AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.2.1

Energy transfers in a system

Past-paper questions

Tier	**Higher**
Question groups	**42**
Available paper years	**2005–2022**

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:** _____

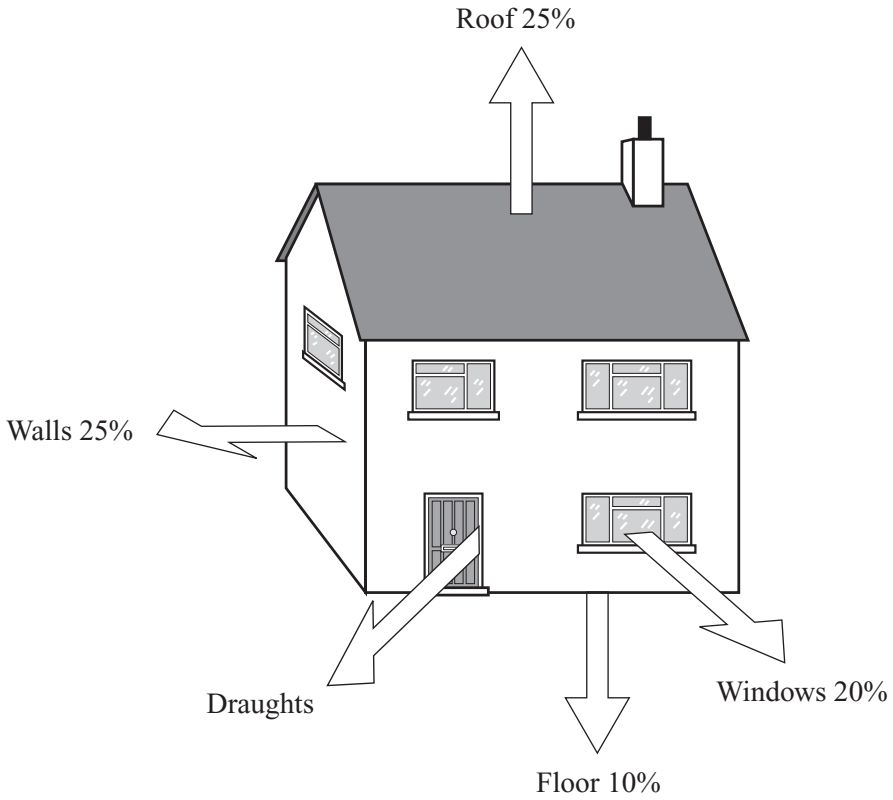
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.1.2.1 Energy transfers in a system

Question 01

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)

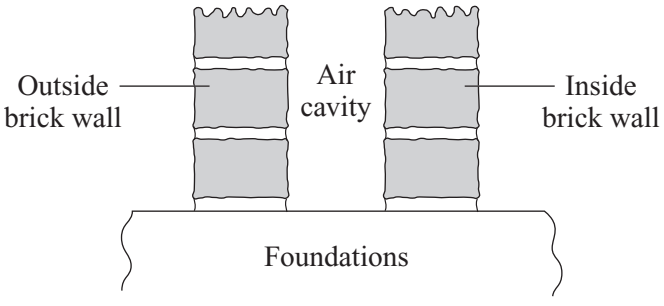
4.1.2.1 Energy transfers in a system

Question 01 · continued

I

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(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)

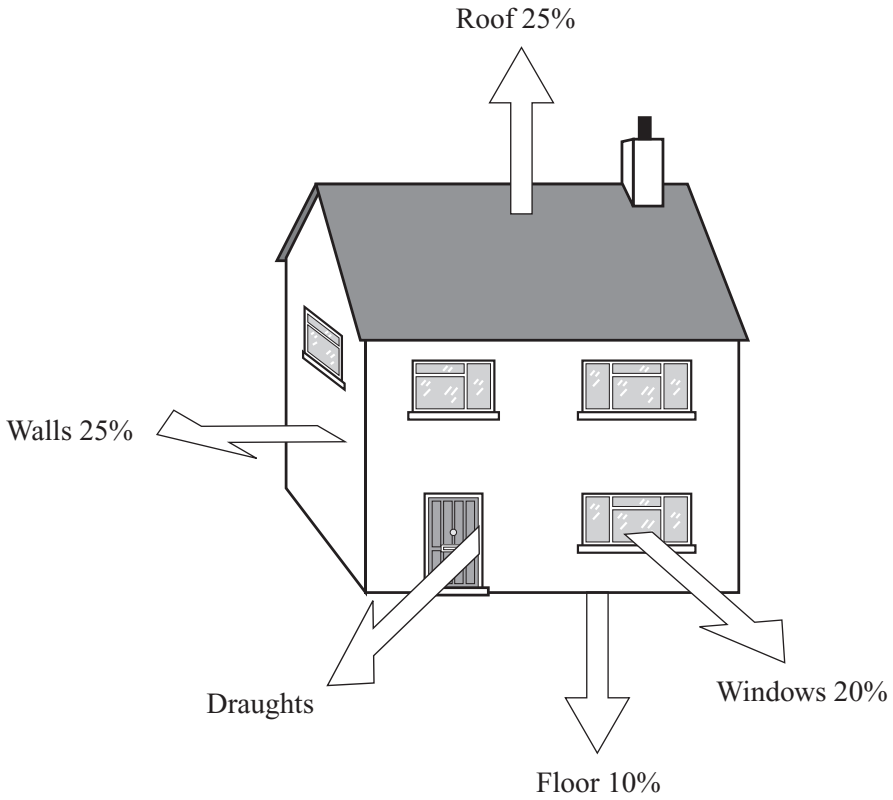
7

4.1.2.1 Energy transfers in a system

Question 02

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)

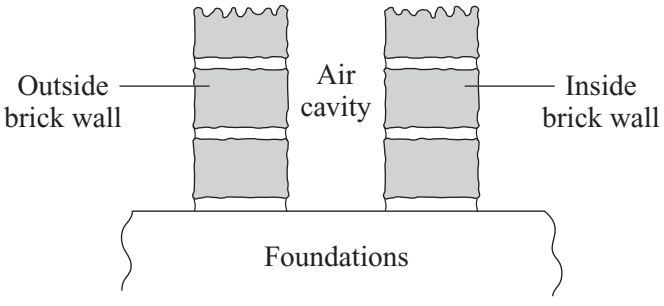
4.1.2.1 Energy transfers in a system

Question 02 · continued

I

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(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)

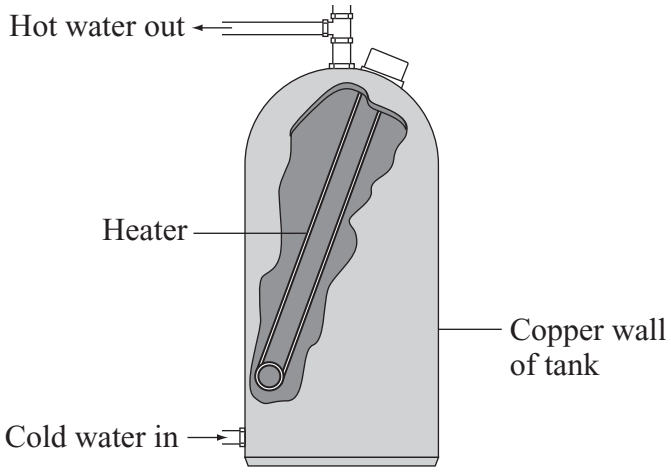
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4.1.2.1 Energy transfers in a system

Question 03

June 2006 | 3451 | Original Q11 | Legacy

11 (a) The diagram shows a copper hot water tank.



Explain, in terms of the particles in the copper, how heat energy is transferred through the wall of the hot water tank.

.....

.....

.....

.....

(2 marks)

4.1.2.1 Energy transfers in a system

Question 03 · continued

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

Method of reducing energy used	Installation cost in £	Money saved each year on energy bills in £
Hot water tank jacket	30	20
Draught proofing	50	15
Under floor insulation	75	20
Upgraded central heating controls	350	80

Which of the methods in the table would be most cost-effective over 5 years?

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

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(3 marks)

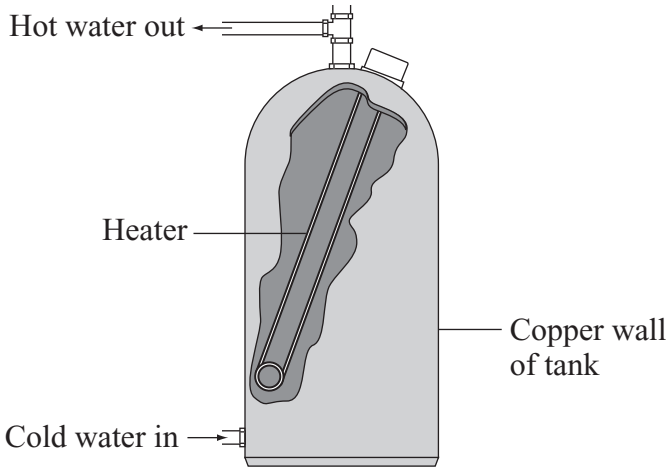
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4.1.2.1 Energy transfers in a system

Question 04

June 2006 | 3462 | Original Q9 | Legacy

9 (a) The diagram shows a copper hot water tank.



Explain, in terms of the particles in the copper, how heat energy is transferred through the wall of the hot water tank.

.....

.....

.....

.....

(2 marks)

4.1.2.1 Energy transfers in a system

Question 04 · continued

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

Method of reducing energy used	Installation cost in £	Money saved each year on energy bills in £
Hot water tank jacket	30	20
Draught proofing	50	15
Under floor insulation	75	20
Upgraded central heating controls	350	80

Which of the methods in the table would be most cost-effective over 5 years?

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

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(3 marks)

5

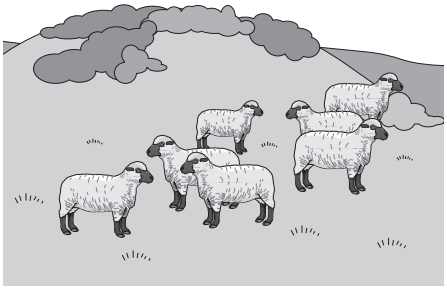
4.1.2.1 Energy transfers in a system

Question 05

November 2006 | PHY1A | Original Q3 | Legacy

QUESTION THREE

Farmers usually keep their sheep outdoors. The air temperature is usually well below the body temperature of the sheep, but their woollen coats are poor heat conductors.



3A Wool is a poor conductor of heat because it . . .

1 is natural.

2 is soft.

3 is warm.

4 traps air.

3B A farmer knows that different sheep transfer heat at different rates.

Which row in the table is correct for the two possible explanations given?

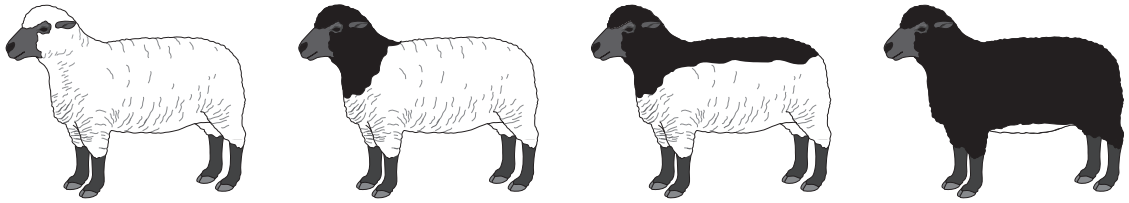
	Because of differences in their shapes	Because of differences in their sizes
1	no	no
2	no	yes
3	yes	no
4	yes	yes

4.1.2.1 Energy transfers in a system

Question 05 · continued

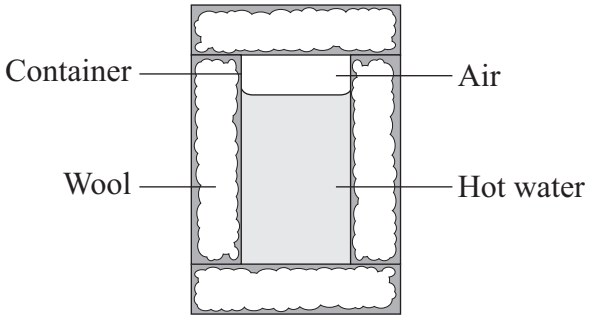
3C The drawings show four black and white sheep. They are identical apart from their colour.

Which sheep will emit most thermal radiation on a cold day?



1 **2** **3** **4**

3D Two students plan to investigate heat transfer through wool. They plan to use a container of hot water which they will insulate with wool.



Which row in the table describes the plan for a series of experiments which are most likely to give useful results?

	Thickness of insulation	Starting temperature	Time interval	Mass of water in container
1	different for each	same for each	same for each	same for each
2	different for each	different for each	same for each	same for each
3	same for each	different for each	different for each	same for each
4	same for each	same for each	different for each	different for each

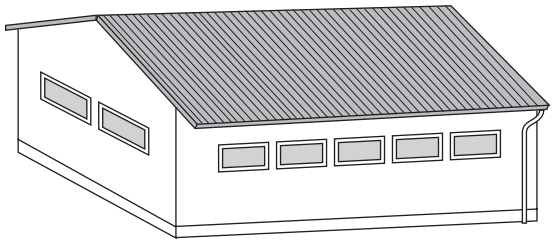
4.1.2.1 Energy transfers in a system

Question 06

November 2006 | PHY1A | Original Q4 | Legacy

QUESTION FOUR

This is a design for a new workshop.



