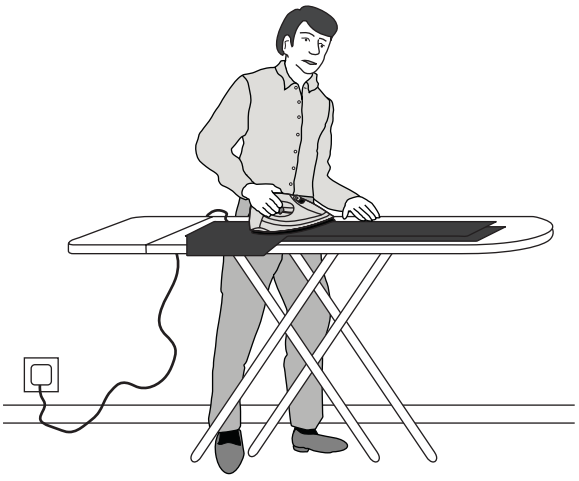
Question 17

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.

4.1.1.1 Energy stores and systems

Question 17 · 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

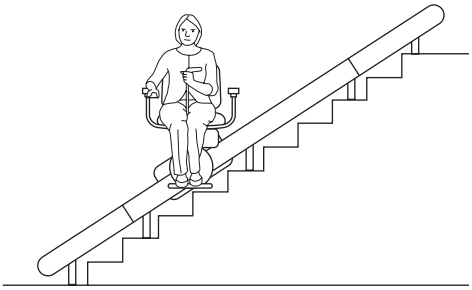
4.1.1.1 Energy stores and systems

Question 18

June 2007 | PHY1A | Original Q2 | Legacy

**QUESTION TWO**

The drawing shows a woman being moved upstairs by a stair lift.



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

**A** electrical energy

**B** gravitational potential energy

**C** sound energy

**D** thermal energy

As the stair lift moves upwards, . . . **1** . . . is usefully transformed to . . . **2** . . . .

Some energy is wasted, mainly as . . . **3** . . . , but also as . . . **4** . . . .

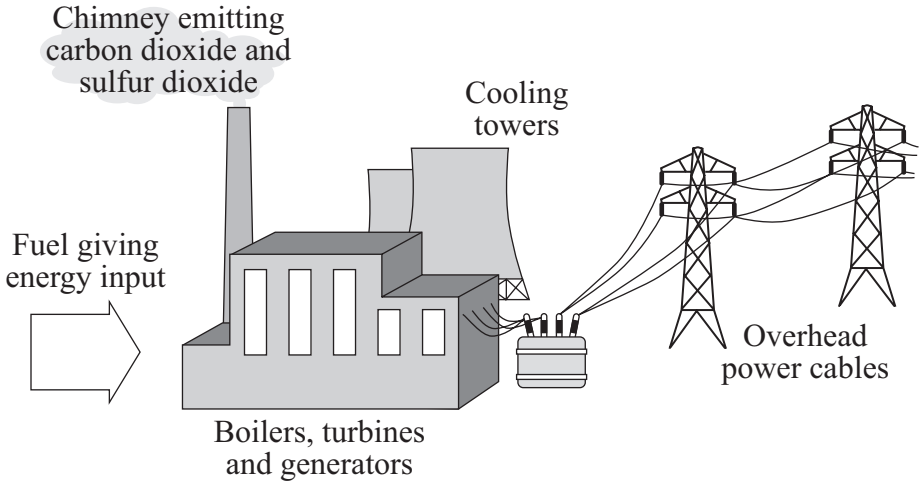
4.1.1.1 Energy stores and systems

Question 19

June 2007 | PHY1A | Original Q5 | Legacy

**QUESTION FIVE**

The diagram shows a power station.




**5A** What type of power station is this?

**1** coal-burning

**2** gas-burning

**3** geothermal

**4** nuclear

**5B** Which part transforms kinetic energy into electrical energy?

**1** boiler

**2** cooling tower

**3** generator

**4** turbine

4.1.1.1 Energy stores and systems

**Question 19 · continued**



**5C** After steam has passed through the turbines, it is passed upwards through the cooling towers. Here, the steam condenses to form water vapour.

What types of pollution are caused by the cooling towers?

**1** chemical and noise

**2** noise and thermal

**3** thermal and visual

**4** visual and chemical

**5D** A fossil-fuel power station is going to be built in a part of the country that does not have a power station.

Which one of the following is **not** an advantage to the local economy?

**1** Carbon dioxide from the power station can be used in local commercial greenhouses.

**2** More jobs will be created.

**3** The power station will be connected to the National Grid.

**4** Waste heat can be used in nearby buildings.

4.1.1.1 Energy stores and systems

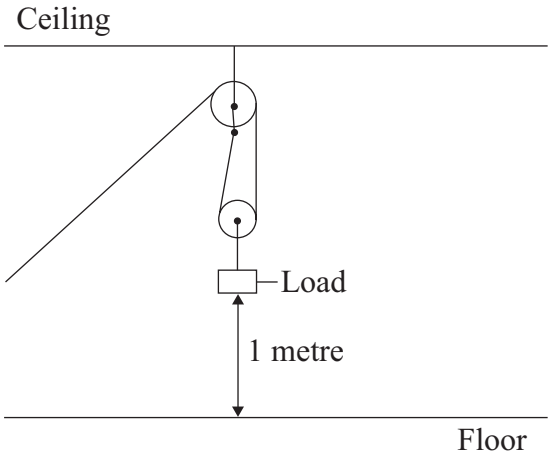
Question 20

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 |

4.1.1.1 Energy stores and systems

Question 20 · 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.

4.1.1.1 Energy stores and systems

Question 21

June 2007 | PHY1H | Original Q6 | Legacy

**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 £ |
|---|---|---|
| Fit a new hot water boiler | 1800 | 200 |
| Fit a solar water heater | 2400 | 100 |
| Fit underfloor heating | 600 | 50 |
| Fit thermostatic radiator valves | 75 | 20 |

Which way of reducing energy consumption is most cost effective over a 10-year period?

To obtain full marks you must support your answer with calculations.

.....

.....

.....

.....

.....

.....

*(3 marks)*

(b) Explain why using an energy-efficient light bulb instead of an ordinary light bulb reduces the amount of carbon dioxide emitted into the atmosphere.

.....

.....

.....

.....

*(2 marks)*

5

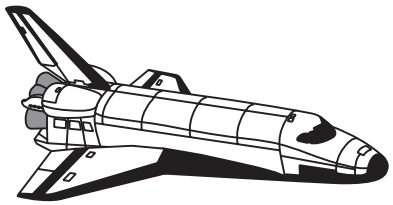
4.1.1.1 Energy stores and systems

Question 22

November 2007 | PHY1A | Original Q1 | Legacy

## QUESTION ONE

The diagram shows the space shuttle returning to Earth. As it moves towards Earth, it moves faster.



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

**A** gravitational potential energy

**B** kinetic energy

**C** light energy

**D** thermal energy

As the shuttle moves towards Earth, it loses . . . **1** . . . .

When the shuttle moves faster, it gains . . . **2** . . . .

When the shuttle enters the Earth's atmosphere, there is a lot of friction. This makes the tiles covering the shuttle glow red. As a result, the shuttle gives off a lot of . . . **3** . . . and a little . . . **4** . . . .

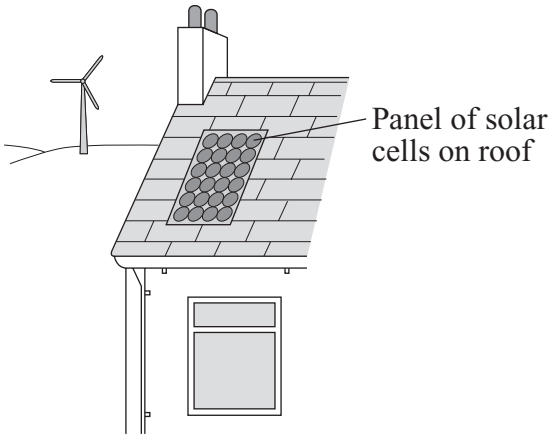
4.1.1.1 Energy stores and systems

Question 23

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

4.1.1.1 Energy stores and systems

Question 23 · 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.

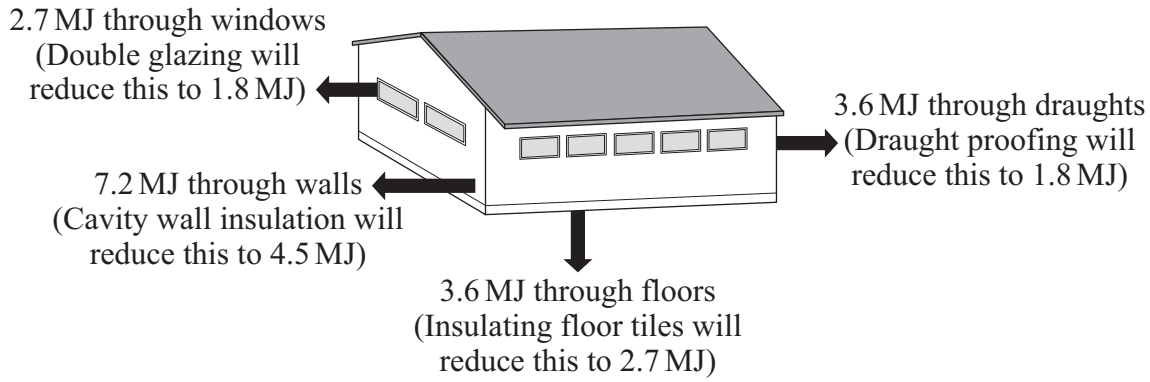
4.1.1.1 Energy stores and systems

Question 24

November 2007 | PHY1A | Original Q6 | Legacy

## QUESTION SIX

The diagram shows some of the ways in which heat is transferred from the inside of a workshop, and how improvements can reduce the losses. The figures are for the average loss per hour on a cold winter's day.




The table gives the cost of the improvements and how much they will save each year.

| Improvement | Cost | Saving each year |
|---|---|---|
| Cavity wall insulation | £900 | £345 |
| Double glazing | £3000 | £115 |
| Draught proofing | £150 | £230 |
| Insulating floor tiles | £600 | £115 |

**6A** Which improvement will result in the largest reduction in heat transfer?

**1** cavity wall insulation

**2** double glazing

**3** draught proofing

**4** insulating floor tiles

Question 24 · continued



**6B** The improvements are designed to reduce energy transfer through different parts of the workshop.

Which improvement reduces the transfer through its part of the workshop by the largest proportion?

**1** cavity wall insulation

**2** double glazing

**3** draught proofing

**4** insulating floor tiles

**6C** On a cold winter's day, what is the approximate total heat loss from the **uninsulated** workshop in an eight-hour period?

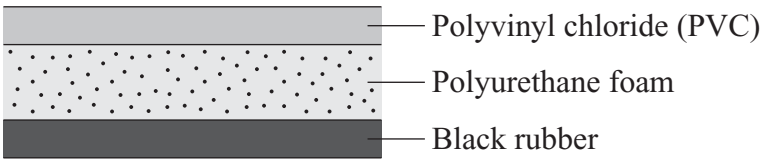
**1** 140 MJ

**2** 150 MJ

**3** 160 MJ

**4** 170 MJ

**6D** The diagram shows a cross-section through the insulating floor tiles.




Which feature makes these tiles good heat insulators?

**1** Air is trapped in the polyurethane foam.

**2** Black rubber is a good emitter of thermal radiation.

**3** They are made of three different materials.

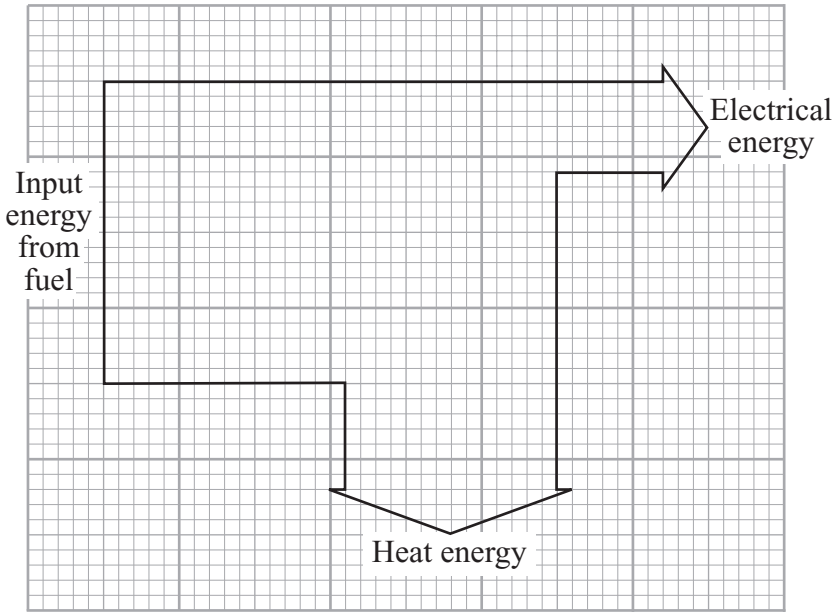
**4** They are on the floor so the heat movement by convection does not affect them.

**4.1.1.1 Energy stores and systems**

**Question 25**

January 2008 | PHY1H | Original Q1 | Legacy

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




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

.....

*(1 mark)*

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

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

Show clearly how you work out your answer.

.....

.....

Efficiency = .....

*(2 marks)*

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

.....

*(1 mark)*

**Question 1 continues on the next page**

**Question 25 · continued**



*BLANK*

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

(i) Transformers are part of the National Grid. Transformers are *efficient* devices.

What is meant by a device being *efficient*?

.....

.....

*(1 mark)*

(ii) When electricity flows through a cable, some energy is transformed into heat.

Explain how the National Grid system reduces the amount of energy lost as heat.

.....

.....

.....

.....

*(2 marks)*

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

- Researchers have found that children living close to overhead power cables are more likely to develop leukaemia.
- The researchers studied two groups of children. One group had developed leukaemia, the other group was healthy.
- Although the researchers found a link, they are unable to explain why it happened. They say that the results may have happened by chance.
- Other factors that have not been investigated, such as the environment, the geographical area or the children's genes, could be important.
- A cancer research charity said that childhood leukaemia was most likely to be caused by factors that parents were unable to control.

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

.....

.....

*(1 mark)*

4.1.1.1 Energy stores and systems

**Question 25 · continued**



*BLANK*

(ii) The information does not say how many children were studied.

Why should this data have been included in the article?

.....

.....

*(1 mark)*

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

Explain why.

.....

.....

.....

.....

*(2 marks)*

(iv) The results of the research carried out by scientists may worry some people.

What do you think scientists should do?

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

| | |
|---|---|
| Scientists should publish their research findings straight away. | ☐ |
| Scientists should not publish their research findings until they have found out as many facts as possible. | ☐ |

Give a reason for your choice.

.....

.....

*(1 mark)*

12

**4.1.1.1 Energy stores and systems**

**Question 26**

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?

.....

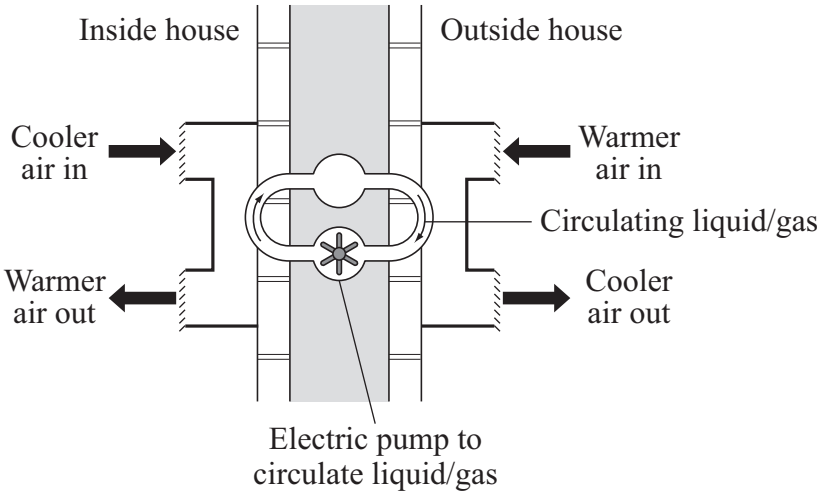
*(1 mark)*

(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)*

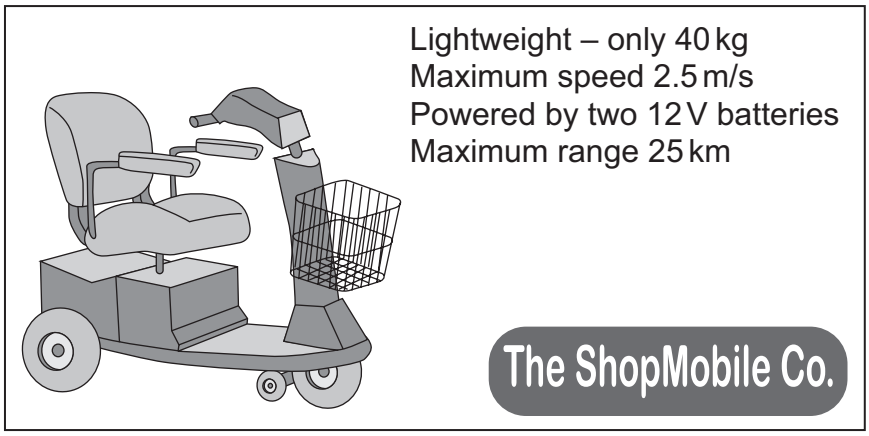
5

**4.1.1.1 Energy stores and systems**

**Question 27**



**3** The picture shows an advert for an electric mobility scooter.




(a) The batteries are joined in series.

(i) What is the potential difference provided by the batteries to the motor?

.....

*(1 mark)*

(ii) The batteries supply a *direct current (d.c.)*.

What is a *direct current (d.c.)*?

.....

.....

*(1 mark)*

(b) At 2.5 m/s on flat ground, the motor takes a current of 3.0 A from the batteries.

(i) Explain why a bigger current is taken from the batteries when the scooter is going uphill at 2.5 m/s.

.....

.....

.....

.....

*(2 marks)*

**Question 27 · continued**



*BLANK*

(ii) What effect does travelling uphill have on the range of the scooter?

.....

*(1 mark)*

(c) The mass of the scooter driver is 80 kg.

Use the equation in the box to calculate the kinetic energy of the scooter **and** driver when they are travelling at maximum speed.

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

Show clearly how you work out your answer.

.....

.....

Kinetic energy = ..... J

*(2 marks)*

(d) A battery which has run down is recharged in 8 hours. The average current delivered by the battery charger is 1.5 A.

Use the equation in the box to calculate the maximum charge stored by **both** batteries.

$$\text{charge} = \text{current} \times \text{time}$$

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

.....

.....

Charge stored = .....

*(3 marks)*

10

4.1.1.1 Energy stores and systems

Question 28

March 2008 | PHY1AP | Original Q8 | Legacy

## QUESTION EIGHT

Many scientists think that changes to the ice caps are affecting global warming.

As the ice melts, dark particles accumulate at the surface of the ice. This reduces the amount of sunlight reflected from the surface of the ice. The extra heat taken in by the ice causes the release of frozen methane. Methane is a potent greenhouse gas.

**8A** The reduction in the amount of sunlight reflected by the ice caps causes more heat to be transferred to the ice by . . .

**1** conduction.

**2** convection.

**3** insulation.

**4** radiation.

**8B** In addition to methane, the other potent greenhouse gas is . . .

**1** carbon monoxide.

**2** carbon dioxide.

**3** ozone.

**4** sulfur dioxide.

4.1.1.1 Energy stores and systems

**Question 28 · continued** March 2008 | PHY1AP | Original Q8 | Legacy

Changes to the ways in which electricity is generated could reduce global warming.

**8C**

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

Centralised power stations are large power stations that supply electricity over a wide area.

A centralised power station wastes two-thirds of the energy supplied to it.

The efficiency of a centralised power station is . . .

**1** 0.23

**2** 0.33

**3** 0.50

**4** 0.67

**8D** Smaller local power stations use the heat that would normally be lost in cooling towers to warm surrounding homes and offices.

A large centralised power station and a group of four smaller local power stations both use the same mass of coal to generate electricity.

In comparison to the large centralised power station, the group of local power stations would . . .

**1** produce less carbon dioxide.

**2** have less impact on the environment.

**3** produce more electricity.

**4** transfer the same amount of useful energy.

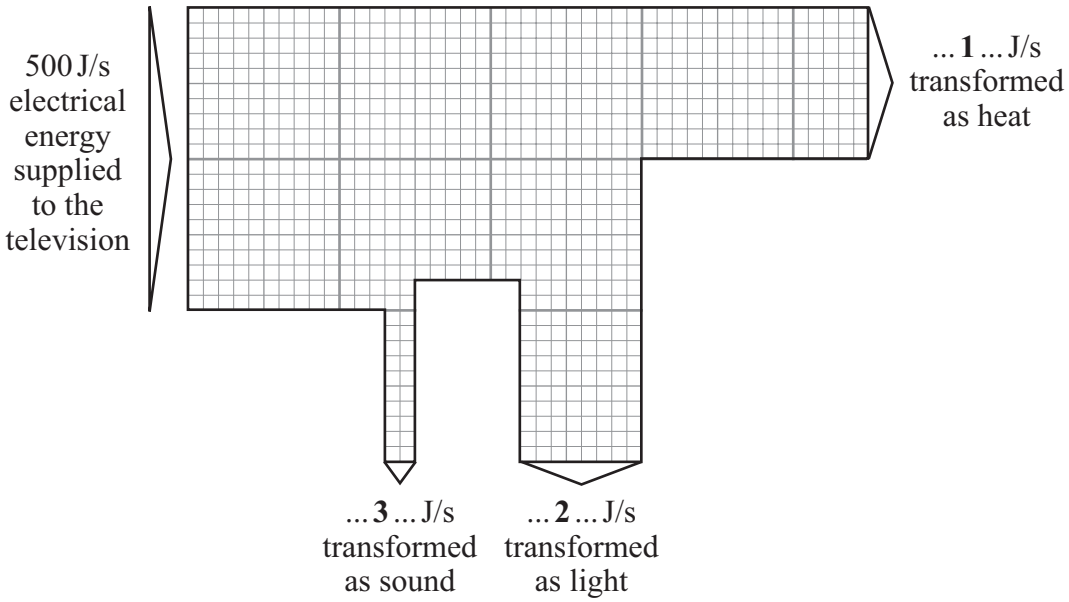
4.1.1.1 Energy stores and systems

Question 29

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** ...

4.1.1.1 Energy stores and systems

Question 29 · continued



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

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**

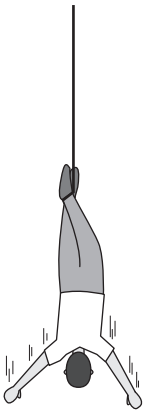
4.1.1.1 Energy stores and systems

Question 30

June 2008 | PHY1AP | Original Q2 | Legacy

## QUESTION TWO

During a bungee jump, energy is transformed.



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

**A** gravitational potential energy

**B** heat (thermal energy)

**C** kinetic energy

**D** elastic potential energy

At the top of the jump there is . . . **1** . . . .

As the bungee jumper falls, he gains . . . **2** . . . .

During the fall, energy is wasted as . . . **3** . . . .

As the bungee cord is stretched, it gains . . . **4** . . . .

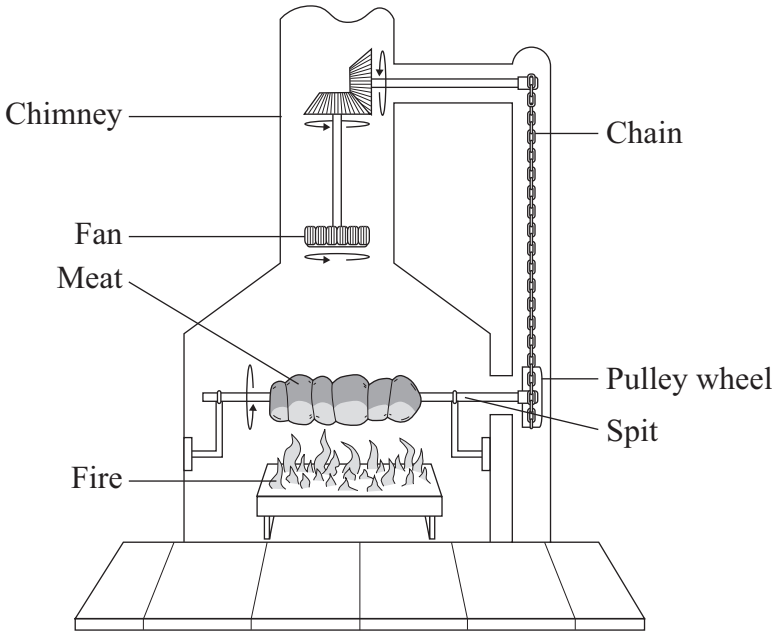
4.1.1.1 Energy stores and systems

Question 31

June 2008 | PHY1AP | Original Q5 | Legacy

## QUESTION FIVE

The diagram shows a device called a spit-roast. The meat is both turned and cooked by the energy from the fire.




**5A** The fan turns because energy is transferred to it by . . .

**1** combustion.

**2** conduction.

**3** convection.

**4** radiation.

**5B** The surface of the meat darkens as it cooks.

As a result of this, the meat . . .

**1** absorbs energy from convection currents less rapidly.

**2** absorbs energy from convection currents more rapidly.

**3** absorbs energy in the form of radiation more easily.

**4** stays hot for longer after it has been removed from the spit.

4.1.1.1 Energy stores and systems



**5C** Heat is transferred through the meat mainly by . . .

**1** conduction.

**2** convection.

**3** convection and radiation.

**4** radiation.

**5D** As the spit turns, some kinetic energy will be transformed and wasted as . . .

**1** chemical energy.

**2** sound energy.

**3** light energy.

**4** electrical energy.

**Turn over for the next question**

4.1.1.1 Energy stores and systems

Question 32

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

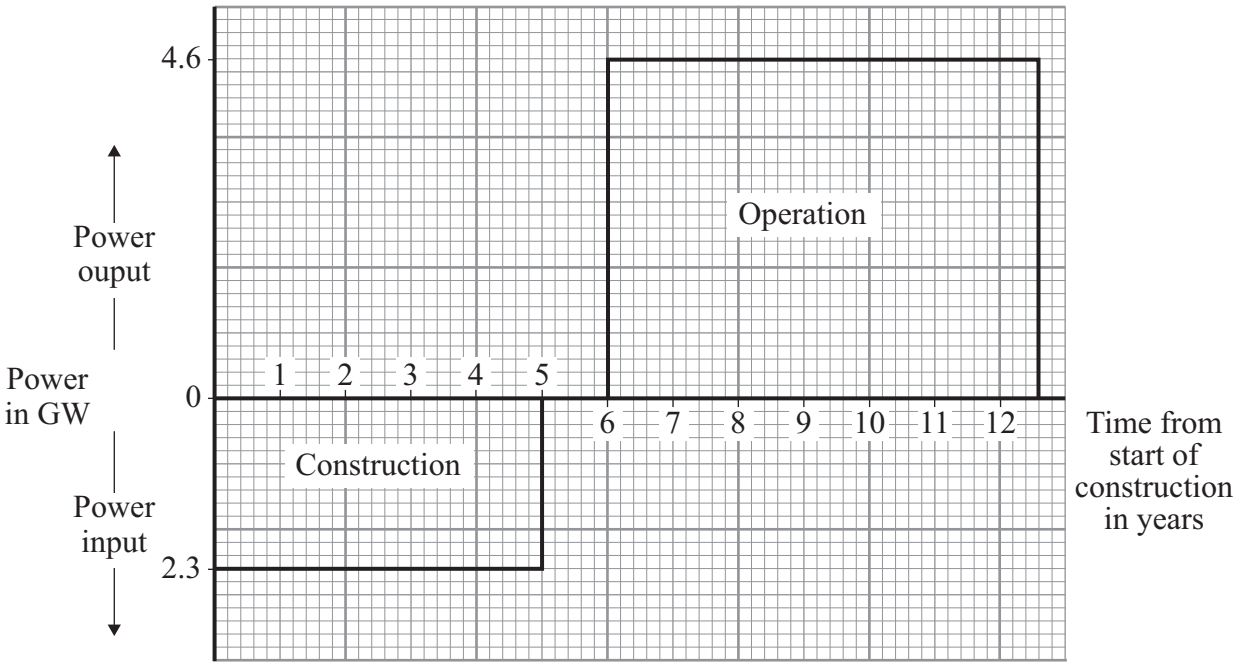
**4** 80 000 hours

Question 32 · 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**

### 4.1.1.1 Energy stores and systems

**Question 33**

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)*

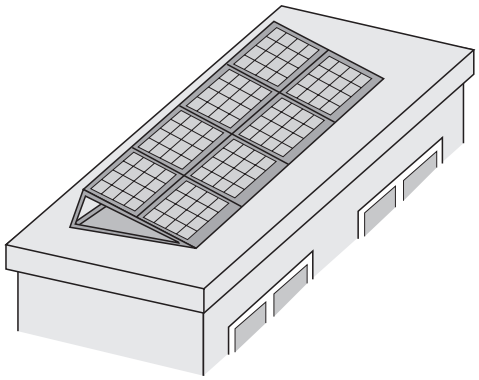
**4** (a) (ii) Name **two** further renewable energy sources used to generate electricity.

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.



4.1.1.1 Energy stores and systems

Question 33 · 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**

4.1.1.1 Energy stores and systems

Question 33 · 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

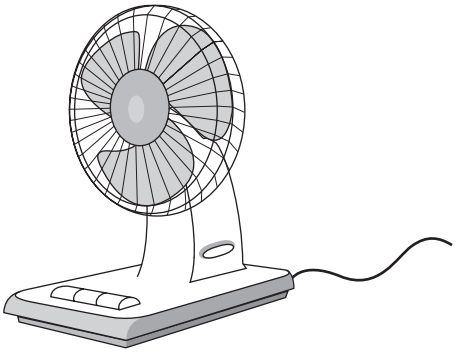
### 4.1.1.1 Energy stores and systems

**Question 34**

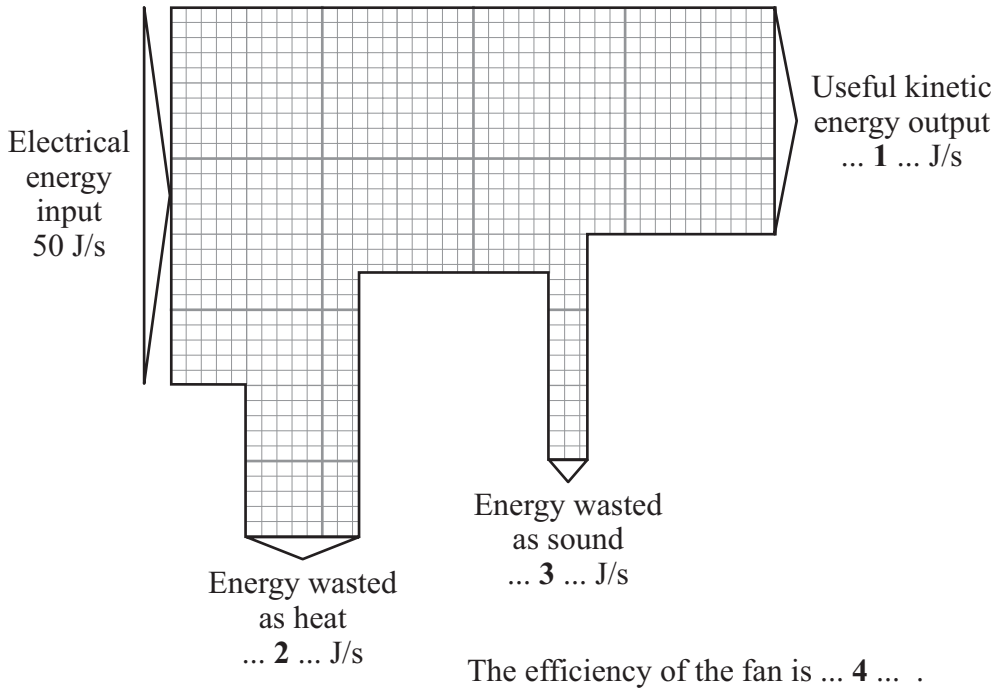
November 2008 | PHY1AP | Original Q1 | Legacy

## QUESTION ONE

The diagram shows an electric fan.



