AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.2.1

Energy transfers in a system

Past-paper questions

Tier	**Foundation**
Question groups	**56**
Available paper years	**2005–2025**

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:** _____

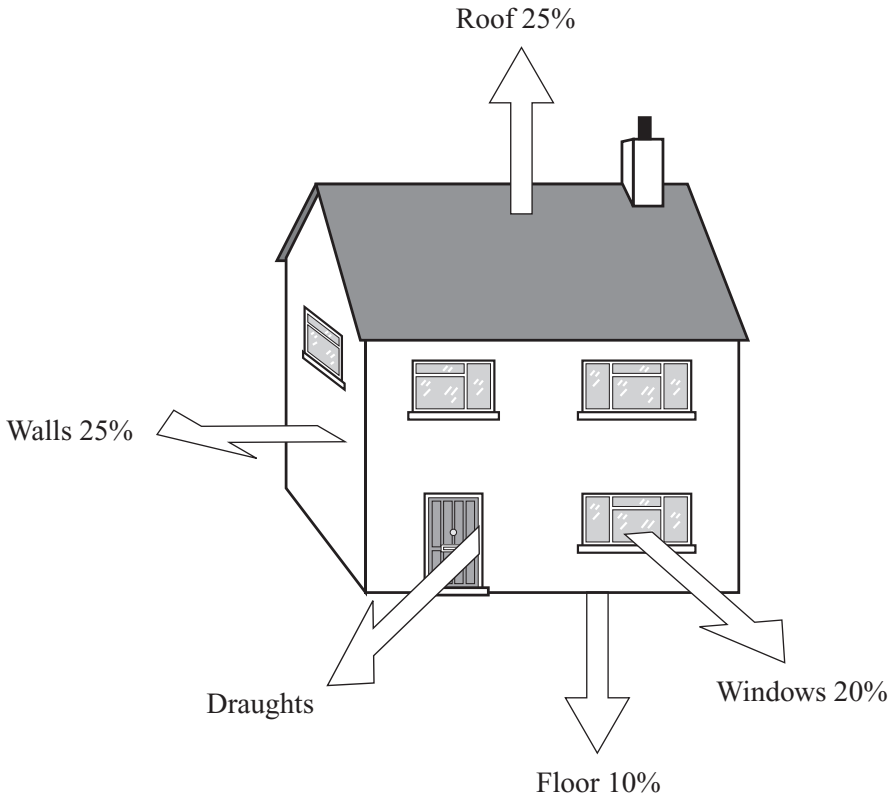
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.1.2.1 Energy transfers in a system

Question 01

June 2005 | 3451 | Original Q13 | Legacy

13 (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.

.....

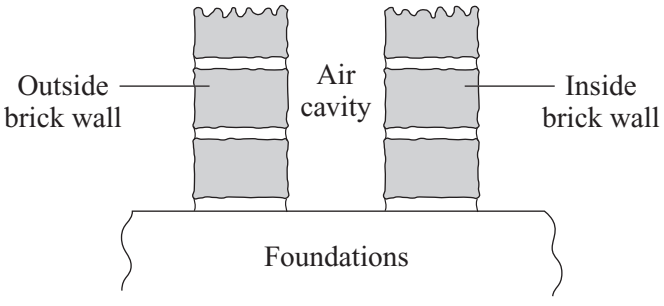
(1 mark)

4.1.2.1 Energy transfers in a system

Question 01 · continued

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)

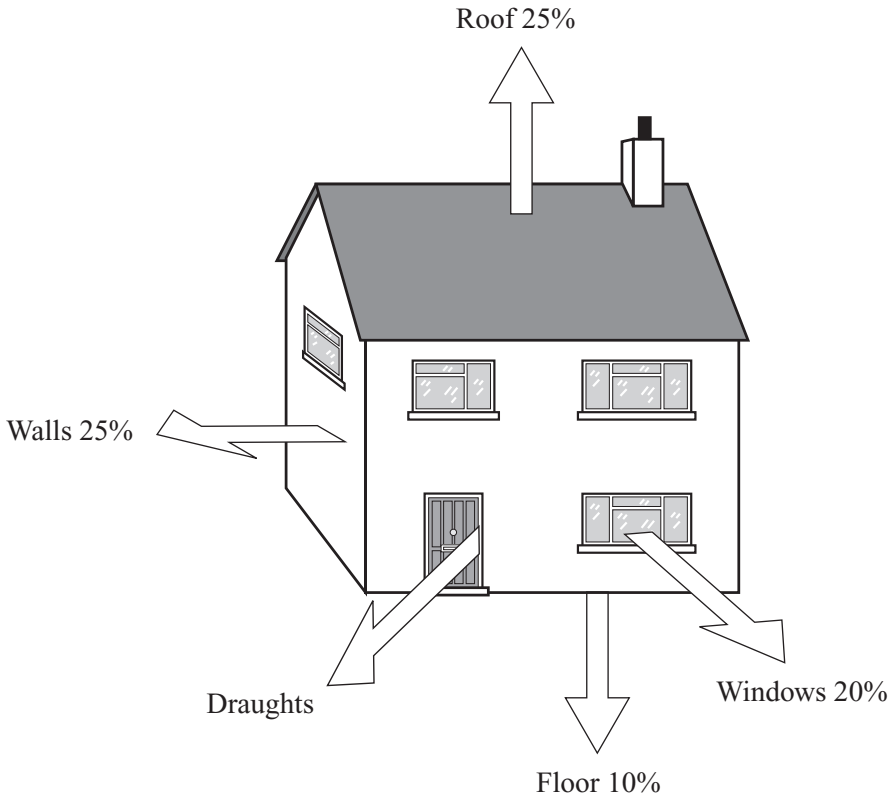
7

4.1.2.1 Energy transfers in a system

Question 02

June 2005 | 3462 | Original Q11 | Legacy

11 (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

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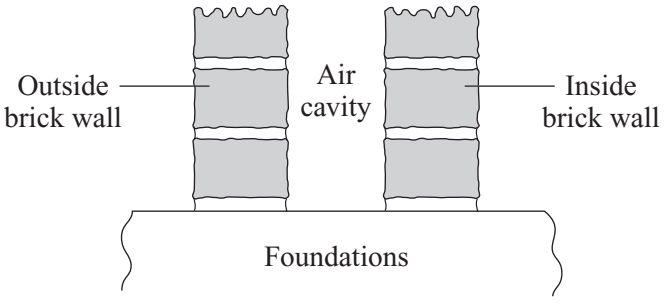
(b) The diagram shows a section through the walls of a house built in 1930.



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 03

November 2006 | PHY1A | Original Q5 | Legacy

QUESTION FIVE

Getting to Mars

The temperature in space is very low. Human body temperature must remain at 37 °C. Heat transfer from the spacecraft is a problem which scientists and engineers have to overcome if travel to Mars is to be possible.

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

A conduction

B convection

C insulation

D radiation

Heat passes through the metal walls of the spacecraft by . . . **1** . . . .

Heat transfer through metal walls can be reduced by . . . **2** . . . .

Heat leaves the spacecraft by the process of . . . **3** . . . .

The process of . . . **4** . . . takes place in air but cannot take place through the vacuum of space.

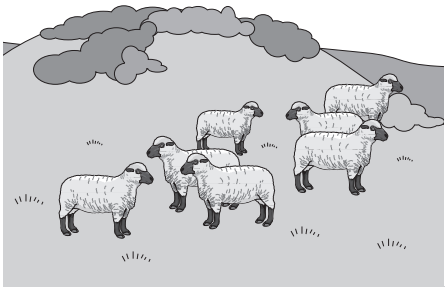
4.1.2.1 Energy transfers in a system

Question 04

November 2006 | PHY1A | Original Q8 | Legacy

QUESTION EIGHT

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.



8A Wool is a poor conductor of heat because it . . .

1 is natural.

2 is soft.

3 is warm.

4 traps air.

8B A farmer knows that different sheep transfer heat at different rates.