4A The owner wants to reduce heat loss from the workshop.

Which decision about changing the design should she make?

1 Have larger windows

2 Have single-glazed, rather than double-glazed, windows

3 Increase the temperature inside the building

4 Increase the thickness of the roof insulation

4B There will be several machines in the building. All of them will have moving parts.

Which statement is **not** correct?

1 All of the machines waste some energy.

2 Friction is often a cause of inefficiency.

3 None of the machines is perfectly efficient.

4 The total energy input is equal to the useful energy output.

4C All energy is eventually transferred to the surroundings as . . .

1 electricity.

2 heat.

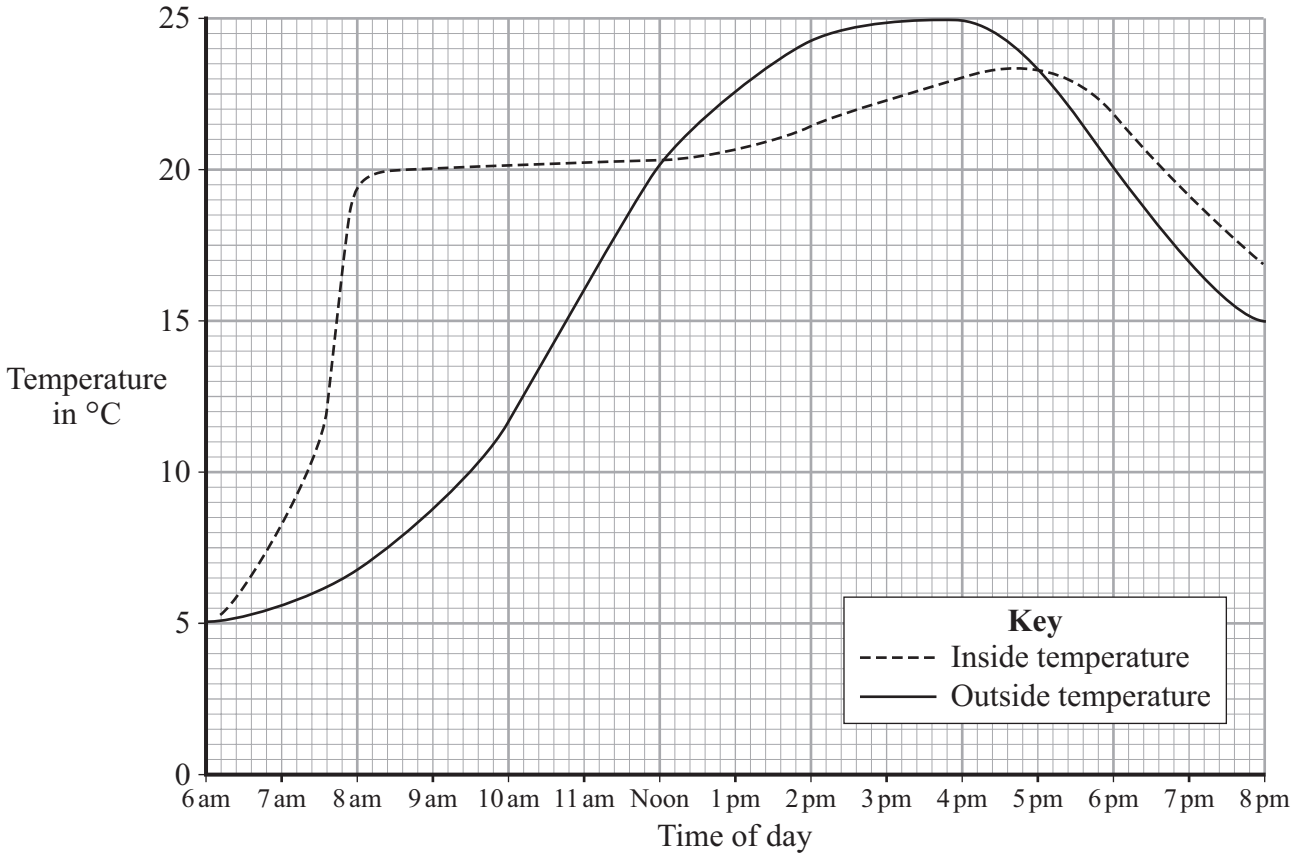
3 light.

4 sound.

4.1.2.1 Energy transfers in a system

Question 06 · continued

4D The graph shows the temperatures inside and outside the workshop.



Which conclusion can be drawn?

The heating in the building was . . .

1 switched on at 6 am, and switched off at noon.

2 switched on at 8 am, and switched off at noon.

3 switched on at 6 am, and switched off at 5 pm.

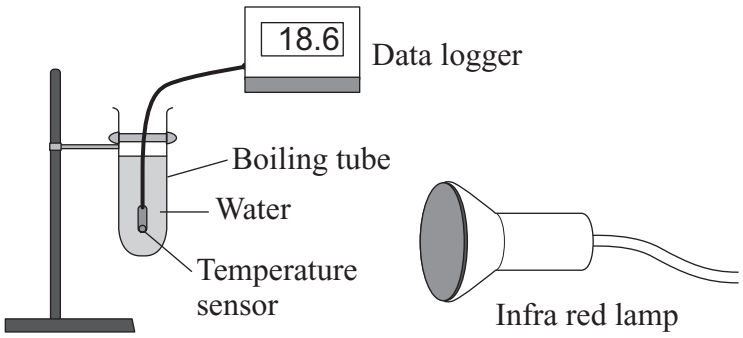
4 switched on at noon, and switched off at 5 pm.

4.1.2.1 Energy transfers in a system

Question 07

1 A student had read about a glacier that had been covered in insulating material. The idea was to slow down the rate at which the glacier melts in the summer.

She investigated this idea using the apparatus shown in the diagram.



(a) These are the steps taken by the student.

- Measure 30 cm^3 of cold water into a boiling tube.
- Place the boiling tube 25 cm from an infra red lamp.
- Record the temperature of the water.
- Switch on the infra red lamp.
- Record the temperature of the water every minute for 5 minutes.
- Repeat with boiling tubes covered in different insulating materials.

(i) Why did she use an infra red lamp?

.....

(1 mark)

(ii) Name **one** control variable in this investigation.

.....

(1 mark)

(iii) Give **one** advantage of using a temperature sensor and data logger instead of a glass thermometer to measure temperature.

.....

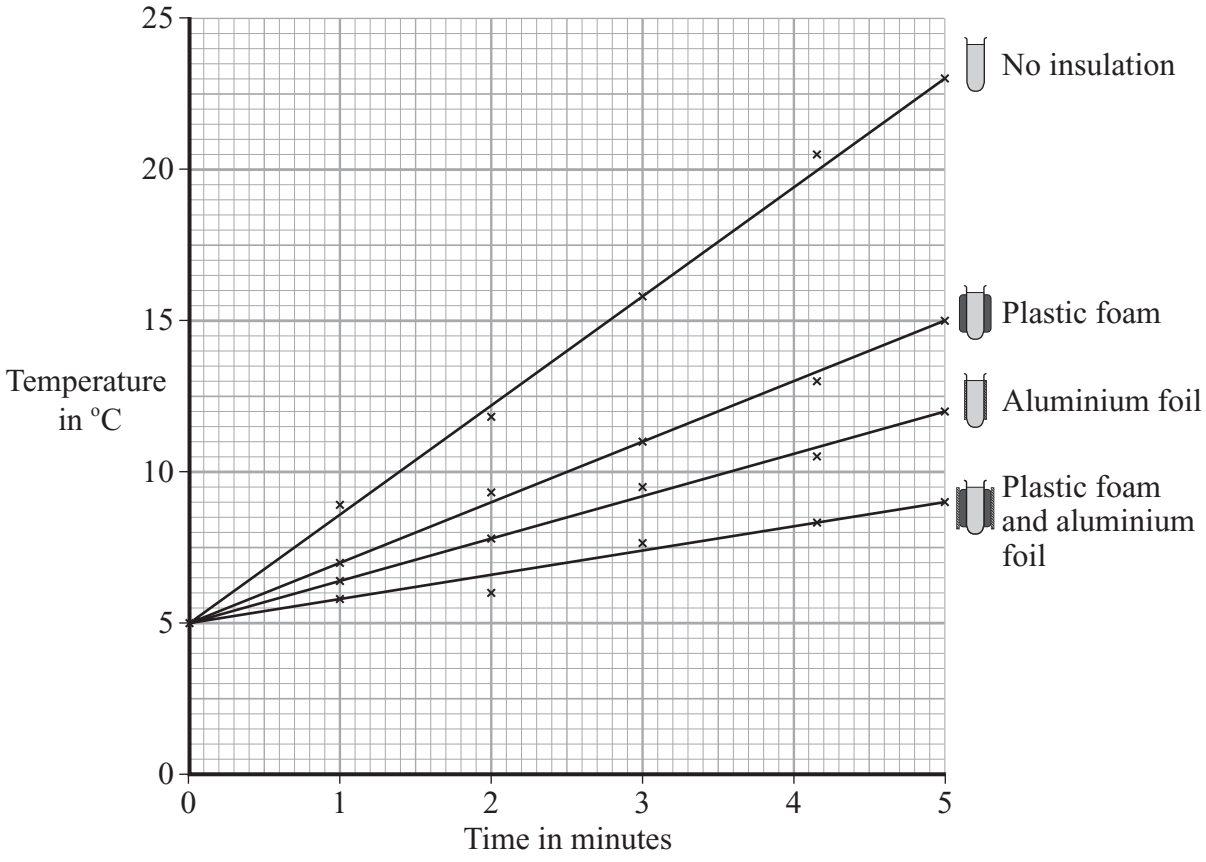
.....

(1 mark)

Question 07 · continued

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(b) The results of the investigation are shown in the graph.



(i) Why did the student use a boiling tube with no insulation?

.....

.....

(1 mark)

(ii) From her results, what should she recommend is used to insulate the glacier?

.....

(1 mark)

Question 1 continues on the next page

4.1.2.1 Energy transfers in a system

Question 07 · continued

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(iii) Explain why the insulation recommended by the student will reduce the heat transfer from the Sun to the glacier.

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(2 marks)

(c) Explain, in terms of particles, how heat is transferred through the glass wall of a boiling tube.

.....

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.....

.....

(2 marks)

9

4.1.2.1 Energy transfers in a system

Question 08

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.

4.1.2.1 Energy transfers in a system

Question 09

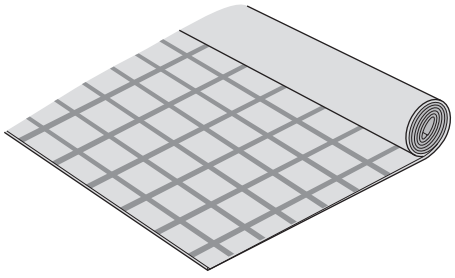
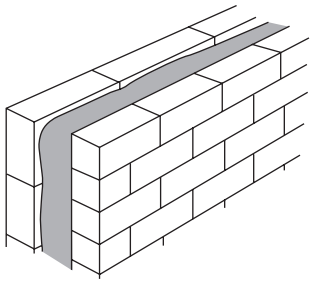
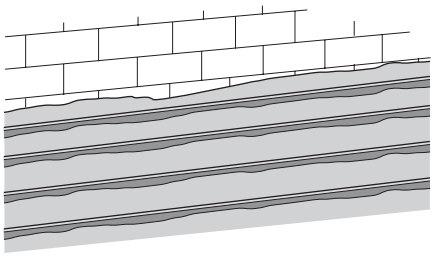
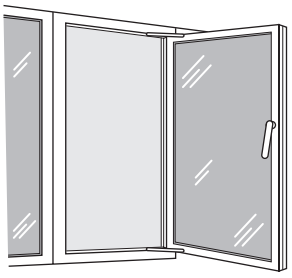
March 2007 | PHY1A | Original Q4 | Legacy

QUESTION FOUR

Energy costs rising

Many householders are concerned at the rising cost of energy.

The drawings are from a magazine article on how to reduce the cost of home heating by using insulation.

Carpeting the floor  Saving per week for each square metre **25p**	**Putting foam in wall cavities**  Saving per week for each square metre **20p**
Insulating the loft  Saving per week for each square metre **10p**	**Fitting double-glazed windows**  Saving per week for each square metre **24p**

4A All the methods shown in the diagrams make use of . . .

1 good emitters of thermal radiation.

2 materials that prevent warm air from rising.

3 trapped air.

4 warm materials.

Question 09 · continued

4B A student is asked to explain why the savings in the magazine article may not be correct for different houses.

The student makes the following points:

- not all double glazing is equally good
- not all insulation in the loft is to the same depth
- the difference between the outside temperature and the inside temperature of the different houses is not constant.

Which one of the following statements is correct?

1 Only the student's first point is correct.

2 Only the student's first two points are correct.

3 All three of the student's points are correct.

4 None of the student's points is correct.

4C An energy saving expert suggests how to reduce the heating bill for a house. She says that having foam inserted in the wall cavity will reduce the heating bill more than having double glazing fitted.