The Sankey diagram gives the energy transformations for the fan.




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

4.1.1.1 Energy stores and systems

Question 34 · continued



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

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

**A** 0.6

**B** 5

**C** 15

**D** 30

**Turn over for the next question**

4.1.1.1 Energy stores and systems

Question 35

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 35 · 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

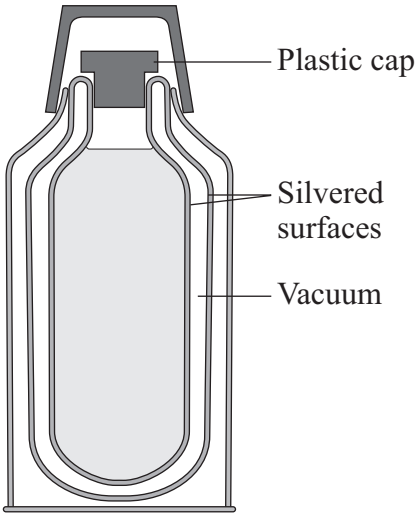
**END OF TEST**

4.1.1.1 Energy stores and systems

Question 36

January 2009 | PHY1H | Original Q1 | Legacy

**1** A vacuum flask is designed to reduce the rate of heat transfer.




**1** (a) (i) Complete the table to show which methods of heat transfer are reduced by each of the features labelled in the diagram.

The first row has been done for you.

| Feature | Conduction | Convection | Radiation |
|---|---|---|---|
| vacuum | ✓ | ✓ | |
| silvered surfaces | | | |
| plastic cap | | | |

*(2 marks)*

**1** (a) (ii) Explain why the vacuum between the glass walls of the flask reduces heat transfer by conduction and convection.

.....

.....

.....

.....

*(2 marks)*

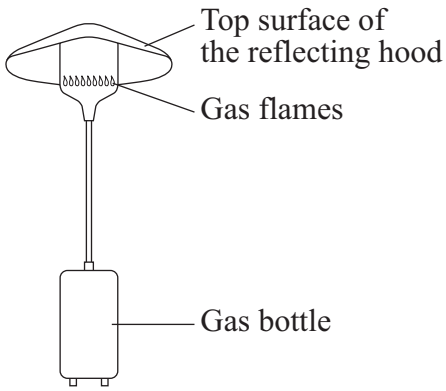
4.1.1.1 Energy stores and systems

Question 36 · continued



*for mark*

**1** (b) The diagram shows a gas flame patio heater.




**1** (b) (i) Explain why the top surface of the reflecting hood should be a light, shiny surface rather than a dark, matt surface.

.....

.....

.....

*(2 marks)*

**1** (b) (ii) Most of the chemical energy in the gas is transformed into heat. A **small** amount of chemical energy is transformed into light.

Draw and label a Sankey diagram for the patio heater.

*(2 marks)*

**1** (b) (iii) State why the total energy supplied to the patio heater must always equal the total energy transferred by the patio heater.

.....

.....

*(1 mark)*

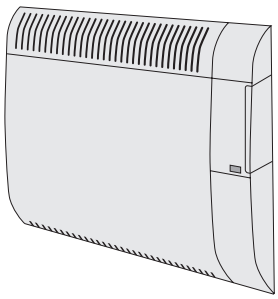
9

4.1.1.1 Energy stores and systems

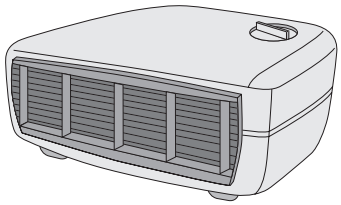
Question 37

January 2009 | PHY1H | Original Q2 | Legacy

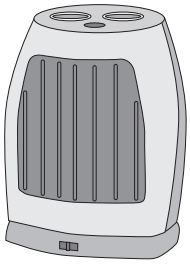
**2** The pictures show three different types of electric heater.



**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)*

4.1.1.1 Energy stores and systems

Question 37 · 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**

**4.1.1.1 Energy stores and systems**

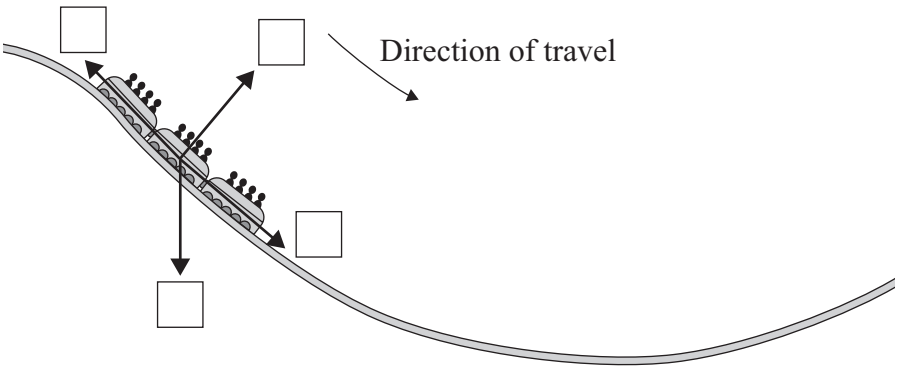
**Question 38**

January 2009 | PHY2H | Original Q1 | Legacy

**1** The diagram shows the passenger train on part of a rollercoaster ride.

**1** (a) Which arrow shows the direction of the resultant force acting on the passenger train?

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




*(1 mark)*

**1** (b) At the bottom of the slope, the passengers in the train all have the same speed but they each have a different kinetic energy.

Why is the kinetic energy of each passenger different?

.....

.....

*(1 mark)*

**1** (c) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

**1** (c) (i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....

.....

Maximum gravitational field strength = ..... N/kg

*(1 mark)*

4.1.1.1 Energy stores and systems

Question 38 · continued



*for mark*

**1** (c) (ii) One of the passengers has a mass of 80 kg.

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

| weight = mass × gravitational field strength |
|---|

Show clearly how you work out your answer.

.....

.....

Maximum weight = ..... N
*(2 marks)*

5

**Turn over for the next question**

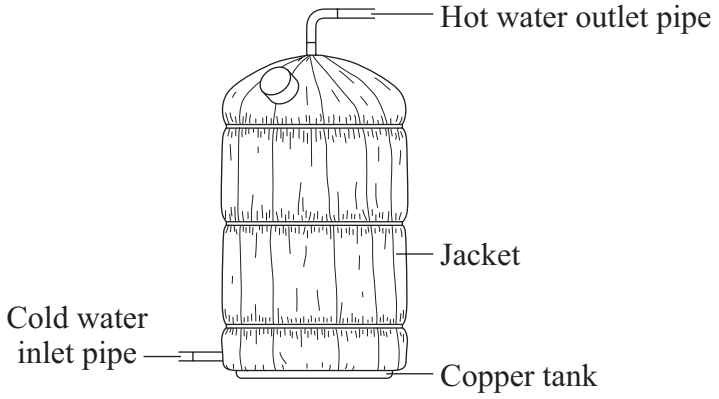
4.1.1.1 Energy stores and systems

Question 39

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.

4.1.1.1 Energy stores and systems

Question 39 · continued



**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

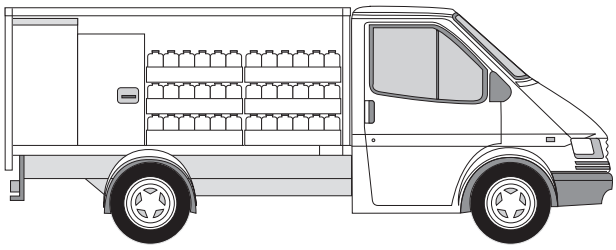
4.1.1.1 Energy stores and systems

Question 40

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

4.1.1.1 Energy stores and systems

**Question 40 · 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.

4.1.1.1 Energy stores and systems

Question 41

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

4.1.1.1 Energy stores and systems

Question 41 · 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

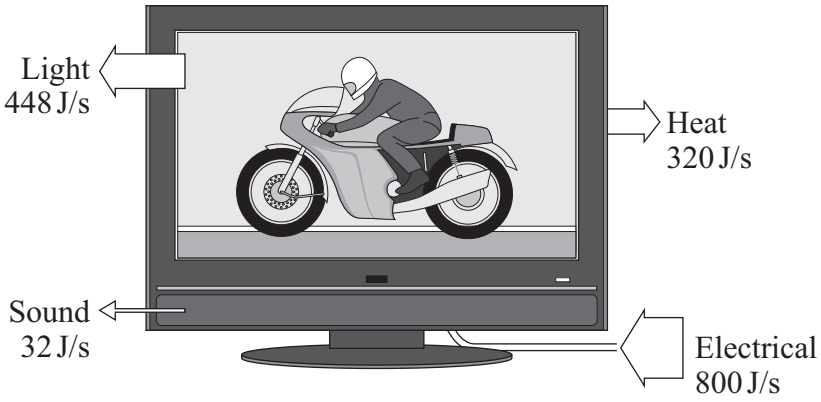
**4** 480

**4.1.1.1 Energy stores and systems**

**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**

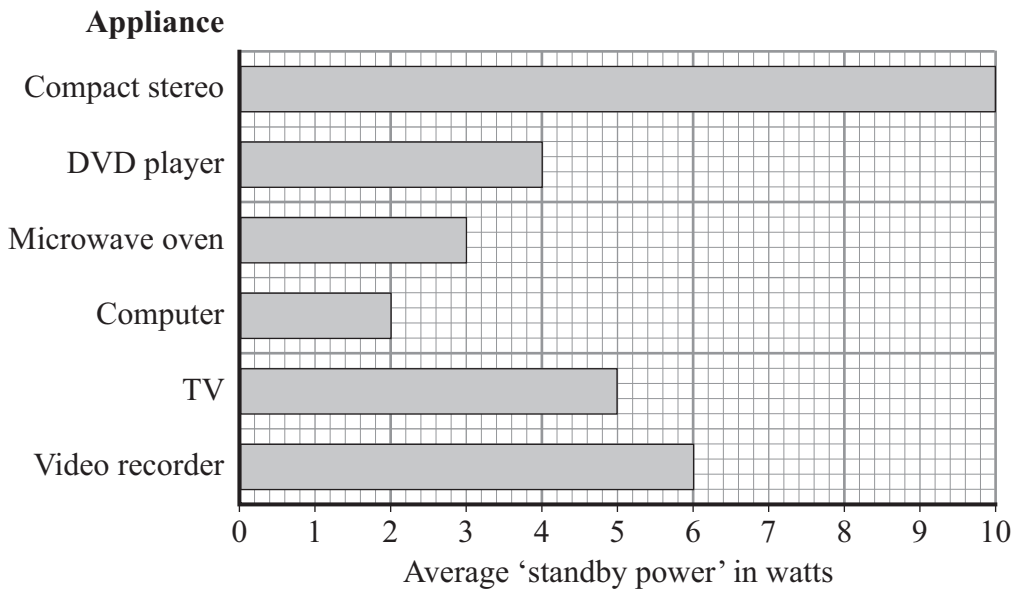
Question 42 · continued



*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)*

4.1.1.1 Energy stores and systems

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 |
|---|

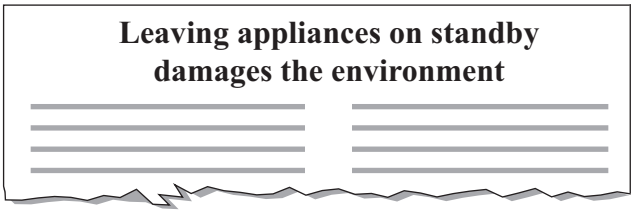
Show clearly how you work out your answer.

.....

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)*

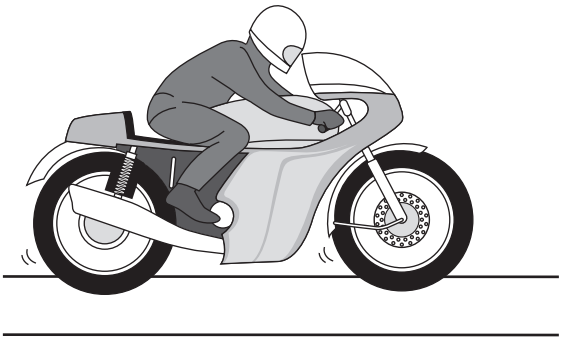
8

4.1.1.1 Energy stores and systems

Question 43

June 2009 | PHY2H | Original Q5 | Legacy

**5** The diagram shows a motorbike of mass 300 kg being ridden along a straight road.



The rider sees a traffic queue ahead. He applies the brakes and reduces the speed of the motorbike from 18 m/s to 3 m/s.

**5** (a) Use the equation in the box to calculate the kinetic energy lost by the motorbike.

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

Show clearly how you work out your answer.

.....

.....

.....

.....

Kinetic energy lost = ..... J

*(2 marks)*

**5** (b) (i) How much work is done on the motorbike by the braking force?

.....

*(1 mark)*

**5** (b) (ii) What happens to the kinetic energy lost by the motorbike?

.....

*(1 mark)*

4

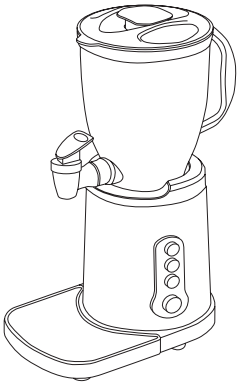
### 4.1.1.1 Energy stores and systems

**Question 44**

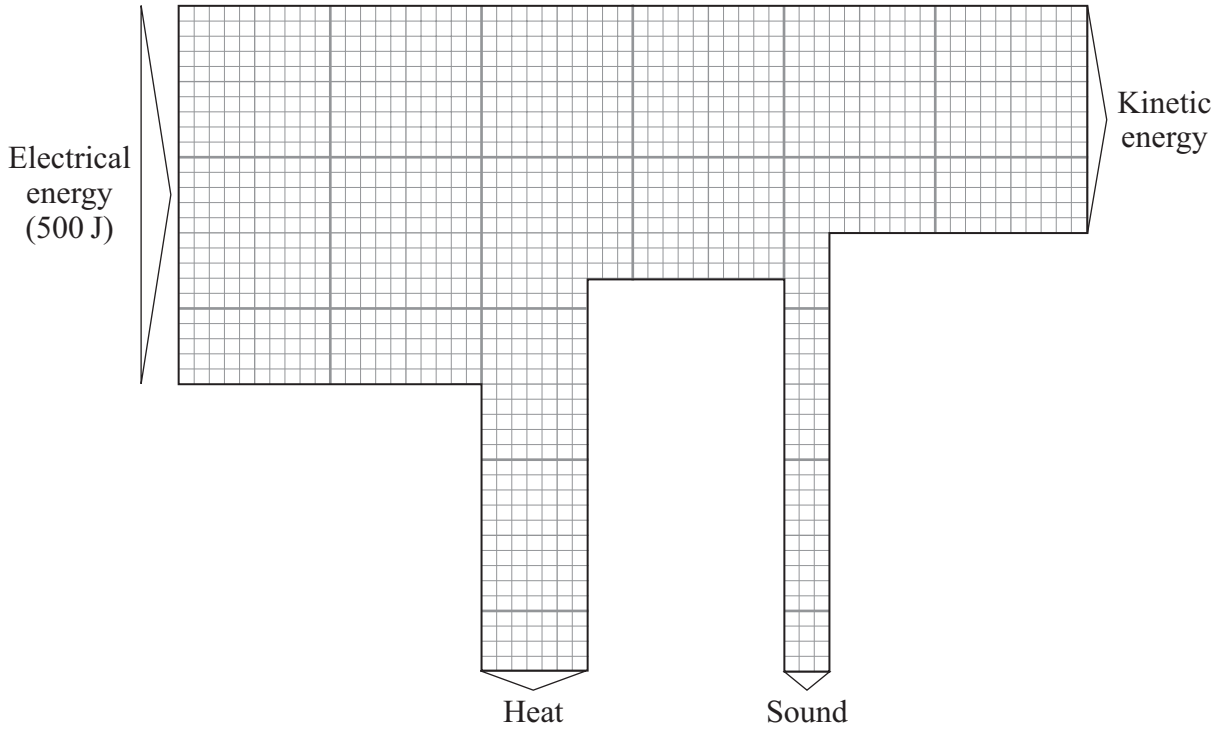
November 2009 | PHY1AP | Original Q1 | Legacy

## QUESTION ONE

The diagram shows a smoothie maker.



The Sankey diagram shows the energy transfers that take place each second in this smoothie maker.



4.1.1.1 Energy stores and systems

Question 44 · continued



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

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

**A** 0.6

**B** 140

**C** 200

**D** 300

The kinetic energy produced each second is . . . **1** . . . J.

The heat produced each second is . . . **2** . . . J.

The total energy wasted each second is . . . **3** . . . J.

The efficiency of the smoothie maker is . . . **4** . . . .

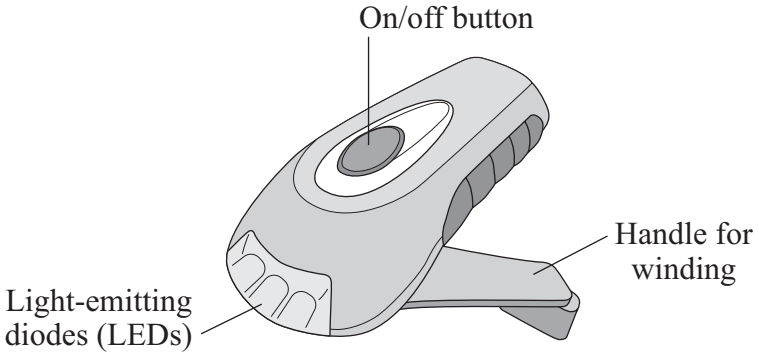
4.1.1.1 Energy stores and systems

Question 45

November 2009 | PHY1AP | Original Q2 | Legacy

## QUESTION TWO

The diagram shows a torch which contains a rechargeable battery. The battery is recharged by winding the handle.




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

**A** chemical

**B** electrical

**C** kinetic

**D** light

When the user winds the handle, the useful energy transformation is from . . . **1** . . . energy to . . . **2** . . energy which is stored in the battery.

When the torch is switched on, the useful output from the battery is . . . **3** . . . energy and the useful output from the LEDs is . . . **4** . . . energy.

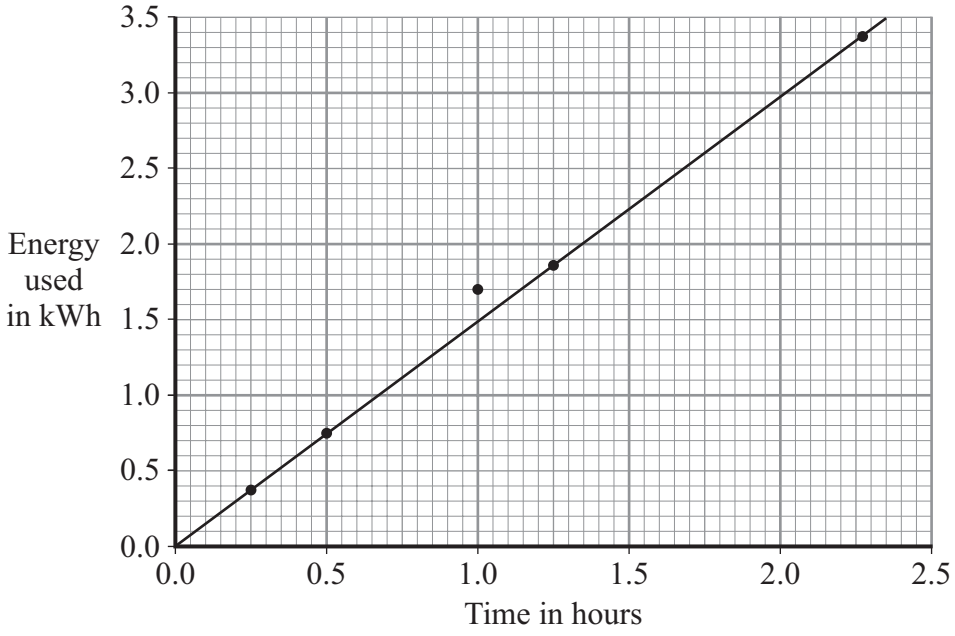
4.1.1.1 Energy stores and systems

Question 46

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.

4.1.1.1 Energy stores and systems

Question 46 · 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

4.1.1.1 Energy stores and systems

Question 47

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 47 · 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**

4.1.1.1 Energy stores and systems

Question 48

November 2009 | PHY1BP | Original Q7 | Legacy

## QUESTION SEVEN

There are two types of radio wave that carry television signals, VHF and UHF.

**7A** Some UHF waves have a frequency that is ten times bigger than some VHF waves.

The wavelength of these UHF waves, in comparison to the VHF ones, is . . .

**1** ten times as big because they travel faster.

**2** one tenth as big because they travel faster.

**3** ten times as big because they travel at the same speed.

**4** one tenth as big because they travel at the same speed.

**7B** One television channel transmits using waves of frequency 1000 MHz.

| wave speed (metre/second, m/s) | = | frequency (hertz, Hz) | × | wavelength (metre, m) |
|---|---|---|---|---|

Speed of electromagnetic waves in a vacuum = 300 000 km/s

1 MHz = 1 million hertz

What is the wavelength of these waves?

**1** 0.3 m

**2** 3.0 m

**3** 0.3 km

**4** 3.0 km

4.1.1.1 Energy stores and systems

Question 48 · continued



**7C** All television transmitters in the UK are going to be switched from analogue to digital signals.

Which row in the table is correct?

| | Analogue signals | Digital signals |
|---|---|---|
| **1** | continuously varying | more prone to interference and cannot be processed by a computer |
| **2** | less prone to interference and can be easily processed by a computer | discrete values only, generally on and off |
| **3** | continuously varying | less prone to interference and can be easily processed by a computer |
| **4** | discrete values only, generally on and off | continuously varying |

**7D** An aerial receives television signals.

The energy transferred by an electromagnetic wave carrying the television signal . . .

**1** makes the aerial hotter so that it can detect the signal.

**2** makes the aerial colder so that it can detect the signal.

**3** creates an alternating current in the aerial with the same frequency as the wave.

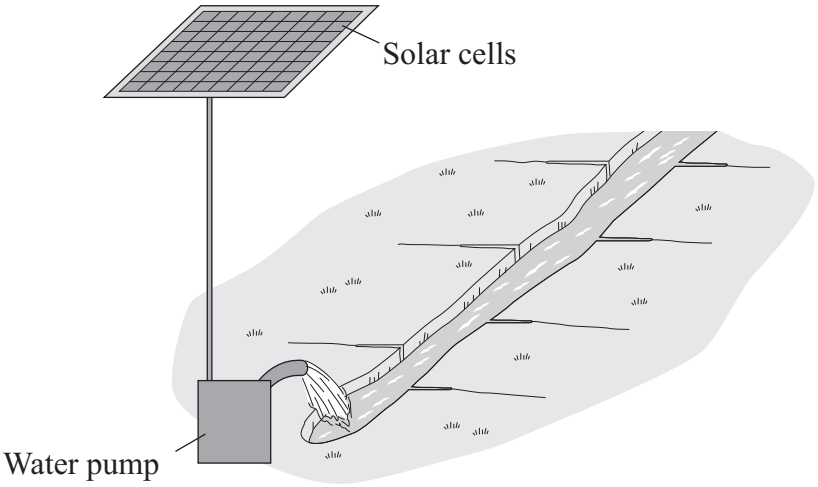
**4** creates a direct current in the aerial with the same frequency as the wave.

4.1.1.1 Energy stores and systems

**Question 49**



**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)*

4.1.1.1 Energy stores and systems

**Question 49 · 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**

4.1.1.1 Energy stores and systems

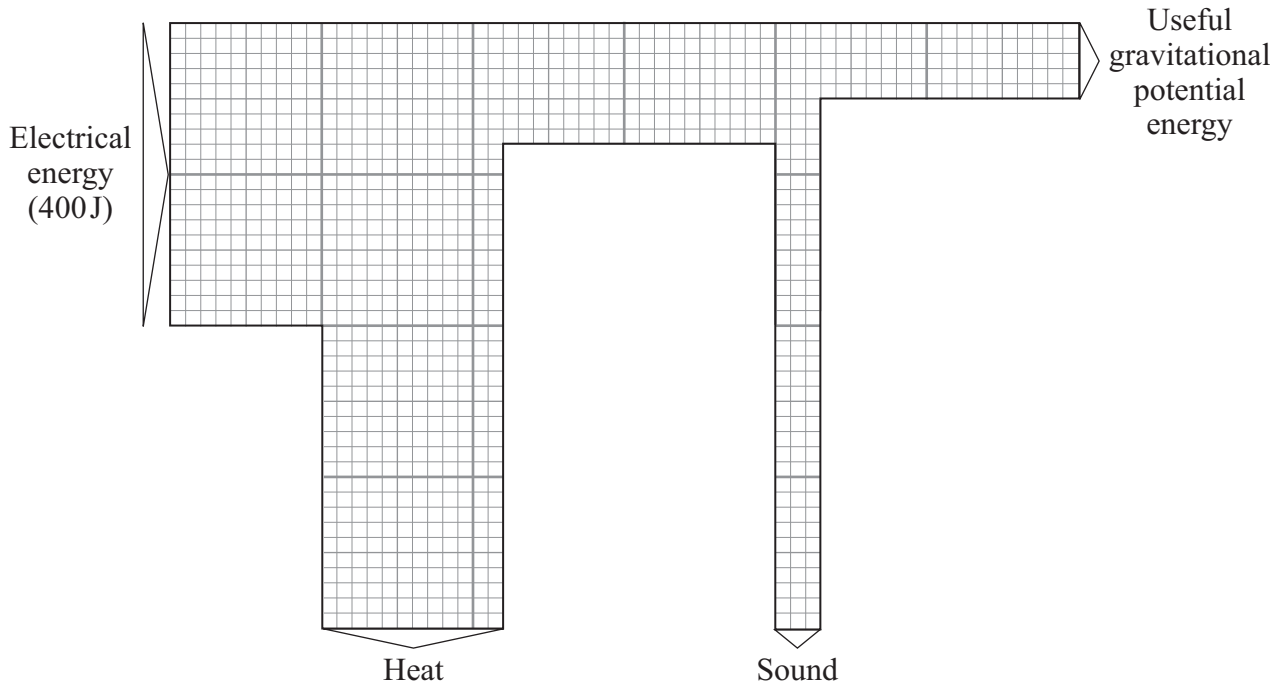
Question 50

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

4.1.1.1 Energy stores and systems

**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** . . . .

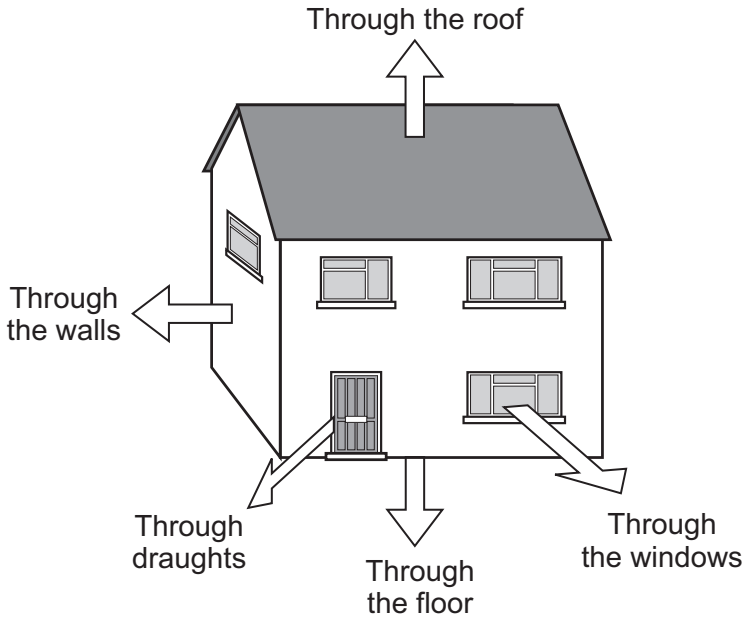
4.1.1.1 Energy stores and systems

Question 51

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

4.1.1.1 Energy stores and systems

Question 51 · 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.

4.1.1.1 Energy stores and systems

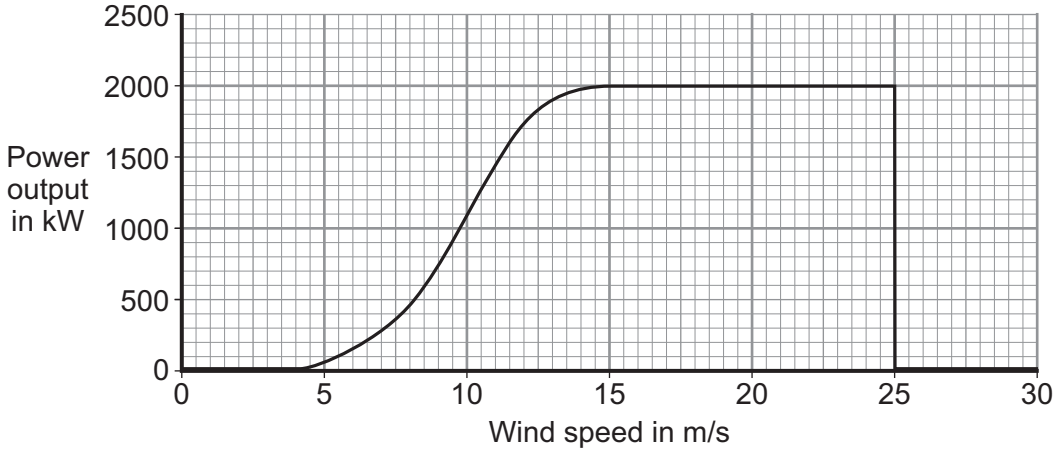
Question 52

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 |

4.1.1.1 Energy stores and systems

Question 52 · 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

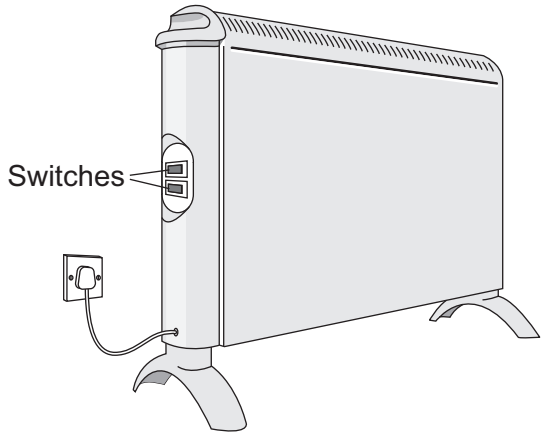
**4** 14.3

### 4.1.1.1 Energy stores and systems

**Question 53**

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)*

4.1.1.1 Energy stores and systems

Question 53 · continued



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

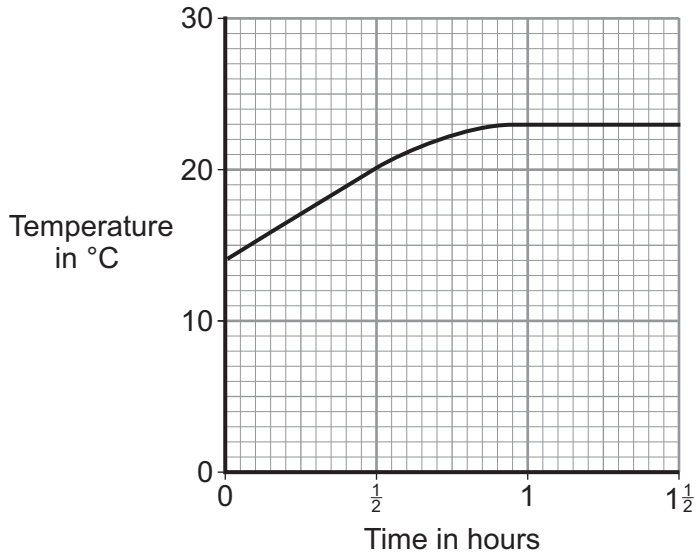
What is meant by a device being very efficient?