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

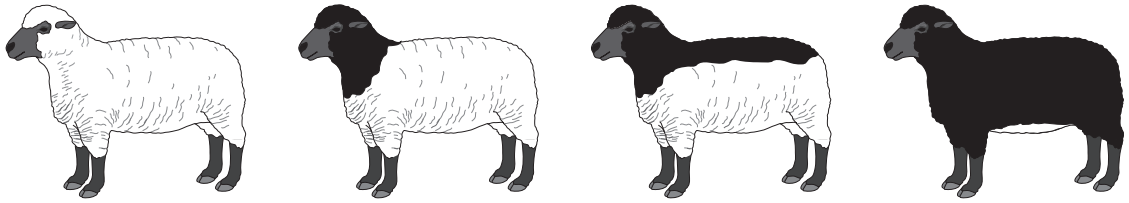
	Because of differences in their shapes	Because of differences in their sizes
1	no	no
2	no	yes
3	yes	no
4	yes	yes

4.1.2.1 Energy transfers in a system

Question 04 · continued

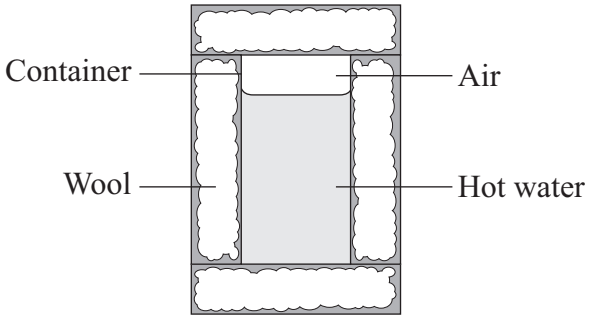
8C The drawings show four black and white sheep. They are identical apart from their colour.

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



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

8D 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

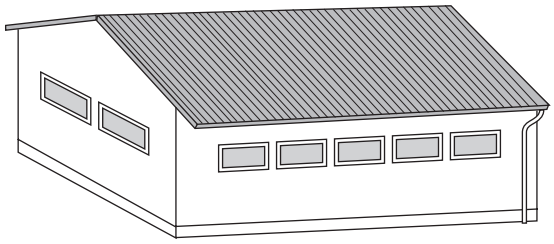
4.1.2.1 Energy transfers in a system

Question 05

November 2006 | PHY1A | Original Q9 | Legacy

QUESTION NINE

This is a design for a new workshop.



9A 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

9B 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.

9C All energy is eventually transferred to the surroundings as . . .

1 electricity.

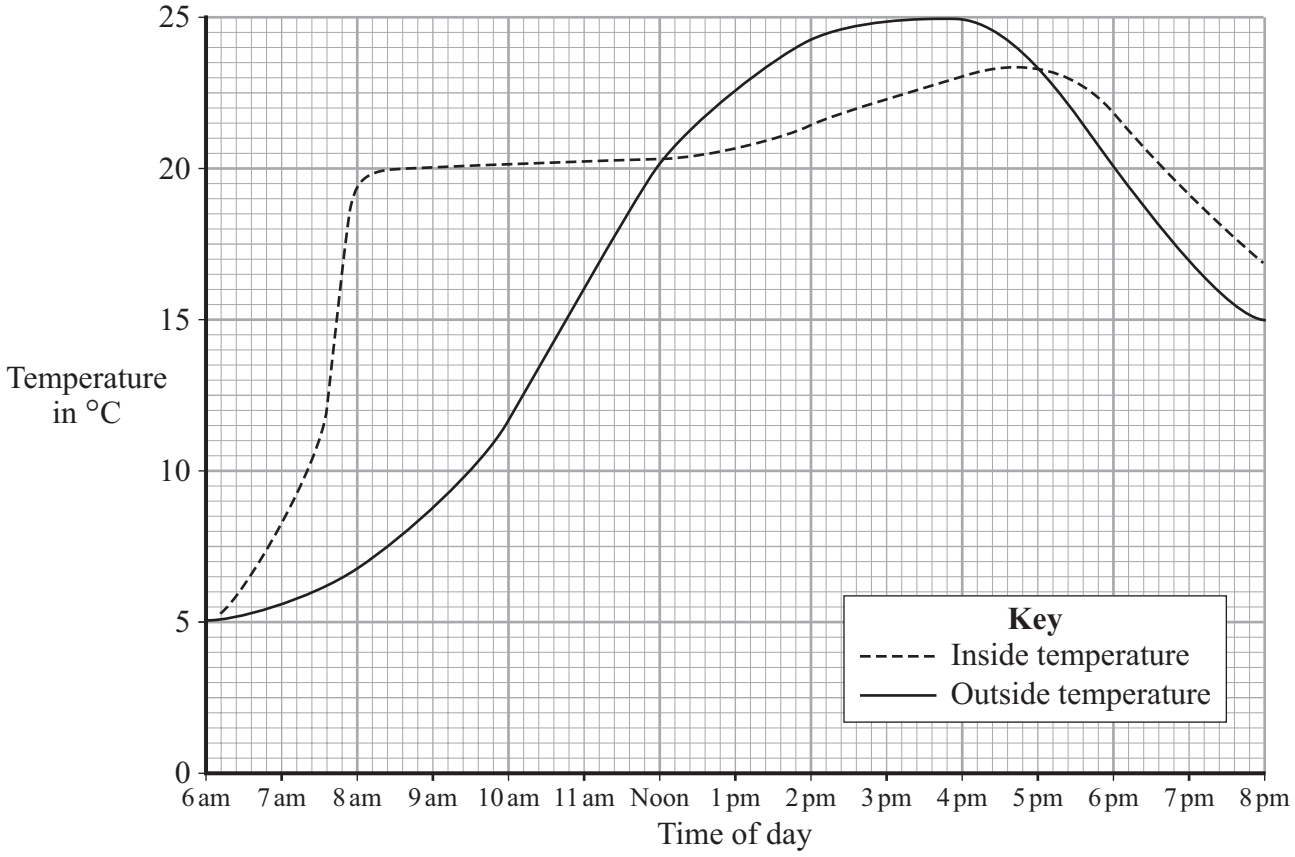
2 heat.

3 light.

4 sound.

Question 05 · continued

9D 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.