Her statement is correct.

This is because . . .

1 foam insulation is cheaper than double glazing.

2 more heat is lost through each square metre of window compared with each square metre of wall.

3 the area of the walls is much greater than the area of the windows.

4 the windows are not always closed.

4D The Government wants to encourage energy saving. There will be several advantages to the environment if this is achieved.

Which of the following will be the most important advantage to the environment?

1 It will be more important to develop renewable energy technology.

2 Less energy will need to be transformed from fossil fuels.

3 Less energy will need to be transformed from renewable resources.

4 There will be no need to build new nuclear power stations.

4.1.2.1 Energy transfers in a system

Question 10

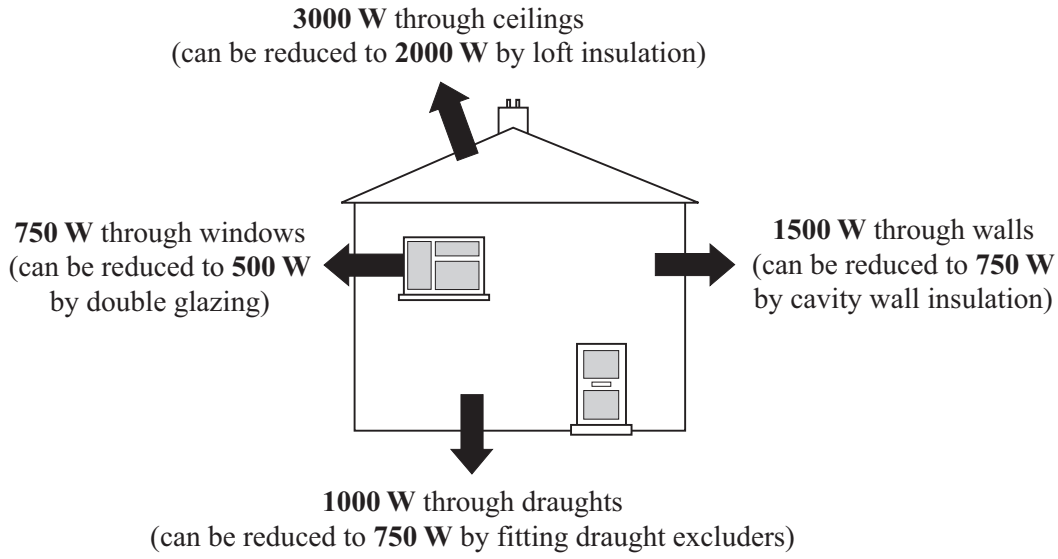
March 2007 | PHY1A | Original Q8 | Legacy

QUESTION EIGHT

Save money with home insulation

The information in this question is taken from a magazine article about home insulation.

The diagram shows some of the ways that heat can be lost from the inside of a house. It also shows how these heat losses may be reduced.



The table shows the cost of reducing the heat loss, how much money can be saved and the pay-back time.

Way of reducing heat loss	Cost	Money saved per year	Pay-back time
Cavity wall insulation	£675		5 years
Double glazing	£2250	£45	50 years
Draught excluders	£15	£45	
Loft insulation	£360	£180	2 years

Question 10 · continued

8A How much money is saved each year if cavity wall insulation is fitted?

1 £ 135

2 £ 145

3 £ 155

4 £ 165

8B What is the pay-back time if draught excluders are fitted?

1 3 months

2 4 months

3 3 years

4 4 years

8C Which way of reducing heat loss gives the greatest reduction as a fraction of the total heat loss from the house?

1 cavity wall insulation

2 double glazing

3 draught excluders

4 loft insulation

8D The owner installs draught excluders and loft insulation.

By what approximate percentage can she expect the total heat loss through the ceilings and by draughts to be reduced?

1 20 %

2 30 %

3 40 %

4 60 %

4.1.2.1 Energy transfers in a system

Question 11

June 2007 | PHY1A | Original Q1 | Legacy

QUESTION ONE

Read this article.

Save energy and save money

Recent research shows that money can be saved in most houses by reducing energy losses. Scientists investigated energy costs in houses. They compared houses where the occupants had similar lifestyles. Some of the houses had large amounts of thermal insulation.

The scientists compared these houses to similar houses with only small amounts of thermal insulation. They found that some households could save more than £500 per year by improving insulation.

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

A conclusion

B control variable

C dependent variable

D independent variable

In this investigation, the amount of insulation was the . . . **1** . . . .

Lifestyle was the . . . **2** . . . .

Energy cost in a house was the . . . **3** . . . .

The amount of money that could be saved by insulation was the . . . **4** . . . .

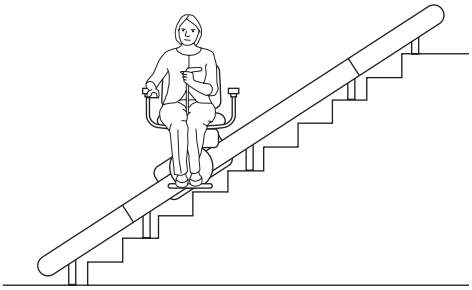
4.1.2.1 Energy transfers in a system

Question 12

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** . . . .

4.1.2.1 Energy transfers in a system

Question 13

June 2007 | PHY1A | Original Q3 | Legacy

QUESTION THREE

A student investigated the question: Does the type of surface affect how an object loses or gains heat? She carried out two experiments.

In her first experiment, she filled two cans with boiling water. One can had a dull, black surface. The other can had a shiny, silver surface.

Later, she measured the temperature of the water in each can.

These are her results.

	Starting temperature of the water	Temperature of the water 15 minutes later
Can with dull, black surface	100 °C	74 °C
Can with shiny, silver surface	100 °C	93 °C

3A The student wanted her experiment to be a fair test.

Which row of the table is most likely to give a fair test?

	Volume of cans	Volume of water	Metal of the cans	Shape of cans
1	same	different	same	same
2	same	same	different	same
3	same	same	same	different
4	same	same	same	same

3B If her results are reliable, the experiment shows that, compared with a shiny, silver surface, a dull, black surface is a . . .

1 better absorber of thermal radiation.

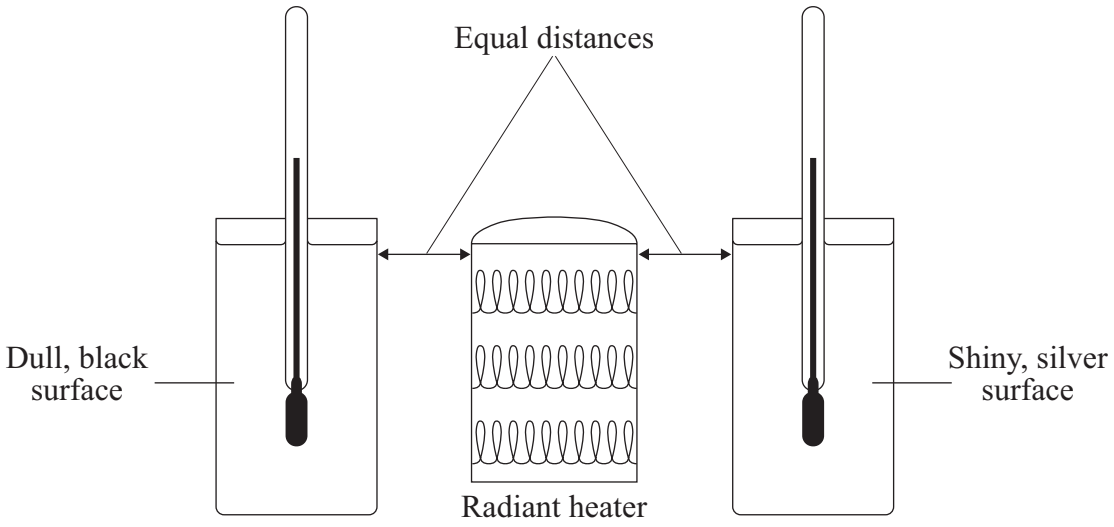
2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation

4.1.2.1 Energy transfers in a system

Question 13 · continued



In her second experiment, the student put cold water in each can. She put a heater (which is a source of thermal radiation) between the cans. She switched the heater on and, ten minutes later, she measured the temperature of the water in each can.

These are the results of her second experiment.

	Starting temperature of the water	Temperature of the water 10 minutes later
Can with dull, black surface	16 °C	37 °C
Can with shiny, silver surface	16 °C	23 °C

3C If her results are reliable, the second experiment shows that, compared with a shiny, silver surface, a dull, black surface is a . . .

1 better absorber of thermal radiation.

2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation.

3D What was the average (mean) rate of the rise in temperature of the water in the can with a dull, black surface?

1 0.9 °C per minute

2 2.1 °C per minute

3 9 °C per minute

4 21 °C per minute

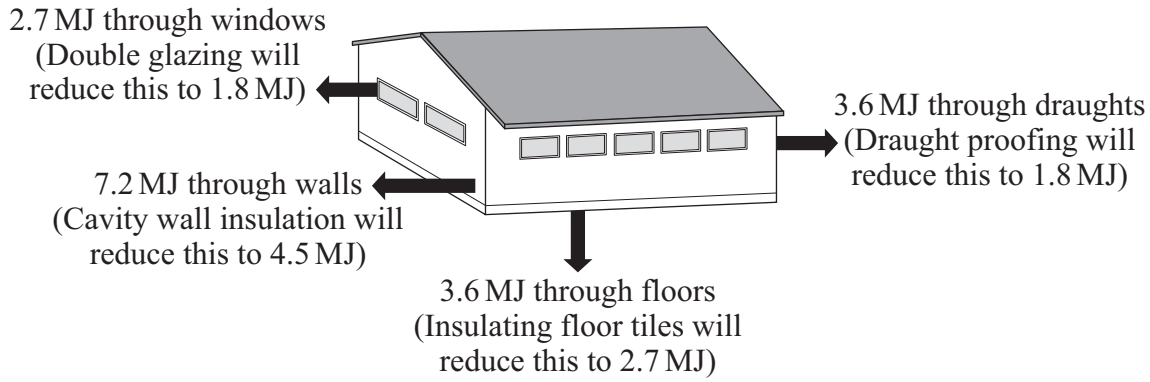
4.1.2.1 Energy transfers in a system

Question 14

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 14 · 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?

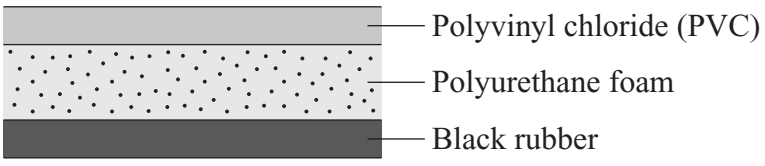
1 140 MJ

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.

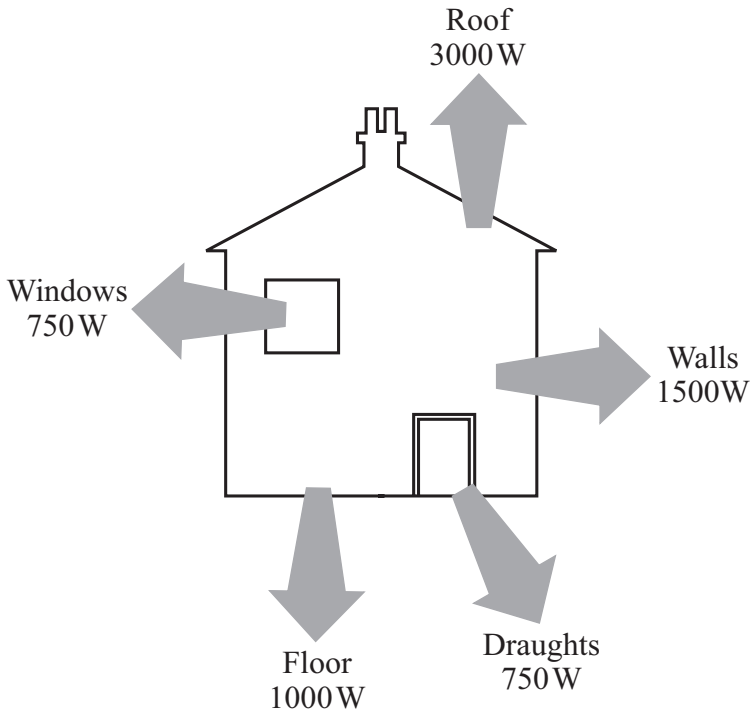
4.1.2.1 Energy transfers in a system

Question 15

March 2008 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

The diagram shows how energy is lost from a house.



5A Heat is lost from the house by . . .

1 conduction only.

2 convection only.

3 convection and radiation only.

4 conduction, convection and radiation.

4.1.2.1 Energy transfers in a system

Question 15 · continued

A house owner looks for ways of reducing these energy losses.

The table shows the costs for different types of insulation.

	Type of insulation	Installation cost in £	Energy loss before installation	% reduction in energy loss after installation
1	Double glazing	4000	750 W	33
2	Floor insulation	300	1000 W	25
3	Loft insulation	200	3000 W	33
4	Wall insulation	600	1500 W	50

5B Which type of insulation, **1**, **2**, **3** or **4**, saves most energy?