.....

.....

*(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)*

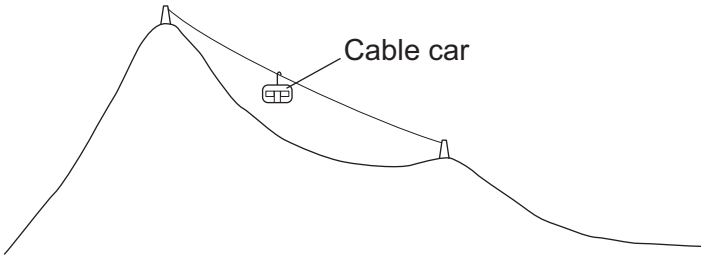
7

### 4.1.1.1 Energy stores and systems

**Question 54**

June 2010 | PHY2H | Original Q1 | Legacy

**1 (a)** The diagram shows a cable car used to take skiers to the top of a mountain.




**1 (a) (i)** The total mass of the cable car and skiers is 7500 kg.

Use the equation in the box to calculate the weight of the cable car and skiers.

| weight = mass × gravitational field strength |
|---|

gravitational field strength = 10 N/kg

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

.....

.....

Weight = .....

*(3 marks)*

4.1.1.1 Energy stores and systems

Question 54 · continued



**1 (a) (ii)** The cable car moves at a constant speed. It lifts skiers through a vertical height of 800 metres in 7 minutes.

Use the following equation to calculate the work done to lift the cable car and skiers.

| work done = force applied × distance moved in the direction of force |
|---|

Show clearly how you work out your answer.

.....

.....

Work done = ..... J

*(2 marks)*

**1 (b)** The diagram shows a skier who is accelerating down a steep ski slope.



**1 (b) (i)** Draw an arrow on the diagram to show the direction of the resultant force acting on the skier.

*(1 mark)*

**1 (b) (ii)** How and why does the kinetic energy of the skier change?

.....

.....

.....

.....

*(2 marks)*

**Question 1 continues on the next page**

4.1.1.1 Energy stores and systems

Question 54 · continued



**1 (c)** Last year, 18 000 skiers suffered a head injury. It is thought that nearly 8000 of these injuries could have been avoided if the skier had been wearing a helmet. However, at present, there are no laws to make skiers wear helmets.

Suggest why skiers should be made aware of the benefits of wearing a helmet.

.....

.....

*(1 mark)*

9

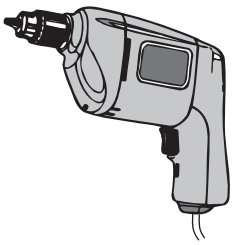
### 4.1.1.1 Energy stores and systems

**Question 55**

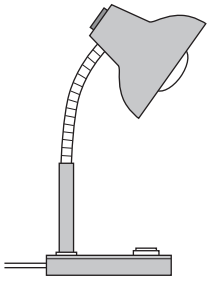
November 2010 | PHY1AP | Original Q1 | Legacy

**QUESTION ONE**

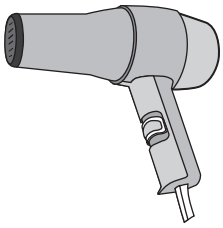
The diagrams show four electrical devices. The Sankey diagrams show the energy transformations involved in the four electrical devices.



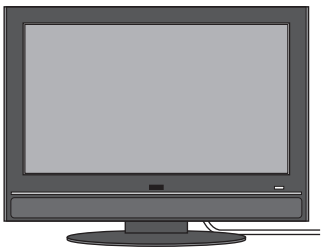
**A**
Electric drill



**B**
Desk lamp



**C**
Hair dryer



**D**
Television

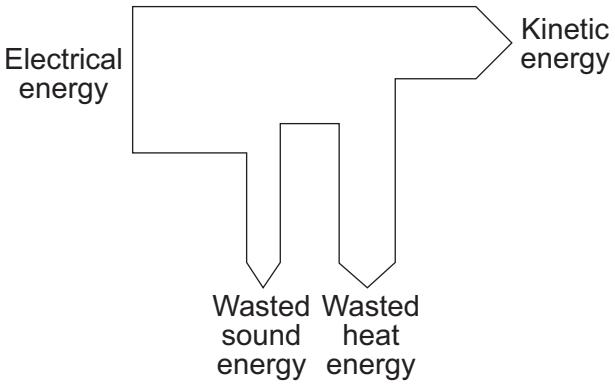
Match devices, **A**, **B**, **C** and **D**, with the Sankey diagrams **1**–**4**.

### 4.1.1.1 Energy stores and systems

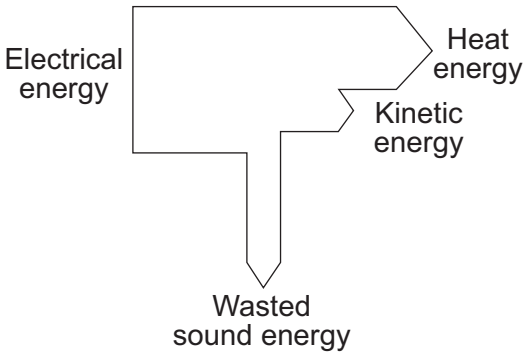
**Question 55 · continued**



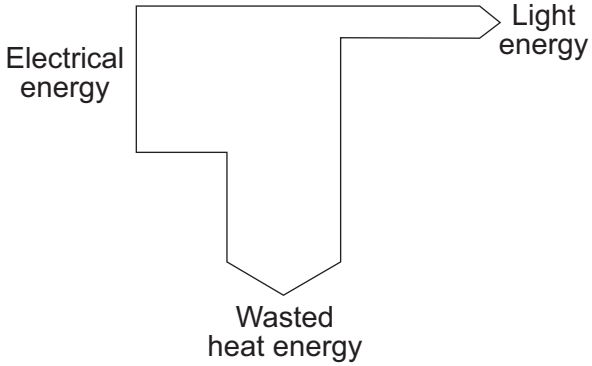
**1**



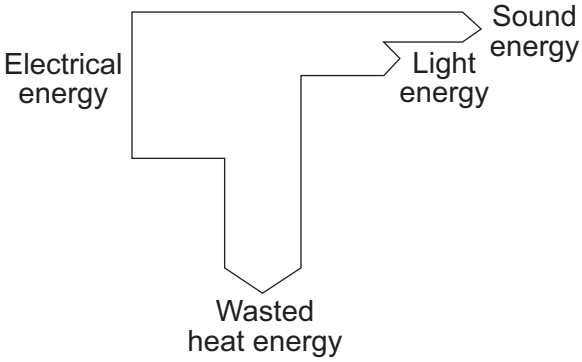

**2**




**3**




**4**



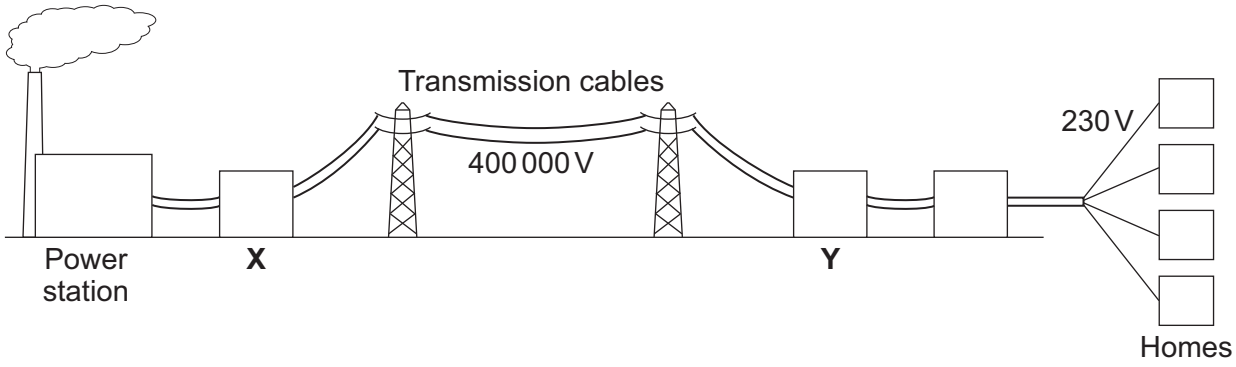
4.1.1.1 Energy stores and systems

Question 56

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 |

4.1.1.1 Energy stores and systems

Question 56 · 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**

4.1.1.1 Energy stores and systems

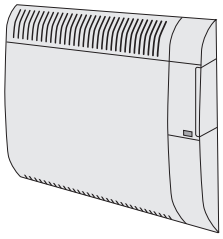
Question 57

November 2010 | PHY1AP | Original Q9 | Legacy

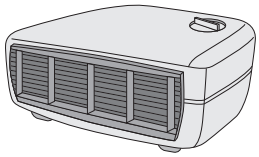
## QUESTION NINE

The pictures show three different types of electric heater.

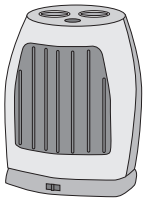
**400 W oil-filled panel heater**
- 3 heat settings
- Efficient background heat
- Safety overheat cut-out



**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

**Question 57 · continued** November 2010 | PHY1AP | Original Q9 | Legacy

**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.

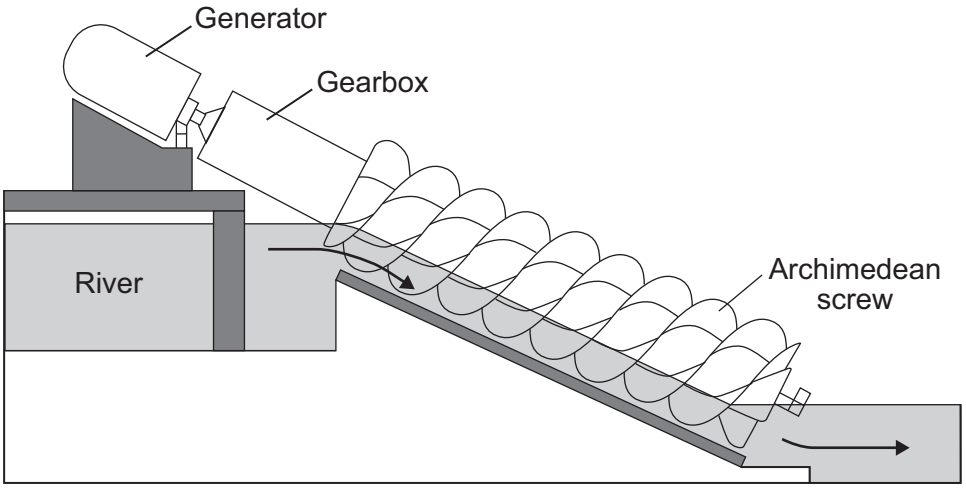
**END OF TEST**

### 4.1.1.1 Energy stores and systems

**Question 58**

January 2011 | PHY1H | Original Q4 | Legacy

**4** The diagram shows a small-scale, *micro-hydroelectricity* generator which uses the energy of falling river water to generate electricity. The water causes a device, called an Archimedean screw, to rotate.
The Archimedean screw is linked to the generator by a gearbox.




**4 (a)** Each second, the *micro-hydroelectricity* generator transforms 80 000 joules of gravitational potential energy into 60 000 joules of electrical energy.

**4 (a) (i)** Fill in the missing word to complete the energy transformation diagram.

| | | |
|---|---|---|
| Gravitational potential energy of the falling water | → ..... energy of the Archimedean screw | → Electrical energy generated |

*(1 mark)*

**4 (a) (ii)** Use the equation in the box to calculate the efficiency of the *micro-hydroelectricity* generator.

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

Show clearly how you work out your answer.

.....

.....

Efficiency = .....

*(2 marks)*

4.1.1.1 Energy stores and systems

Question 58 · continued



**4 (b)** The power output from a conventional large-scale hydroelectric power station is 100 000 times more than the power output from a micro-hydroelectric system.

Give **one** disadvantage of a conventional large-scale hydroelectric power station compared to the micro-hydroelectric system.

.....

.....

*(1 mark)*

**4 (c)** The electricity generated by a micro-hydroelectric system is transferred via a transformer directly to local homes. The electricity generated by a conventional large-scale hydroelectric power station is transferred to the National Grid, which distributes the electricity to homes anywhere in the country.

**4 (c) (i)** What is the National Grid?

.....

.....

*(1 mark)*

**4 (c) (ii)** Explain why transferring the electricity directly to local homes is more efficient than using the National Grid to distribute the electricity.

.....

.....

.....

.....

*(2 marks)*

7

### 4.1.1.1 Energy stores and systems

**Question 59**

January 2011 | PHY1H | Original Q6 | Legacy

**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)*

4.1.1.1 Energy stores and systems

Question 59 · 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)*

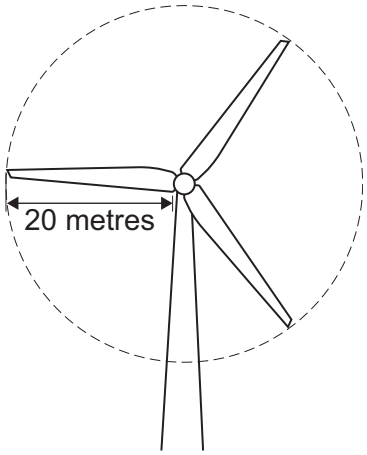
5

4.1.1.1 Energy stores and systems

Question 60

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

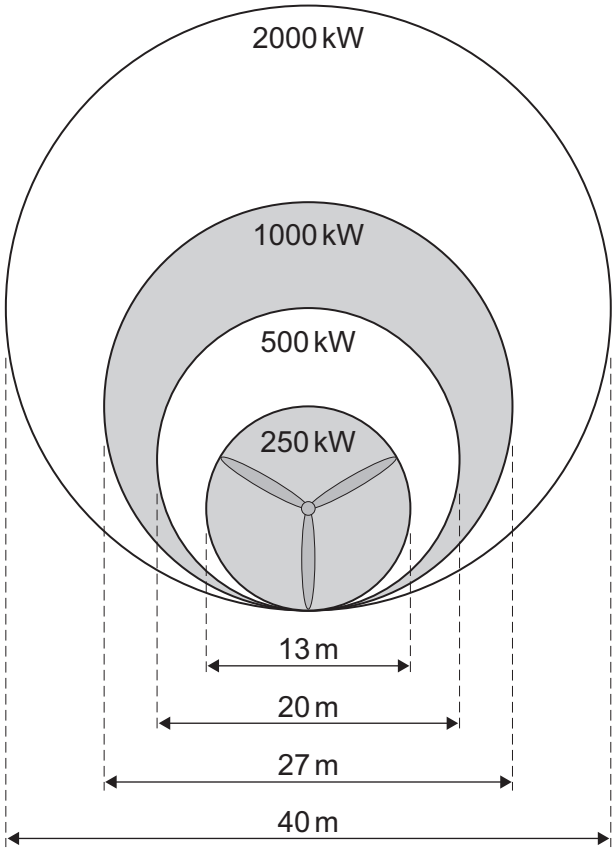
*(2 marks)*

4.1.1.1 Energy stores and systems

Question 60 · 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

4.1.1.1 Energy stores and systems

Question 61

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.

4.1.1.1 Energy stores and systems

Question 61 · 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**

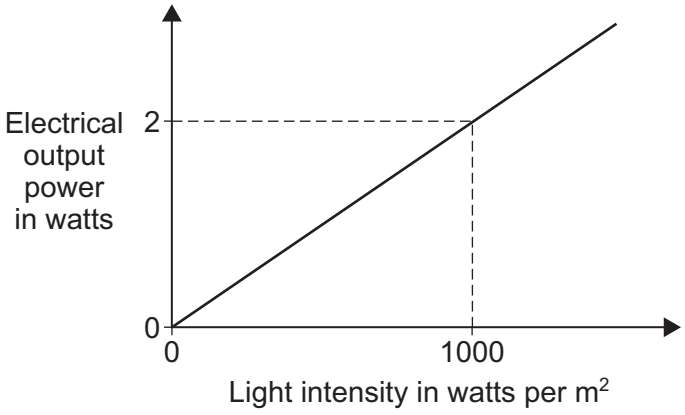
4.1.1.1 Energy stores and systems

Question 62

March 2011 | PHY1AP | Original Q9 | Legacy

**QUESTION NINE**

The diagram shows the electrical output power of a typical solar cell as the light intensity on it changes. The solar cell has a surface area of 100 $cm^2$.




**9A** The graph shows that . . .

**1** the output power is directly proportional to the light intensity.

**2** the output power decreases as the light intensity increases.

**3** as the light intensity decreases the output power increases.

**4** the output power is not affected by the light intensity.

**9B** The output power of the solar cell is directly proportional to the area of the cell exposed to light.

A similar solar cell has an area of 50 $cm^2$. The light intensity was 1000 watts per $metre^2$.

What is the output power of this solar cell?

**1** 0 watts

**2** 1 watt

**3** 2 watts

**4** 4 watts

4.1.1.1 Energy stores and systems

Question 62 · continued



A satellite in space uses solar energy as its power source.
The satellite needs 3 kJ of energy per second.
One square metre of solar cells on the satellite produces 250 joules of energy per second.

**9C** What area of solar cells is needed to power the satellite?

**1** 12 $m^2$

**2** 83 $m^2$

**3** 300 $m^2$

**4** 400 $m^2$

**9D** The efficiency of the solar cells is 0.2

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

Considering the total energy requirement of the satellite, how much solar energy falls on the solar cells each second?

**1** 15 J

**2** 600 J

**3** 15 kJ

**4** 600 kJ

**END OF TEST**

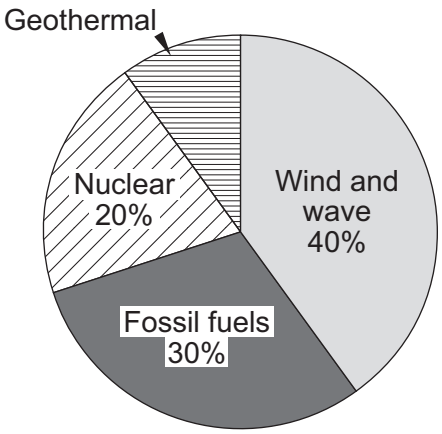
### 4.1.1.1 Energy stores and systems

**Question 63**

June 2011 | PHY1AP | Original Q1 | Legacy

**QUESTION ONE**

The pie chart shows how a country's electricity demands are met using different energy sources.




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

**A** 10 %

**B** 20 %

**C** 40 %

**D** 50 %

The percentage of electricity generated from non-renewable sources is . . . **1** . . . .

The percentage of electricity generated from geothermal sources is . . . **2** . . . .

The percentage of electricity generated using a source that produces radioactive waste is . . . **3** . . . .

The percentage of electricity generated using the kinetic energy of the source directly is . . . **4** . . . .

4.1.1.1 Energy stores and systems

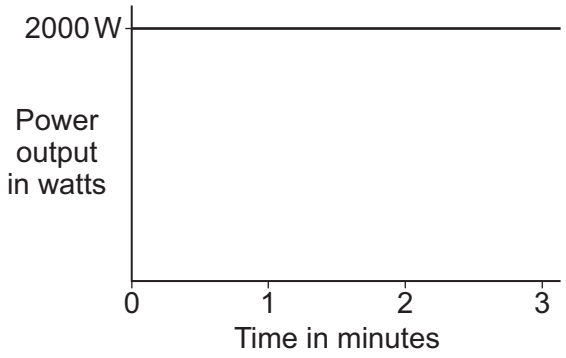
Question 64

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.

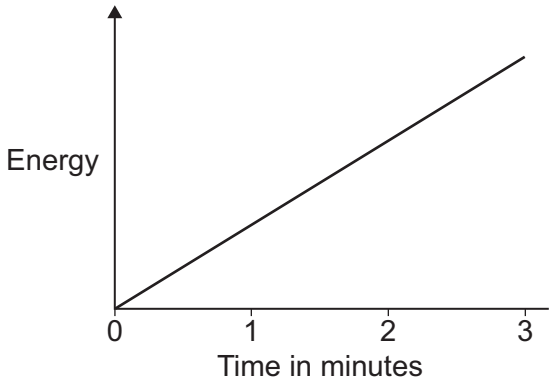
The graph shows how the power output of the kettle varies with time.



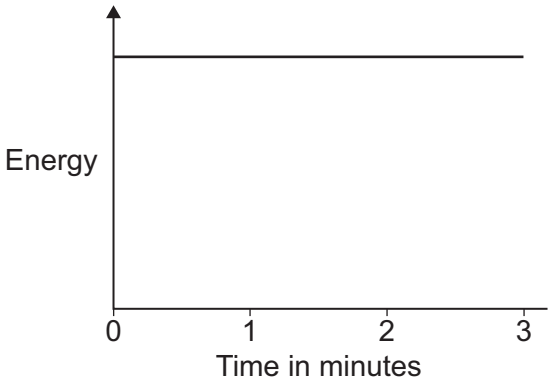

| energy transferred (kilowatt-hour, kWh) | = | power (kilowatt, kW) | × | time (hour, h) |
|---|---|---|---|---|

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

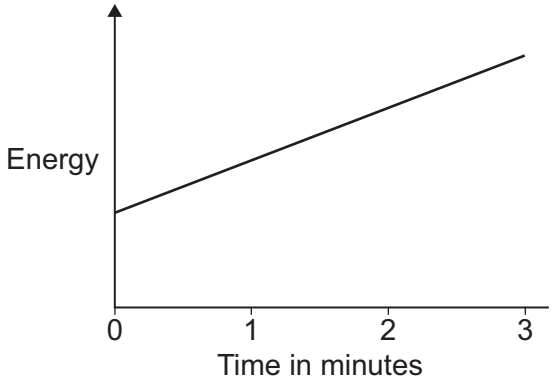
**1**



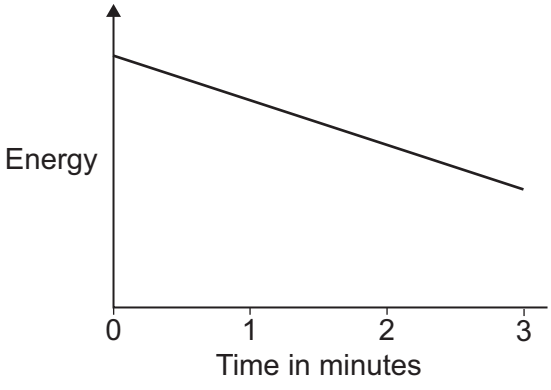

**2**




**3**




**4**



4.1.1.1 Energy stores and systems

Question 64 · 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

4.1.1.1 Energy stores and systems

Question 65

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?

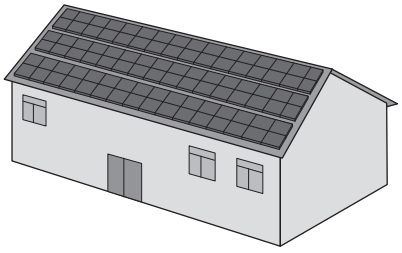
**1** Solar cells need a large area of land because solar cells are not very efficient.

**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 65 · continued



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

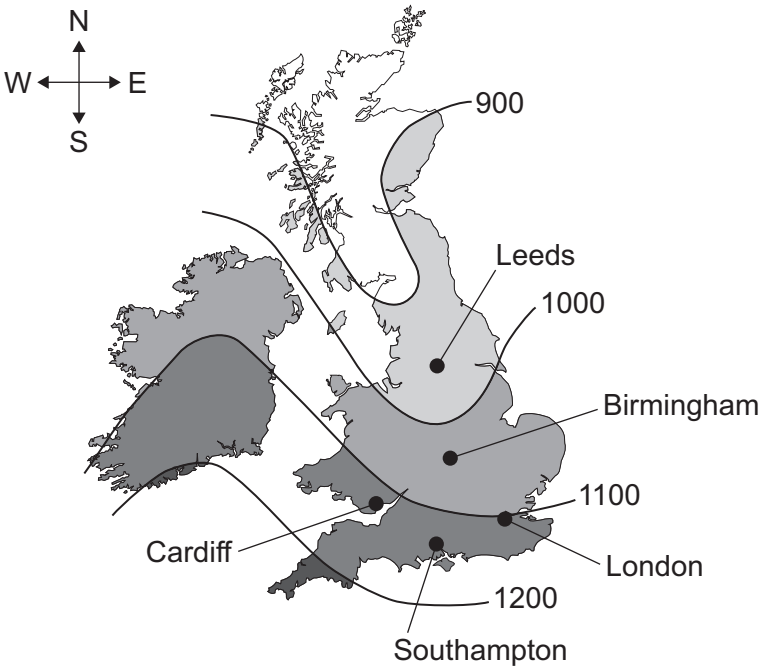



**Table 1** gives figures for the annual solar radiation, in kWh / $m^2$, for London. The table also gives data for various angles of tilt and for various directions that an array faces.

**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**

4.1.1.1 Energy stores and systems

Question 65 · 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

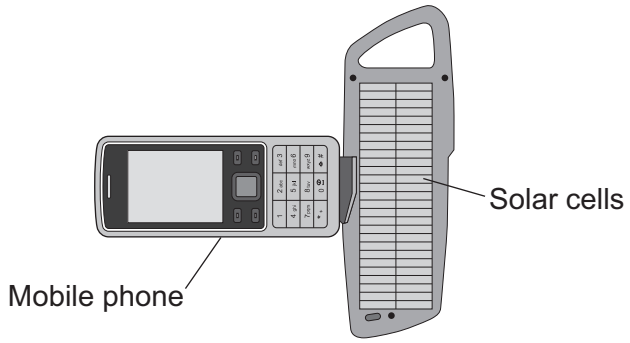
**END OF TEST**

### 4.1.1.1 Energy stores and systems

**Question 66**

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)*

4.1.1.1 Energy stores and systems

Question 66 · 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

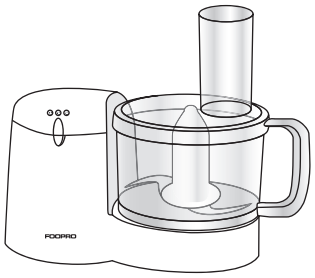
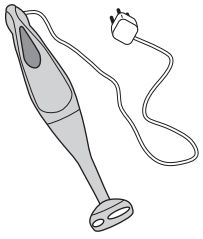
4.1.1.1 Energy stores and systems

Question 67

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

4.1.1.1 Energy stores and systems

Question 67 · continued



**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.

### 4.1.1.1 Energy stores and systems

**Question 68**

June 2012 | PH1HP | Original Q1 | Legacy

**1** A wood burning stove is used to heat a room.



The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

**1 (a)** The air next to the stove is warmed by infrared radiation.

How does the design of the stove help to improve the rate of energy transfer by infrared radiation?

.....

.....

.....

.....

*(2 marks)*

4.1.1.1 Energy stores and systems

Question 68 · continued



**1 (b)** Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

Efficiency = .....

*(2 marks)*

**1 (c)** Some of the energy from the burning wood is wasted as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

.....

*(1 mark)*

**1 (d)** Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1 .....

.....

2 .....

.....

*(2 marks)*

**Question 1 continues on the next page**

4.1.1.1 Energy stores and systems

Question 68 · continued



**1 (e)** The metal case of the stove gets hot when the fire is lit.

Here is some information about the stove.

| | |
|---|---|
| Mass of metal case | 100 kg |
| Starting temperature of metal case | 20 °C |
| Final temperature of metal case | 70 °C |
| Specific heat capacity of metal case | 510 J/kg °C |

Calculate the energy required to raise the temperature of the metal case to 70 °C.

Use the correct equation from the Physics Equations Sheet.

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

.....

.....

.....

.....

Energy required = .....

*(3 marks)*

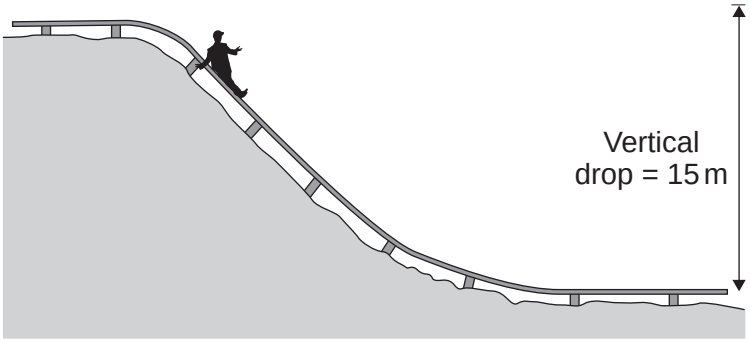
10

### 4.1.1.1 Energy stores and systems

**Question 69**

June 2012 | PH2HP | Original Q4 | Legacy

**4** The miners working in a salt mine use smooth wooden slides to move quickly from one level to another.




**4 (a)** A miner of mass 90 kg travels down the slide.

Calculate the change in gravitational potential energy of the miner when he moves 15m vertically downwards.

| gravitational field strength = 10 N/kg |
|---|

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Change in gravitational potential energy = ..... J

*(2 marks)*

4.1.1.1 Energy stores and systems

Question 69 · continued



**4 (b)** Calculate the **maximum** possible speed that the miner could reach at the bottom of the slide.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Give your answer to an appropriate number of significant figures.

.....

.....

.....

.....

Maximum possible speed = ..... m/s

*(3 marks)*

**4 (c)** The speed of the miner at the bottom of the slide is much less than the calculated maximum possible speed.

Explain why.

.....

.....

.....

.....

.....

.....

.....