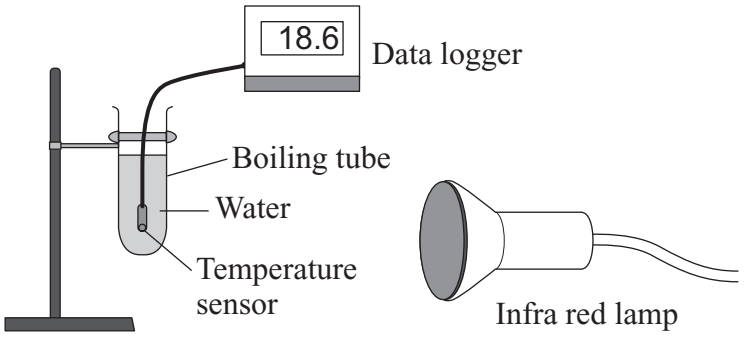
END OF TEST

4.1.2.1 Energy transfers in a system

Question 06

6 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 06 · continued

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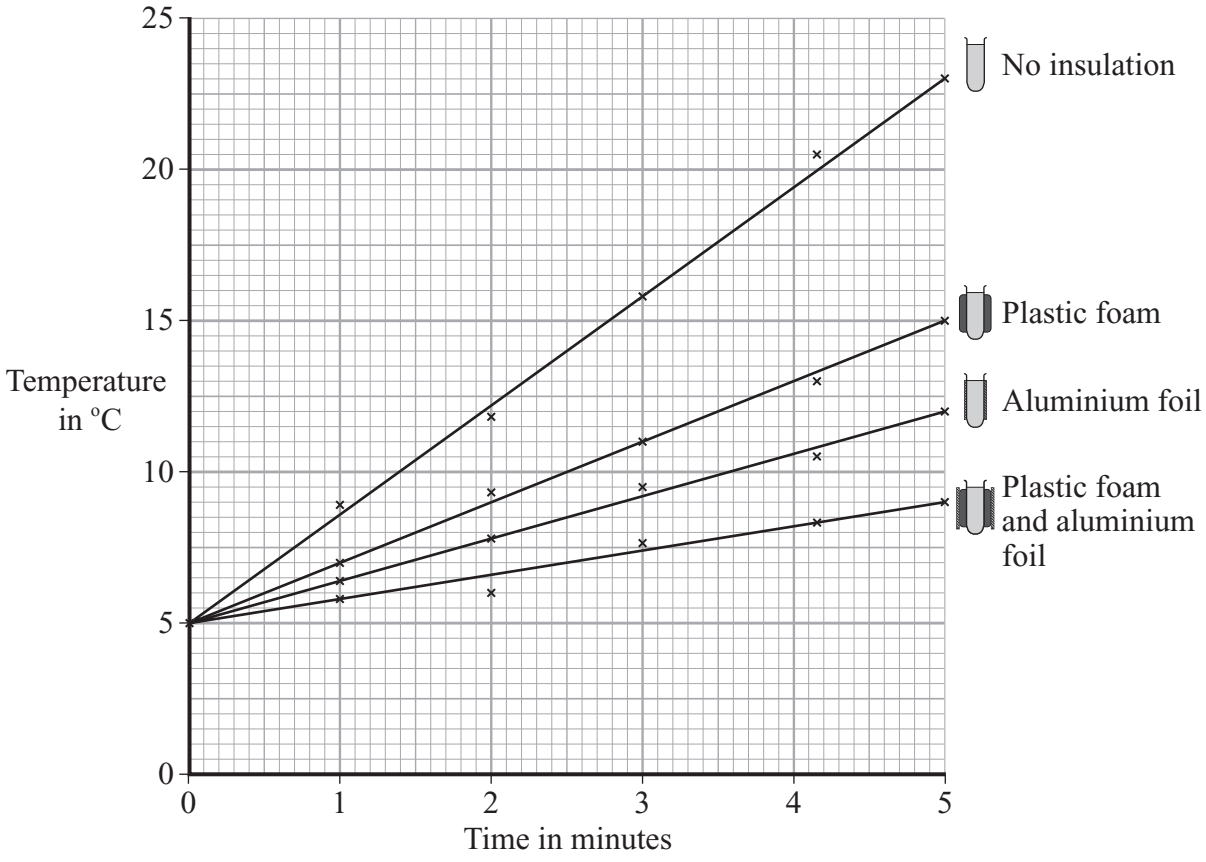
(b) The results of the investigation are shown in the graph.



(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 6 continues on the next page

4.1.2.1 Energy transfers in a system

Question 06 · 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.

.....

.....

.....

.....

.....

(2 marks)

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

.....

.....

.....

.....

(2 marks)

9

4.1.2.1 Energy transfers in a system

Question 07

March 2007 | PHY1A | Original Q3 | Legacy

QUESTION THREE

A gas fire transfers heat to a room in various ways.

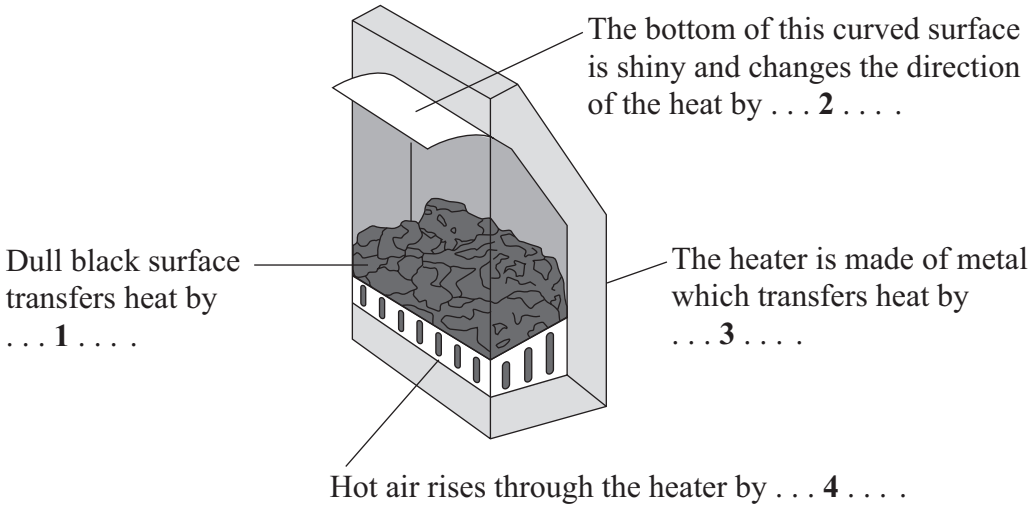
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A conduction

B convection

C radiation

D reflection



4.1.2.1 Energy transfers in a system

Question 08

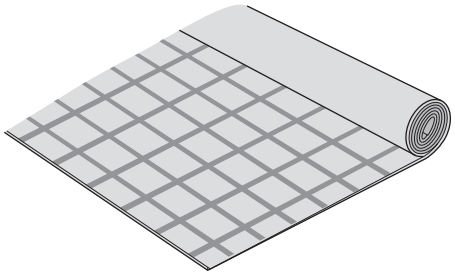
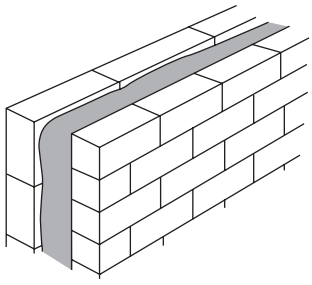
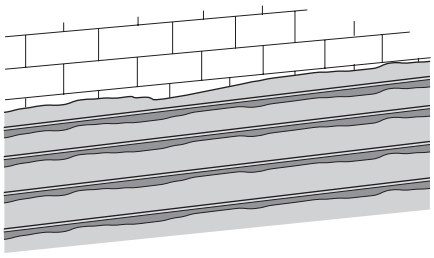
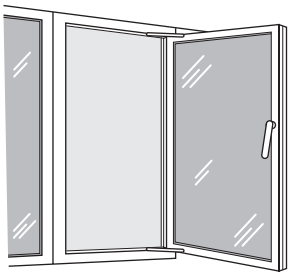
March 2007 | PHY1A | Original Q9 | Legacy

QUESTION NINE

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**

9A 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 08 · continued

9B 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.

9C 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.

9D 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.

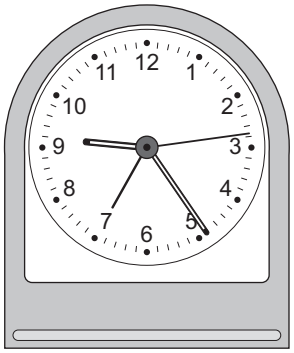
4.1.2.1 Energy transfers in a system

Question 09

June 2007 | PHY1A | Original Q1 | Legacy

QUESTION ONE

The drawing shows a battery-operated alarm clock.



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

A chemical

B electrical

C kinetic

D thermal

The clock contains a battery and an electric motor.

The battery is designed to transform . . . **1** . . . energy to . . . **2** . . . energy.

The motor is designed to transform electrical energy to . . . **3** . . . energy.

In the motor, some energy is wasted as . . . **4** . . . energy.