5C Which type of insulation, **1**, **2**, **3** or **4**, saves most energy for each pound (£) spent?

5D The house owner decides to insulate the walls, floor and loft only.

In the first year, the saving on the heating bill is £400.

Heating prices stay constant.

The total time taken to recover the installation costs is . . .

1 0.36 years.

2 2.75 years.

3 12.75 years.

4 13.125 years.

4.1.2.1 Energy transfers in a system

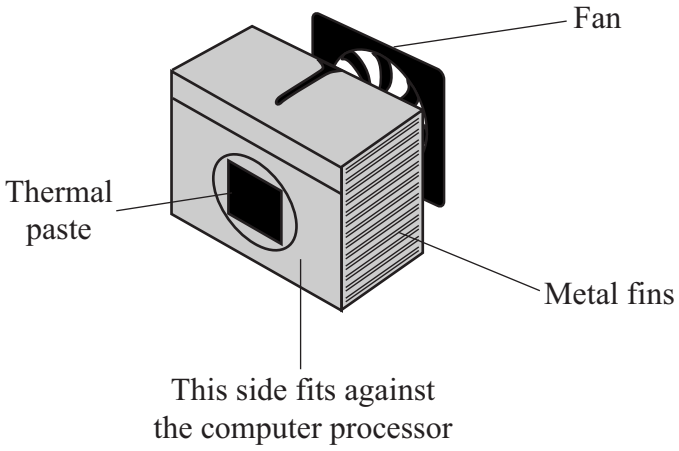
Question 16

March 2008 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

The diagram shows a fan-assisted cooler designed to be fitted inside a computer.

The thermal paste ensures that heat can transfer easily from the computer's processor.



9A The metal fins are painted black to . . .

1 increase heat transfer by conduction.

2 increase heat transfer by radiation.

3 reduce heat transfer by conduction.

4 reduce heat transfer by radiation.

9B The thermal paste is there to . . .

1 decrease the transfer of heat by conduction.

2 decrease the transfer of heat by radiation.

3 increase the transfer of heat by conduction.

4 increase the transfer of heat by radiation.

4.1.2.1 Energy transfers in a system

Question 16 · continued

9C Which process or processes is/are aided by the fan?

1 conduction only

2 convection and conduction

3 conduction and radiation

4 radiation only

9D Which one of the following causes the heat transfer through the metal fins?

1 electrons which collide with both ions and other electrons

2 electrons which do **not** collide with either ions or other electrons

3 ions which collide with both electrons and other ions

4 ions which do **not** collide with either electrons or other ions

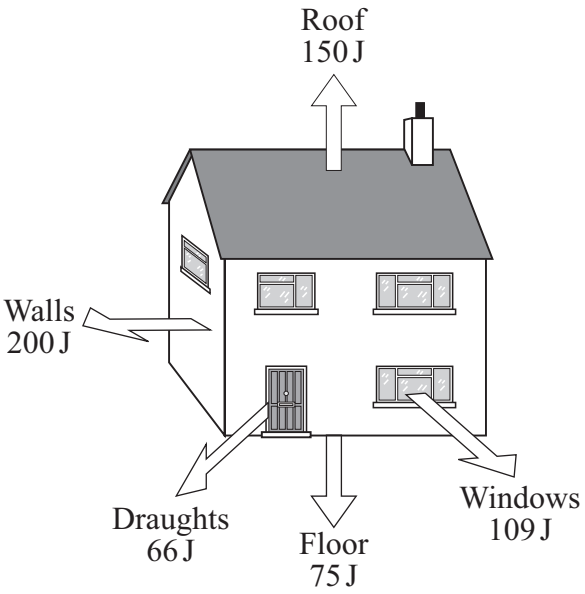
END OF TEST

4.1.2.1 Energy transfers in a system

Question 17

June 2008 | PHY1H | Original Q5 | Legacy

5 (a) The diagram shows how much heat is lost each second from different parts of an uninsulated house.



5 (a) (i) Each year, the house costs £760 to heat.

How much money is being wasted because of heat lost through the roof?

Show clearly how you work out your answer.

.....

.....

(2 marks)

5 (a) (ii) Insulating the loft would cut the heat lost through the roof by 50%.

The loft insulation has a payback time of $1\frac{1}{2}$ years.

How much did the loft insulation cost to buy?

.....

Cost of loft insulation = £ .....

(1 mark)

5 (b) What happens to the wasted energy?

.....

.....

(1 mark)

4

4.1.2.1 Energy transfers in a system

Question 18

November 2008 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The table gives information about the cost of fitting different types of insulation in a house. The table also gives the savings made per year after insulation was fitted.

Method of insulation	Cost to install	Savings per year
Double glazing	£8000	£150
Cavity wall insulation	£1250	£150
Loft insulation	£400	£100
Foil behind radiators	£10	£5

4A Which method of insulation in the table does **not** involve trapped air?

1 cavity wall insulation

2 double glazing

3 foil behind radiators

4 loft insulation

4B Double glazing reduces heat loss by . . .

1 conduction only.

2 convection only.

3 conduction and convection.

4 convection and radiation.

4C Which method of insulation pays for itself in the shortest time?

1 cavity wall insulation

2 double glazing

3 foil behind radiators

4 loft insulation

4.1.2.1 Energy transfers in a system

Question 18 · continued

4D What is the pay-back time for loft insulation?

1 0.25 year

2 0.50 year

3 2 years

4 4 years

Turn over for the next question

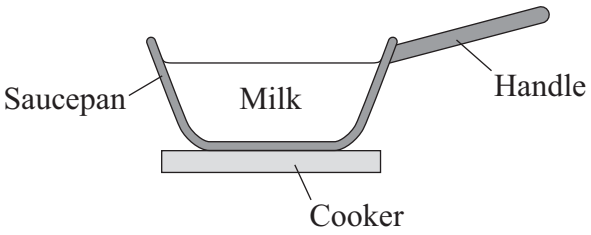
4.1.2.1 Energy transfers in a system

Question 19

March 2009 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The diagram shows a saucepan of hot milk on a cooker.



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

A conduction

B convection

C insulation

D radiation

Heat is transferred from the cooker to the milk.

The heat is transferred from the cooker through the saucepan by . . . **1** . . . .

Heat is transferred through the milk by . . . **2** . . . .

The saucepan is shiny to reduce heat loss by . . . **3**. . . .

The handle of the saucepan is made of plastic. The plastic acts as . . . **4** . . . .

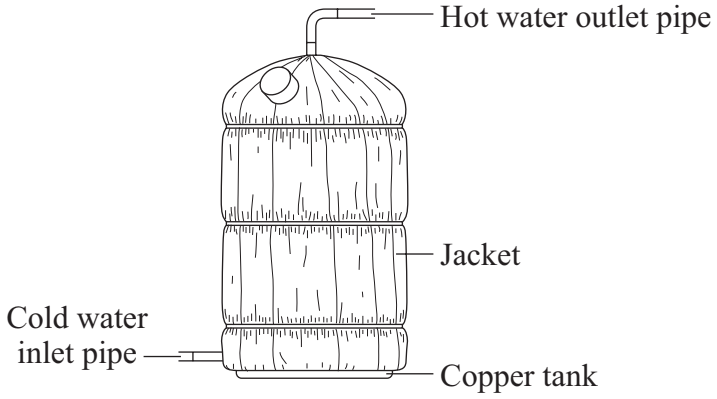
4.1.2.1 Energy transfers in a system

Question 20

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.

4.1.2.1 Energy transfers in a system

Question 20 · 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

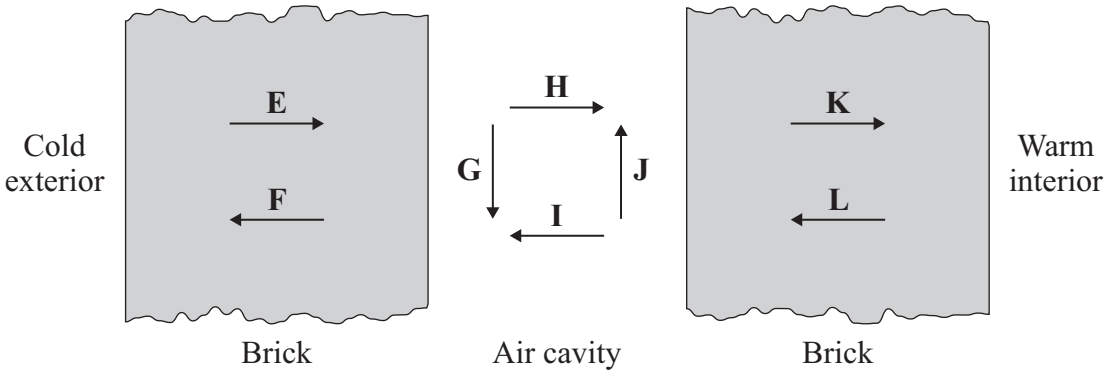
4.1.2.1 Energy transfers in a system

Question 21

March 2009 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The diagram shows a section through the cavity wall of a house. The arrows indicate the directions by which heat transfer might take place.



8A Which arrows represent the process of heat transfer called conduction?

1 **E**, **H** and **K**

2 **H** and **I**

3 **L**, **I** and **F**

4 **J** and **G**

8B Conduction in metals is the transfer of heat by . . .

1 the movement of free electrons.

2 the heated substance expanding and rising.

3 the heated substance contracting and rising.

4 the heated substance expanding and falling.

8C Which arrows represent the process of heat transfer called convection?

1 **E**, **H** and **K**

2 **H** and **I**

3 **L**, **I** and **F**

4 **J** and **G**

4.1.2.1 Energy transfers in a system

Question 21 · continued

8D Convection is the transfer of heat by . . .

1 the movement of free electrons.

2 the heated substance expanding and rising.

3 the heated substance contracting and rising.

4 the heated substance expanding and falling.

Turn over for the next question

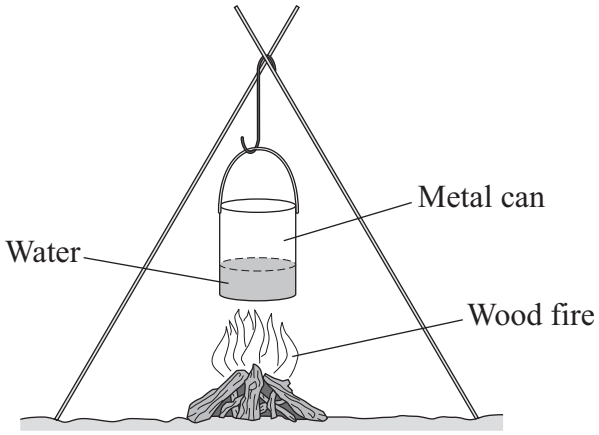
4.1.2.1 Energy transfers in a system

Question 22

June 2009 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

On a camping trip, some students heated some water in a metal can.



6A Thermal energy is transferred through the metal walls of the can by . . .

1 convection currents in the metal.

2 free electrons gaining energy and moving quickly.

3 infra red radiation passing through the metal.

4 atoms moving through the metal.

6B Thermal energy spreads through the water by . . .

1 ions moving more quickly.

2 particles of water expanding, becoming less dense and rising.

3 particles of water contracting, becoming denser and falling.

4 the water expanding, becoming less dense and rising.

6C A lot of thermal energy is lost from the fire into the air by . . .

1 conduction only.

2 convection only.

3 mainly convection and radiation.

4 conduction, convection and radiation.

4.1.2.1 Energy transfers in a system

6D The can and the water become hot.

The outer surface of the can transfers energy to the surroundings by . . .

1 infra red radiation passing through the air.

2 metal particles gaining energy and escaping.

3 the air contracting, becoming less dense and falling.

4 the air expanding, becoming denser and rising.

Turn over for the next question

4.1.2.1 Energy transfers in a system

Question 23

November 2009 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The table gives information about some ways of insulating a house.

Type of insulation	Cost of insulation	Savings per year	Pay-back time
Double glazing	£6000	£200	30 years
Cavity wall insulation	£500	£100	
Loft insulation		£90	3 years
Draught proofing	£100		10 years

4A What is the pay-back time for cavity wall insulation?

1 $\frac{1}{5}$ year

2 1 year

3 4 years

4 5 years

4B What would be the cost of loft insulation for this house?

1 £30

2 £90

3 £270

4 £540

4C Some methods of insulation involve trapped air.

Which methods of heat transfer are reduced by trapped air?

1 conduction and convection

2 conduction and radiation

3 convection and radiation

4 conduction, convection and radiation

4.1.2.1 Energy transfers in a system

Question 23 · continued

4D The government often gives grants for fitting insulation.

What is the main reason for the government doing this?