*(3 marks)*

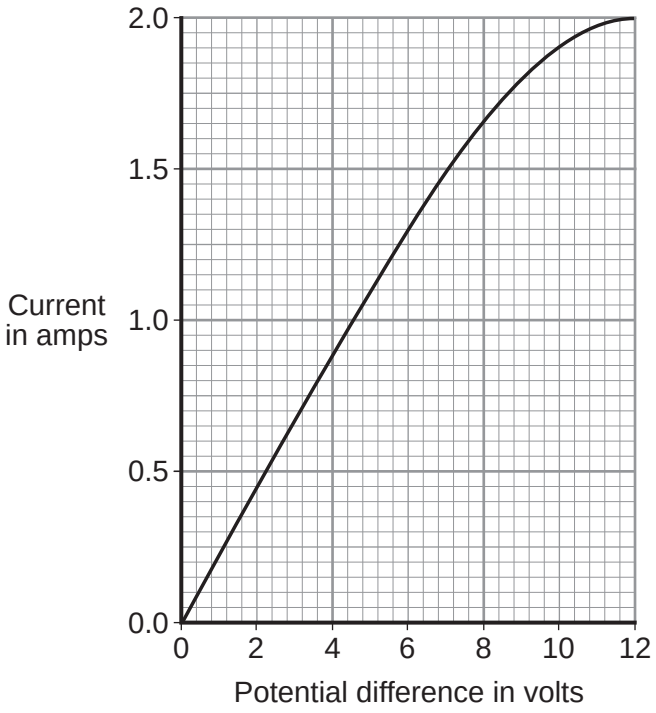
8

### 4.1.1.1 Energy stores and systems

**Question 70**

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)*

4.1.1.1 Energy stores and systems

Question 70 · continued



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

Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

*(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

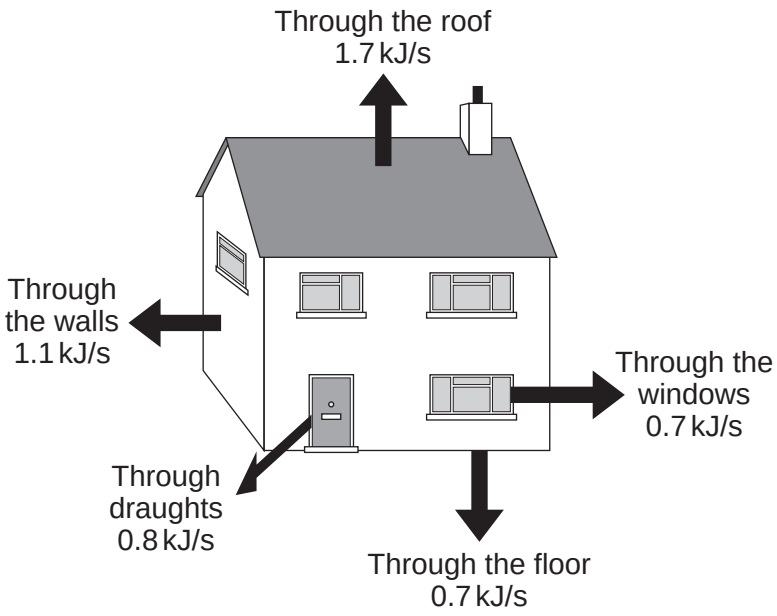
### 4.1.1.1 Energy stores and systems

**Question 71**

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)*

4.1.1.1 Energy stores and systems

Question 71 · 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**

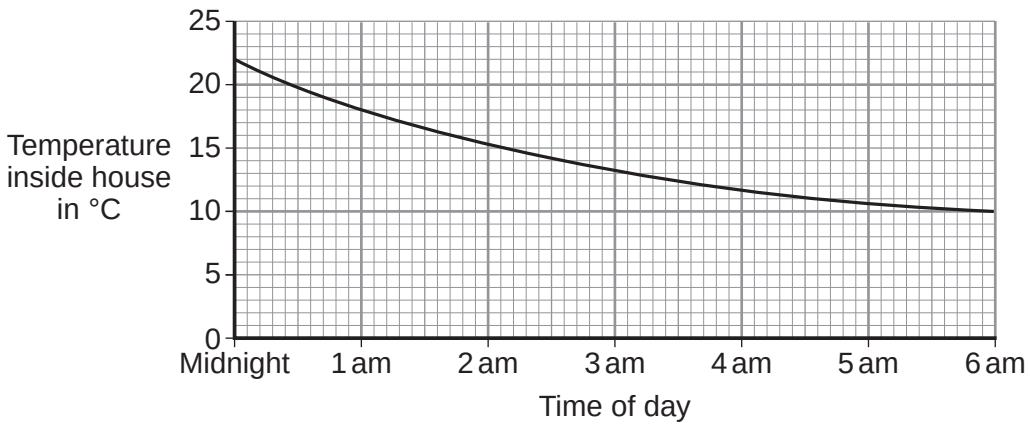
4.1.1.1 Energy stores and systems

Question 71 · 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.

.....

.....

*(2 marks)*

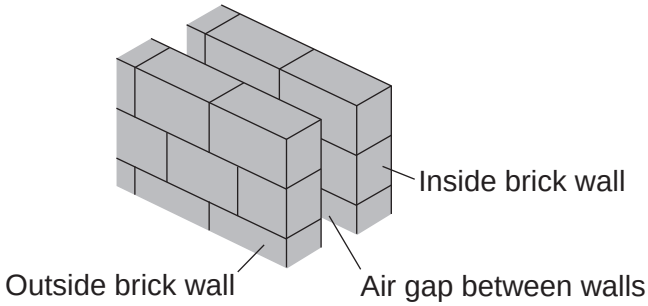
4.1.1.1 Energy stores and systems

Question 71 · continued



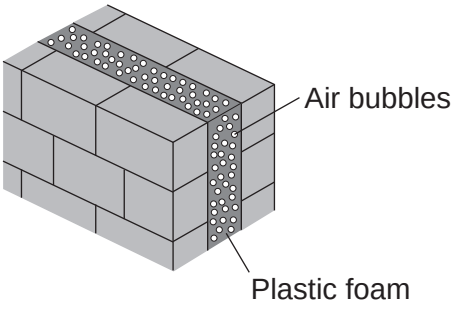
**1 (b)** **Diagram 2** shows how the walls of the house are constructed.
**Diagram 3** shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

**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.

.....

.....

.....

.....

*(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**

4.1.1.1 Energy stores and systems

Question 71 · 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.

.....

.....

.....

.....

.....

*(2 marks)*

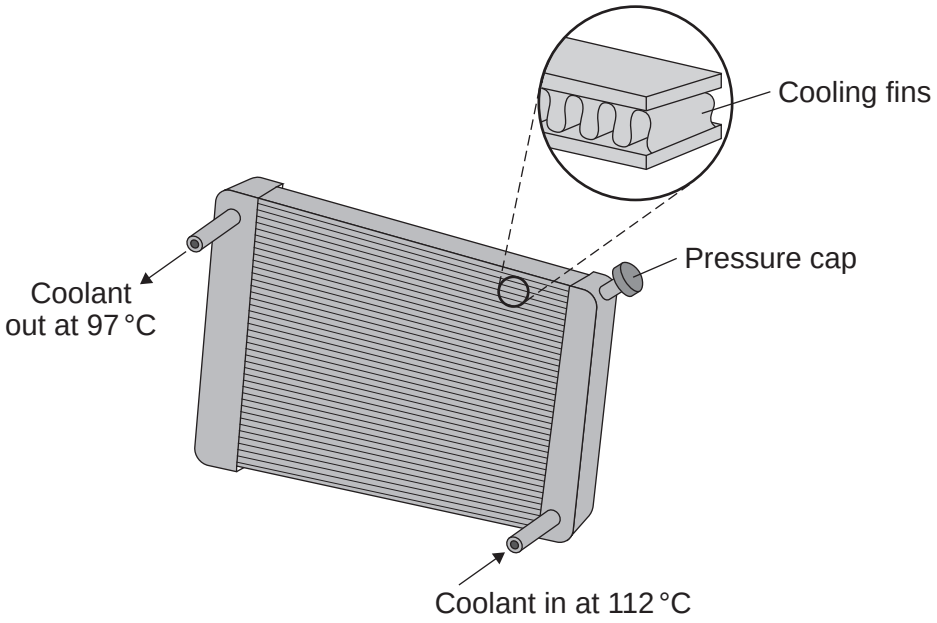
11

### 4.1.1.1 Energy stores and systems

**Question 72**

January 2013 | PH1HP | Original Q2 | Legacy

**2** The diagram shows a car radiator. The radiator is part of the engine cooling system.




Liquid coolant, heated by the car engine, enters the radiator. As the coolant passes through the radiator, the radiator transfers energy to the surroundings and the temperature of the coolant falls.

**2 (a)** Why is the radiator painted black?

.....

.....

.....

.....

*(2 marks)*

**Question 2 continues on the next page**

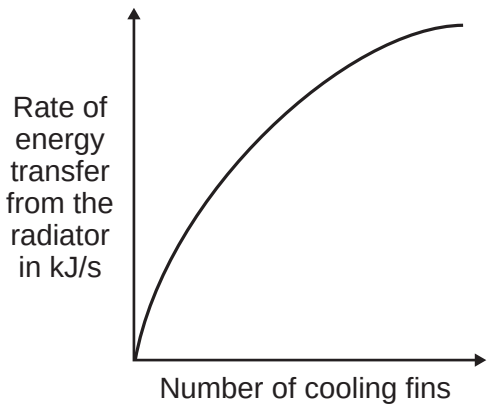
4.1.1.1 Energy stores and systems

Question 72 · continued



**2 (b)** Different radiators have different numbers of cooling fins along the length of the radiator.

The sketch graph shows how the number of cooling fins affects the rate of energy transfer from the radiator.




The number of cooling fins affects the rate of energy transfer from the radiator.

Explain how.

.....

.....

.....

.....

*(2 marks)*

4.1.1.1 Energy stores and systems

Question 72 · continued



**2 (c)** When the car engine is working normally, 2 kg of coolant passes through the radiator each second. The temperature of the coolant falls from 112 °C to 97 °C.

Calculate the energy transferred each second from the coolant.

Specific heat capacity of the coolant = 3800 J/kg °C.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Energy transferred each second = ..... J

*(3 marks)*

**2 (d)** On cold days, some of the energy transferred from a hot car engine is used to warm the air inside the car. This is a useful energy transfer.

What effect, if any, does this energy transfer have on the overall efficiency of the car engine?

Draw a ring around the correct answer.

| **decreases the efficiency** | **does not change the efficiency** | **increases the efficiency** |
|---|---|---|

Give a reason for your answer.

.....

.....

.....

*(2 marks)*

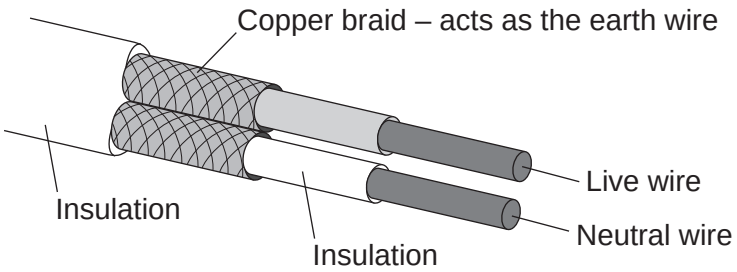
**9**

### 4.1.1.1 Energy stores and systems

**Question 73**

January 2013 | PH2HP | Original Q6 | Legacy

**6** The diagram shows the structure of a cable. The cable is part of an undersoil heating circuit inside a large greenhouse.




**6 (a)** The cable is connected to the mains electricity supply through a residual current circuit breaker (RCCB). If the cable is accidentally cut the RCCB automatically switches the circuit off.

**6 (a) (i)** What is the frequency of the mains electricity supply in the UK?

.....

*(1 mark)*

**6 (a) (ii)** What happens, as the cable is cut, to cause the RCCB to switch the circuit off?

.....

.....

.....

.....

*(2 marks)*

**6 (a) (iii)** A circuit can also be switched off by the action of a fuse.

Give **one** advantage of using a RCCB to switch off a circuit rather than a fuse.

.....

.....

*(1 mark)*

4.1.1.1 Energy stores and systems

Question 73 · continued



**6 (b)** The 230 volt mains electricity supply causes a current of 11 amps to flow through the cable.

**6 (b) (i)** Calculate the amount of charge that flows through the cable when the cable is switched on for 2 hours and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Charge = .....

*(3 marks)*

**6 (b) (ii)** Calculate the energy transferred from the cable to the soil in 2 hours.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Energy transferred =..... J

*(2 marks)*

**6 (c)** The heating circuit includes a thermistor. The thermistor is buried in the soil and acts as a thermostat to control the increase in the temperature of the soil.

Describe how an **increase** in the temperature of the soil affects the thermistor.

.....

.....

.....

.....

*(2 marks)*

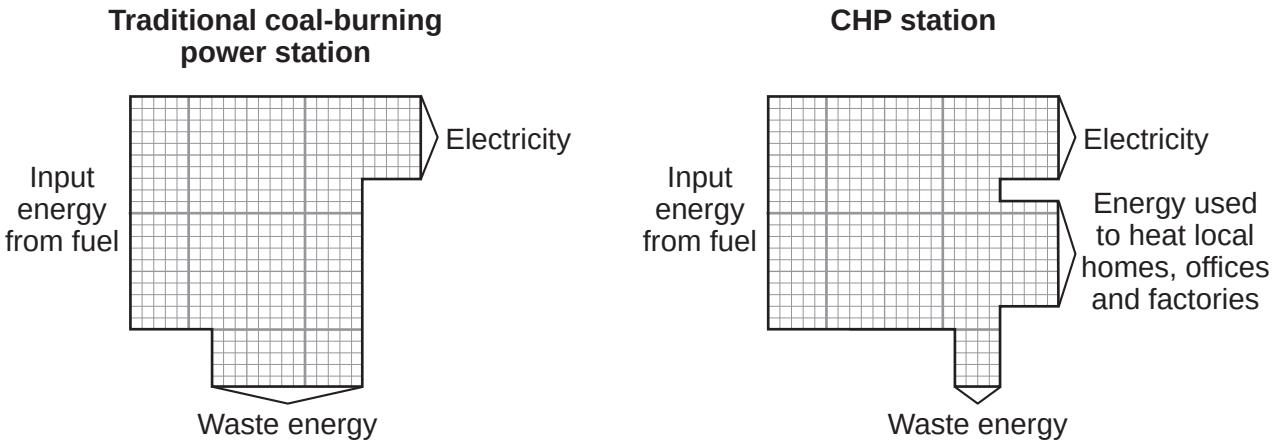
11

### 4.1.1.1 Energy stores and systems

**Question 74**

June 2013 | PH1HP | Original Q1 | Legacy

**1** The Sankey diagrams show the energy transfers in a traditional coal-burning power station and a combined heat and power (CHP) station.




**1 (a)** What effect does the waste energy from a power station have on the surroundings?

.....

.....

*(1 mark)*

**1 (b)** Calculate the efficiency of the CHP station.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Efficiency = .....

*(2 marks)*

4.1.1.1 Energy stores and systems

Question 74 · continued



**1 (c)** Why is a CHP station more efficient than a traditional coal-burning power station?

.....

.....

.....

.....

*(2 marks)*

**1 (d)** A CHP station is usually used to meet the demand for electricity within the local area. The electricity is not transmitted and distributed through the National Grid.

**1 (d) (i)** What is the National Grid?

Tick (✓) **one** box.

A system of cables and pylons. ☐

A system of cables and transformers. ☐

A system of cables, transformers and power stations. ☐

*(1 mark)*

**1 (d) (ii)** Using the electricity locally and not transmitting it through the National Grid increases the overall efficiency of a CHP station by 7%.

Give **one** reason why.

.....

.....

*(1 mark)*

7

### 4.1.1.1 Energy stores and systems

**Question 75**

June 2013 | PH1HP | Original Q3 | Legacy

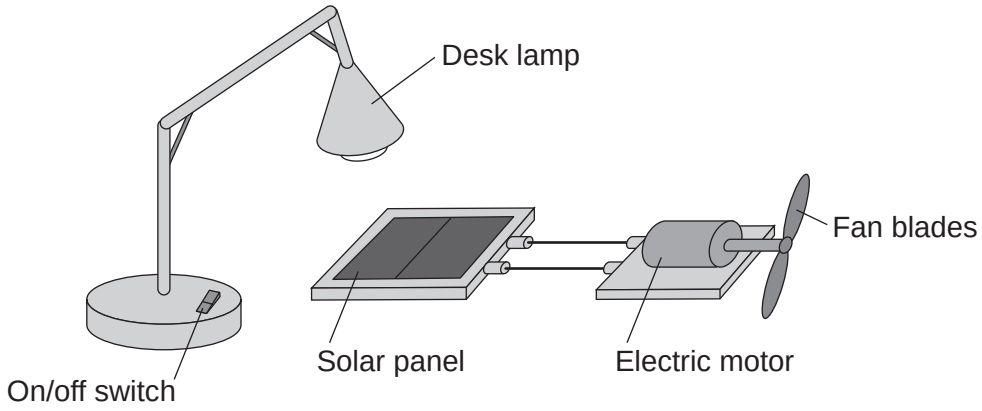
**3 (a)** Light waves transfer energy.

**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.

.....

.....

.....

.....

*(2 marks)*

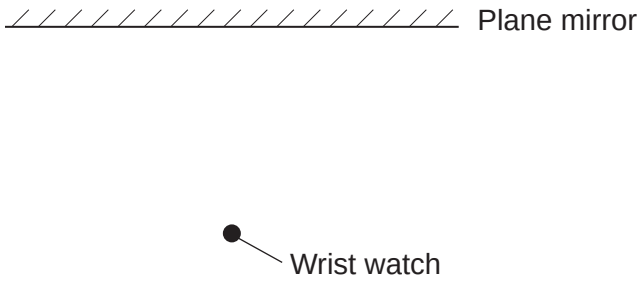
4.1.1.1 Energy stores and systems

Question 75 · 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)*

8

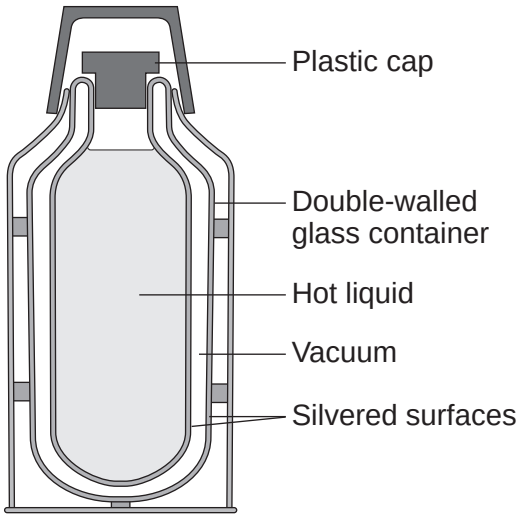
### 4.1.1.1 Energy stores and systems

**Question 76**

June 2013 | PH1HP | Original Q4 | Legacy

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

The diagram shows the structure of a vacuum flask.




A vacuum flask is designed to reduce the rate of energy transfer by heating processes.

Describe how the design of a vacuum flask keeps the liquid inside hot.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

4.1.1.1 Energy stores and systems

Question 76 · continued



.....

.....

.....

.....

*(6 marks)*

**4 (b)** Arctic foxes live in a very cold environment.



Arctic foxes have small ears.

How does the size of the ears help to keep the fox warm in a cold environment?

.....

.....

.....

.....

.....

*(2 marks)*

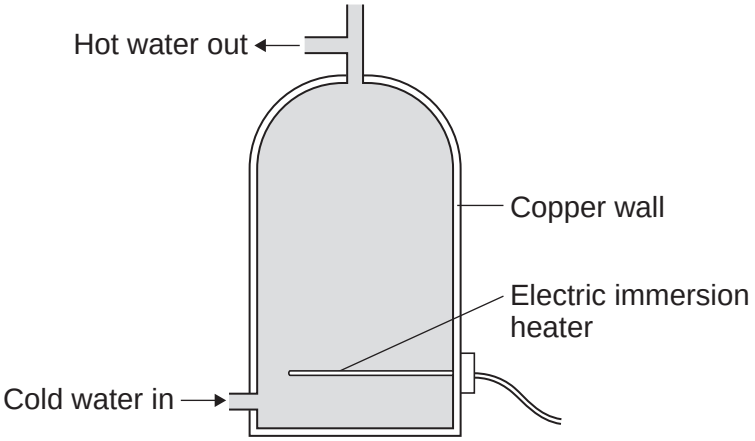
8

4.1.1.1 Energy stores and systems

Question 77

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.

.....

.....

.....

.....

.....

.....

.....

.....

*(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**

4.1.1.1 Energy stores and systems

Question 77 · continued

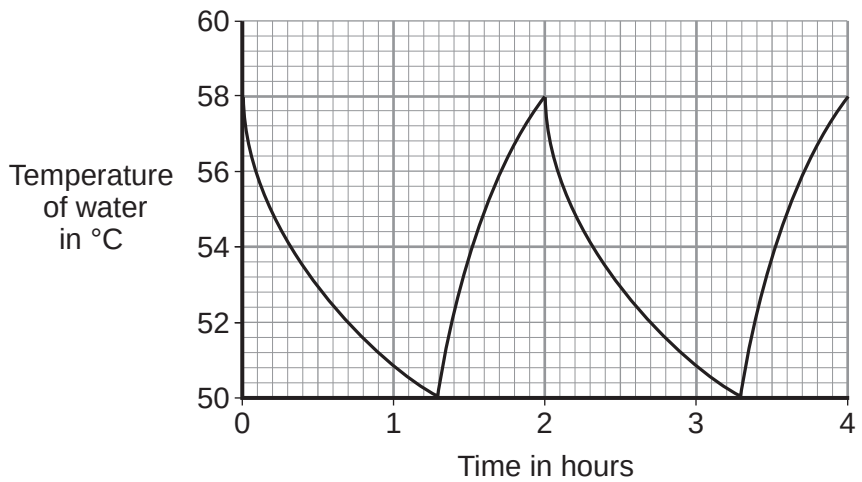


**5 (c)** The immersion heater has a thermostat to control the water temperature.

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.

.....

.....

.....

.....

*(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.

.....

.....

.....

Mass = ..... kg

*(3 marks)*

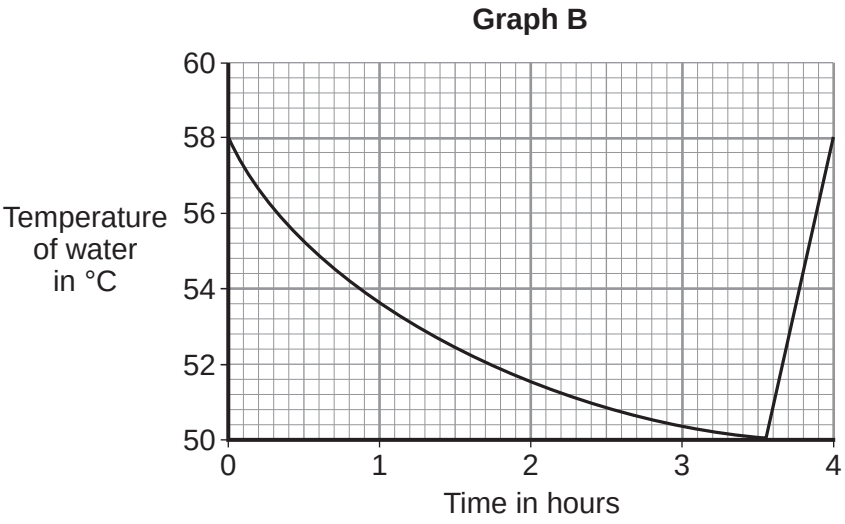
4.1.1.1 Energy stores and systems

Question 77 · 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.




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.

.....

.....

.....

.....

.....

.....

*(3 marks)*

13

### 4.1.1.1 Energy stores and systems

**Question 78**

June 2013 | PH2HP | Original Q4 | Legacy

**4 (a)** The stopping distance of a vehicle is made up of two parts, the thinking distance and the braking distance.

**4 (a) (i)** What is meant by *thinking distance*?

.....

.....

*(1 mark)*

**4 (a) (ii)** State **two** factors that affect thinking distance.

1 .....

.....

2 .....

.....

*(2 marks)*

**4 (b)** A car is travelling at a speed of 20 m/s when the driver applies the brakes. The car decelerates at a constant rate and stops.

**4 (b) (i)** The mass of the car and driver is 1600 kg.

Calculate the kinetic energy of the car and driver before the brakes are applied.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Kinetic energy = ..... J

*(2 marks)*

**4 (b) (ii)** How much work is done by the braking force to stop the car and driver?

Work done = ..... J

*(1 mark)*

4.1.1.1 Energy stores and systems

Question 78 · continued



**4 (b) (iii)** The braking force used to stop the car and driver was 8000 N.

Calculate the braking distance of the car.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Braking distance = ..... m

*(2 marks)*

**4 (b) (iv)** The braking distance of a car depends on the speed of the car and the braking force applied.

State **one** other factor that affects braking distance.

.....

.....

*(1 mark)*

**4 (b) (v)** Applying the brakes of the car causes the temperature of the brakes to increase.

Explain why.

.....

.....

.....

.....

*(2 marks)*

**Question 4 continues on the next page**

4.1.1.1 Energy stores and systems

Question 78 · continued



**4 (c)** Hybrid cars have an electric engine and a petrol engine. This type of car is often fitted with a regenerative braking system. A regenerative braking system not only slows a car down but at the same time causes a generator to charge the car's battery.

State and explain the benefit of a hybrid car being fitted with a regenerative braking system.

.....

.....

.....

.....

.....

.....

*(3 marks)*

14

### 4.1.1.1 Energy stores and systems

**Question 79**

June 2014 | PH1HP | Original Q5 | Legacy

**5 (a)** Iceland is a country that generates nearly all of its electricity from renewable sources.

In 2013, about 80% of Iceland's electricity was generated using hydroelectric power stations (HEP).

Describe how electricity is generated in a hydroelectric power station. Include the useful energy transfers taking place.

**[4 marks]**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

4.1.1.1 Energy stores and systems

Question 79 · continued



**5 (b)** The UK produces most of its electricity from fossil fuels.

Many people in the UK leave their televisions in 'stand by' mode when not in use, instead of switching them off.

It is better for the environment if people switch off their televisions, instead of leaving them in 'stand by' mode.

Explain why.

**[3 marks]**

.....

.....

.....

.....

.....

.....

**5 (c)** A scientist wrote in a newspaper:

'Appliances that do not automatically switch off when they are not being used should be banned.'

Suggest why scientists alone cannot make the decision to ban these appliances.

**[1 mark]**

.....

.....

8

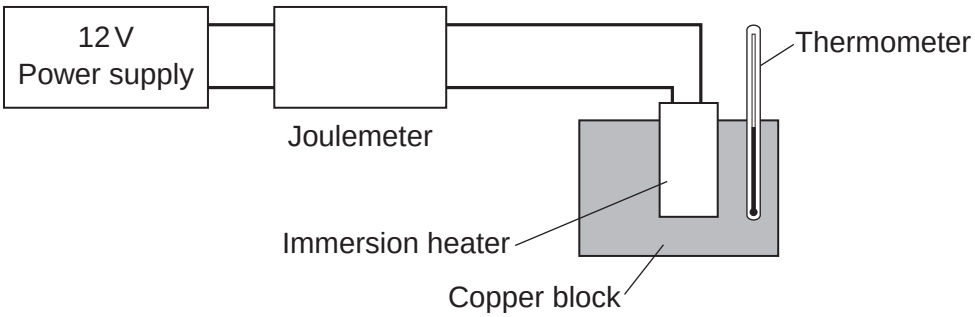
4.1.1.1 Energy stores and systems

Question 80

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.

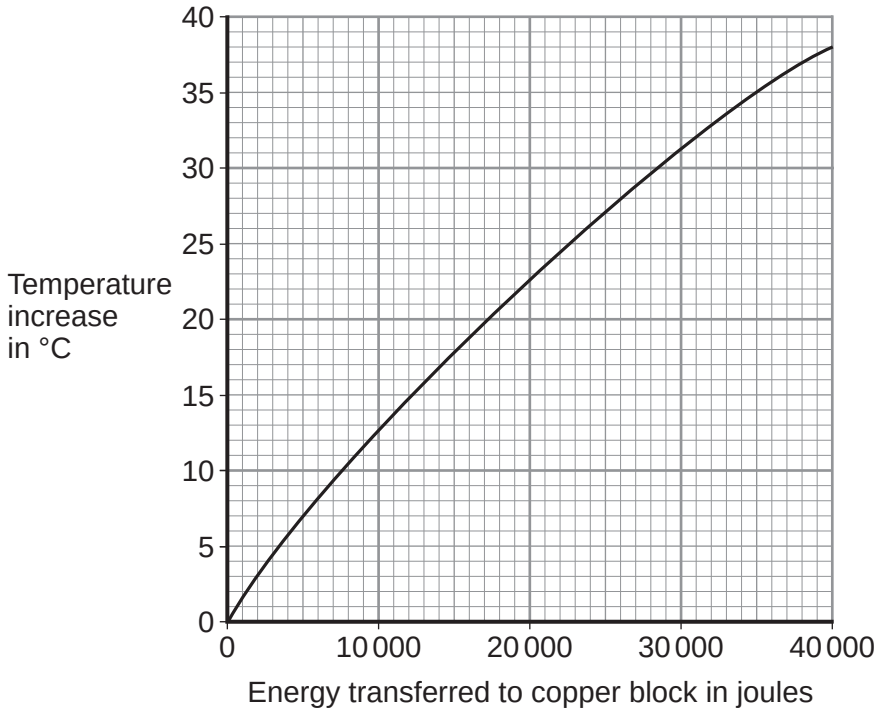
The energy transferred by the heater to the block was measured using the joulemeter.

The temperature of the block was recorded every minute.

The temperature increase was calculated.

**Figure 8** shows the student's results.

**Figure 8**



4.1.1.1 Energy stores and systems

Question 80 · 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

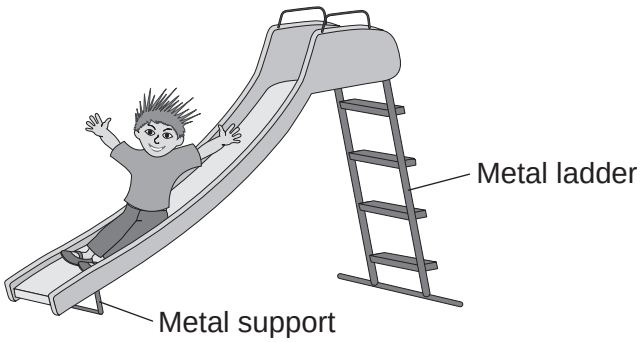
### 4.1.1.1 Energy stores and systems

**Question 81**

June 2014 | PH2HP | Original Q1 | Legacy

**1** **Figure 1** shows a slide in a children's playground.

**Figure 1**




**1 (a)** A child of mass 18 kilograms goes down the slide.

The vertical distance from the top to the bottom of the slide is 2.5 metres.

Calculate the decrease in gravitational potential energy of the child sliding from the top to the bottom of the slide.

Gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

.....

.....

.....

Decrease in gravitational potential energy = ..... J

4.1.1.1 Energy stores and systems

Question 81 · continued



**1 (b)** The slide is made of plastic.

**1 (b) (i)** The child becomes electrically charged when he goes down the slide.

Explain why.

**[2 marks]**

.....

.....

.....

.....

**1 (b) (ii)** Going down the slide causes the child's hair to stand on end.

What conclusion about the electrical charge on the child's hair can be made from this observation?

**[2 marks]**

.....

.....

Give a reason for your answer.

.....

.....

**1 (b) (iii)** Why would the child **not** become electrically charged if the slide was made from metal?

**[1 mark]**

.....

.....

7

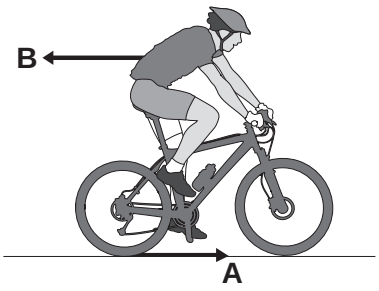
4.1.1.1 Energy stores and systems

Question 82

June 2014 | PH2HP | Original Q3 | Legacy

**3 (a)** **Figure 2** shows the horizontal forces acting on a moving bicycle and cyclist.

**Figure 2**




**3 (a) (i)** What causes force **A**?

Draw a ring around the correct answer.

**[1 mark]**

**friction** **gravity** **weight**

**3 (a) (ii)** What causes force **B**?

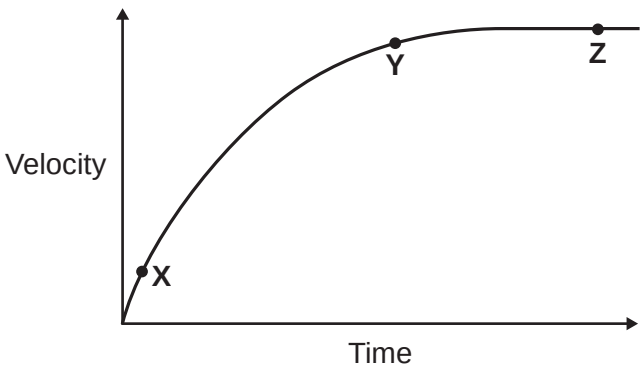
**[1 mark]**

.....

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

**Figure 3** shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.

**Figure 3**



4.1.1.1 Energy stores and systems

**Question 82 · continued**



Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

- between the points **X** and **Y**
- and between the points **Y** and **Z**, marked on the graph in **Figure 3**.

**[6 marks]**

Extra space .....

4.1.1.1 Energy stores and systems

Question 82 · continued



**3 (b) (i)** The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

Use the correct equation from the Physics Equations Sheet.

**[3 marks]**

.....

.....

.....

Work done = .....

**3 (b) (ii)** Complete the following sentences.

**[2 marks]**

When the brakes are used, the bicycle slows down. The kinetic energy of the bicycle ..... .