4.1.2.1 Energy transfers in a system

Question 10

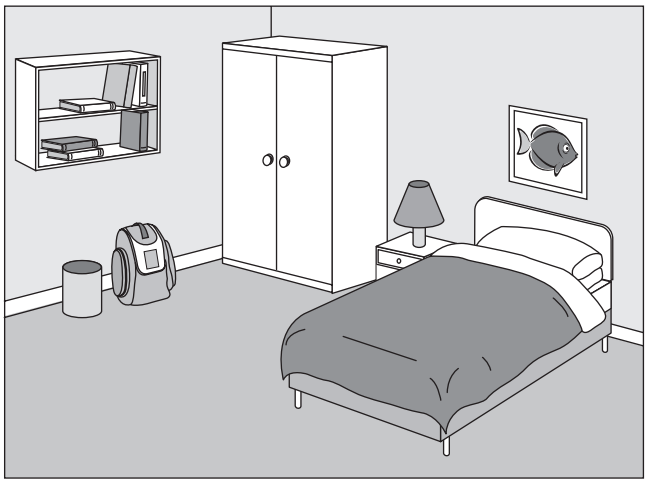
June 2007 | PHY1A | Original Q2 | Legacy

QUESTION TWO

The drawing shows part of a bedroom. The bedroom is heated by an electric fire.

There is a loft space above the bedroom ceiling. Above the bedroom ceiling is a layer of fibreglass.

When the electric fire is switched off, the bedroom cools down.



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

A conduction

B convection

C insulation

D radiation

The bedroom cools down because heat is transferred through the floor, the ceiling and the walls by . . . **1** . . . .

Heat is transferred from the outside of the walls by . . . **2** . . . .

Heat is transferred through the air in the loft by . . . **3** . . . .

Fibreglass reduces heat transfer through the ceiling because it has good . . . **4** . . . properties.

4.1.2.1 Energy transfers in a system

Question 11

June 2007 | PHY1A | Original Q6 | Legacy

QUESTION SIX

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 Q8 | Legacy

QUESTION EIGHT

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

8A 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

8B 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.

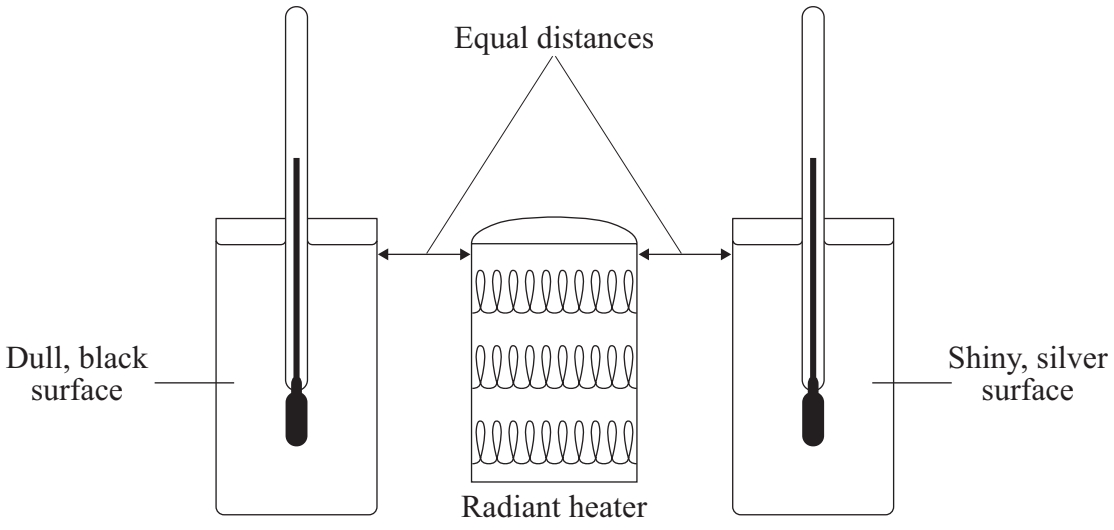
2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation.

4.1.2.1 Energy transfers in a system

Question 12 · continued June 2007 | PHY1A | Original Q8 | Legacy



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

8C 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.

8D 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

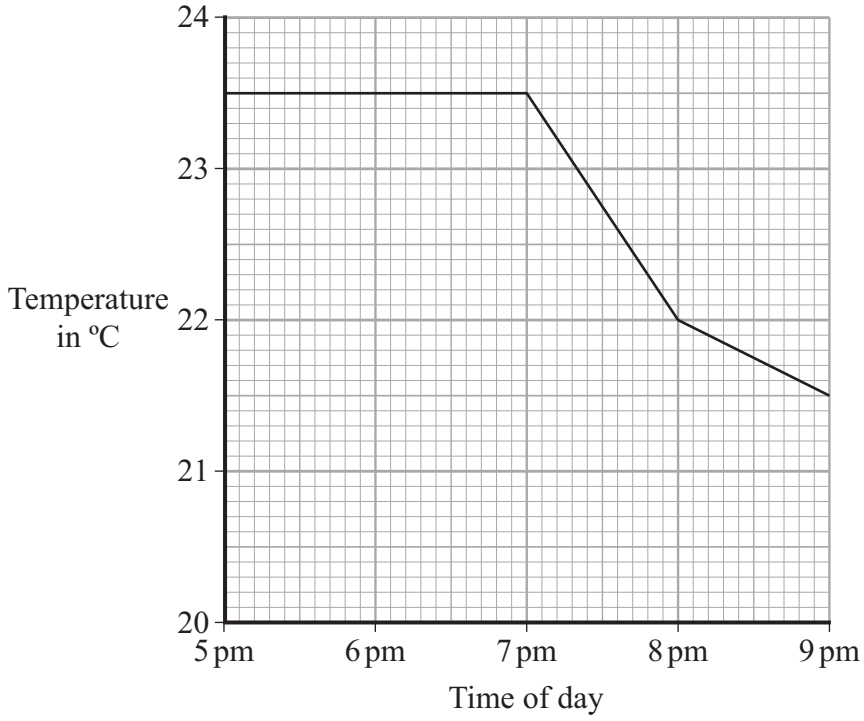
4 21 °C per minute

4.1.2.1 Energy transfers in a system

Question 13

June 2007 | PHY1F | Original Q3 | Legacy

3 (a) The graph shows the temperature inside a flat between 5 pm and 9 pm.
The central heating was on at 5 pm.



(i) What time did the central heating switch off?

.....

(1 mark)

(ii) Closing the curtains reduces heat loss from the flat.

What time do you think the curtains were closed?

.....

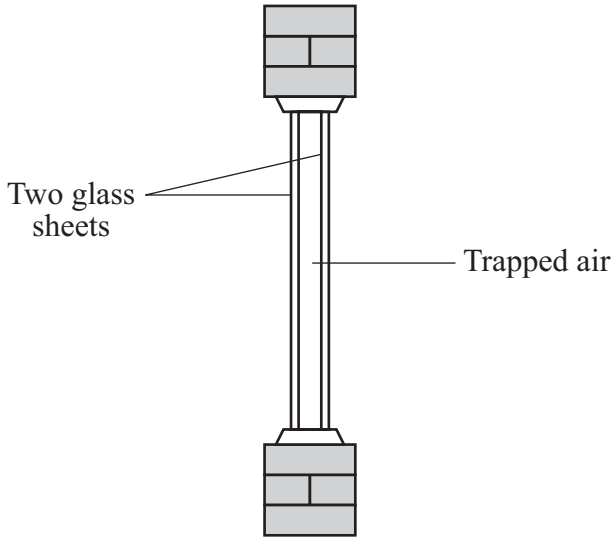
Give a reason for your answer.

.....

.....

(2 marks)

(b) Less heat is lost through double-glazed windows than through single-glazed windows.



A double-glazed window

Complete the following sentences by choosing the correct words from the box.
Each word may be used once or not at all.

conduction	**conductor**	**convection**	**evaporation**	**insulator**	**radiation**

Air is a good ..... . When trapped between two sheets of glass it reduces heat loss by ..... and ..... .

(3 marks)

(c) The table gives information about three types of house insulation.

Type of insulation	Cost to install	Money saved each year on heating bills	Payback time
Double glazing	£4000	£200	20 years
Loft insulation	£300	£100	3 years
Cavity wall insulation	£600	£150	

(i) Use the information in the table to calculate the payback time for cavity wall insulation.

.....