1 Fitting insulation helps to conserve energy resources.

2 Fitting insulation increases the value of the house.

3 Governments are trying to support double-glazing companies.

4 Governments make a lot of money out of selling insulation.

Turn over for the next question

4.1.2.1 Energy transfers in a system

Question 24

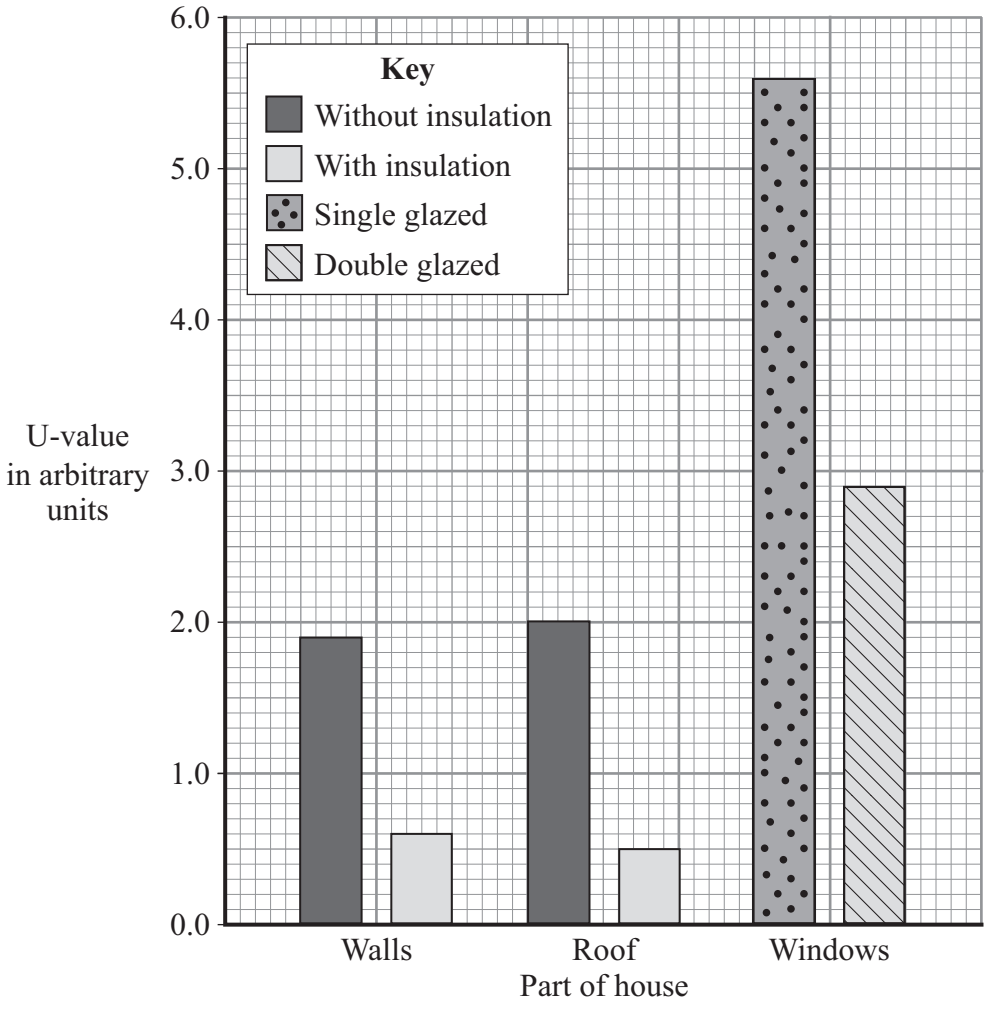
March 2010 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

Different parts of a house have different 'U-values'.

Figure 1 shows some U-values for the walls, the roof and the windows of a house with and without insulation.

Figure 1



5A The U-value for a cavity wall with insulation is different from the U-value of a cavity wall without insulation.

Using **Figure 1**, what is the percentage change in U-value when cavity wall insulation is fitted?

1 25 %

2 33 %

3 68 %

4 75 %

Question 24 · continued

5B Which of the following statements is correct?

1 Double-glazed windows have a higher U-value than single glazed windows.

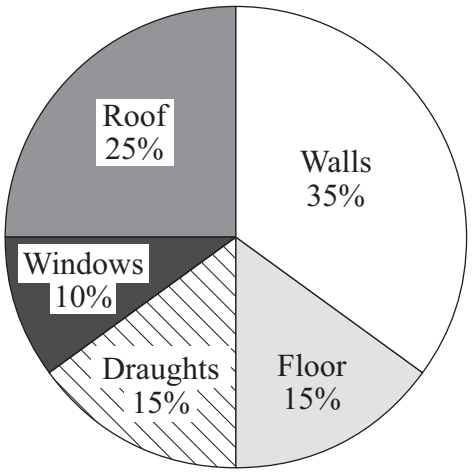
2 The higher the U-value, the higher the rate of loss of heat.

3 Putting insulation in the loft, halves the U-value of the roof.

4 U-values are always greater than 1.

Figure 2 shows the percentage of heat lost from different parts of a house **without** insulation.

Figure 2



A house that is **not** insulated loses heat at the rate of 2 kW.

5C According to **Figure 2**, the combined rate of loss of heat from draughts and through the floors is . . .

1 0.3 kW

2 0.6 kW

3 1.4 kW

4 1.7 kW

5D The rate of loss of heat through the walls, roof and windows of a house that is **not** insulated will be reduced by 50% if insulation is installed.

What would be the rate of loss of heat from the house after this installation?

1 0.3 kW

2 0.7 kW

3 1.0 kW

4 1.3 kW

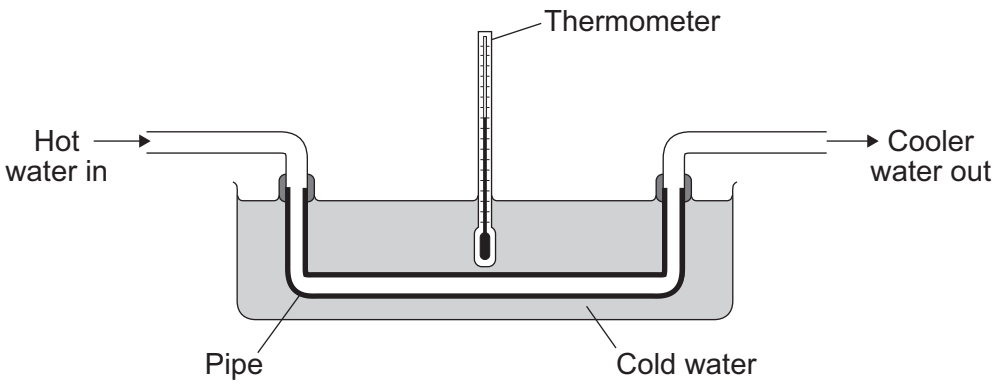
4.1.2.1 Energy transfers in a system

Question 25

June 2010 | PHY1H | Original Q1 | Legacy

1 Heat exchangers are devices that are used to transfer heat from one place to another.

The diagram shows a simple heat exchanger used by a student in an investigation. Heat is transferred from the hot water inside the pipe to the cold water outside the pipe.



1 (a) By which process is heat transferred from the hot water inside the pipe to the cold water outside the pipe?

.....

(1 mark)

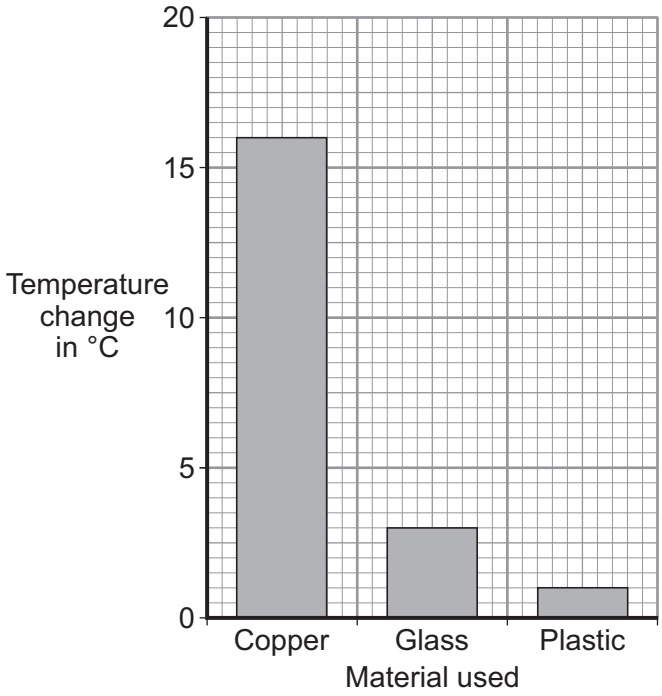
1 (b) The student wanted to find out if the efficiency of a heat exchanger depends on the material used to make the pipe. The student tested three different materials. For each material, the rate of flow of hot water through the pipe was kept the same.

The results obtained by the student are recorded in the table and displayed in the bar chart.

Material	Temperature of the cold water at the start in °C	Temperature of the cold water after 10 minutes in °C
Copper	20	36
Glass	20	23
Plastic	20	21

4.1.2.1 Energy transfers in a system

Question 25 · continued



1 (b) (i) The rate of flow of hot water through the pipe was one of the control variables in the investigation.

Give **one** other control variable in the investigation.

.....

(1 mark)

1 (b) (ii) Why did the student draw a bar chart rather than a line graph?

.....

.....

(1 mark)

1 (b) (iii) Which **one** of the three materials made the best heat exchanger?

.....

Give a reason for your answer.

.....

.....

.....

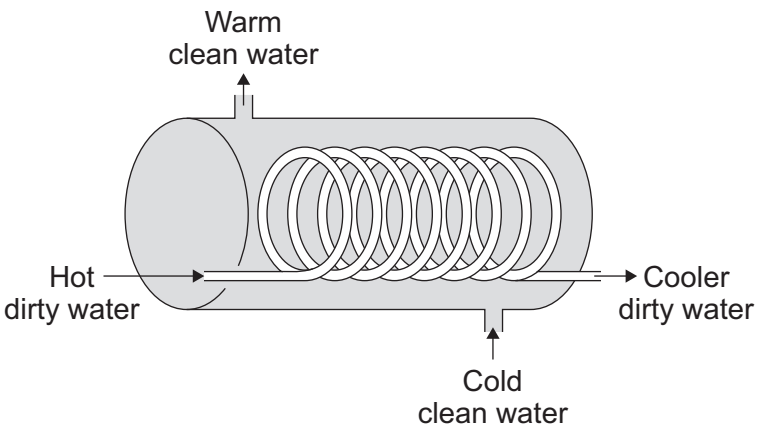
(2 marks)

Question 1 continues on the next page

4.1.2.1 Energy transfers in a system

Question 25 · continued

1 (c) The student finds a picture of a heat exchanger used in an industrial laundry.
The heat exchanger uses hot, dirty water to warm cold, clean water.



Why does this heat exchanger transfer heat faster than the heat exchanger used by the student in the investigation?

.....

.....

(1 mark)

6

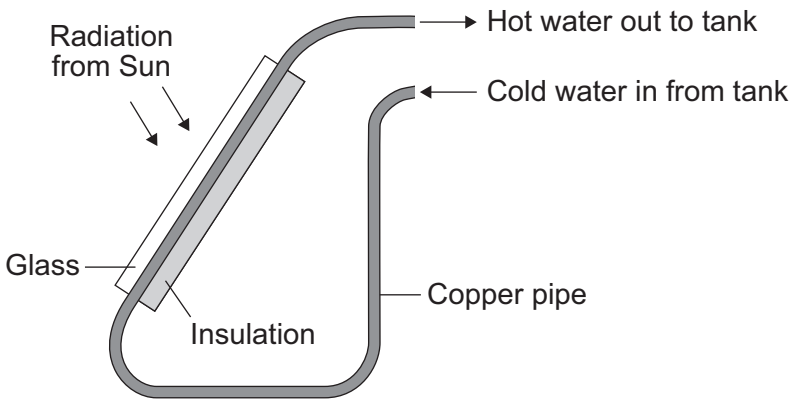
4.1.2.1 Energy transfers in a system

Question 26

November 2010 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The diagram shows a solar panel fitted to the roof of a house.
The solar panel is used for heating water.



- The panel is 5 m long and 2 m wide.
- Each square metre of panel receives 0.6 kJ of solar energy each second when the Sun is shining.

8A The solar panel collects . . .

1 infra red radiation from the Sun and transforms it into electricity.

2 infra red radiation from the Sun and uses it to heat water.

3 light energy from the Sun and transforms it into electricity.

4 ultraviolet radiation from the Sun and uses it to heat water.

8B The total amount of solar energy, in kJ, collected by the panel in 5 hours when the Sun is shining is . . .

1 1 800

2 10 800

3 21 600

4 108 000

4.1.2.1 Energy transfers in a system

Question 26 · continued

8C The pipe inside the solar panel has a black surface because . . .

1 black surfaces are good reflectors of radiation.

2 black surfaces are good absorbers of radiation.

3 black surfaces are good emitters of radiation.

4 black surfaces stay hot for longer.

8D The hot water tank is placed higher than the solar panel.

This is because . . .

1 heated water contracts, and sinks.

2 heated water contracts, and rises.

3 heated water expands, and rises.

4 heated water expands, and sinks.

Turn over for the next question

4.1.2.1 Energy transfers in a system

Question 27

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)

4.1.2.1 Energy transfers in a system

Question 27 · 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

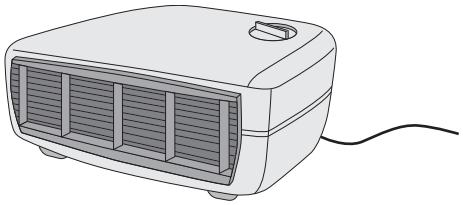
4.1.2.1 Energy transfers in a system

Question 28

March 2011 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

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



Fan heater

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

1 kinetic and sound energy.