At the same time, the ..... of the brakes increases.

13

### 4.1.1.1 Energy stores and systems

**Question 83**

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.

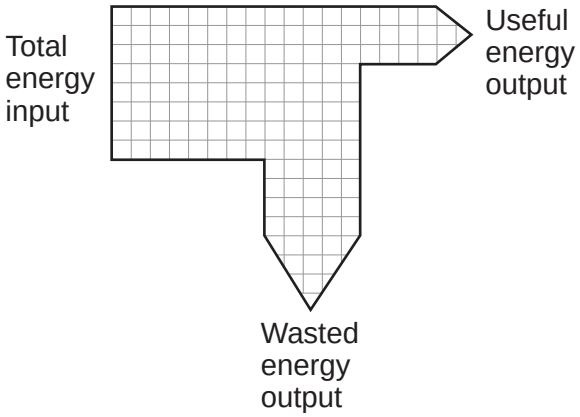
4.1.1.1 Energy stores and systems

Question 83 · 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

4.1.1.1 Energy stores and systems

Question 84

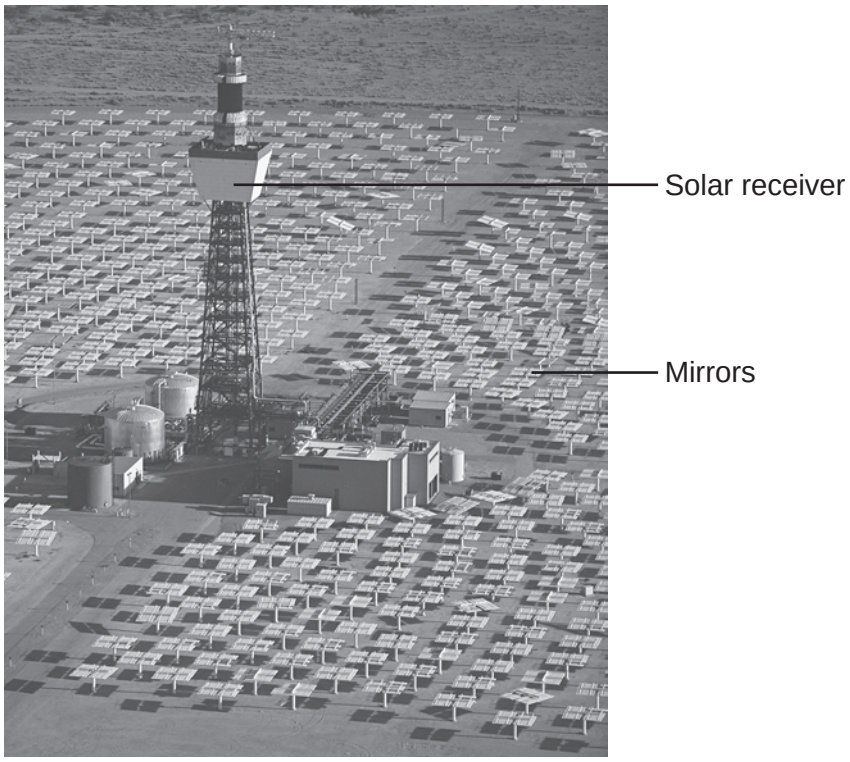
June 2015 | PH1HP | Original Q5 | Legacy

**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]**

.....

4.1.1.1 Energy stores and systems

Question 84 · 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 84 · 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:

$$\text{Capacity factor} = \frac{\text{actual electrical output per year}}{\text{maximum possible electrical output per year}}$$

4.1.1.1 Energy stores and systems

Question 84 · 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

4.1.1.1 Energy stores and systems

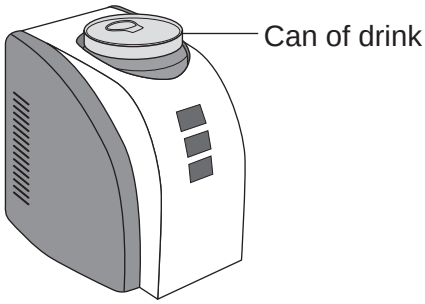
Question 85

June 2015 | PH1HP | Original Q7 | Legacy

**7** A 'can-chiller' is used to make a can of drink colder.

**Figure 7** shows a can-chiller.

**Figure 7**




**7 (a)** The initial temperature of the liquid in the can was 25.0 °C.
The can-chiller decreased the temperature of the liquid to 20.0 °C.
The amount of energy transferred from the liquid was 6930 J.
The mass of liquid in the can was 0.330 kg.

Calculate the specific heat capacity of the liquid.

Give the unit.

Use the correct equation from the Physics Equations Sheet.

**[4 marks]**

.....

.....

.....

.....

Specific heat capacity = ..... unit .....

4.1.1.1 Energy stores and systems

Question 85 · continued



**7 (b)** Energy is transferred through the metal walls of the can of drink by conduction. Explain how.

**[4 marks]**

.....

.....

.....

.....

.....

.....

.....

.....

**7 (c)** The energy from the can of drink is transferred to the air around the can-chiller. A convection current is set up around the can-chiller. Explain how.

**[3 marks]**

.....

.....

.....

.....

.....

.....

**7 (d)** The can-chiller has metal cooling fins that are designed to transfer energy quickly to the surroundings.

Give **two** features that would help the metal cooling fins to transfer energy quickly to the surroundings.

**[2 marks]**

1 .....

2 .....

13

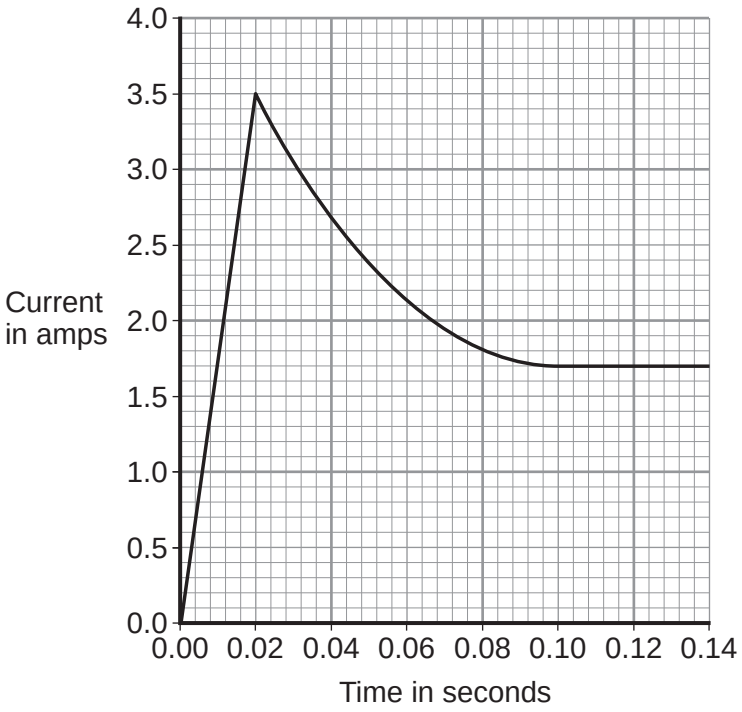
### 4.1.1.1 Energy stores and systems

**Question 86**

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 .....

4.1.1.1 Energy stores and systems

Question 86 · 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

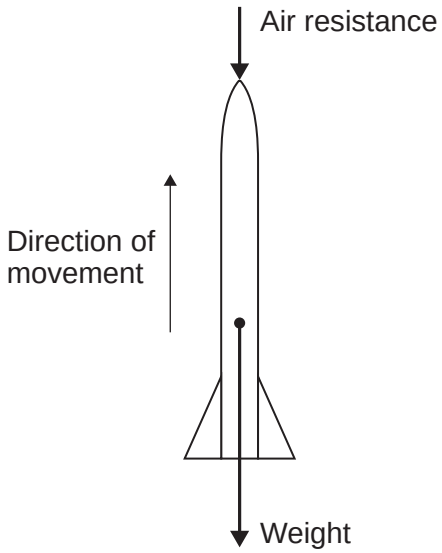
4.1.1.1 Energy stores and systems

Question 87

June 2015 | PH2HP | Original Q6 | Legacy

**6 (a)** **Figure 7** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

**Figure 7**




**6 (a) (i)** How does the velocity of the rocket change as the rocket moves **upwards**?

**[2 marks]**

.....

Give a reason for your answer.

.....

.....

**6 (a) (ii)** The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

**[1 mark]**

.....

.....

.....

4.1.1.1 Energy stores and systems

Question 87 · continued



**6 (b)** The speed of the rocket just after being launched is 12 m/s.
The mass of the rocket is 0.05 kg.

**6 (b) (i)** Calculate the kinetic energy of the rocket just after being launched.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

.....

.....

.....

Kinetic energy = ..... J

**6 (b) (ii)** As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

**[1 mark]**

Maximum gravitational potential energy = ..... J

**6 (b) (iii)** Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

.....

.....

.....

Maximum height = ..... m

**Question 6 continues on the next page**

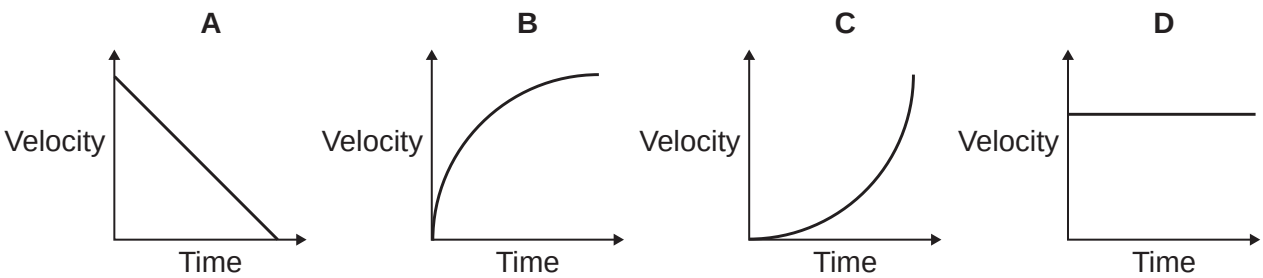
4.1.1.1 Energy stores and systems

Question 87 · continued



**6 (b) (iv)** **Figure 8** shows four velocity–time graphs.

**Figure 8**




Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?

**[1 mark]**

Write the correct answer in the box.

4.1.1.1 Energy stores and systems

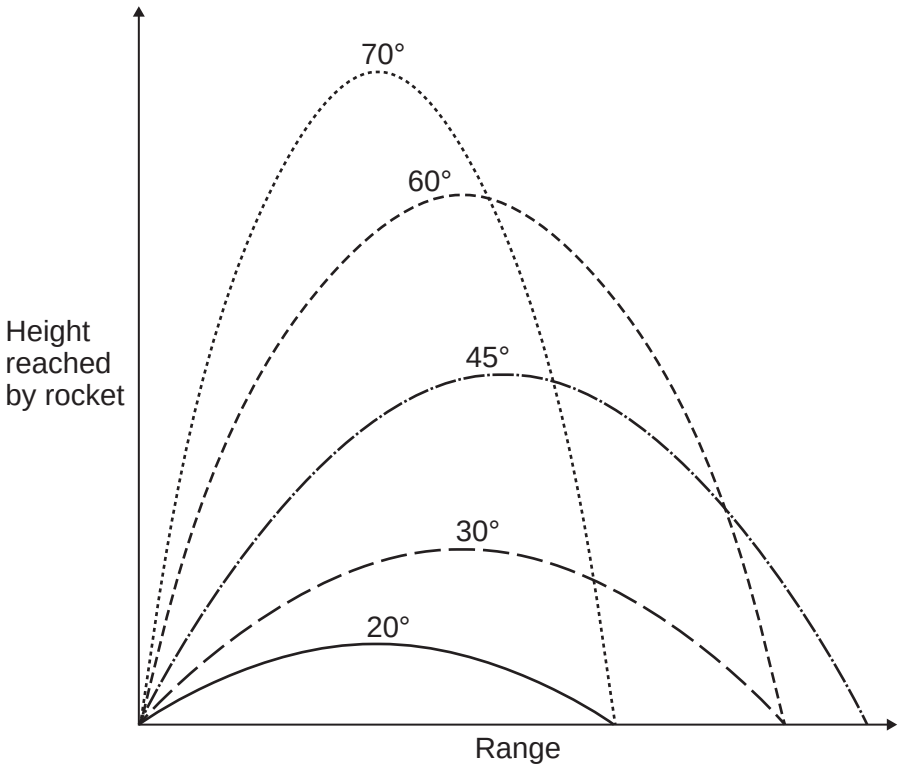
Question 87 · continued



**6 (c)** The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

**Figure 9** shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

**Figure 9**




What pattern links the angle at which the rocket is launched and the range of the rocket?

**[2 marks]**

.....

.....

.....

.....

11

4.1.1.1 Energy stores and systems

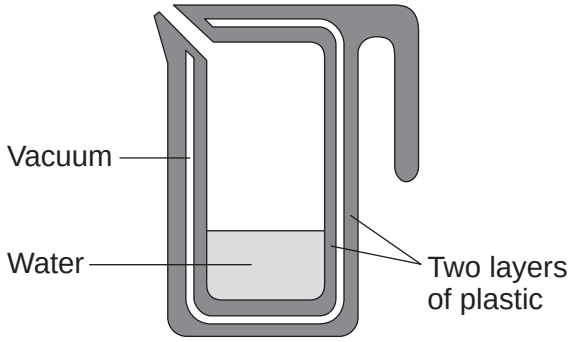
Question 88

June 2016 | PH1HP | Original Q5 | Legacy

**5** A new design for a kettle is made from two layers of plastic separated by a vacuum. After the water in the kettle has boiled, the water stays hot for at least 2 hours.

The new kettle is shown in **Figure 5**.

**Figure 5**




**5 (a)** Explain why the vacuum reduces energy transfer to the surroundings.

**[2 marks]**

4.1.1.1 Energy stores and systems

Question 88 · continued



**5 (b)** The energy transferred from the water in the kettle to the surroundings in 2 hours is 46 200 J.

The mass of water in the kettle is 0.50 kg.

The specific heat capacity of water is 4200 J/kg °C.

The initial temperature of the water is 100 °C.

**5 (b) (i)** Calculate the temperature of the water in the kettle after 2 hours.

Use the correct equation from the Physics Equations Sheet.

**[3 marks]**

Temperature after 2 hours = _____ °C

**5 (b) (ii)** Calculate the average power output from the water in the kettle to the surroundings in 2 hours.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

Average power output = _____ W

7

4.1.1.1 Energy stores and systems

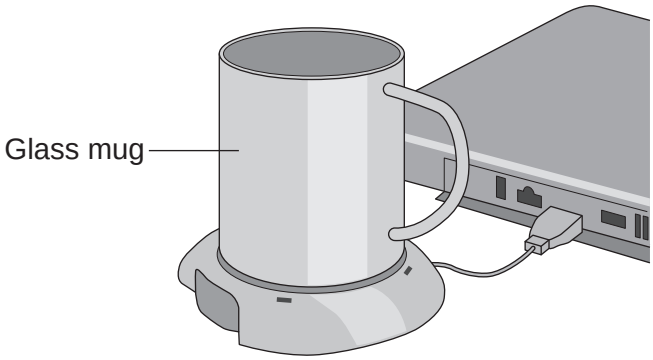
Question 89

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]**

_____

_____

_____

_____

4.1.1.1 Energy stores and systems

Question 89 · 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

4.1.1.1 Energy stores and systems

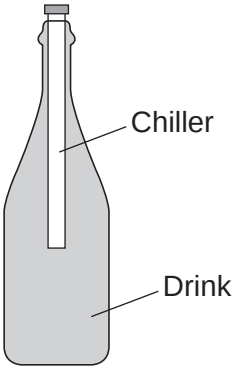
Question 90

June 2017 | PH1HP | Original Q8 | Legacy

**8** **Figure 9** shows a drink chiller in use.

The cold drink chiller is inserted into a warm bottle of drink, so the temperature of the drink decreases.

**Figure 9**




**8 (a)** Explain how a convection current is formed in the drink in the bottle.

**[4 marks]**

4.1.1.1 Energy stores and systems

Question 90 · continued



**8 (b)** As the chiller warms, the drink cools.

State how the rate of energy transfer from the drink to the chiller changes as the chiller warms.

Give a reason for your answer.

**[2 marks]**

**8 (c)** As the drink bottle cools down, water vapour in the air condenses on the outside of the bottle.

Explain why.

**[3 marks]**

9

4.1.1.1 Energy stores and systems

Question 91

June 2017 | PH2HP | Original Q5 | Legacy

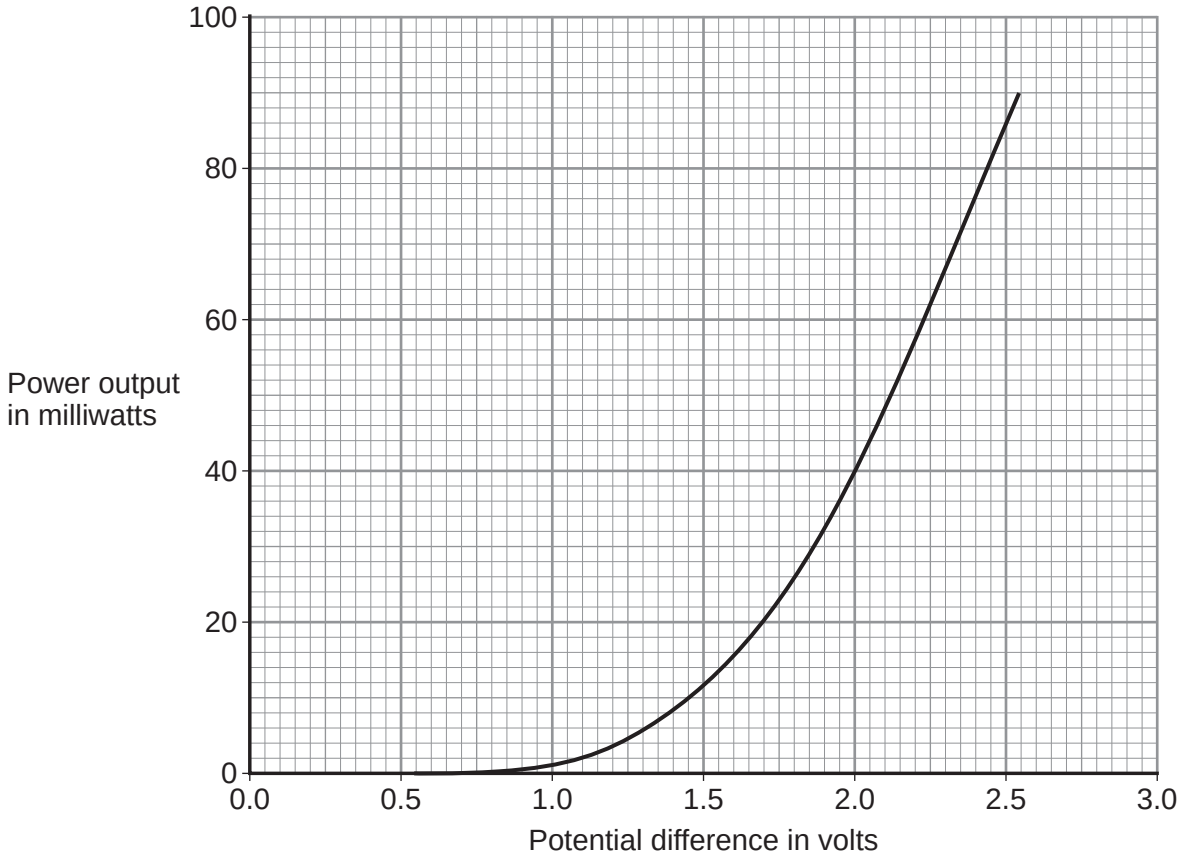
**5** The lighting in a home may be provided by LED bulbs, filament bulbs or halogen bulbs.

**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

4.1.1.1 Energy stores and systems

Question 91 · 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]**

4.1.1.1 Energy stores and systems

Question 92

June 2018 | 8463/1H | Original Q4

**0 4** **Figure 5** shows a cyclist riding along a straight, level road at a constant speed.

**Figure 5**



**0 4 . 1** Complete the sentences.

**[2 marks]**

As the cyclist rides along the road, the _____ energy store in the cyclist's body decreases.

The speed of the cyclist is constant when the work done by the cyclist is _____ the work done against air resistance.

**Question 4 continues on the next page**

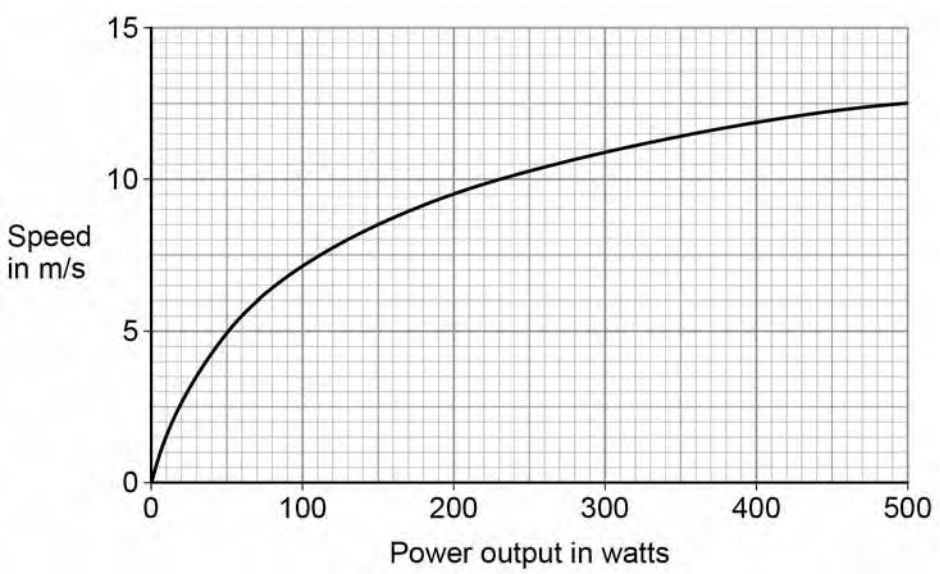
4.1.1.1 Energy stores and systems

Question 92 · continued



**Figure 6** shows how the speed changes as the power output of the cyclist changes.

**Figure 6**




**0 4 . 2** Write down the equation that links power, time and work done.

**[1 mark]**

**0 4 . 3** Calculate the work done by the cyclist when his power output is 200 W for 1800 seconds.

**[3 marks]**

Work done = _____ J

4.1.1.1 Energy stores and systems

Question 92 · continued



**0 4 . 4** Calculate the percentage increase in speed of the cyclist when the power output changes from 200 W to 300 W.

**[2 marks]**

Percentage increase in speed = _____

**0 4 . 5** The maximum speed this cyclist can travel on a level road is 14 m/s.

How does cycling uphill affect the maximum speed of this cyclist?

Explain your answer.

**[3 marks]**

11

4.1.1.1 Energy stores and systems

Question 93

June 2018 | 8463/1H | Original Q10

**1 0** **Figure 16** shows a wind turbine.

**Figure 16**



**1 0 . 1** At a particular wind speed, a volume of $2.3 \times 10^4$ $m^3$ of air passes the blades each second.

The density of air is 1.2 $kg/m^3$.

Calculate the mass of air passing the blades per second.

**[3 marks]**

Mass of air per second = _____ kg

**1 0 . 2** The power output of the turbine is directly proportional to the kinetic energy of the air passing the blades each second.

Describe the effect on the power output when the wind speed is halved.

**[3 marks]**

4.1.1.1 Energy stores and systems

Question 93 · continued



**1 0 . 3** At a different wind speed, the wind turbine has a power output of 388 kW.

The mass of air passing the wind turbine each second is 13 800 kg.

Calculate the speed of the air passing the blades each second.

Assume that the process is 100% efficient.

**[3 marks]**

Speed of air = _____ m/s

9

4.1.1.1 Energy stores and systems

Question 94

June 2018 | 8463/2H | Original Q1

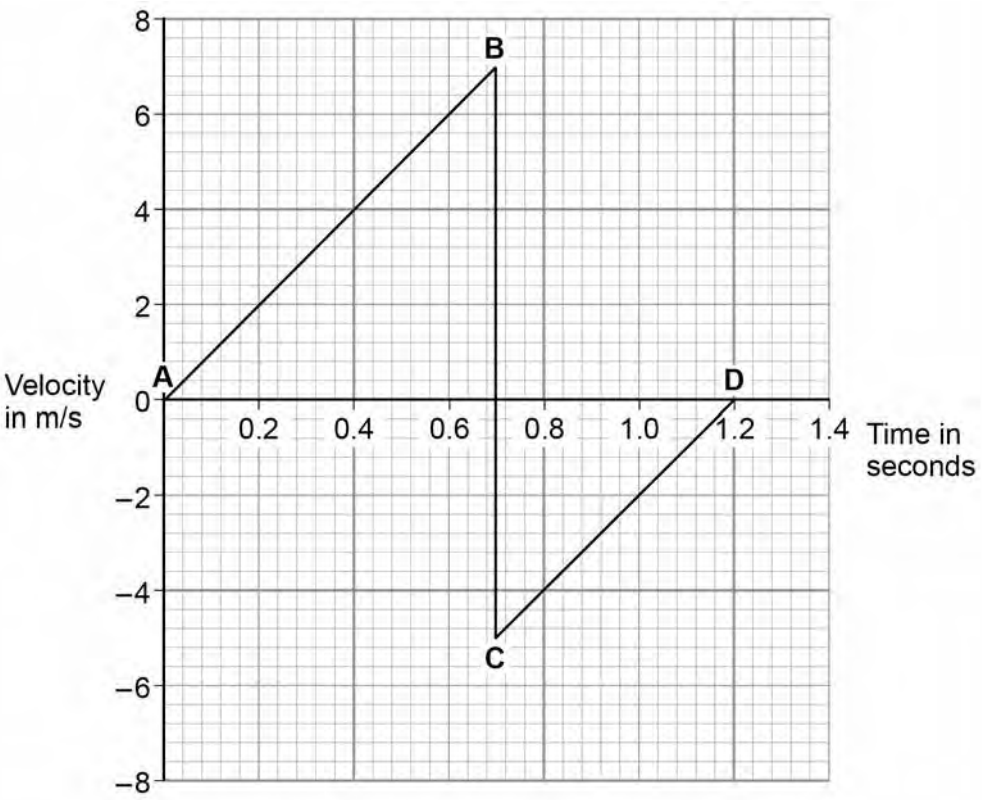
**0 1** A child drops a ball.

The ball hits the ground and bounces.

**Figure 1** shows the velocity-time graph for the ball from when the ball is dropped until when the ball reaches the top of its first bounce.

Air resistance has been ignored.

**Figure 1**




**0 1 . 1** Describe the motion of the ball between points **A** and **B** on **Figure 1**.

**[2 marks]**

**0 1 . 2** What direction is the ball moving between points **C** and **D** on **Figure 1**?

**[1 mark]**

4.1.1.1 Energy stores and systems

Question 94 · continued



**0 1 . 3** The ball and the Earth form a system.

What is meant by 'a system'?

Tick **one** box.

**[1 mark]**

A group of objects that interact. ☐

Objects with big differences in mass. ☐

Objects with gravitational potential energy. ☐

**0 1 . 4** When the ball hits the ground, energy is transferred from the ball to the Earth.

Explain how the data in **Figure 1** shows this energy transfer.

**[4 marks]**

8

4.1.1.1 Energy stores and systems

Question 95

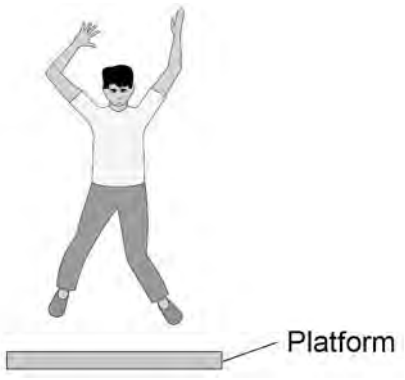
June 2019 | 8463/1H | Original Q3

**0 3** A scientist investigated how the maximum muscle power of humans varies with age and gender.

The scientist asked volunteers to stand on a platform and to jump as high as they could.

**Figure 4** shows a volunteer taking part in the experiment.

**Figure 4**




An electronic timer measured the time that the volunteer was in the air.

**0 3 . 1** The muscle power in watts per kg is calculated using the following equation:

$$\text{muscle power} = \frac{9.8 \times \text{jump height}}{\text{time}}$$

One volunteer has a muscle power of 41 W/kg

He was in the air for 0.12 s

Calculate his jump height.

**[3 marks]**

Jump height = _____ m

Question 95 · continued



**0 3 . 2** Write down the equation which links kinetic energy, mass and speed.

**[1 mark]**

**0 3 . 3** One volunteer had a kinetic energy of 270 J and a speed of 3.0 m/s at the moment he left the ground.

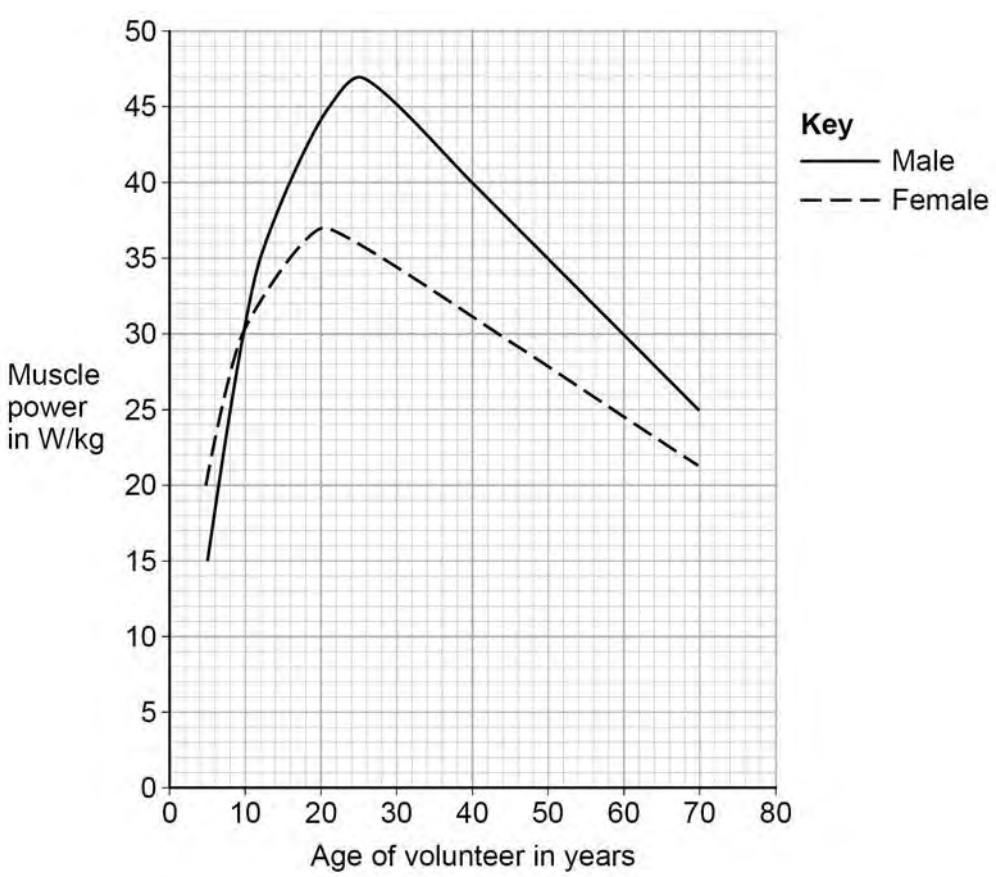
Calculate his mass.

**[3 marks]**

Mass = _____ kg

**Figure 5** shows the scientist's results.

**Figure 5**



4.1.1.1 Energy stores and systems

Question 95 · continued



**0 3 . 4** Compare the muscle power of males with the muscle power of females.

Use data from **Figure 5** in your answer.