(1 mark)

Question 3 continues on the next page

4.1.2.1 Energy transfers in a system

Question 13 · continued

June 2007 | PHY1F | Original Q3 | Legacy

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(ii) Explain why people often install loft insulation before installing double glazing or cavity wall insulation.

.....

.....

.....

.....

(2 marks)

9

Question 14

November 2007 | PHY1A | Original Q4 | Legacy

QUESTION FOUR

The table gives information about some methods of conserving energy in a house.

	Method of conserving energy	Installation cost in £	Yearly saving in energy bills in £
1	loft insulation	110	60
2	jacket around hot water tank	10	18
3	cavity wall insulation	500	50
4	thermostatic radiator valves	75	15

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

A the method that costs most to install

B the method that conserves most energy

C the method that pays for itself in less than one year

D the method that takes five years to pay for itself

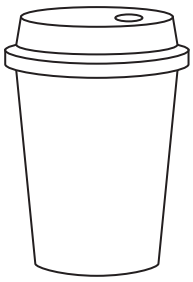
4.1.2.1 Energy transfers in a system

Question 15

March 2008 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

Polystyrene cups are designed to keep drinks hot.



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

A conduction

B convection

C insulation

D radiation

The white colour of the cup reduces heat loss by . . . **1** . . . .

The lid reduces heat loss by . . . **2** . . . .

Polystyrene is a material that reduces heat loss by . . . **3** . . . .

Making the cup from thicker polystyrene would improve the . . . **4** . . . .

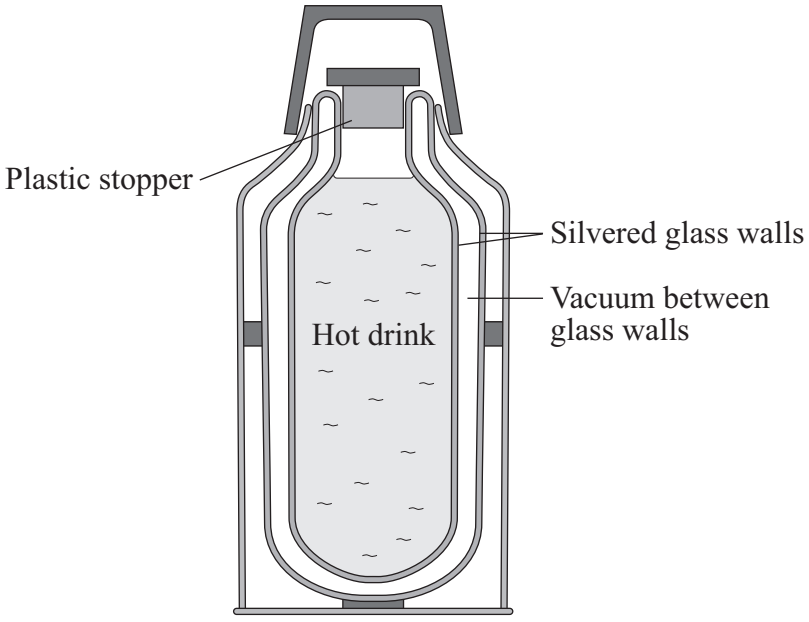
4.1.2.1 Energy transfers in a system

Question 16

June 2008 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

The diagram shows a vacuum flask.



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

A conduction

B convection

C insulation

D radiation

The stopper prevents hot air from rising out of the flask.

This reduces heat loss by . . . **1** . . . .

Plastic is used for the stopper because it has good . . . **2** . . . properties.

This means that the plastic reduces heat loss by . . . **3** . . . .

The silvered glass walls reduce heat loss by . . . **4** . . . .

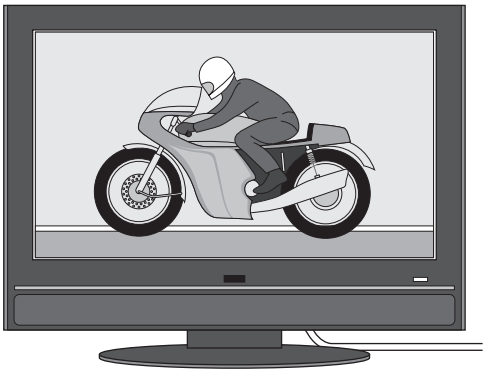
4.1.2.1 Energy transfers in a system

Question 17

November 2008 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The drawing shows a television set.



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

A electrical

B heat

C light

D sound

The television is designed to transform . . . **1** . . . energy into . . . **2** . . . energy at the screen.

The loudspeaker transforms kinetic energy into . . . **3** . . . energy.

Some energy is wasted as . . . **4** . . . .

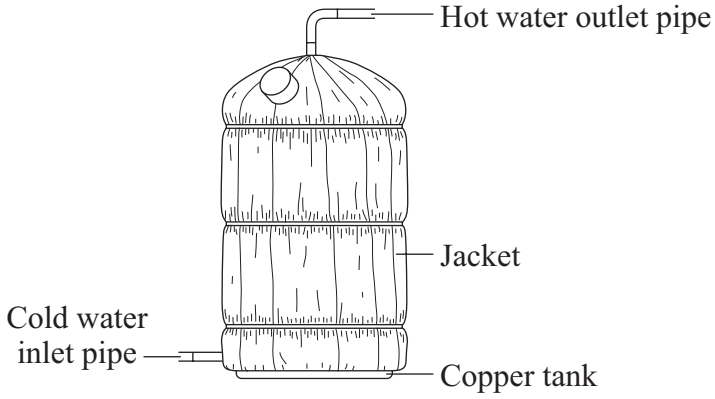
4.1.2.1 Energy transfers in a system

Question 18

November 2008 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

The diagram shows a jacket fitted to a hot water tank.



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

A conduction

B convection

C insulation

D radiation

Heat will travel through the copper wall of the tank by . . . **1** . . . .

The jacket helps to keep the water warm because the fibreglass inside the jacket provides . . . **2** . . . .

The hot water outlet is at the top of the tank because hot water will rise to the top by . . . **3** . . . .

Heat would be lost from the surface of the tank by . . . **4** . . . .

4.1.2.1 Energy transfers in a system

Question 19

November 2008 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

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

9A 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

9B Double glazing reduces heat loss by . . .

1 conduction only.

2 convection only.

3 conduction and convection.

4 convection and radiation.

9C 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 19 · continued

9D What is the pay-back time for loft insulation?

1 0.25 year

2 0.50 year

3 2 years

4 4 years

END OF TEST

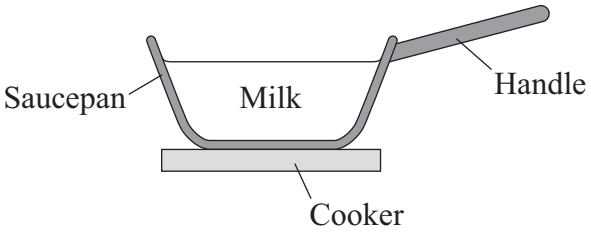
4.1.2.1 Energy transfers in a system

Question 20

March 2009 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

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** . . . .

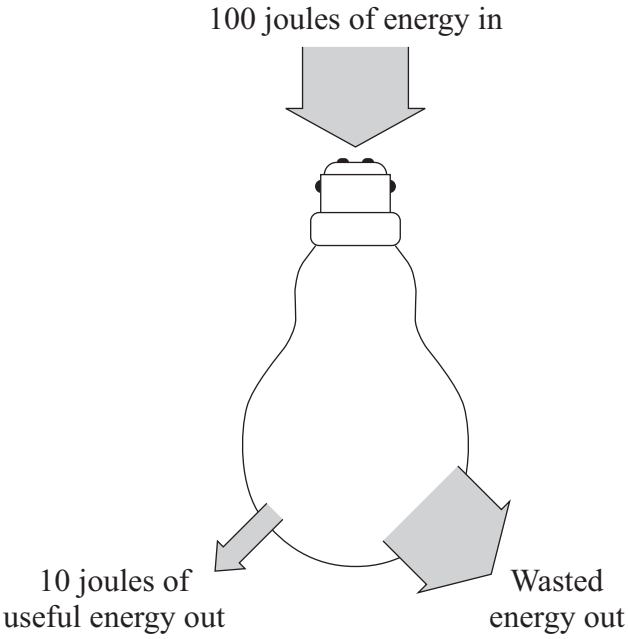
4.1.2.1 Energy transfers in a system

Question 21

March 2009 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows a tungsten filament lamp and the energy used by the lamp in one second.