2 light and thermal energy.

3 sound and light energy.

4 thermal and kinetic energy.

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

1 chemical energy.

2 kinetic energy.

3 sound energy.

4 thermal energy.

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

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

1 conduction.

2 convection.

3 evaporation.

4 radiation.

4.1.2.1 Energy transfers in a system

Question 28 · continued

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

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

Electricity costs 15p per kWh

What is the cost of this energy?

1 5p

2 45p

3 £5

4 £45

Turn over for the next question

4.1.2.1 Energy transfers in a system

Question 29

June 2011 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

Many people use a duvet on their beds to keep them warm at night.

Duvets contain fibres which trap small pockets of air. The pockets of air help to keep us warm because air is a poor thermal conductor. The fibres also reduce movement of the air. This reduces convection currents in the air.

6A Why is air a poor thermal conductor?

1 the air particles are close together

2 the air particles do not move

3 the air particles are far apart

4 there are no black surfaces in air

6B What causes convection currents?

1 warmed air expands, becomes more dense and falls

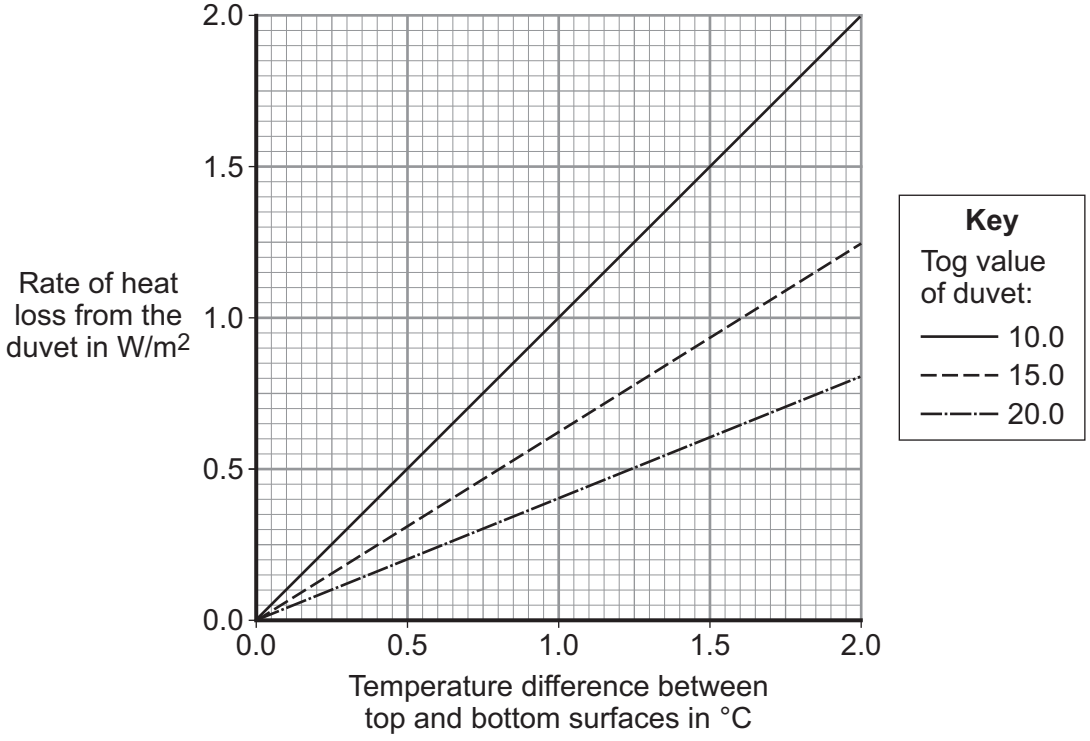
2 warmed air contracts, becomes less dense and rises

3 warmed air contracts, becomes more dense and rises

4 warmed air expands, becomes less dense and rises

The effectiveness of a duvet can be found by calculating the difference in temperature between the top and bottom surfaces of the duvet and the rate of heat loss from the duvet. The effectiveness of a duvet is measured in units called 'Togs'.

The graph shows how the rate of heat loss from three duvets varies with the temperature difference between top and bottom surfaces of each duvet.



4.1.2.1 Energy transfers in a system

Question 29 · continued

6C The graph shows that the rate of heat loss depends on . . .

1 the Tog value only.

2 the temperature difference only.

3 the area only.

4 the Tog value and the temperature difference.

6D Which of these Tog values would be the best for a duvet in a very cold climate?

1 5.0

2 10.0

3 15.0

4 17.5

Turn over for the next question

4.1.2.1 Energy transfers in a system

Question 30

June 2011 | PHY2H | Original Q1 | Legacy

1 **Diagram 1** shows a hairdryer.
Diagram 2 shows how the heaters and fan of the hairdryer are connected to a 3-pin plug.
The hairdryer does not have an earth wire.

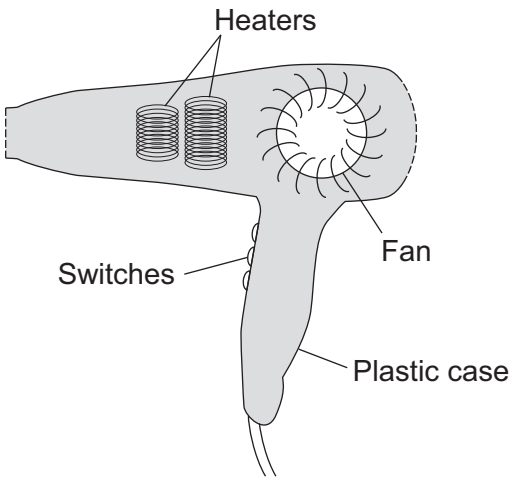


Diagram 1

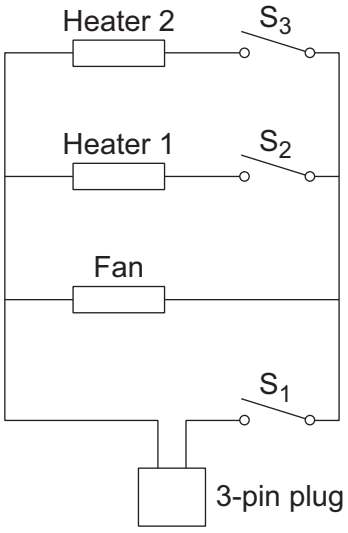


Diagram 2

1 (a) What colour is the insulation around the wire connected to the live pin inside the plug?

.....

(1 mark)

1 (b) Why does the hairdryer **not** need an earth wire?

.....

.....

(1 mark)

1 (c) All the switches are shown in the OFF position.

1 (c) (i) Which switch or switches have to be ON to make:

(1) only the fan work; .....

(2) heater 2 work? .....

(2 marks)

4.1.2.1 Energy transfers in a system

Question 30 · continued

1 (c) (ii) The heaters can only be switched on when the fan is also switched on.

Explain why.

.....

.....

.....

.....

.....

(2 marks)

1 (d) The table shows the current drawn from the 230 volt mains electricity supply when different parts of the hairdryer are switched on.

	Current in amps
Fan only	1.0
Fan and heater 1	4.4
Fan and both heaters	6.5

Use the equation in the box to calculate the maximum power of the hairdryer.

power = current × potential difference

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

.....

.....

Maximum power = ...

(3 marks)

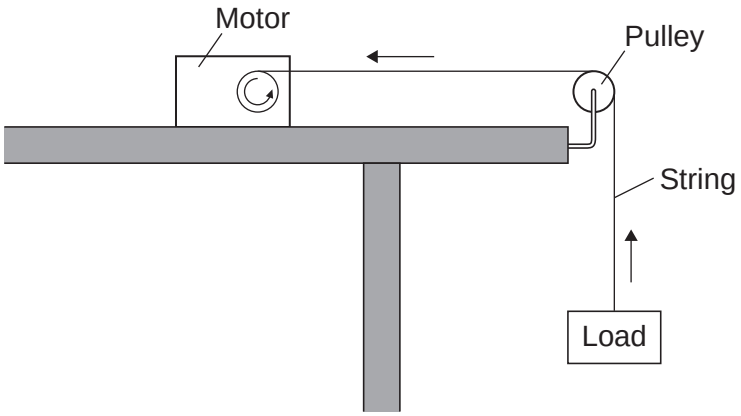
9

4.1.2.1 Energy transfers in a system

Question 31

June 2012 | PH1HP | Original Q2 | Legacy

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



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

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

.....

(1 mark)

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

.....

.....

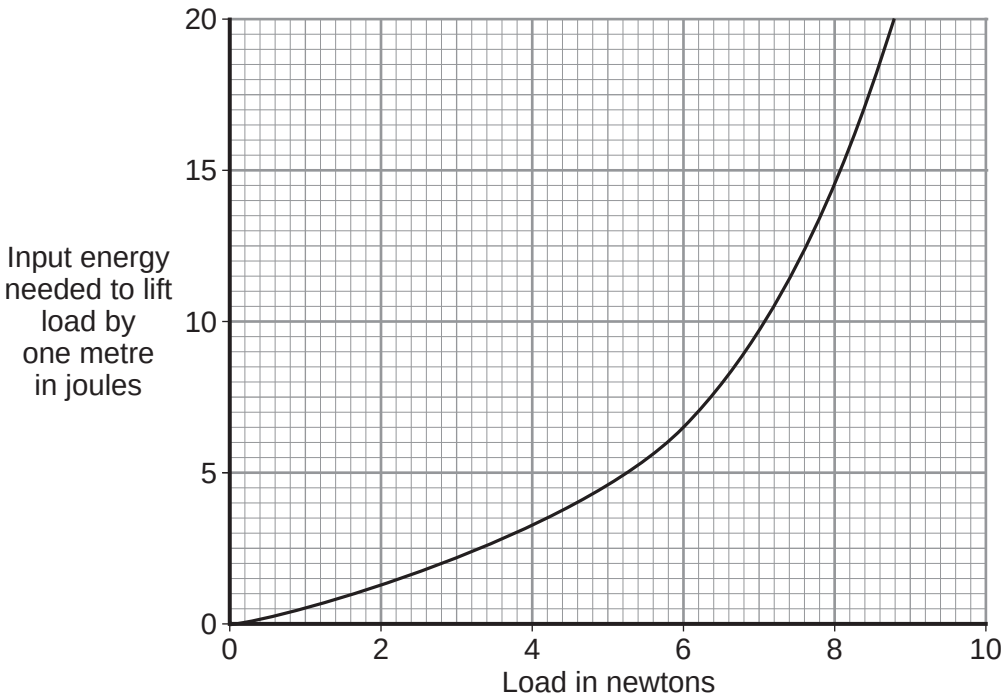
(1 mark)

Question 2 continues on the next page

4.1.2.1 Energy transfers in a system

Question 31 · continued

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



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

.....

.....

.....

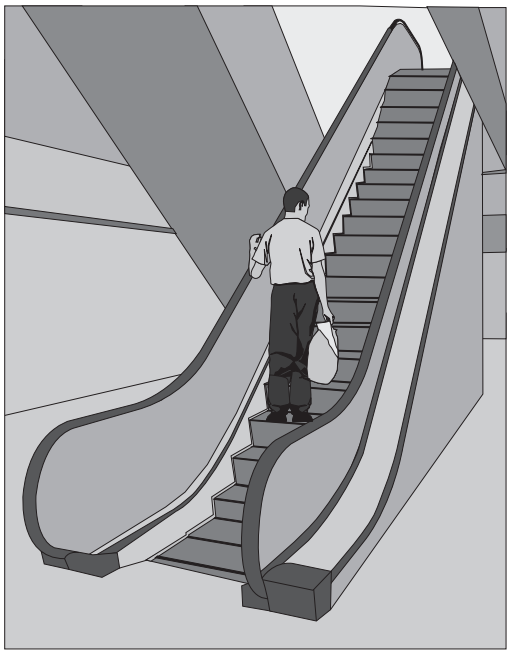
.....

(2 marks)

4.1.2.1 Energy transfers in a system

Question 31 · continued

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



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

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

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

.....

Cost = ... pence
(3 marks)

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

.....