**[4 marks]**

**0 3 . 5** The muscle power of each volunteer was measured five times.

The highest muscle power reading was recorded instead of calculating an average.

Suggest **one** reason why.

**[1 mark]**

12

4.1.1.1 Energy stores and systems

Question 96

June 2019 | 8463/1H | Original Q4

**0 4** Electric cars have motors that are powered by a battery.

Diesel cars have engines that are powered by diesel fuel.

**Table 2** compares one type of electric car with one type of diesel car.

**Table 2**

| Power source | Energy density in MJ / kg | Mass of power source in kg | Total mass of car in kg | Time to recharge battery or refill fuel tank in minutes |
|---|---|---|---|---|
| **Battery** | 0.95 | 280 | 1600 | 40 |
| **Diesel fuel** | 45 | 51 | 1500 | 3 |

**0 4 . 1** The electric car has a range of 400 km with a fully charged battery.

The diesel car has a range of 1120 km with a full tank of diesel.

Explain the difference in the time needed to complete a 500 km journey using the electric car compared with the diesel car.

Assume both cars travel at the same speed.

**[2 marks]**

4.1.1.1 Energy stores and systems

Question 96 · continued



**0 4 . 2** Energy density is the amount of energy stored per kilogram of the energy source.

Show why the diesel car has a greater range than the electric car.

Use data from **Table 2**.

Assume the efficiency of the two cars is the same.

Include calculations in your answer.

**[3 marks]**

**Question 4 continues on the next page**

4.1.1.1 Energy stores and systems

Question 96 · continued

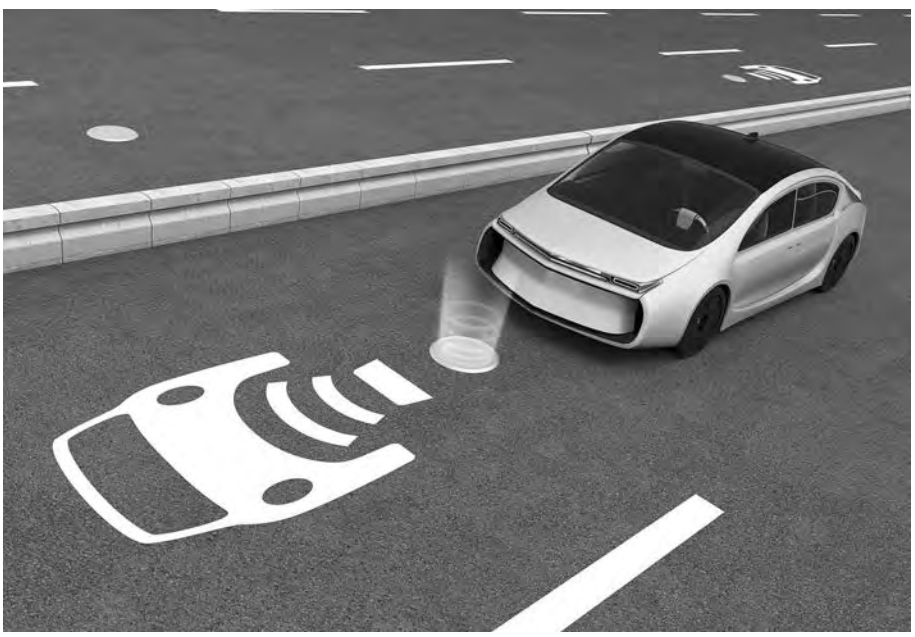


Engineers have developed a way of charging electric cars while they are driving along the road.

Coils of wire buried under the road transfer energy to the car's battery as the car is passing over the coils.

**Figure 6** shows a charging lane on a motorway.

**Figure 6**



**0 4 . 3** Suggest **two** advantages of using this method to charge electric cars compared with plugging them into the mains electricity supply.

**[2 marks]**

1 _____

_____

_____

_____

2 _____

_____

_____

_____

4.1.1.1 Energy stores and systems

Question 96 · continued



**0 4 . 4** When electric cars are not being driven, energy stored in their batteries could be used to meet sudden peaks in electricity demand.

Suggest how.

**[2 marks]**

9

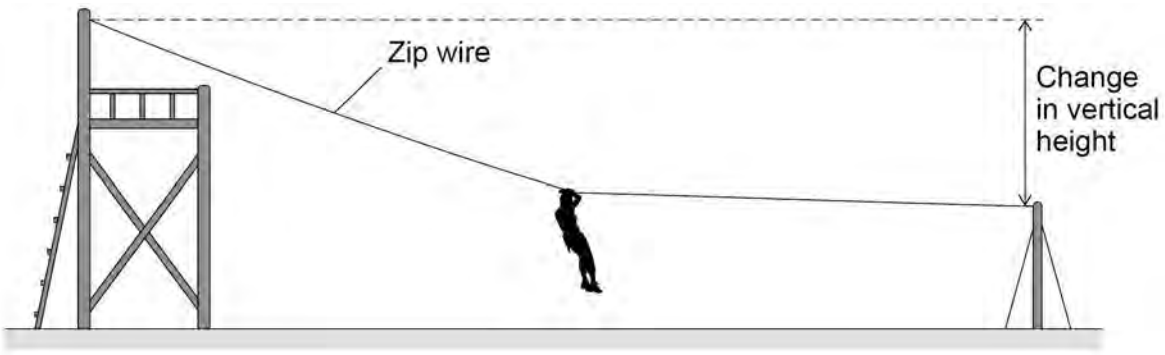
4.1.1.1 Energy stores and systems

Question 97

June 2019 | 8463/1H | Original Q7

**0 7** **Figure 9** shows a person sliding down a zip wire.

**Figure 9**




**0 7 . 1** As the person slides down the zip wire, the change in the gravitational potential energy of the person is 1.47 kJ

The mass of the person is 60 kg

gravitational field strength = 9.8 N/kg

Calculate the change in vertical height of the person.

**[3 marks]**

Change in vertical height = _____ m

4.1.1.1 Energy stores and systems

Question 97 · continued



**0 7 . 2** As the person moves down the zip wire her increase in kinetic energy is less than her decrease in gravitational potential energy.

Explain why.

**[2 marks]**

**0 7 . 3** Different people have different speeds at the end of the zip wire.

Explain why.

**[2 marks]**

7

4.1.1.1 Energy stores and systems

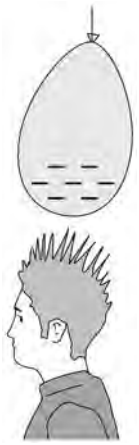
Question 98

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

4.1.1.1 Energy stores and systems

Question 98 · 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

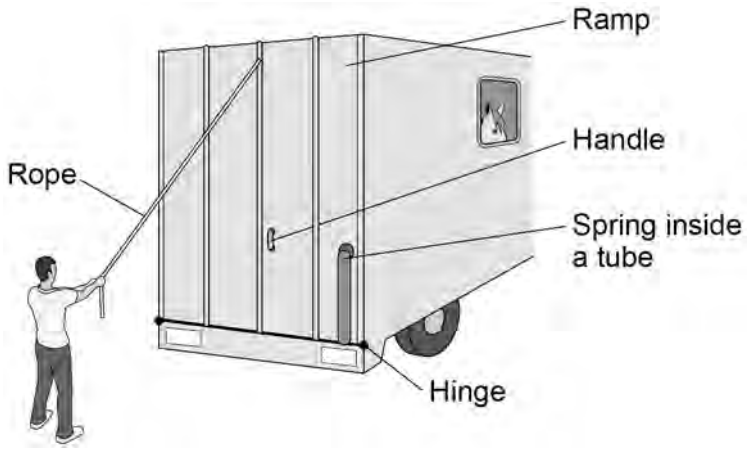
4.1.1.1 Energy stores and systems

Question 99

June 2019 | 8463/2H | Original Q10

**1 0** **Figure 19** shows the back of a lorry. The lorry is used to carry horses.

**Figure 19**




The ramp is lowered by pulling on the rope or by pulling on the handle.

The hinge acts as a pivot.

**1 0 . 1** Explain why it is easier to lower the ramp by pulling on the rope rather than pulling on the handle.

**[2 marks]**

**Question 10 continues on the next page**

4.1.1.1 Energy stores and systems

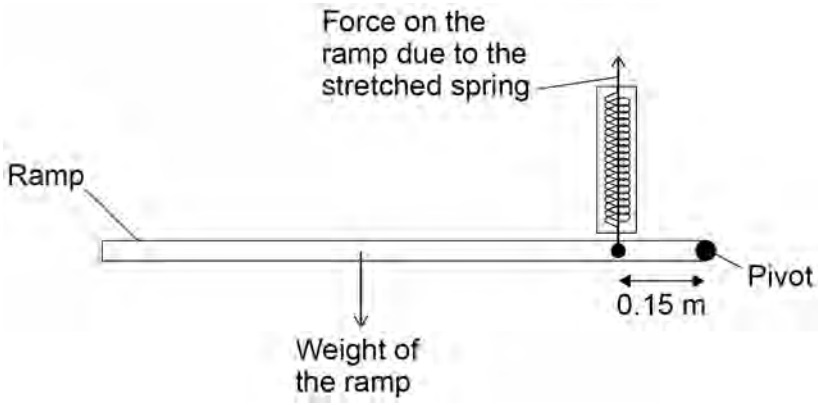
Question 99 · continued



When the ramp is lowered, work is done to stretch a spring on the side of the ramp. Elastic potential energy is stored in the stretched spring.

**Figure 20** shows the ramp part way down in a balanced horizontal position.

**Figure 20**




**1 0 . 2** With the ramp horizontal:

the moment caused by the weight of the ramp = 924 Nm

the spring is stretched by 0.250 m

Calculate the elastic potential energy stored in the stretched spring.

Use data from **Figure 20**.

**[6 marks]**

Elastic potential energy = _____ J

8

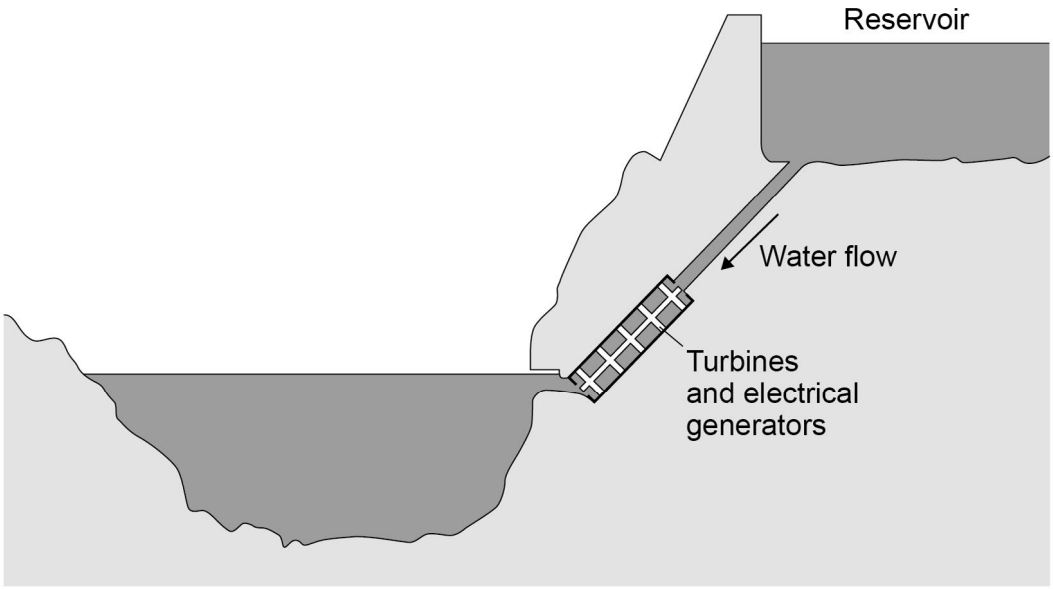
4.1.1.1 Energy stores and systems

Question 100

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 ($\rho$), 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

4.1.1.1 Energy stores and systems

Question 100 · 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 $1.5 \times 10^9$ 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**

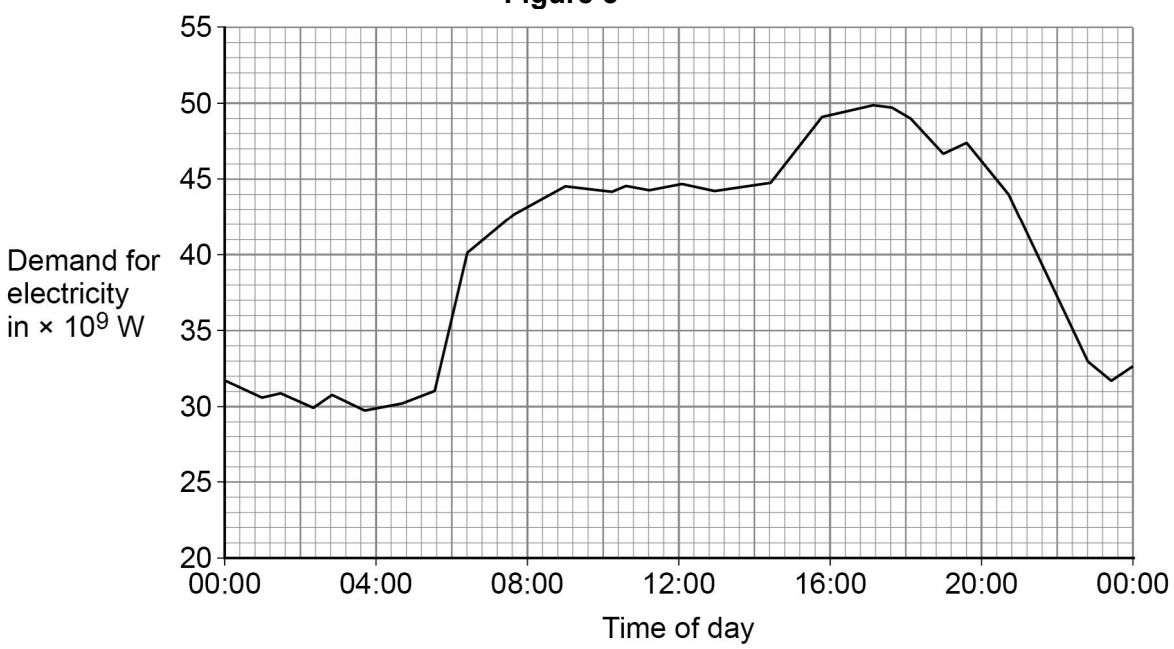
4.1.1.1 Energy stores and systems

Question 100 · 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 $1.5 \times 10^9$ 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**

4.1.1.1 Energy stores and systems

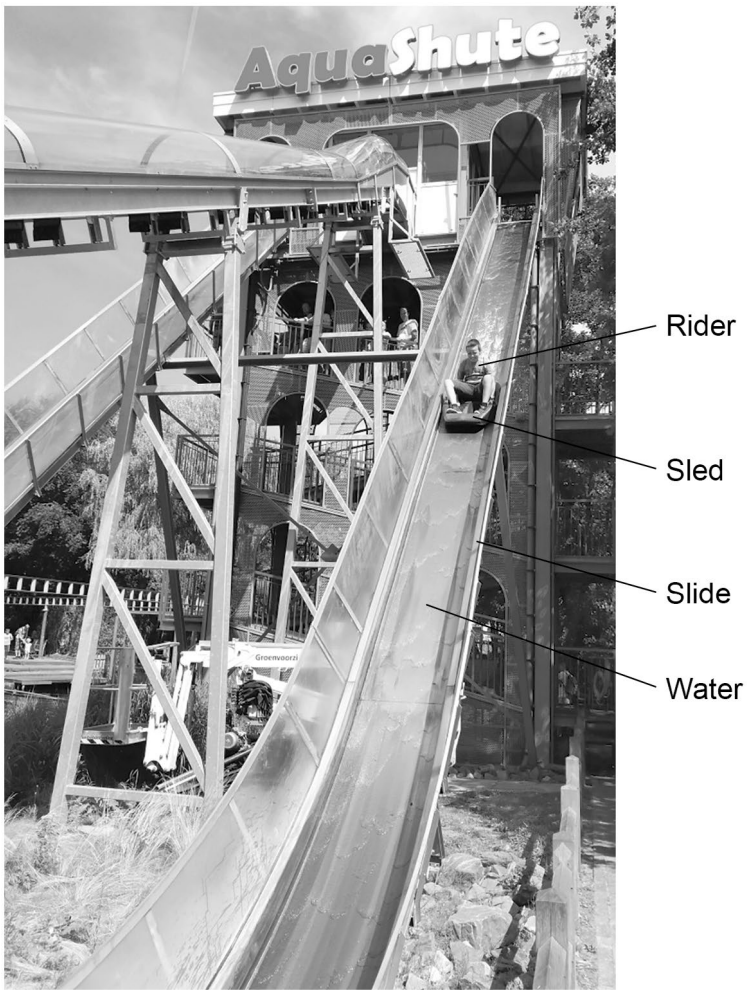
Question 101

November 2020 | 8463/1H | Original Q6

**0 6** **Figure 9** shows a theme park ride called AquaShute.

Riders of the AquaShute sit on a sled and move down a slide.

**Figure 9**




**0 6 . 1** A light gate and data logger can be used to determine the speed of each rider and sled.

What two measurements are needed to determine the speed of a rider and sled?

**[2 marks]**

Tick (✓) **two** boxes.

- Gravitational field strength ☐
- Length of sled ☐
- Mass of rider and sled ☐
- Temperature of surroundings ☐
- Time for sled to pass light gate ☐

4.1.1.1 Energy stores and systems

Question 101 · continued



**0 6 . 2** The decrease in gravitational potential energy of one rider on the slide was 8.33 kJ.

The rider moved through a vertical height of 17.0 m.

gravitational field strength = 9.8 N/kg

Calculate the mass of the rider.

**[4 marks]**

Mass of rider = _____ kg

**0 6 . 3** At the bottom of the slide, all riders and their sleds have approximately the same speed.

Explain why.

**[4 marks]**

10

4.1.1.1 Energy stores and systems

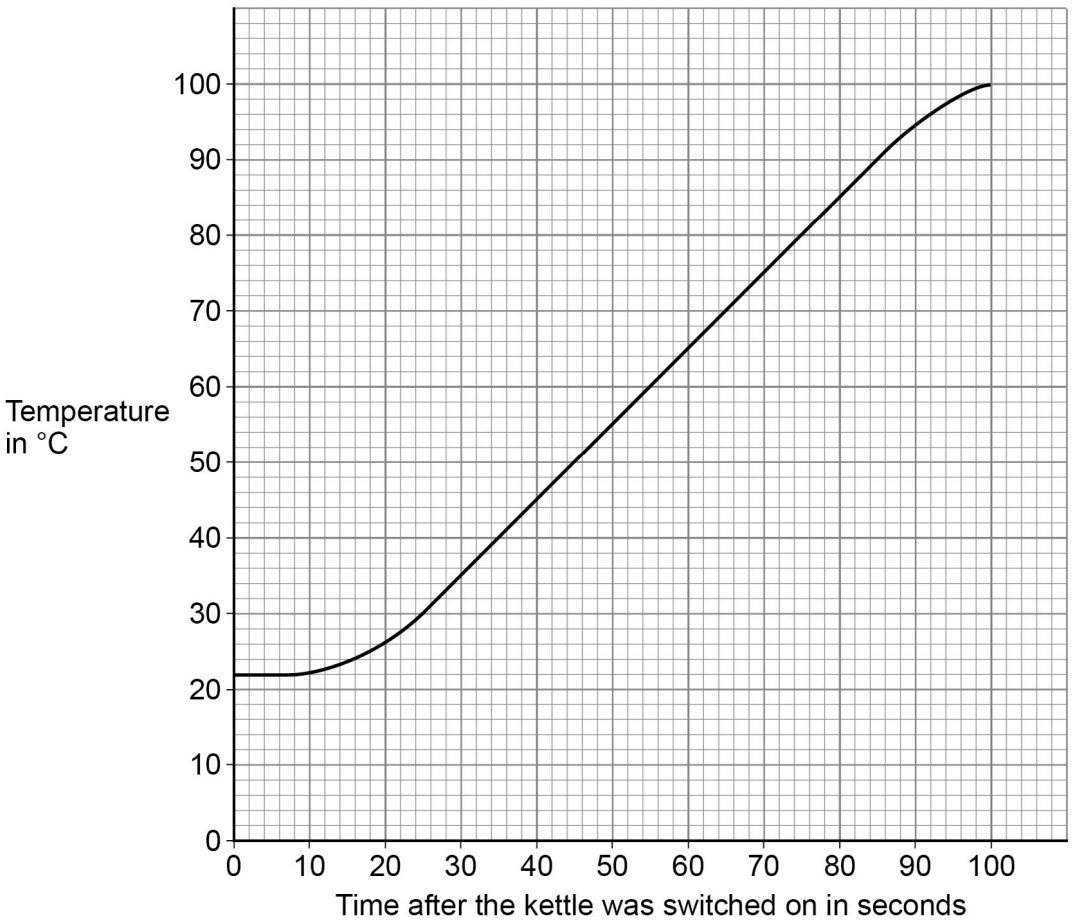
Question 102

November 2020 | 8463/1H | Original Q7

**0 7** An electric kettle was switched on.

**Figure 10** shows how the temperature of the water inside the kettle changed.

**Figure 10**




**0 7 . 1** When the kettle was switched on the temperature of the water did **not** immediately start to increase.

Suggest **one** reason why.

**[1 mark]**

4.1.1.1 Energy stores and systems

Question 102 · continued



**0 7 . 2** The energy transferred to the water in 100 seconds was 155 000 J.

specific heat capacity of water = 4200 J/kg °C

Determine the mass of water in the kettle.

Use **Figure 10**.

Give your answer to 2 significant figures.

**[5 marks]**

Mass of water (2 significant figures) = _____ kg

**0 7 . 3** The straight section of the line in **Figure 10** can be used to calculate the useful power output of the kettle.

Explain how.

**[3 marks]**

9

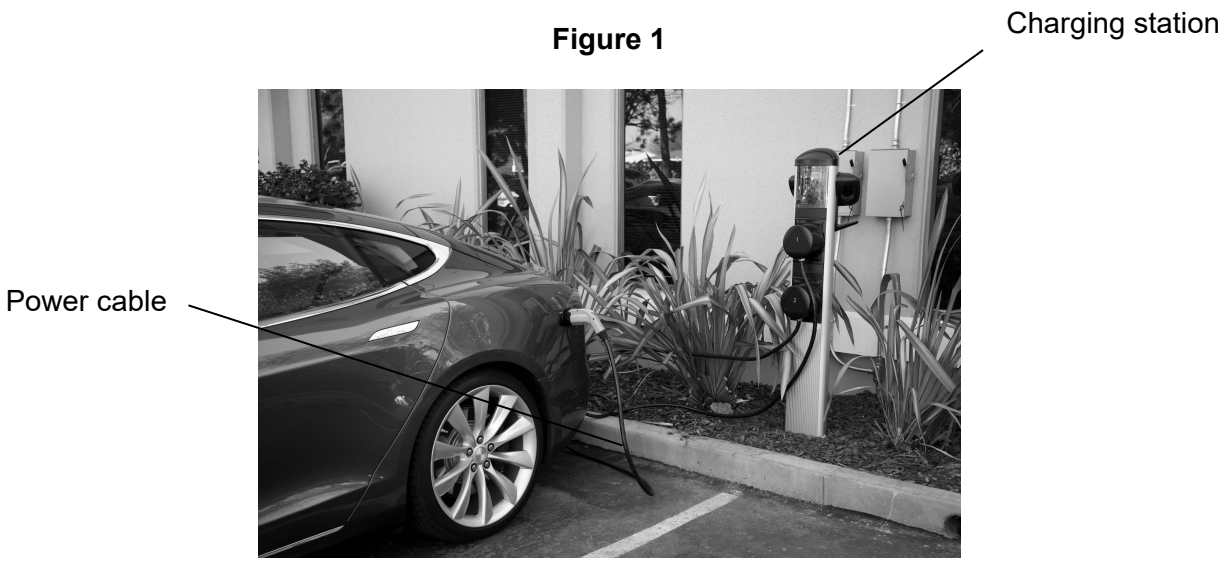
4.1.1.1 Energy stores and systems

Question 103



**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**

4.1.1.1 Energy stores and systems

Question 103 · 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

4.1.1.1 Energy stores and systems

Question 103 · 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**

4.1.1.1 Energy stores and systems

Question 103 · 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

4.1.1.1 Energy stores and systems

Question 104

November 2021 | 8463/1H | Original Q5

**0 5 . 1** During one year, $1.25 \times 10^{18}$ J of energy was transferred from the National Grid.

number of seconds in 1 year = $3.16 \times 10^{7}$

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

**[2 marks]**

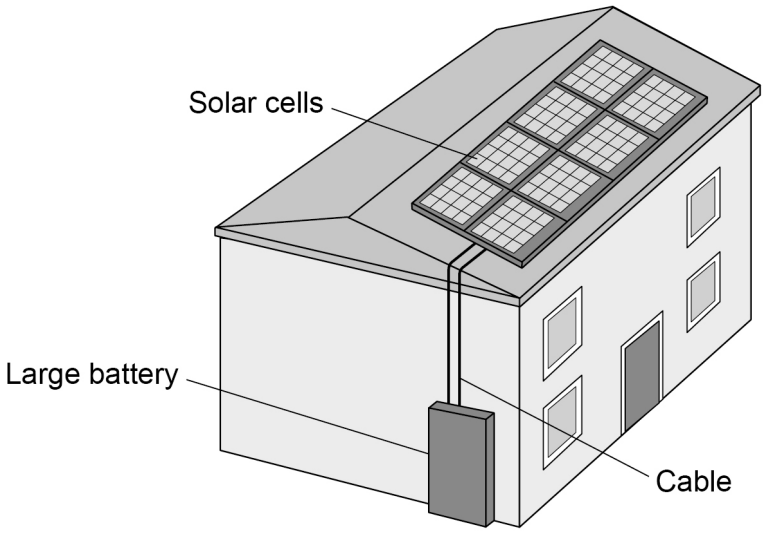
Energy each second (3 significant figures) = _____ J

**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**



4.1.1.1 Energy stores and systems

Question 104 · 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**

4.1.1.1 Energy stores and systems

Question 104 · 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

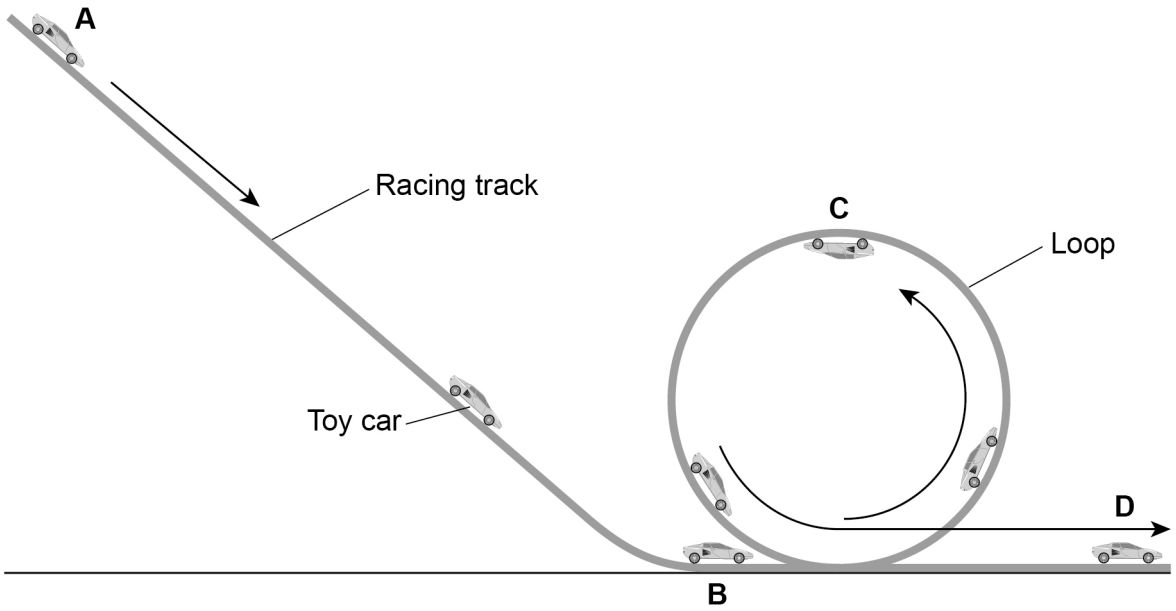
4.1.1.1 Energy stores and systems

Question 105

November 2021 | 8463/1H | Original Q8

**0 8** **Figure 11** shows a toy car in different positions on a racing track.

**Figure 11**




**0 8 . 1** The toy car and racing track can be modelled as a closed system.

Why can the toy car and racing track be considered 'a closed system'?

**[1 mark]**

Tick (✓) **one** box.

The racing track and the car both have gravitational potential energy. ☐

The racing track and the car are always in contact with each other. ☐

The total energy of the racing track and the car is constant. ☐

4.1.1.1 Energy stores and systems

Question 105 · continued



**0 8 . 2** The car is released from rest at position **A** and accelerates due to gravity down the track to position **B**.

mass of toy car = 0.040 kg

vertical height between position **A** and position **B** = 90 cm

gravitational field strength = 9.8 N/kg

Calculate the maximum possible speed of the toy car when it reaches position **B**.

**[5 marks]**

Speed = _____ m/s

**Question 8 continues on the next page**

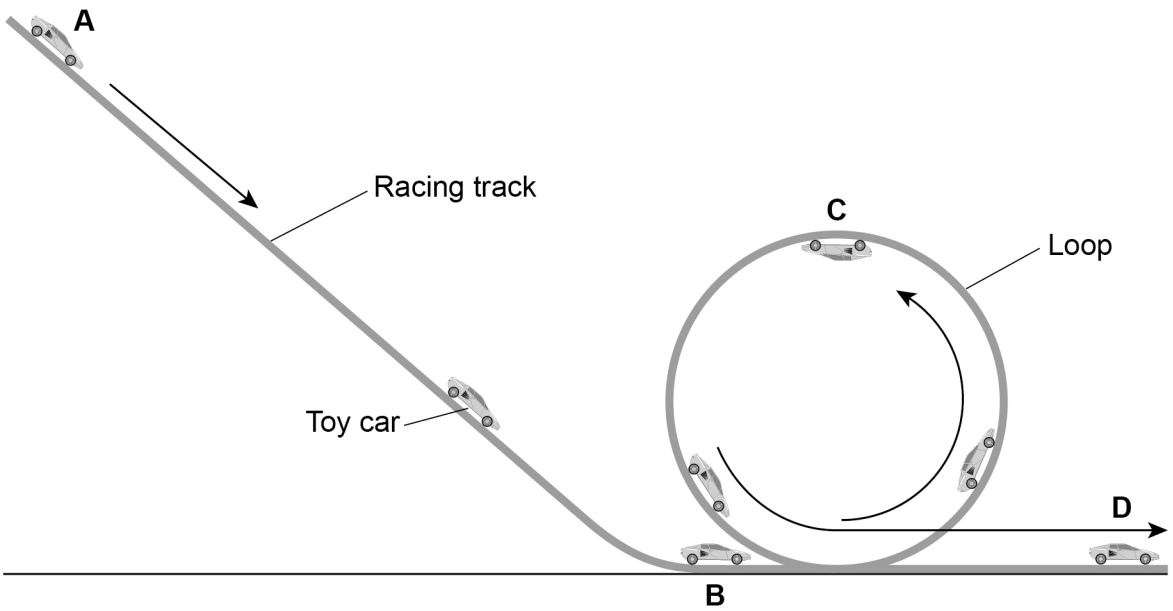
4.1.1.1 Energy stores and systems

Question 105 · continued



**Figure 11** is repeated below.

**Figure 11**




**0 8 . 3** At position **C** the car's gravitational potential energy is 0.20 J greater than at position **B**.

How much kinetic energy does the car need at position **B** to complete the loop of the track?