7A How many joules of energy are wasted each second?

1 10

2 80

3 90

4 100

7B What type of wasted energy is produced by the lamp?

1 electrical

2 heat

3 light

4 sound

4.1.2.1 Energy transfers in a system

Question 21 · continued March 2009 | PHY1AP | Original Q7 | Legacy

7C What happens to the wasted energy?

1 It is transformed into useful energy.

2 It is destroyed.

3 It spreads out and becomes easier to use.

4 It spreads out and becomes more difficult to use.

7D What is the efficiency of the lamp?

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

1 0.1

2 0.8

3 0.9

4 1.0

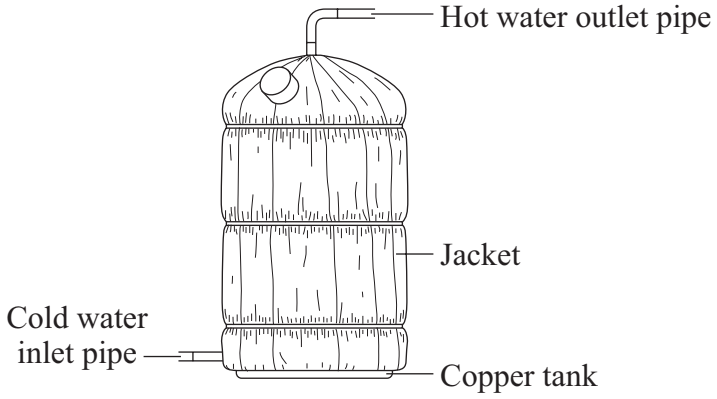
4.1.2.1 Energy transfers in a system

Question 22

March 2009 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

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



9A 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.

9B 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 22 · continued

9C 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

9D 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

END OF TEST

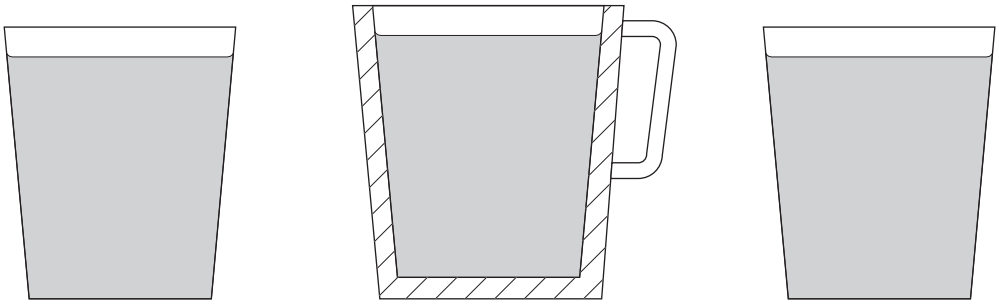
4.1.2.1 Energy transfers in a system

Question 23

June 2009 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

The diagram shows three mugs containing hot tea. The second mug is in a plastic holder.



Metal mug | Metal mug in plastic holder | Plastic mug

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

A conduction

B convection

C insulation

D radiation

Putting a lid on a mug reduces heat loss by . . . **1** . . . .

Placing a mug in a plastic holder increases . . . **2** . . . .

Painting a mug so that it has a light, shiny surface decreases heat loss by . . . **3** . . . .

Using a plastic mug, rather than a metal one, reduces heat loss by . . . **4** . . . . .

4.1.2.1 Energy transfers in a system

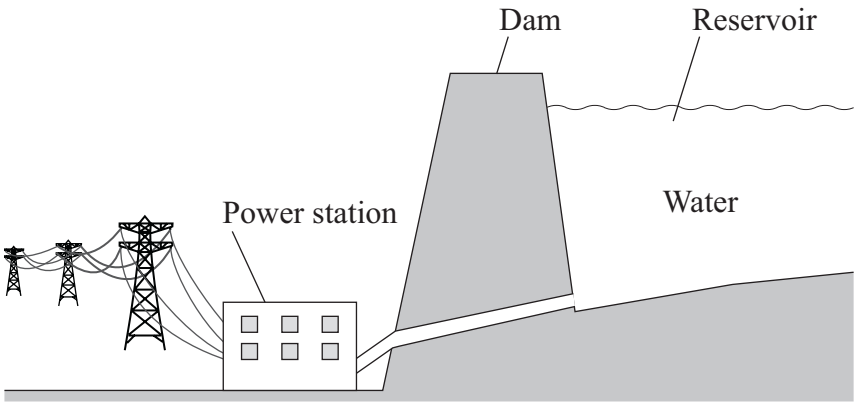
Question 24

June 2009 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

Useful energy can be obtained from falling water.

The diagram shows one way of doing this.



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

A electrical

B gravitational potential

C heat (thermal energy)

D kinetic

Large amounts of . . . **1** . . . energy are stored in the water in the reservoir.

Water flowing down from this reservoir has . . . **2** . . . energy which can turn a turbine.

The turbine can power a generator which produces useful . . . **3** . . . energy.

Some energy is wasted in the power station as . . . **4** . . . .

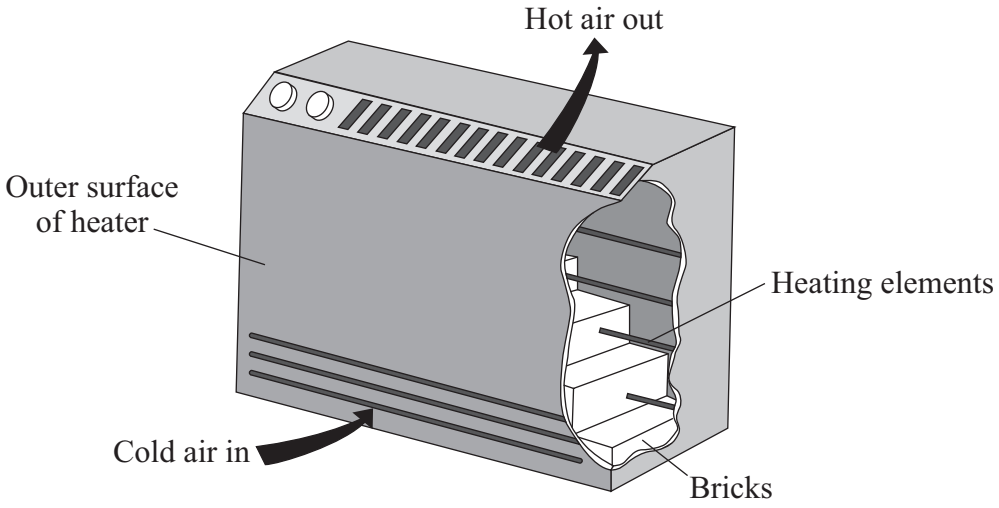
4.1.2.1 Energy transfers in a system

Question 25

June 2009 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

The diagram shows the construction of one type of heater. The bricks inside the heater warm up during the night when the cost of electricity is lower. The bricks then emit heat (thermal energy) during the day.



6A The bricks warm up because they . . .

1 absorb heat.

2 insulate heat.

3 radiate heat.

4 reflect heat.

6B The diagram shows the main thermal energy transfer of the heater as it warms the room.

By what process does this heater transfer most of its energy throughout a room in a house?

1 conduction from the bricks

2 conduction from the outside surface of the heater

3 convection currents in the air

4 radiation from the outside surface of the heater

Question 25 · continued

6C To give out the most heat, what would be the best outside surface for the heater?