.....
(1 mark)

8

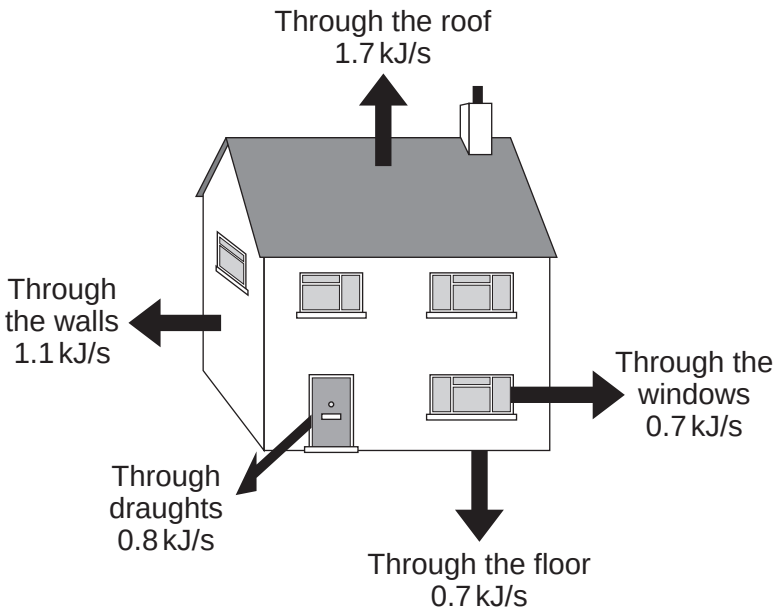
4.1.2.1 Energy transfers in a system

Question 32

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)

4.1.2.1 Energy transfers in a system

Question 32 · 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)

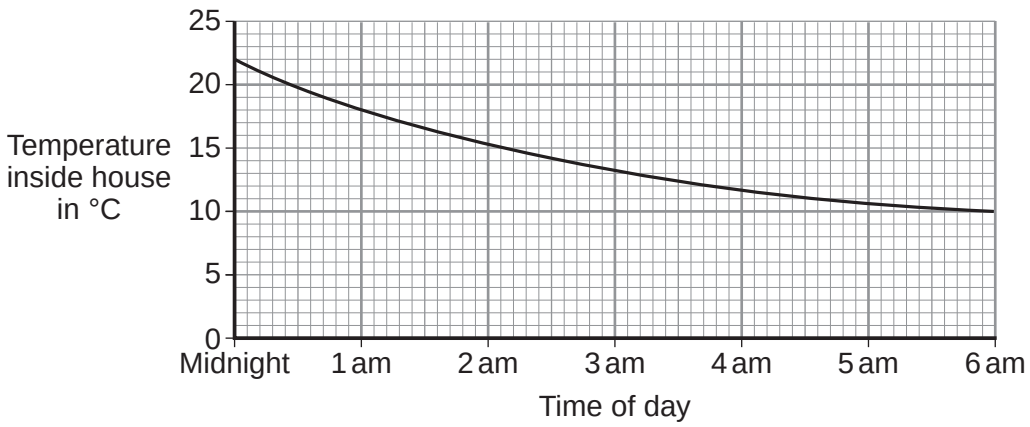
Question 1 continues on the next page

4.1.2.1 Energy transfers in a system

Question 32 · 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.

.....

.....

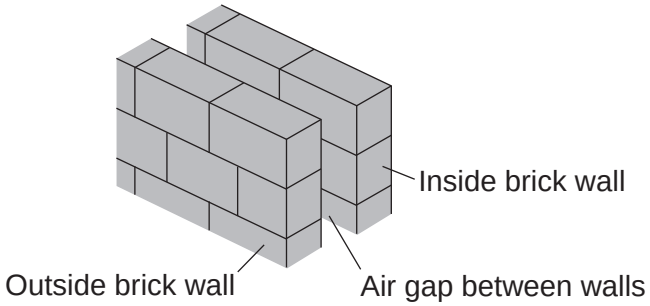
(2 marks)

4.1.2.1 Energy transfers in a system

Question 32 · continued

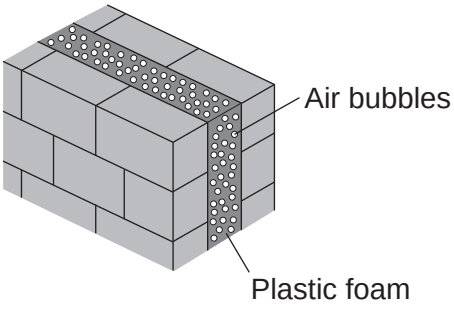
1 (b) **Diagram 2** shows how the walls of the house are constructed.
Diagram 3 shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

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

4.1.2.1 Energy transfers in a system

Question 32 · continued

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

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

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

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(2 marks)

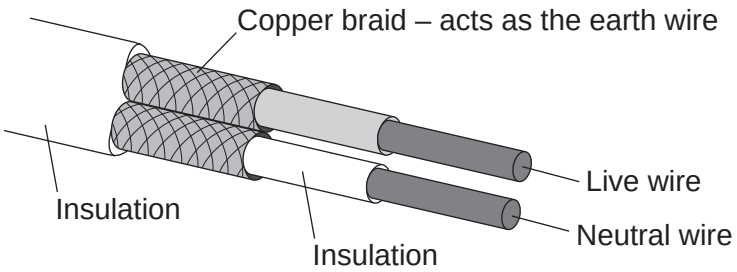
11

4.1.2.1 Energy transfers in a system

Question 33

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)

4.1.2.1 Energy transfers in a system

Question 33 · 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

4.1.2.1 Energy transfers in a system

Question 34

June 2013 | PH1HP | Original Q3 | Legacy

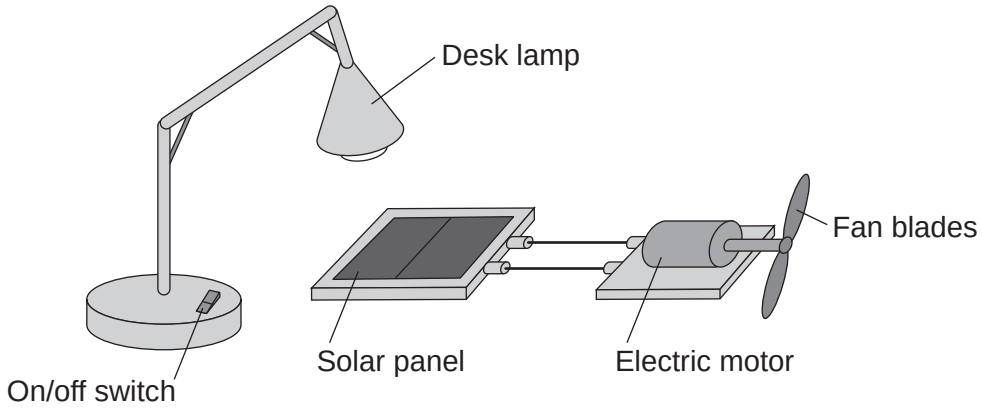
3 (a) Light waves transfer energy.

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

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

(1 mark)

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



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

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

.....

.....

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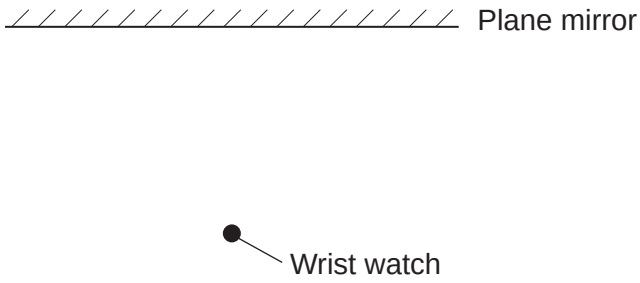
(2 marks)

4.1.2.1 Energy transfers in a system

Question 34 · 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)

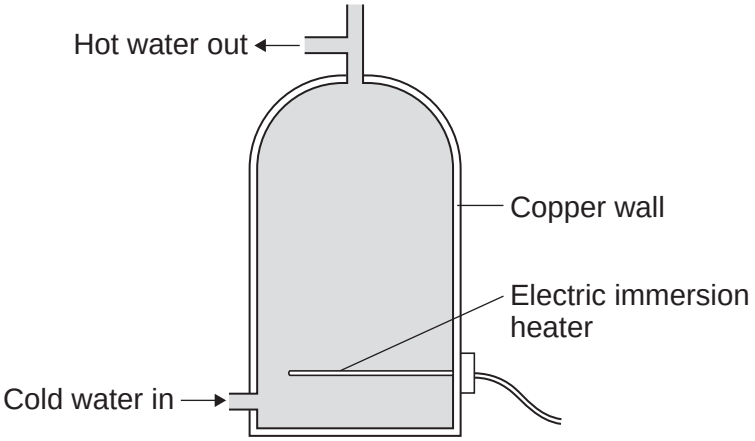
8

4.1.2.1 Energy transfers in a system

Question 35

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

4.1.2.1 Energy transfers in a system

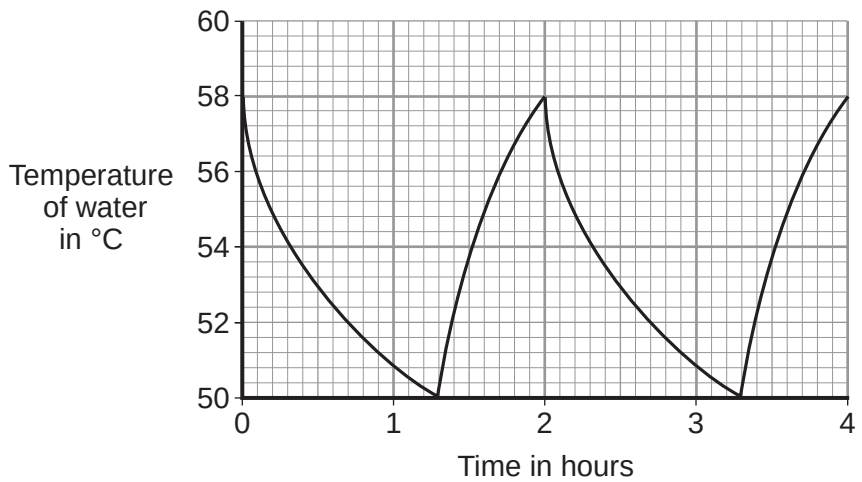
Question 35 · continued

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

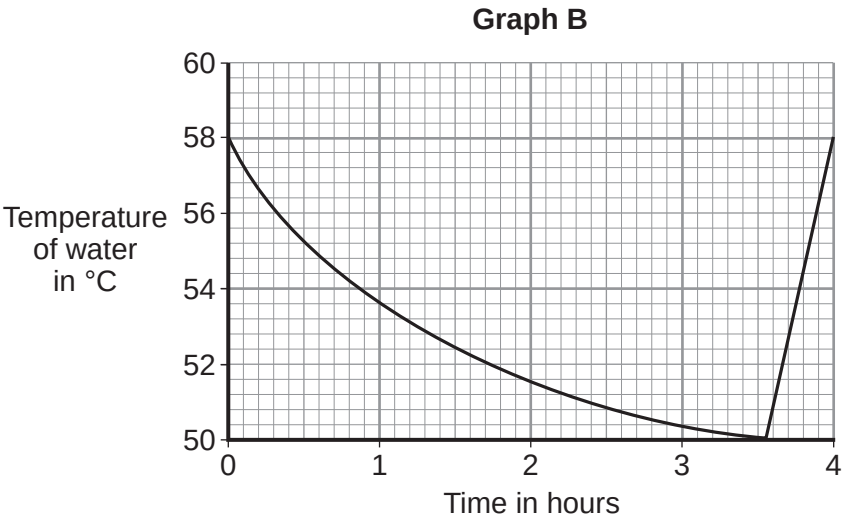
(3 marks)

4.1.2.1 Energy transfers in a system

Question 35 · 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.

.....

.....

.....

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.....

.....

(3 marks)

13

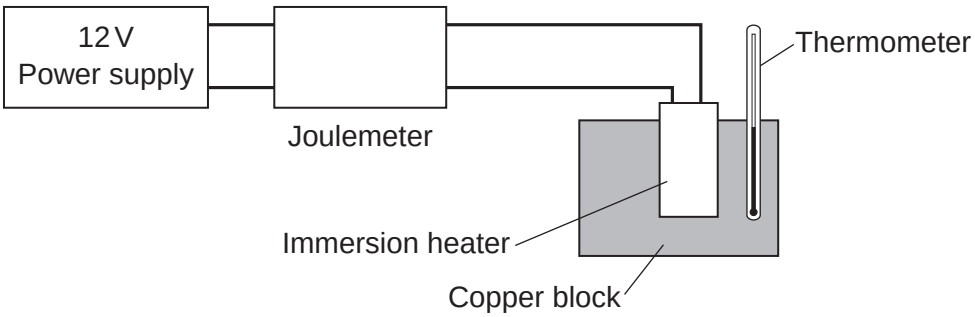
4.1.2.1 Energy transfers in a system

Question 36

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.

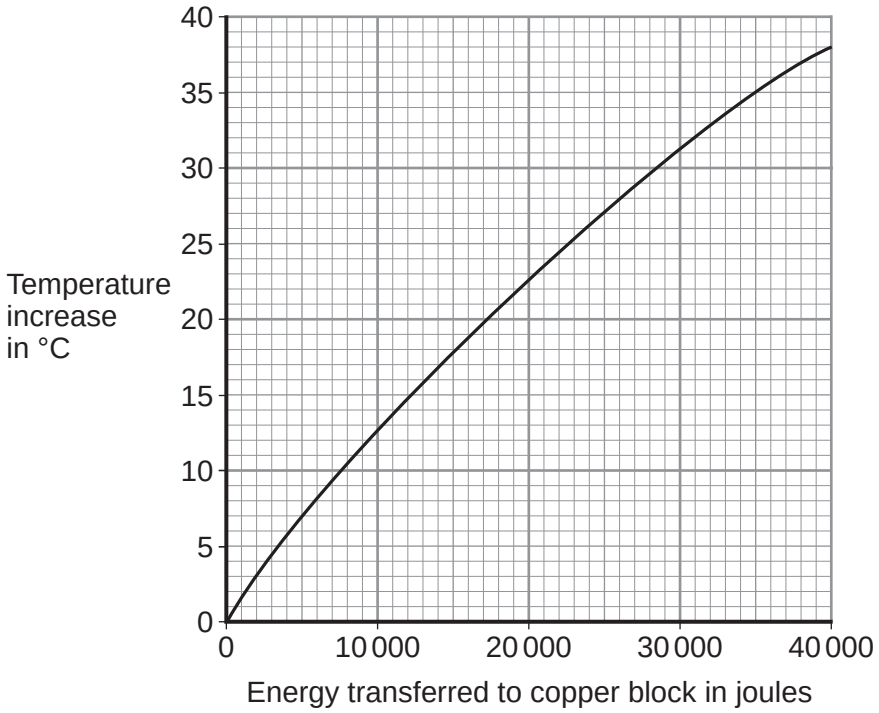
The energy transferred by the heater to the block was measured using the joulemeter.