Give a reason for your answer.

**[2 marks]**

Tick (✓) **one** box.

Less than 0.20 J ☐

Exactly 0.20 J ☐

More than 0.20 J ☐

Reason _____

_____

_____

8

4.1.1.1 Energy stores and systems

Question 106

November 2021 | 8463/1H | Original Q11

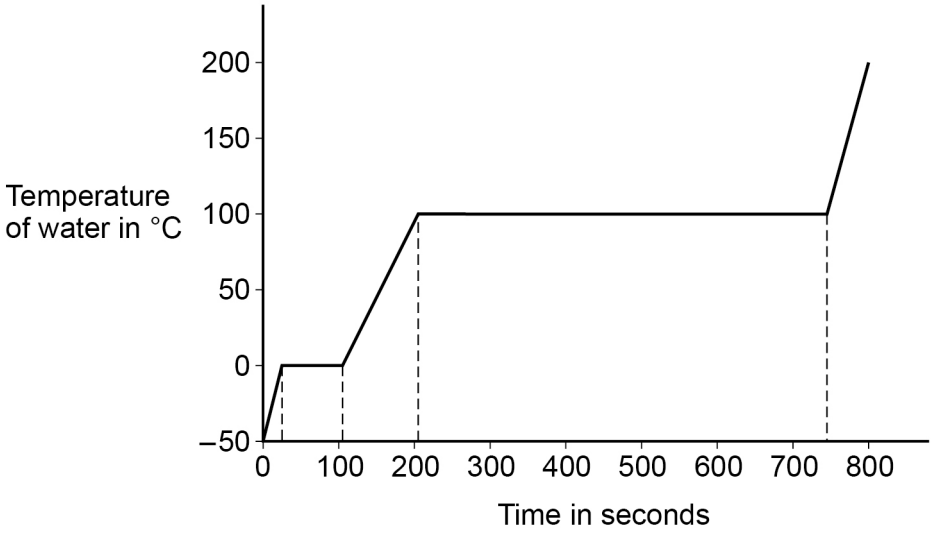
**1 1** A student investigated how the temperature of a lump of ice varied as the ice was heated.

The student recorded the temperature until the ice melted and then the water produced boiled.

**Figure 17** shows the student's results.

The power output of the heater was constant.

**Figure 17**




**1 1 . 1** The specific heat capacity of ice is less than the specific heat capacity of water.

Explain how **Figure 17** shows this.

**[2 marks]**

4.1.1.1 Energy stores and systems

Question 106 · continued



**1 1 . 2** The specific latent heat of fusion of ice is less than the specific latent heat of vaporisation of water.

Explain how **Figure 17** shows this.

**[2 marks]**

**1 1 . 3** A second student did the same investigation and recorded the temperature until the water produced boiled.

In the second student's investigation more thermal energy was transferred to the surroundings.

Describe **two** ways the results of the experiment in **Figure 17** would have been different.

**[2 marks]**

1

2

**Question 11 continues on the next page**

4.1.1.1 Energy stores and systems

Question 106 · continued



**1 1 . 4** When the water was boiling, 0.030 kg of water turned into steam.

The energy transferred to the water was 69 kJ.

Calculate the specific latent heat of vaporisation of water.

Give the unit.

**[5 marks]**

Specific latent heat of vaporisation = _____

Unit _____

11

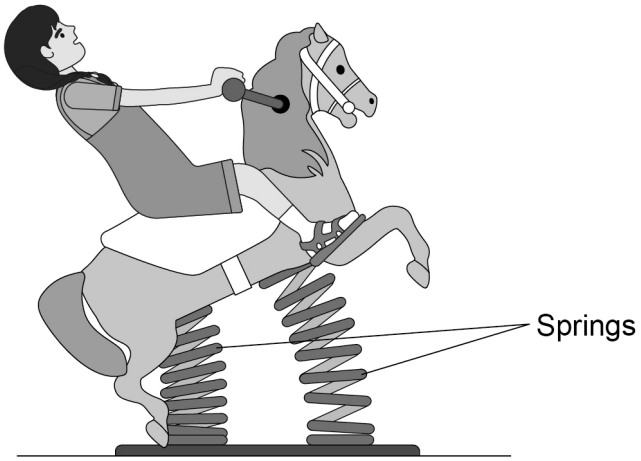
4.1.1.1 Energy stores and systems

Question 107

November 2021 | 8463/2H | Original Q2

**0 2** **Figure 3** shows a child on a playground toy.

**Figure 3**




**0 2 . 1** The springs have been elastically deformed.

Explain what is meant by 'elastically deformed'.

**[2 marks]**

**Question 2 continues on the next page**

4.1.1.1 Energy stores and systems

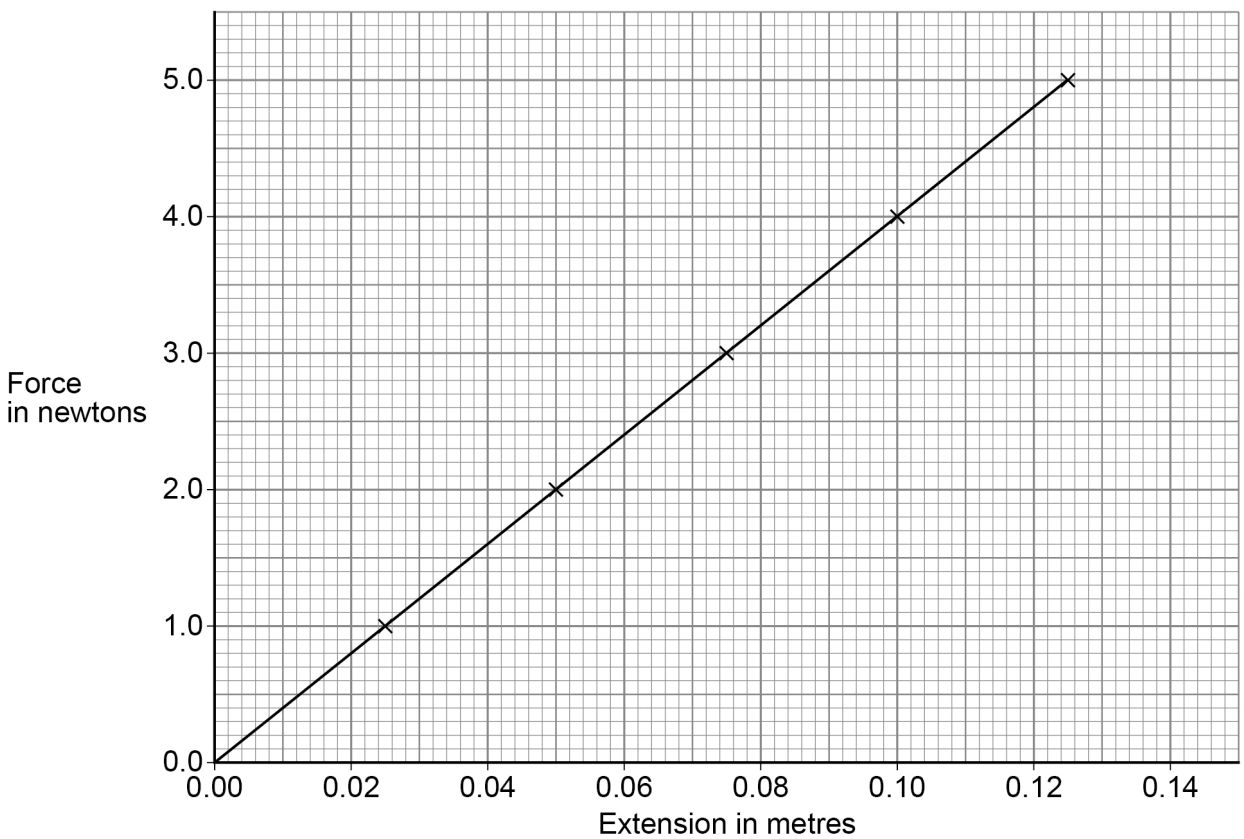
Question 107 · continued



A student investigated the relationship between the force applied to a spring and the extension of the spring.

**Figure 4** shows the results.

**Figure 4**



4.1.1.1 Energy stores and systems

Question 107 · continued



**0 2 . 2** Describe a method the student could use to obtain the results given in **Figure 4**.

You should include a risk assessment for **one** hazard in the investigation.

Your answer may include a diagram.

**[6 marks]**

**Question 2 continues on the next page**

Question 107 · continued



**0 2 . 3** Which equation links extension ($e$), force ($F$) and spring constant ($k$).

**[1 mark]**

Tick (✓) **one** box.

force = spring constant × (extension)$^2$ ☐

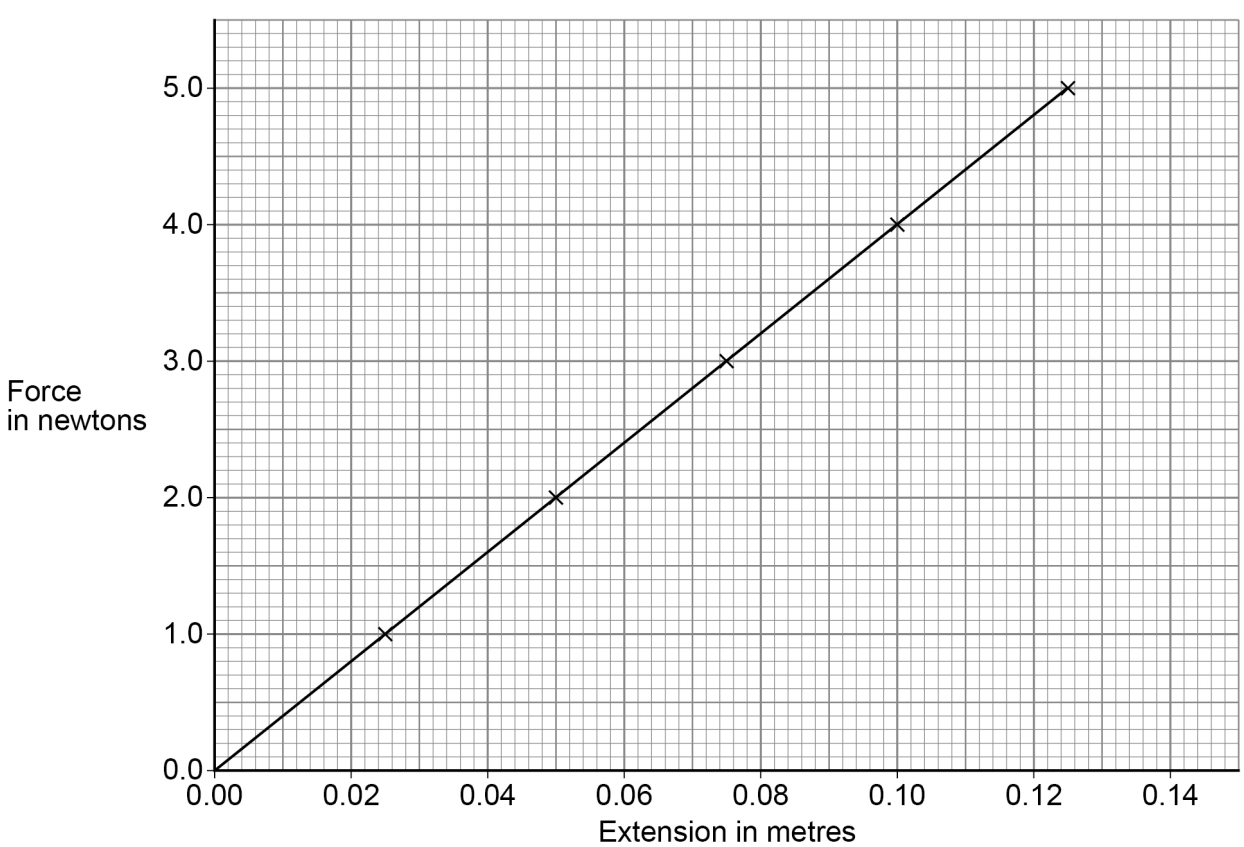
force = spring constant × extension ☐

force = $\frac{\text{extension}}{\text{spring constant}}$ ☐

force = $\frac{\text{spring constant}}{\text{extension}}$ ☐

**Figure 4** is repeated below.

**Figure 4**



4.1.1.1 Energy stores and systems

Question 107 · continued



**0 2 . 4** Determine the spring constant of the spring.

Use **Figure 4**.

**[3 marks]**

Spring constant = _____ N/m

**0 2 . 5** The student concluded:

'The extension of the spring is directly proportional to the force applied to the spring.'

Describe how **Figure 4** supports the student's conclusion.

**[2 marks]**

**Question 2 continues on the next page**

4.1.1.1 Energy stores and systems

Question 107 · continued



**0 2 . 6** The student repeated the investigation using a different spring with a spring constant of 13 N/m.

Calculate the elastic potential energy of the spring when the extension of the spring was 20 cm.

Use the Physics Equations Sheet.

**[3 marks]**

Elastic potential energy = _____ J

17

4.1.1.1 Energy stores and systems

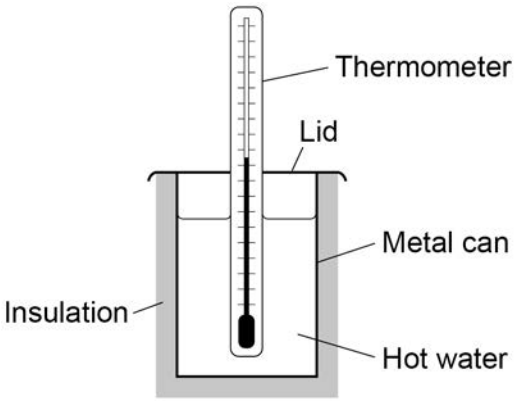
Question 108



**0 4** A student investigated the insulating properties of different materials.

**Figure 4** shows some of the equipment used by the student.

**Figure 4**




This is the method used:

1. Wrap insulating material around the can.
2. Put a fixed volume of boiling water in the can.
3. Place the lid on the top of the can.
4. Measure the time taken for the temperature of the water to decrease by a fixed amount.
5. Repeat steps 1–4 using the same thickness of different insulating materials.

**0 4 . 1** Identify the independent variable and the dependent variable in this investigation.

**[2 marks]**

Independent variable _____

Dependent variable _____

4.1.1.1 Energy stores and systems

Question 108 · continued



The student used two different types of thermometer to measure the temperature changes.

**Figure 5** shows a reading on each thermometer.

**Figure 5**




**0 4 . 2** What is the resolution of thermometer **B**?

**[1 mark]**

Resolution = _____ °C

**0 4 . 3** Thermometer **A** is more likely to be misread.

Give **one** reason why.

**[1 mark]**

_____

_____

_____

**Question 4 continues on the next page**

4.1.1.1 Energy stores and systems

Question 108 · continued



**0 4 . 4** For one type of insulating material, the temperature of the water decreased from 85.0 °C to 65.0 °C.

The energy transferred from the water was 10.5 kJ.

specific heat capacity of water = 4200 J/kg °C

Calculate the mass of water in the can.

Use the Physics Equations Sheet.

**[3 marks]**

Mass = _____ kg

4.1.1.1 Energy stores and systems

Question 108 · continued



**0 4 . 5** **Table 2** shows the results for two insulating materials.

**Table 2**

| Material | Time for temperature to decrease by 20 °C in seconds |
|---|---|
| X | 450 |
| Y | 745 |

Explain how the results in **Table 2** can be used to compare the thermal conductivity of the two materials.

**[2 marks]**

9

4.1.1.1 Energy stores and systems

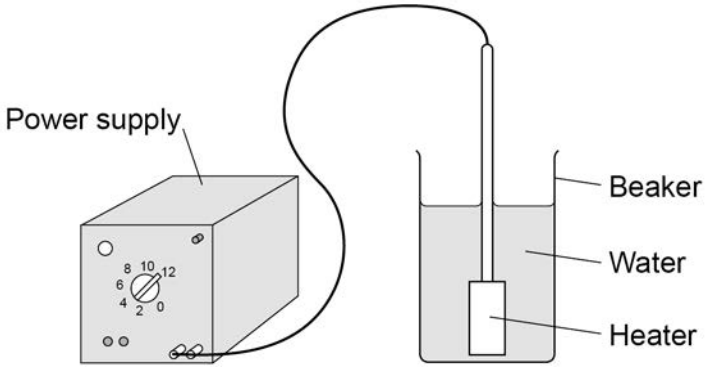
Question 109

June 2022 | 8463/1H | Original Q8

**0 8** A student determined the specific latent heat of vaporisation of water.

**Figure 9** shows some of the equipment used.

**Figure 9**




This is the method used:

1. Put 50 $cm^3$ of water in a beaker.
2. Measure the mass of the beaker and water.
3. Use a heater to boil the water and keep it boiling for 600 seconds.
4. Measure the mass of the beaker and water after 600 seconds.

**0 8 . 1** What measuring instrument should be used to measure the volume of water?

**[1 mark]**

**0 8 . 2** What is a hazard in the student's investigation?

**[1 mark]**

Tick (✓) **one** box.

- burns ☐
- boiling water ☐
- heatproof gloves ☐
- safety goggles ☐

4.1.1.1 Energy stores and systems

Question 109 · continued



**0 8 . 3** The initial mass of the beaker and water was 0.080 kg.

The final mass of the beaker and water was 0.071 kg.

The energy transferred by the immersion heater as the water boiled was 25 200 J.

Calculate the specific latent heat of vaporisation of water given by the student's data.

Give the unit.

Use the Physics Equations Sheet.

**[5 marks]**

Specific latent heat of vaporisation = _____ Unit _____

**Question 8 continues on the next page**

4.1.1.1 Energy stores and systems

Question 109 · continued



**0 8 . 4** Some thermal energy was transferred to the surroundings while the water was being heated.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

**[2 marks]**

**0 8 . 5** Some of the water evaporated before its temperature reached 100 °C.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

**[2 marks]**

**11**

4.1.1.1 Energy stores and systems

Question 110

June 2022 | 8463/1H | Original Q11

1 1 **Figure 12** shows some hair straighteners.

Hair straighteners contain heating elements.

**Figure 12**



1 1 . 1 When the hair straighteners reach normal operating temperature, an LED turns on.

Draw the circuit symbol for an LED in the box.

**[1 mark]**

4.1.1.1 Energy stores and systems

Question 110 · continued

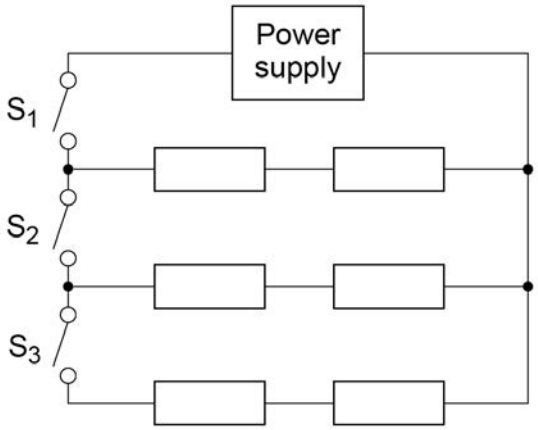


**Figure 13** shows the circuit diagram for the hair straighteners.

Each resistor represents a heating element.

The power output of the hair straighteners can be changed by closing different switches.

**Figure 13**




**11.2** Why do the hair straighteners **not** turn on when only switch $S_2$ is closed?

**[1 mark]**

**Question 11 continues on the next page**

4.1.1.1 Energy stores and systems

Question 110 · continued



**1 1 . 3** The hair straighteners have a maximum power output of 120 W.

The energy transferred to the hair straighteners to reach normal operating temperature is 3.6 kJ.

Calculate the time taken for the hair straighteners to reach normal operating temperature when operating at maximum power.

Use the Physics Equations Sheet.

**[4 marks]**

Time = _____ seconds

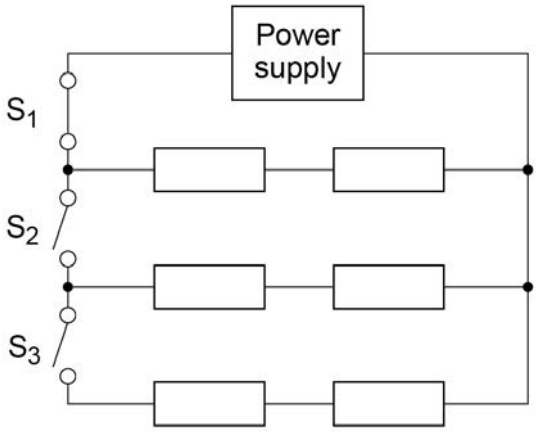
4.1.1.1 Energy stores and systems

Question 110 · continued



**1 1 . 4** **Figure 14** shows the hair straighteners circuit with switch $S_1$ closed.

**Figure 14**




Switch $S_2$ and switch $S_3$ are then closed at the same time.

Explain what happens to the power output of the power supply.

**[3 marks]**

9

4.1.1.1 Energy stores and systems

Question 111



**0 4** Hailstones are small balls of ice. Hailstones form in clouds and fall to the ground.

**Figure 7** shows different-sized hailstones.

**Figure 7**



A hailstone falls from a cloud and accelerates.

**0 4 . 1** Why does the hailstone accelerate?

**[1 mark]**

**0 4 . 2** The hailstone stops accelerating and reaches terminal velocity.

Explain why the hailstone reaches terminal velocity.

**[3 marks]**

4.1.1.1 Energy stores and systems

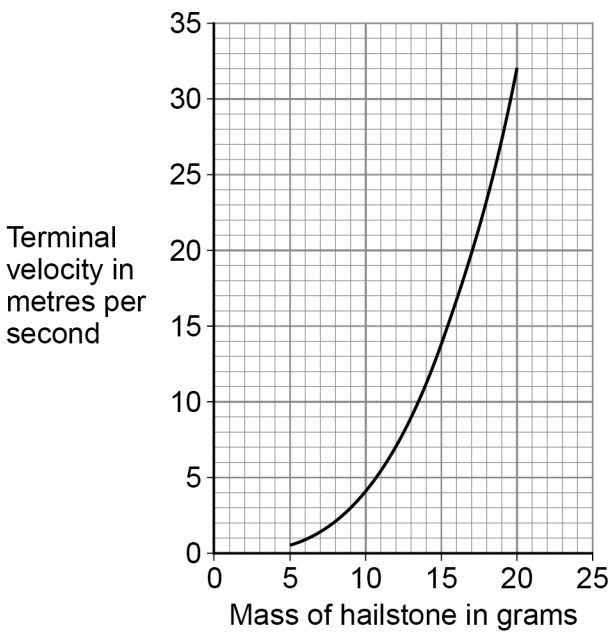
Question 111 · continued



A scientist investigated how the mass of hailstones affects their terminal velocity.

**Figure 8** shows the results.

**Figure 8**




**0 4 . 3** Why does terminal velocity increase with mass?

**[1 mark]**

Tick (✓) **one** box.

As mass increases the cross-sectional surface area of a hailstone increases. ☐

As mass increases the volume of a hailstone increases. ☐

As mass increases the weight of a hailstone increases. ☐

4.1.1.1 Energy stores and systems

Question 111 · continued



**0 4 . 4** Explain the difference in the maximum kinetic energy of a hailstone with a mass of 10 g and a hailstone with a mass of 20 g.

**[3 marks]**

**0 4 . 5** The kinetic energy of a hailstone is measured in joules.

Which of the following is the same as 1 joule?

**[1 mark]**

Tick (✓) **one** box.

1 N m ☐

1 N/m ☐

1 N/m$^2$ ☐

1 N m$^2$ ☐

**Question 4 continues on the next page**

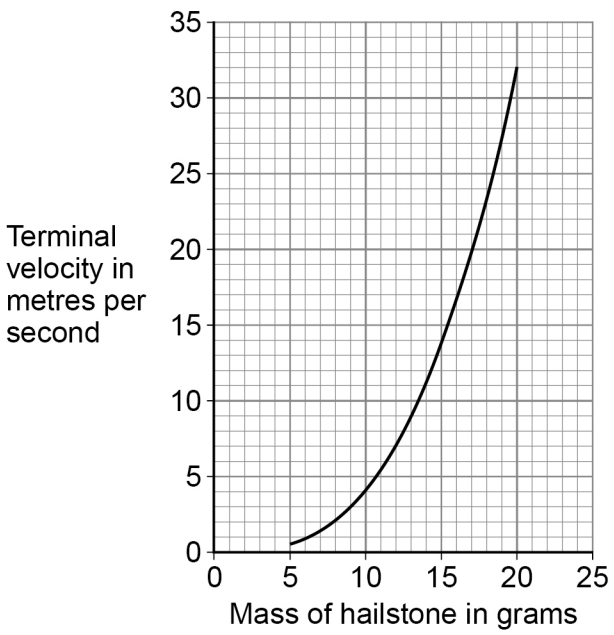
4.1.1.1 Energy stores and systems

Question 111 · continued



**Figure 8** is repeated below.

**Figure 8**




**0 4 . 6** A hailstone hit the ground at its terminal velocity of 25 m/s.

The hailstone took 0.060 s to stop moving.

Determine the average force on the hailstone as it hit the ground.

Use information from **Figure 8**.

Use the Physics Equations Sheet.

**[3 marks]**

Average force = _____ N

12

4.1.1.1 Energy stores and systems

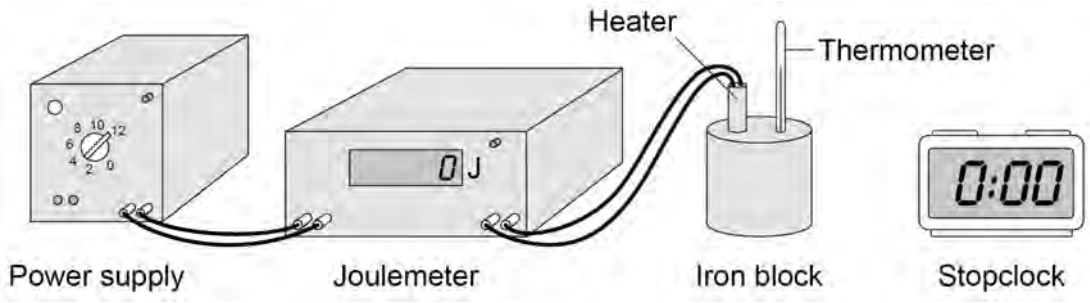
Question 112

June 2023 | 8463/1H | Original Q2

**0 2** **Figure 2** shows the equipment a student used to determine the specific heat capacity of iron.

The iron block the student used has two holes, one for the heater and one for the thermometer.

**Figure 2**




**0 2 . 1** Before the power supply was switched on, the thermometer was used to measure the temperature of the iron block.

The student left the thermometer in the iron block for a few minutes before recording the initial temperature.

Suggest why.

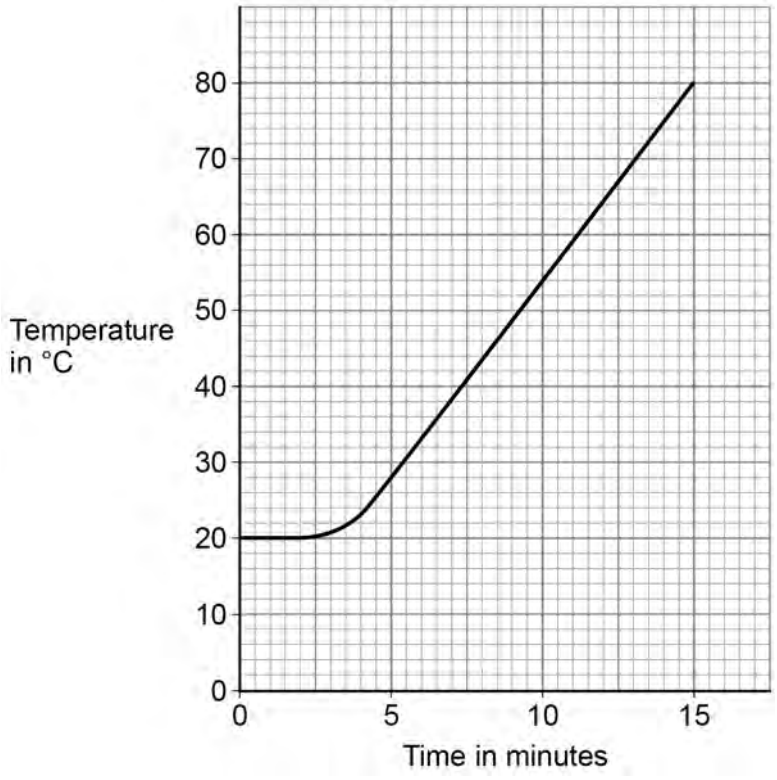
**[1 mark]**

Question 112 · continued



**0 2 . 2** **Figure 3** shows how the temperature changed after the power supply was switched on.

**Figure 3**




The energy transferred to the iron block between 5 and 10 minutes was 26 000 J.

The mass of the iron block was 2.0 kg.

Calculate the specific heat capacity of iron.

Use information from **Figure 3** and the Physics Equations Sheet.

**[4 marks]**

Specific heat capacity = _____ J/kg °C

4.1.1.1 Energy stores and systems

Question 112 · continued



**0 2 . 3** The student repeated the investigation but wrapped insulation around the iron block.

What effect will adding insulation have had on the investigation?

**[2 marks]**

Tick (✓) **two** boxes.