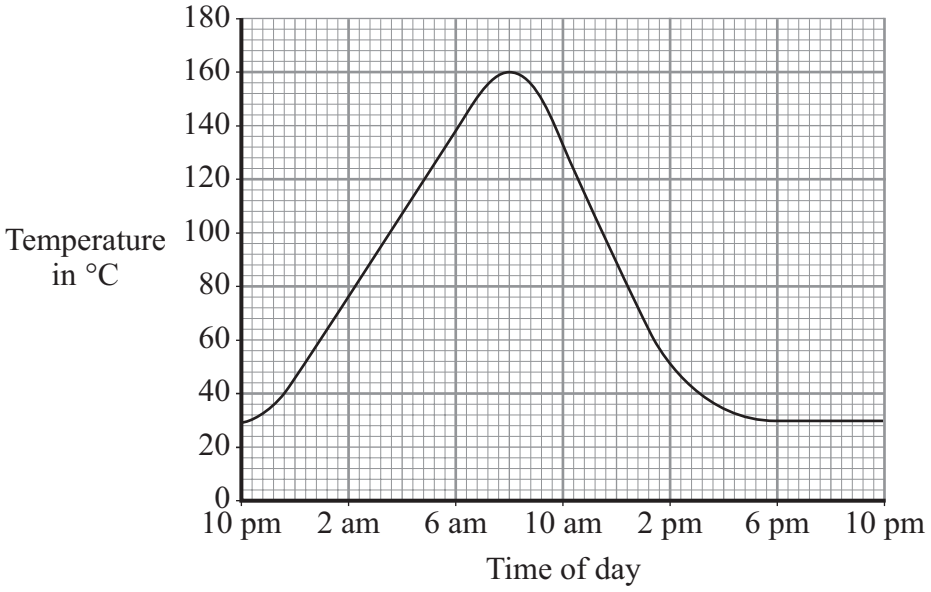
1 dark, matt

2 dark, shiny

3 light, shiny

4 light, matt

6D The graph shows how the temperature of the bricks changes during a 24-hour period.



At what time did the bricks reach their highest temperature?

1 8 am

2 10 am

3 6 pm

4 10 pm

4.1.2.1 Energy transfers in a system

Question 26

November 2009 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

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

9A What is the pay-back time for cavity wall insulation?

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

2 1 year

3 4 years

4 5 years

9B What would be the cost of loft insulation for this house?

1 £30

2 £90

3 £270

4 £540

9C 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 26 · continued

9D 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.

END OF TEST

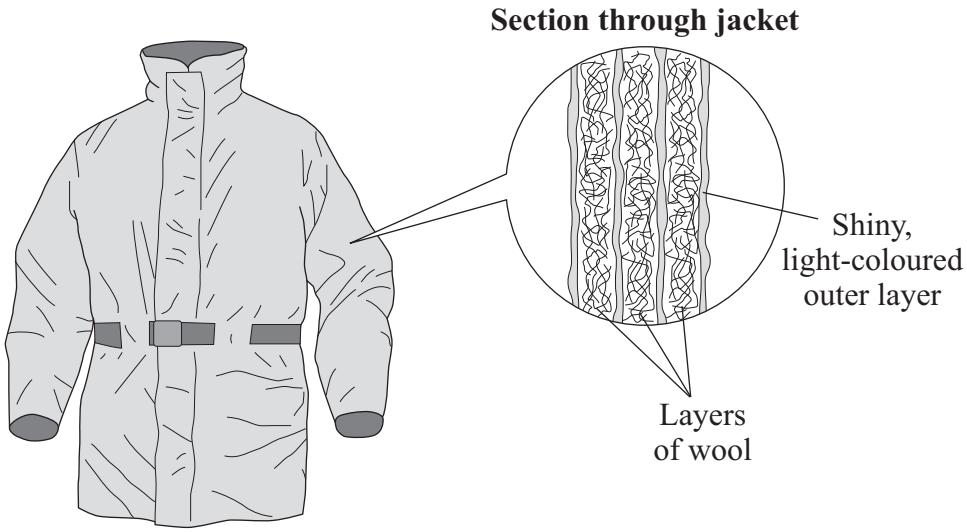
4.1.2.1 Energy transfers in a system

Question 27

March 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The diagram shows a jacket designed to keep Arctic explorers warm.



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

A conduction

B convection

C insulation

D radiation

The shiny, light-coloured outer layer of the jacket reduces heat loss by . . . **1** . . . .

Using more layers of wool improves . . . **2** . . . .

The air trapped in the wool cannot rise, which reduces heat loss by . . . **3** . . . .

Heat is transferred through a solid material by . . . **4** . . . .

4.1.2.1 Energy transfers in a system

Question 28

June 2010 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about the transfer of heat.

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

A conduction

B convection

C insulation

D radiation

The rate of heat loss from a hot object can be reduced by . . . **1** . . . .

Heat is transferred from the Sun to the Earth by . . . **2** . . . .

Heat is transferred through the air in a room mainly by . . . **3** . . . .

Heat is transferred along a metal bar by . . . **4** . . . .

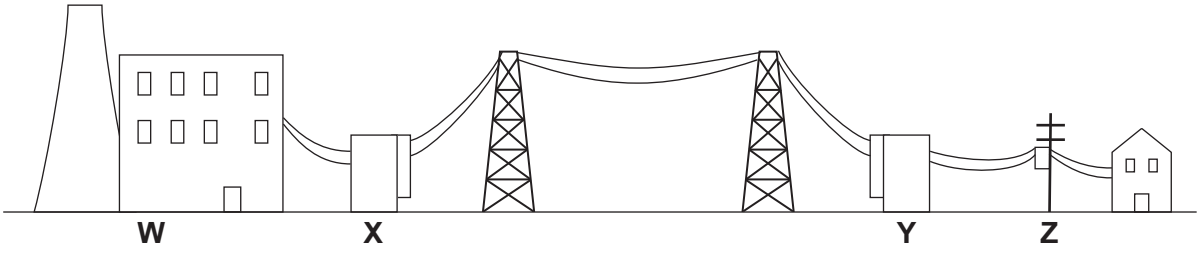
4.1.2.1 Energy transfers in a system

Question 29

June 2010 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows how electricity is transferred from a power station to consumers.



7A Which labelled part, **W**, **X**, **Y** or **Z**, is a step-up transformer?

1 **W**

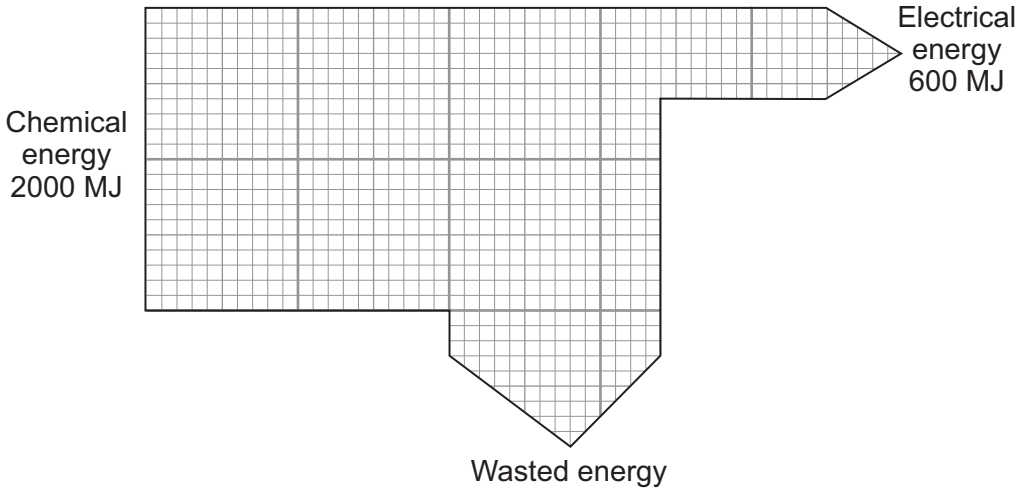
2 **X**

3 **Y**

4 **Z**

Fuel is burned in this power station.