The temperature of the block was recorded every minute.

The temperature increase was calculated.

Figure 8 shows the student's results.

Figure 8



4.1.2.1 Energy transfers in a system

Question 36 · 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

4.1.2.1 Energy transfers in a system

Question 37

June 2015 | PH1HP | Original Q2 | Legacy

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

A householder wants to reduce her energy bills. She collected information about a number of ways of reducing energy used. The information is shown in **Table 1**.

Table 1

Ways of reducing energy used	Cost to buy and install in £	Money saved per year in £
Install an energy-efficient boiler	2 000	320
Insulate the loft	400	200
Install double-glazed windows	12 000	120
Install cavity wall insulation	415	145

Use the information in **Table 1** to compare the different ways of reducing the energy used. Your answer should include some calculations.

[6 marks]

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4.1.2.1 Energy transfers in a system

Question 37 · continued

Extra space .....

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2 (b) Increasing the amount of insulation in a house affects the total U-value of the house.

2 (b) (i) What is meant by the term 'U-value'?

[1 mark]

.....

.....

.....

2 (b) (ii) How is the U-value affected by increasing the amount of insulation?

[1 mark]

.....

8

4.1.2.1 Energy transfers in a system

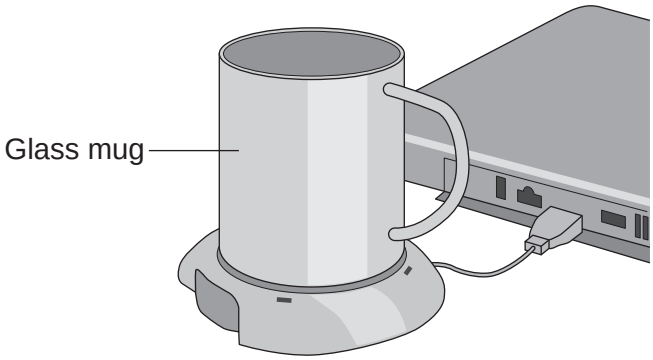
Question 38

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]

_____

_____

_____

_____

4.1.2.1 Energy transfers in a system

Question 38 · 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

4.1.2.1 Energy transfers in a system

Question 39

June 2017 | PH1HP | Original Q2 | Legacy

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

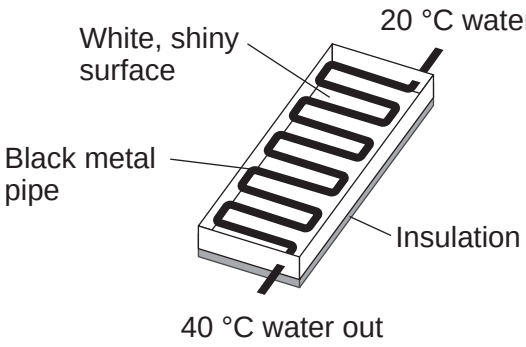
Solar panels use energy from the Sun to heat water.

Two different designs of solar panel are shown in **Figure 1**.

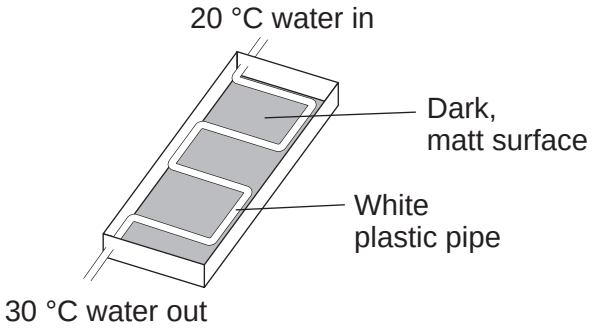
Both designs have the same water flow rate.

Figure 1

Design A



Design B



Explain why **Design A** is better than **Design B** at heating water.

[6 marks]

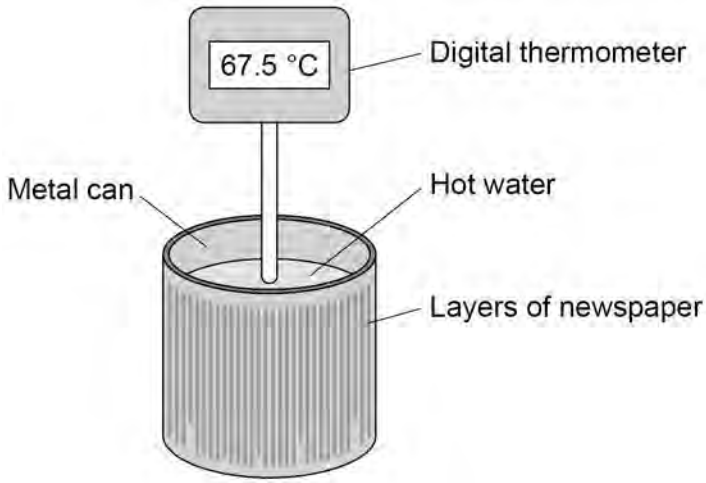
4.1.2.1 Energy transfers in a system

Question 40

0 2 A student investigated the insulating properties of newspaper.

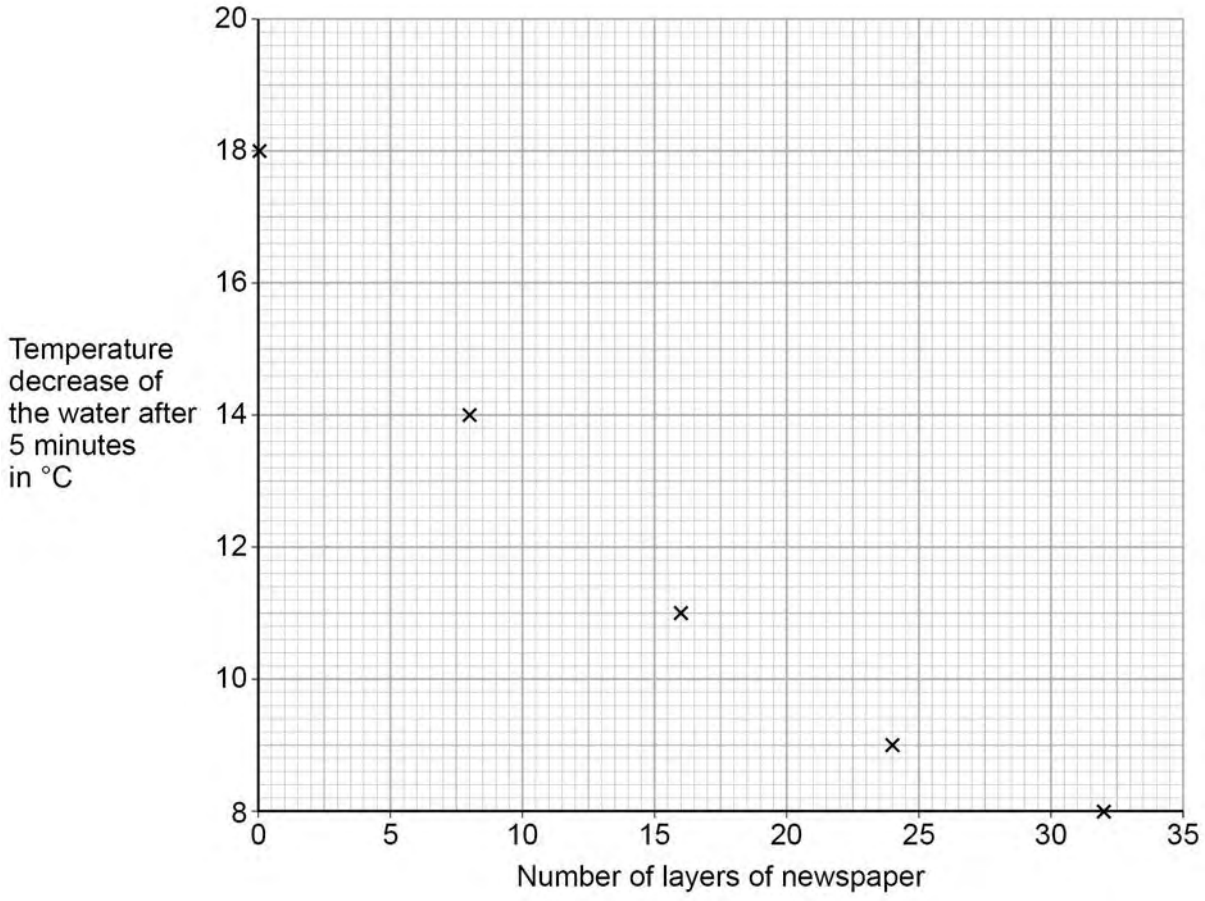
Figure 1 shows the apparatus the student used.

Figure 1



The student's results are shown in **Figure 2**.

Figure 2



4.1.2.1 Energy transfers in a system

Question 40 · continued

0 2 . 1 Describe a method the student could have used to obtain the results shown in **Figure 2**.

[6 marks]

Question 2 continues on the next page

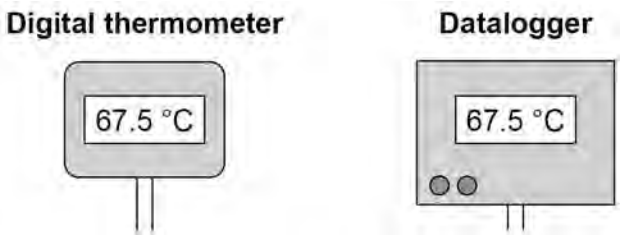
4.1.2.1 Energy transfers in a system

Question 40 · continued

0 2 . 2 The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 3 shows the readings on the digital thermometer and the datalogger.

Figure 3



The datalogger records 10 readings every second.

The student considered using a temperature probe and datalogger.

Explain why it was **not** necessary to use a temperature probe and datalogger for this investigation.

[2 marks]

8

4.1.2.1 Energy transfers in a system

Question 41

0 8 A student investigated the thermal conductivity of different metals.

This is the method used:

1. Measure the mass of an ice cube.
2. Put the ice cube on a metal block which is at room temperature.
3. Measure the mass of the ice cube after one minute.
4. Repeat with other blocks of the same mass made from different metals.

Figure 10



Table 3 shows the student's results.

Table 3

Metal	Initial mass of ice cube in grams	Final mass of ice cube in grams	Change in mass of ice cube in grams
Aluminium	25.85	21.14	4.71
Copper	26.20	20.27	5.93
Lead	25.53	21.97	3.56
Steel	24.95	19.45	5.50

Question 41 · continued

0 8 . 1 The initial temperature of each ice cube was –15 °C

Why was it important that the initial temperature of each ice cube was the same?

[1 mark]

Tick (✓) **one** box.

- Initial temperature was a continuous variable. ☐
- Initial temperature was a control variable. ☐
- Initial temperature was the dependent variable. ☐
- Initial temperature was the independent variable. ☐

0 8 . 2 Which metal had the highest thermal conductivity?

Give a reason for your answer.

[2 marks]

Metal: _____

Reason: _____

_____

_____

0 8 . 3 Suggest **one** source of random error in the student's investigation.

[1 mark]

_____

_____

_____

_____

4.1.2.1 Energy transfers in a system

Question 41 · continued

0 8 . 4 An ice cube has a temperature of –15.0 °C

The total thermal energy needed to raise the temperature of this ice cube to 0.0 °C and completely melt the ice cube is 5848 J

specific heat capacity of ice = 2100 J/kg °C
specific latent heat of fusion of ice = 334 000 J/kg

Calculate the mass of the ice cube.

[5 marks]

Mass of ice cube = _____ kg

9

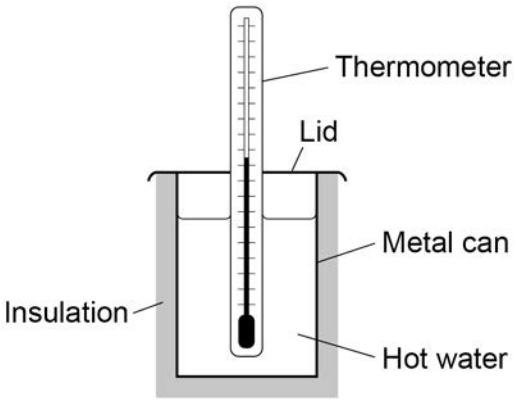
4.1.2.1 Energy transfers in a system

Question 42

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 _____

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

4.1.2.1 Energy transfers in a system

Question 42 · 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

4.1.2.1 Energy transfers in a system

Question 42 · 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