- The calculated specific heat capacity will be more accurate. ☐
- The iron block will transfer thermal energy to the surroundings at a lower rate. ☐
- The power output of the heater will be lower than expected. ☐
- The temperature of the iron block will increase more slowly than expected. ☐
- The uncertainty in the temperature measurement will be greater. ☐

7

4.1.1.1 Energy stores and systems

Question 113

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

4.1.1.1 Energy stores and systems

Question 113 · continued



**0 4 . 2** The generator transfers 3.0 kW of electrical power.

Calculate the time taken for the generator to transfer $2.16 \times 10^7$ 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**

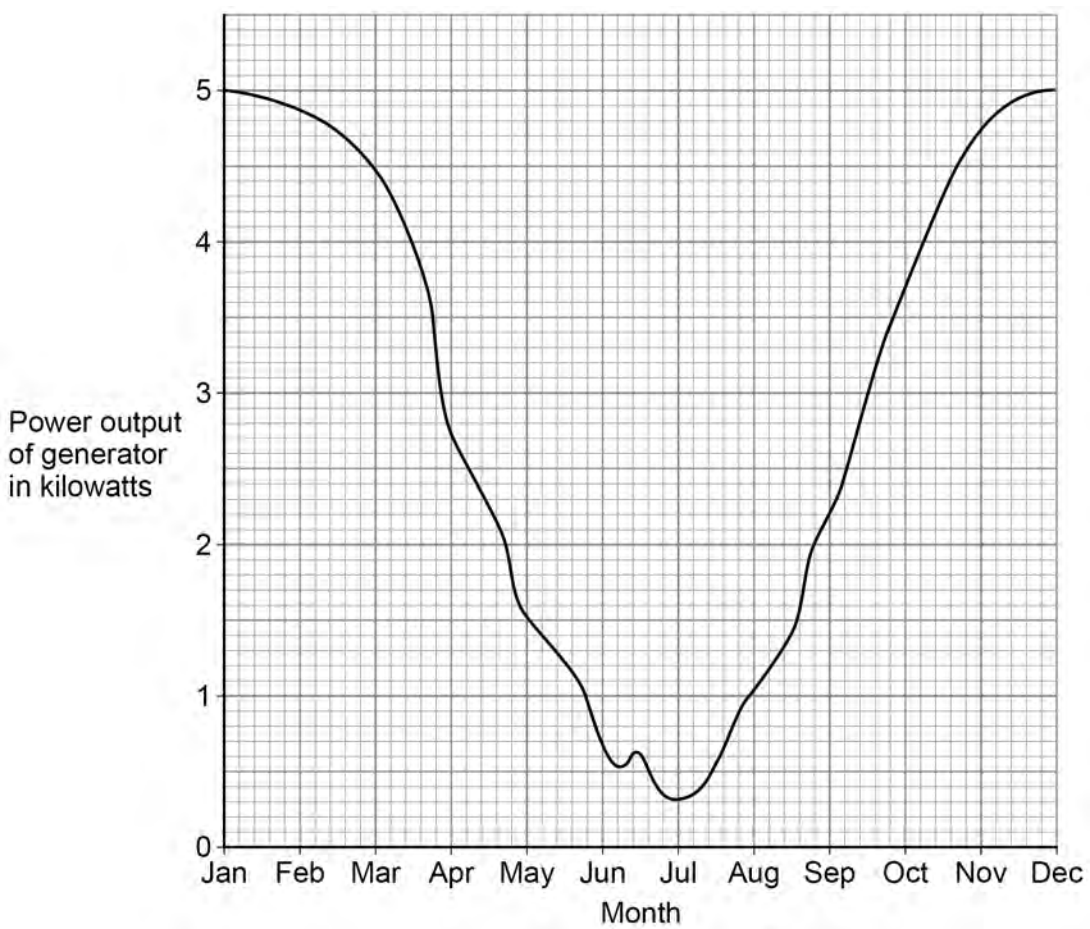
4.1.1.1 Energy stores and systems

Question 113 · continued



**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

4.1.1.1 Energy stores and systems

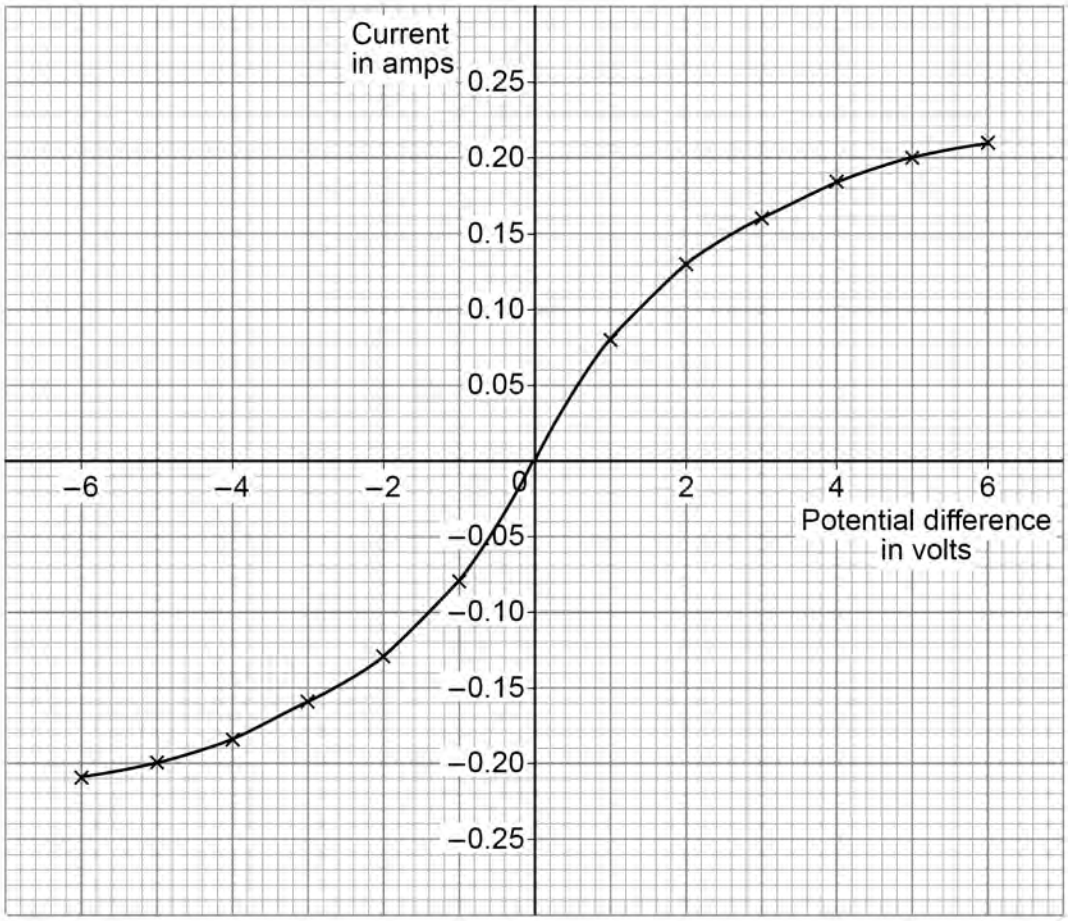
Question 114



**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**



4.1.1.1 Energy stores and systems

Question 114 · continued



**0 6 . 1** Describe a method the student could use to obtain these results.

You should include a circuit diagram.

**[6 marks]**

4.1.1.1 Energy stores and systems

Question 114 · 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

4.1.1.1 Energy stores and systems

Question 114 · 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**

4.1.1.1 Energy stores and systems

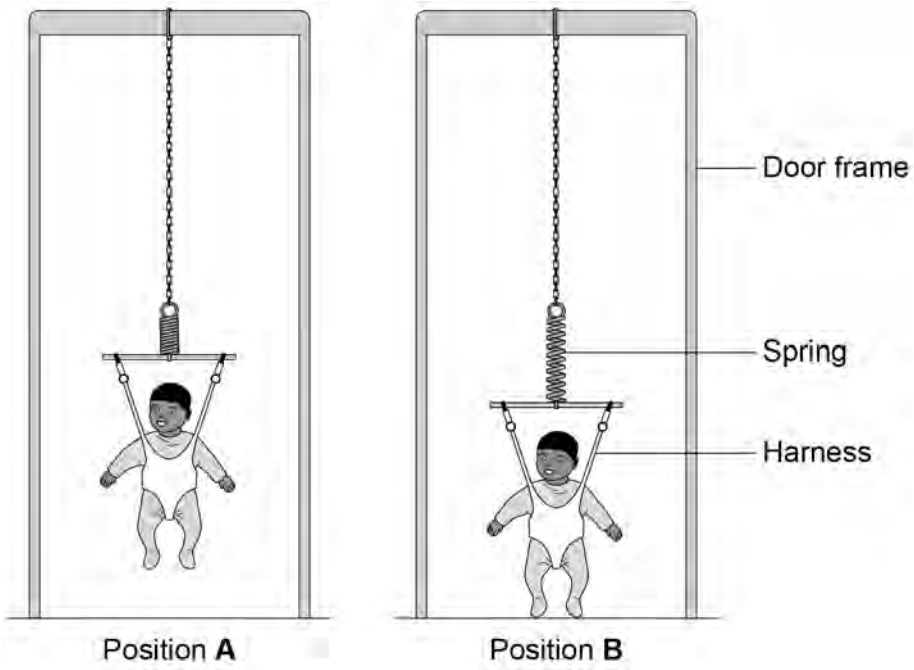
Question 115

June 2023 | 8463/1H | Original Q7

**0 7** A baby bouncer is a harness attached to a spring that hangs from a door frame.

**Figure 7** shows a baby in a baby bouncer in two positions.

**Figure 7**




**0 7 . 1** The baby bouncer should not be used with babies that have a mass greater than 12 kg.

Suggest **one** reason why.

**[1 mark]**

4.1.1.1 Energy stores and systems

Question 115 · continued



**0 7 . 2** In positions **A** and **B** the baby is stationary.

Describe the energy transfers as the baby moves from position **A** to position **B**.

**[3 marks]**

**0 7 . 3** In one position the extension of the spring is 8.0 cm.

The elastic potential energy stored by the spring is 4.0 J.

Calculate the spring constant of the spring.

Use the Physics Equations Sheet.

**[4 marks]**

Spring constant = _____ N/m

8

4.1.1.1 Energy stores and systems

Question 116

June 2023 | 8463/2H | Original Q1

**0 1** Infrared waves are transverse waves.

**0 1 . 1** Complete the sentence.

**[1 mark]**

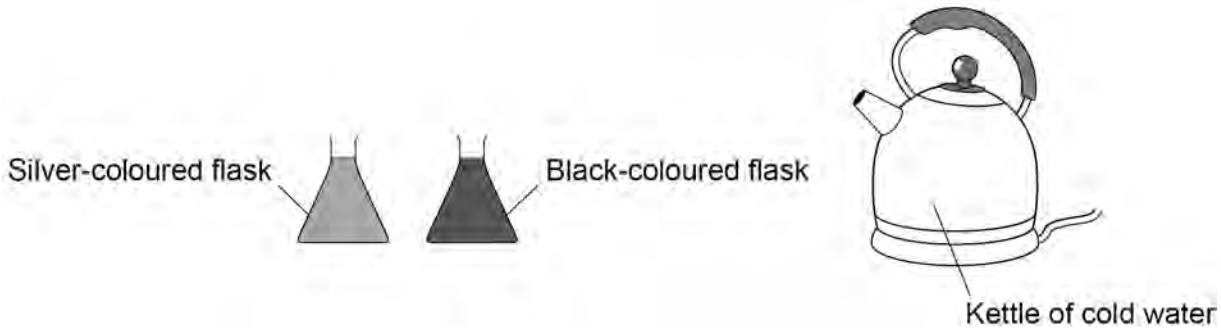
In a transverse wave, the direction of oscillation is _____

to the direction of energy transfer by the wave.

A student investigated how the colour of a surface affects the rate at which the surface emits infrared radiation.

**Figure 1** shows some of the equipment used.

**Figure 1**



4.1.1.1 Energy stores and systems

Question 116 · continued



**0 1 . 2** The student wrote the following hypothesis:

‘The black-coloured flask will emit more infrared radiation than the silver-coloured flask during 10 minutes of cooling.’

Describe a method to test this hypothesis.

**[6 marks]**

**Question 1 continues on the next page**

4.1.1.1 Energy stores and systems

Question 116 · continued



**0 1 . 3** When will the flasks emit infrared radiation at the greatest rate?

Give a reason for your answer.

**[2 marks]**

Tick (✓) **one** box.

During the 1st minute ☐

During the 5th minute ☐

During the 9th minute ☐

Reason _____

_____

Question 116 · continued



Another student investigated the absorption of infrared radiation by different surface colours.

The student filled four hollow metal cubes with cold water.

Each cube was the same size but had a different surface colour.

The cubes were then placed the same distance from an infrared heater.

After 10 minutes, the student measured the temperature increase of the water inside each cube.

**0 1 . 4** What was the dependent variable in this investigation?

**[1 mark]**

**0 1 . 5** **Table 1** shows the results.

**Table 1**

| Surface colour of the cube | Temperature increase after 10 minutes in °C |
|---|---|
| Matt white | 3.0 |
| Shiny white | 2.0 |
| Matt black | 6.5 |
| Shiny black | 4.0 |

Give **two** conclusions that can be made from the results in **Table 1**.

**[2 marks]**

1

2

4.1.1.1 Energy stores and systems

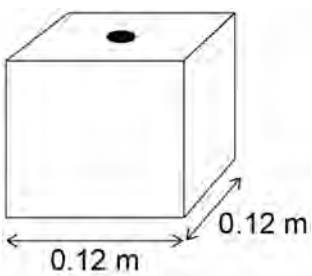
Question 116 · continued



**Figure 2** shows one of the cubes. The cube is filled with water.

The weight of the water exerts a pressure on the bottom of the cube.

**Figure 2**




Use the Physics Equations Sheet to answer questions **01.6** and **01.7**.

**0 1 . 6** Which equation correctly links area, force and pressure?

**[1 mark]**

Tick (✓) **one** box.

pressure = force × area$^2$ ☐

pressure = force × area ☐

pressure = $\frac{\text{force}}{\text{area}}$ ☐

pressure = $\frac{\text{area}}{\text{force}}$ ☐

4.1.1.1 Energy stores and systems

Question 116 · continued



**0 1 . 7** The water pressure at the bottom of the cube is 1500 Pa.

Calculate the force of the water on the bottom of the cube.

**[4 marks]**

Force = _____ N

17

**Turn over for the next question**

4.1.1.1 Energy stores and systems

Question 117

June 2024 | 8463/1H | Original Q1

**0 1** **Figure 1** shows a wind turbine.

**Figure 1**



Wind turbines may generate electricity when the electricity is not needed.

Two methods that can be used to store the energy from the turbine are:

**Method A**: Heating water to a high temperature.

**Method B**: Pumping water uphill into a reservoir.

**0 1 . 1** Which energy store increases when water is heated?

**[1 mark]**

**0 1 . 2** Which energy store increases when water is pumped uphill into a reservoir?

**[1 mark]**

4.1.1.1 Energy stores and systems

Question 117 · continued



**0 1 . 3** **Table 1** shows information about the two methods of storing energy.

**Table 1**

| Method | Energy stored per 100 kg of water in kJ | Percentage of stored energy wasted | Installation |
|---|---|---|---|
| **A**: Increasing water temperature by 80 °C | 33 600 | 40% | Anywhere |
| **B**: Pumping water uphill to a height of 500 m | 490 | 25% | High mountains |

Compare the advantages and disadvantages of the two methods of storing energy.

Include calculations in your answer.

**[4 marks]**

**Question 1 continues on the next page**

4.1.1.1 Energy stores and systems

Question 117 · continued



**0 1 . 4** Decreasing the amount of carbon dioxide released by different activities will help slow down climate change.

Transport and generating electricity are the two activities that released the largest amounts of carbon dioxide in the UK in 2018.

Explain **one** change that would reduce the amount of carbon dioxide released by **each** activity.

**[4 marks]**

Transport _____

_____

_____

_____

_____

Generating electricity _____

_____

_____

_____

_____

10

4.1.1.1 Energy stores and systems

Question 118

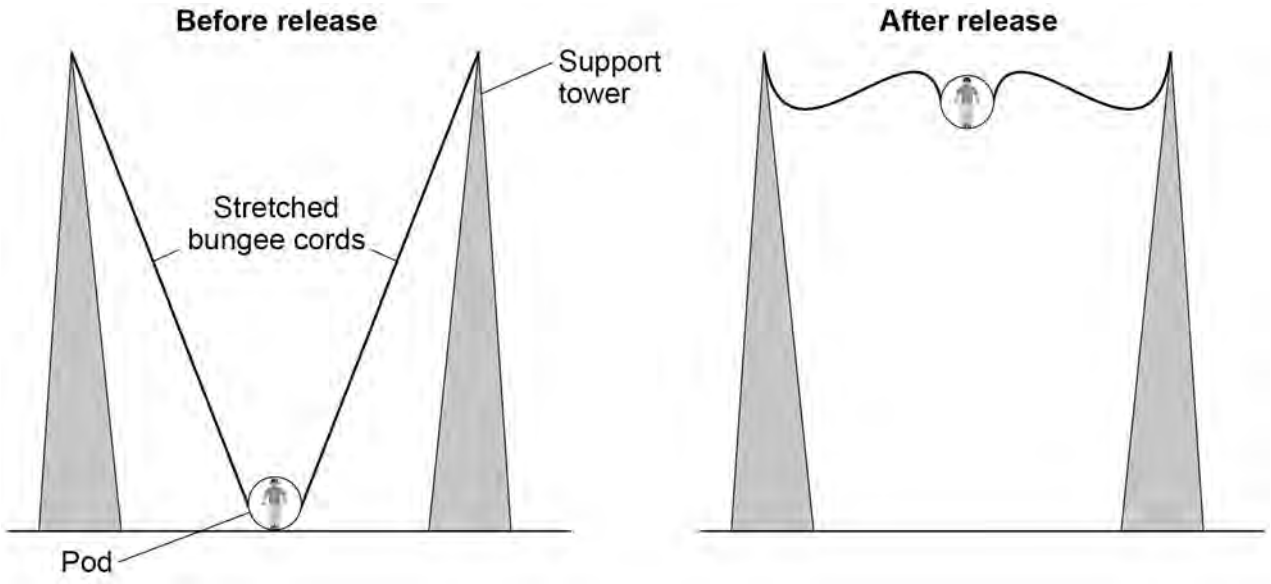
June 2024 | 8463/1H | Original Q6

**0 6** In a ride at a theme park, a person is strapped into a pod that is attached to two stretched bungee cords.

The bungee cords behave like springs.

**Figure 10** shows a person using the ride.

**Figure 10**




**0 6 . 1** Which energy store increases as the bungee cords are stretched?

**[1 mark]**

4.1.1.1 Energy stores and systems

Question 118 · continued



**0 6 . 2** When the pod is released, the pod accelerates upwards.

Before the pod is released the extension of **each** of the two bungee cords is 8.0 m.

The spring constant of each bungee cord is 735 N/m.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod.

Use the Physics Equations Sheet.

**[6 marks]**

Maximum height = _____ m

**0 6 . 3** The actual maximum height reached by the pod will be lower than the correct answer to Question **06.2**

Explain why.

**[2 marks]**

9

4.1.1.1 Energy stores and systems

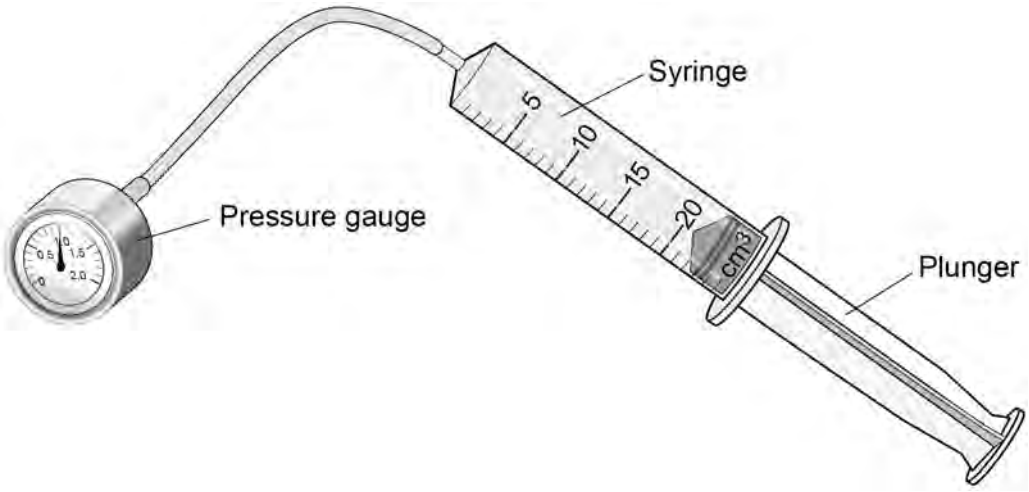
Question 119

June 2024 | 8463/1H | Original Q8

**0 8** A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

**Figure 12** shows the equipment used.

**Figure 12**




**0 8 . 1** When the plunger was pushed slowly into the syringe, the pressure in the syringe increased.

The temperature of the air remained constant.

Explain why the pressure increased.

**[3 marks]**

4.1.1.1 Energy stores and systems

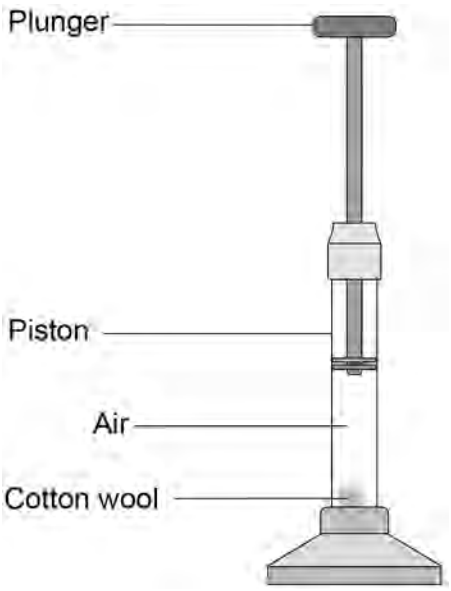
Question 119 · continued



A fire piston is a special type of syringe that can be used to start fires.

**Figure 13** shows a fire piston.

**Figure 13**




The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

**0 8 . 2** How does an increase in temperature affect the air particles inside the piston?

**[1 mark]**

Tick (✓) **one** box.

- The mean kinetic energy of the particles increases. ☐
- The mean potential energy of the particles increases. ☐
- The mean separation of the particles increases. ☐

4.1.1.1 Energy stores and systems

Question 119 · continued



**0 8 . 3** When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is $2.60 \times 10^{-8}$ kg.

specific heat capacity of air = 1.01 kJ/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

**[4 marks]**

Temperature change = _____ °C

8

4.1.1.1 Energy stores and systems

Question 120

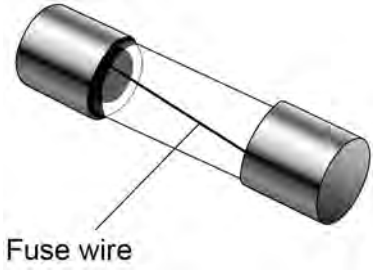
June 2024 | 8463/1H | Original Q10

**1 0** The live wire in a three-core cable is connected to a fuse inside a plug.

A fuse contains a wire that is designed to melt when the current gets too great.

**Figure 17** shows a fuse.

**Figure 17**




**1 0 . 1** What colour is the insulation covering the live wire in a three-core cable?

**[1 mark]**

**1 0 . 2** Draw the circuit symbol for a fuse in the box below.

**[1 mark]**

4.1.1.1 Energy stores and systems

Question 120 · continued



**1 0 . 3** The fuse wire melts when there is a charge flow of 2.0 C for 400 ms.

Calculate the current in the fuse wire.

Use the Physics Equations Sheet.

**[4 marks]**

Current = _____ A

**1 0 . 4** When the fuse wire is at its melting point, the additional energy needed to melt the wire is 1.02 J.

specific latent heat of fuse wire = 60 kJ/kg

Calculate the mass of the fuse wire.

Use the Physics Equations Sheet.

**[4 marks]**

Mass = _____ kg

**Question 10 continues on the next page**

4.1.1.1 Energy stores and systems

Question 120 · continued



**1 0 . 5** The calculation in Question **10.4** assumes there is no energy transferred to the surroundings.

How would the time taken for the wire to melt be affected if some energy was transferred to the surroundings?

Give a reason for your answer.

**[2 marks]**

Tick (✓) **one** box.

Time taken would decrease ☐

Time taken would stay the same ☐

Time taken would increase ☐

Reason _____

_____

_____

12

4.1.1.1 Energy stores and systems

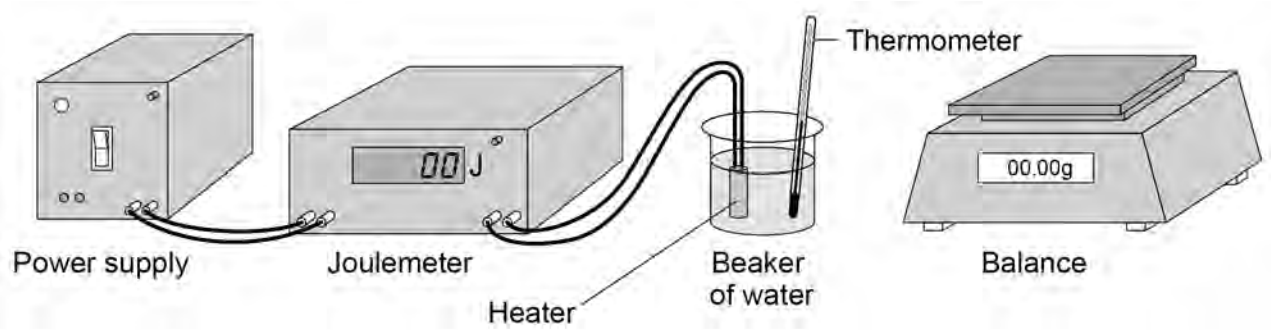
Question 121



**0 2** A student determined the specific heat capacity of water.

**Figure 4** shows the apparatus used.

**Figure 4**




The joulemeter measures energy transfer.

**0 2 . 1** Give **one** hazard in the investigation.

**[1 mark]**

**0 2 . 2** Describe how the student could determine the specific heat capacity of water using the apparatus in **Figure 4**.

**[6 marks]**

4.1.1.1 Energy stores and systems

Question 121 · continued



Extra space

**0 2 . 3** One source of error in the experiment was energy loss to the surroundings.

Suggest **one** change to the apparatus to reduce energy loss to the surroundings.

**[1 mark]**

**0 2 . 4** The student's value for the specific heat capacity of water was 4410 J/kg °C.

The actual value for the specific heat capacity of water is 4200 J/kg °C.

Calculate the percentage difference between the student's value and the actual value.

**[2 marks]**

Percentage difference = _____ %

**10**

4.1.1.1 Energy stores and systems

Question 122

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

4.1.1.1 Energy stores and systems

Question 122 · 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 122 · continued

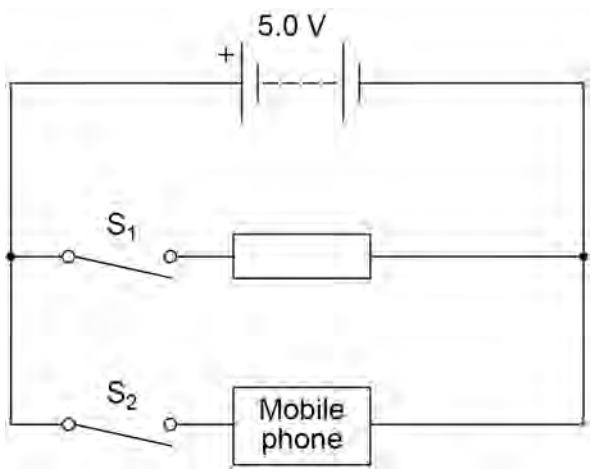


**0 6 . 3** The circuit inside the hand warmer can be connected to a mobile phone to recharge the mobile phone.

**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

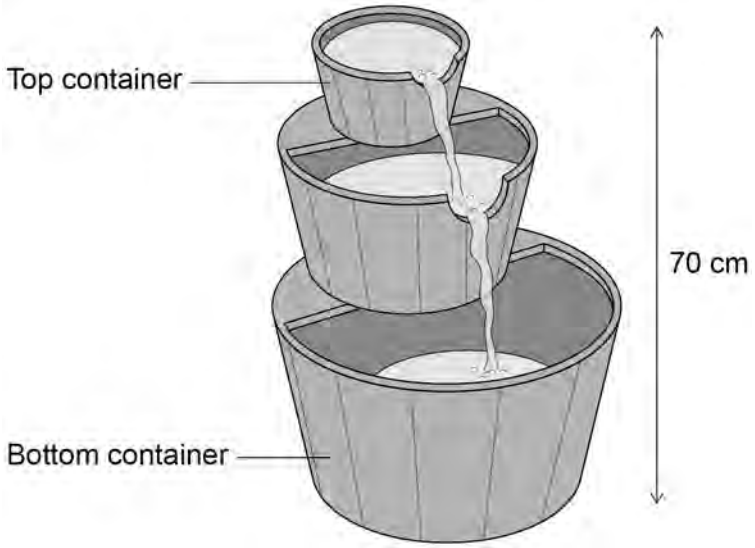
4.1.1.1 Energy stores and systems

Question 123

June 2025 | 8463/1H | Original Q9

**0 9** **Figure 11** shows a garden water feature.

**Figure 11**




The water feature has an electric motor that pumps water from the bottom container to the top container.

**0 9 . 1** The pump transfers 0.343 J of gravitational potential energy to the water each second.

gravitational field strength = 9.8 N/kg

Determine the mass of water passing through the pump each second.

Use the Physics Equations Sheet.

**[4 marks]**

Mass = _____ kg

4.1.1.1 Energy stores and systems

Question 123 · continued



**0 9 . 2** The power of the pump motor is 4.86 W.

The resistance of the pump motor is 6.0 Ω.

Calculate the charge flow through the motor in 30 minutes.

Use the Physics Equations Sheet.

**[6 marks]**

Charge flow = _____ C

**0 9 . 3** The pump motor breaks and is replaced with a new motor.

The new pump motor has the same power input, but has a greater efficiency.

Explain how the new pump motor would affect the flow of water in the water feature.

**[2 marks]**

12

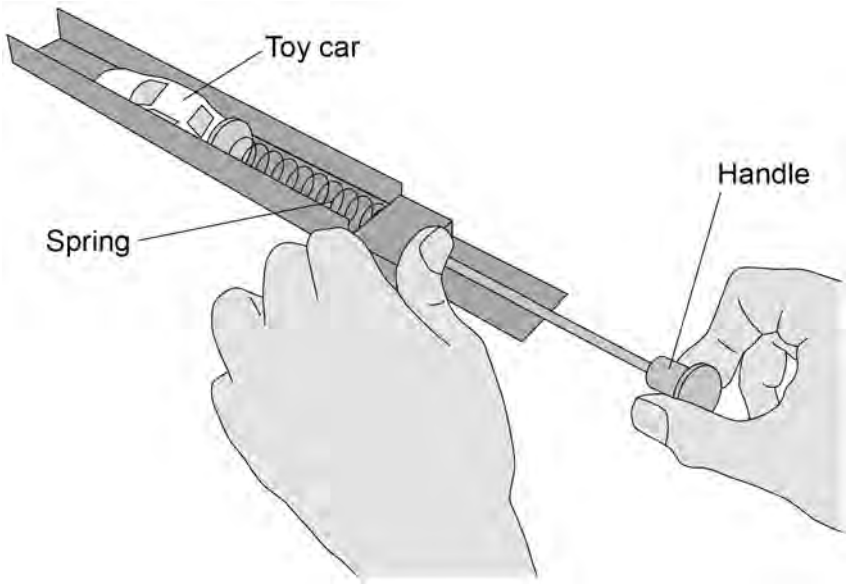
4.1.1.1 Energy stores and systems

Question 124

June 2025 | 8463/1H | Original Q10

**1 0** **Figure 12** shows a device that accelerates a toy car at the start of a race track.

**Figure 12**



4.1.1.1 Energy stores and systems

Question 124 · continued



**1 0 . 1** Pulling the handle compresses the spring in the device by 0.075 m.

When the handle is released, the energy stored in the compressed spring is transferred to the toy car.

spring constant = 64 N/m

mass of toy car = 0.052 kg

Calculate the maximum possible speed of the toy car just after the car starts to move.

Use the Physics Equations Sheet.

Give your answer to **2** significant figures.

**[6 marks]**

Maximum possible speed (2 significant figures) = _____ m/s

**Question 10 continues on the next page**

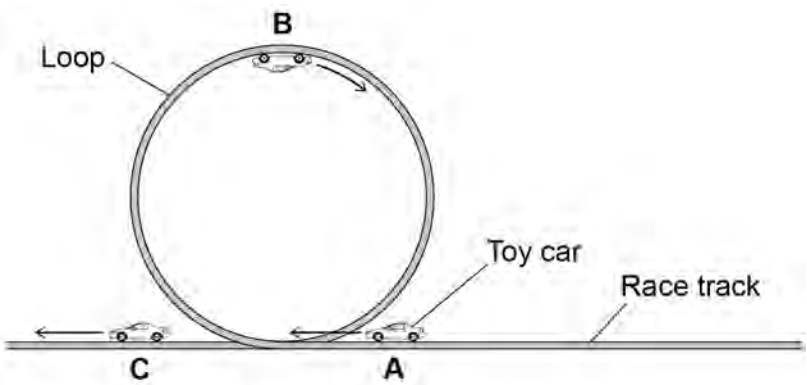
4.1.1.1 Energy stores and systems

Question 124 · continued



**1 0 . 2** **Figure 13** shows the path of the toy car along a loop section of the race track.

**Figure 13**




The car moves along the track from position **A** to position **B** and then to position **C**.

Describe how the energy stores of the car change as the car moves along the track from position **A** to position **C**.

Ignore the effects of friction and air resistance.

**[3 marks]**

4.1.1.1 Energy stores and systems

Question 124 · continued



**1 0 . 3** At the end of the race track, the toy car passes through a light gate that measures the speed of the car.

Which **two** measurements are needed to determine the speed of the car?

**[2 marks]**

Tick (✓) **two** boxes.

- Length of the toy car ☐
- Mass of the toy car ☐
- Temperature of the room ☐
- Time for the toy car to pass the light gate ☐
- Total length of the race track ☐

11