The Sankey diagram shows the energy transformations for this power station.



7B How much energy is wasted?

1 30 MJ

2 600 MJ

3 1400 MJ

4 2600 MJ

4.1.2.1 Energy transfers in a system

Question 29 · continued

7C The efficiency of the power station can be calculated using this equation.

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

What is the efficiency of this power station?

1 0.30

2 0.33

3 0.60

4 0.70

7D What happens to the energy that is wasted?

1 It is transferred into useful energy.

2 It warms up the surroundings.

3 It is recycled.

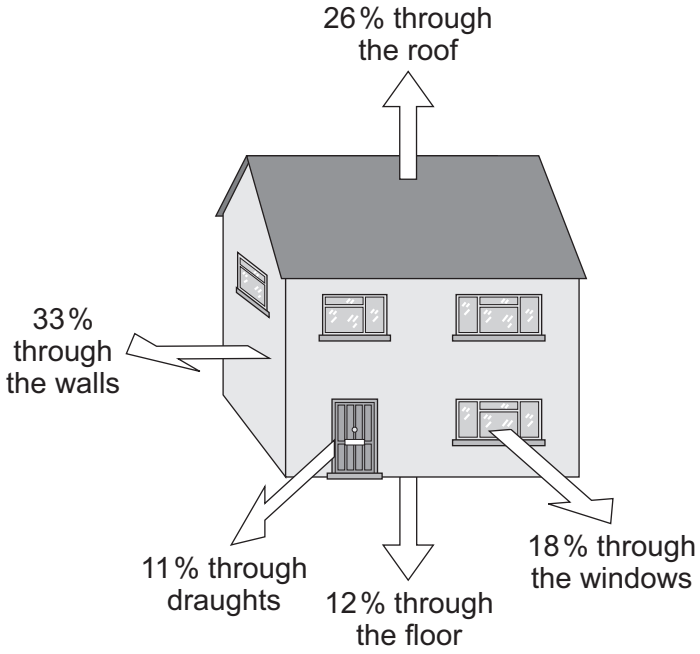
4 It is stored until needed.

4.1.2.1 Energy transfers in a system

Question 30

June 2010 | PHY1F | Original Q4 | Legacy

4 The diagram shows where heat is lost from a house that is **not** insulated.



4 (a) (i) Through which part of the house is most heat lost?

.....

(1 mark)

4 (a) (ii) How can the heat loss through the windows be reduced?

.....

.....

(1 mark)

4.1.2.1 Energy transfers in a system

Question 30 · continued

4 (b) A homeowner wants to reduce her energy bills and make her home more energy efficient. The table shows five ways this could be done. The table also shows how much money each way would save the homeowner each year.

	Cost	Money saved each year
Installing loft insulation	£175	£60
Fitting draught-proofing	£45	£20
Installing cavity wall insulation	£300	£80
Adding a hot water tank jacket	£15	£20
Using energy efficient light bulbs	£60	£30

4 (b) (i) Which **one** of the five ways of reducing energy bills would reduce the yearly energy bill the most?

.....

(1 mark)

4 (b) (ii) This year the homeowner has only got £60 to spend to improve the energy efficiency of her home.

Use the information in the table to explain what the homeowner should spend this money on.

.....

.....

.....

.....

(2 marks)

5

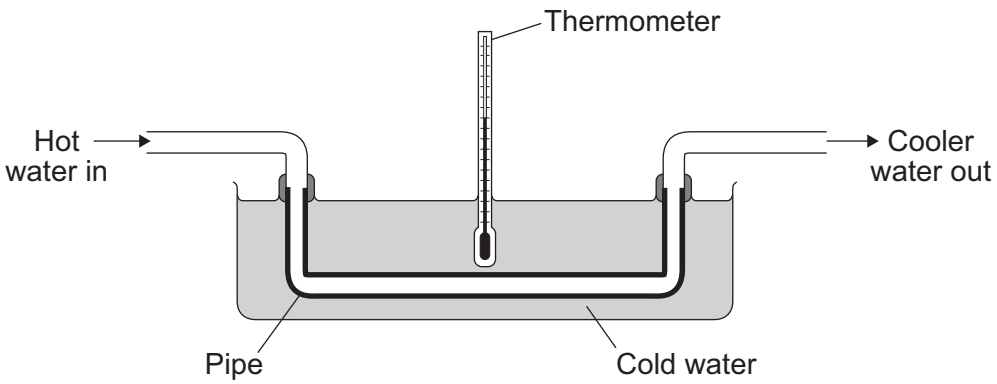
4.1.2.1 Energy transfers in a system

Question 31

June 2010 | PHY1F | Original Q6 | Legacy

6 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.



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

.....

(1 mark)

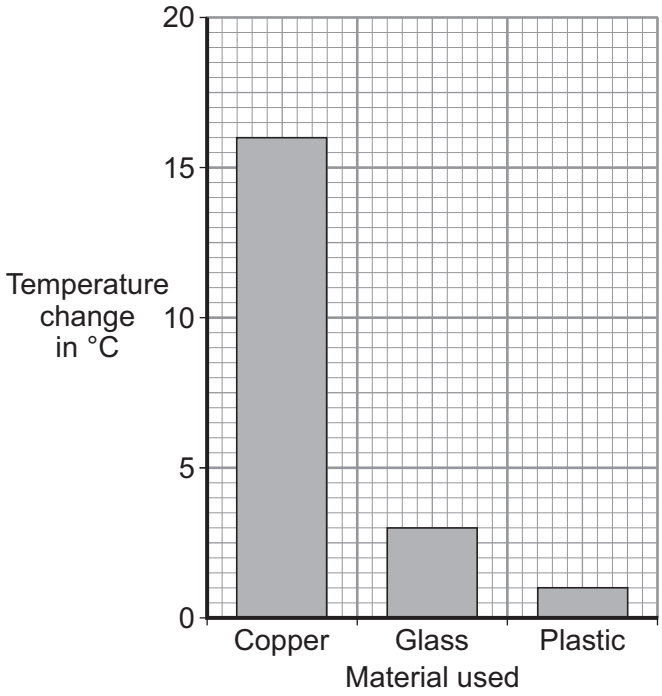
6 (b) The student wanted to find out if the efficiency of a heat exchanger depends on the material used to make the pipe. The student tested three different materials. For each material, the rate of flow of hot water through the pipe was kept the same.

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 31 · continued



6 (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)

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

.....

.....

(1 mark)

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

.....

Give a reason for your answer.

.....

.....

.....

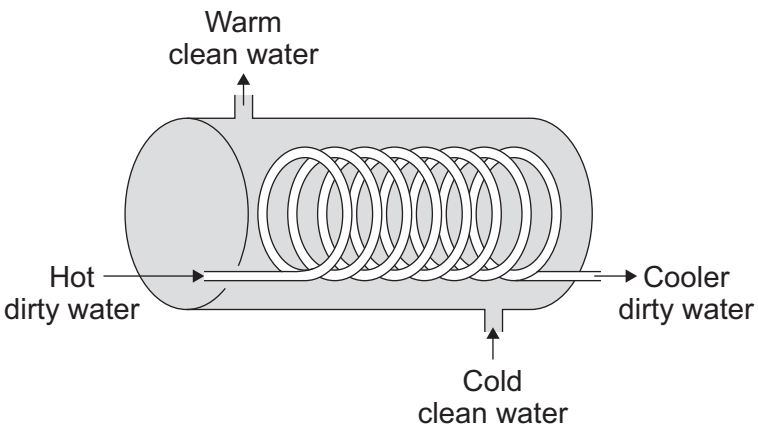
(2 marks)

Question 6 continues on the next page

4.1.2.1 Energy transfers in a system

Question 31 · continued

6 (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

Turn to page 18 for Question 7

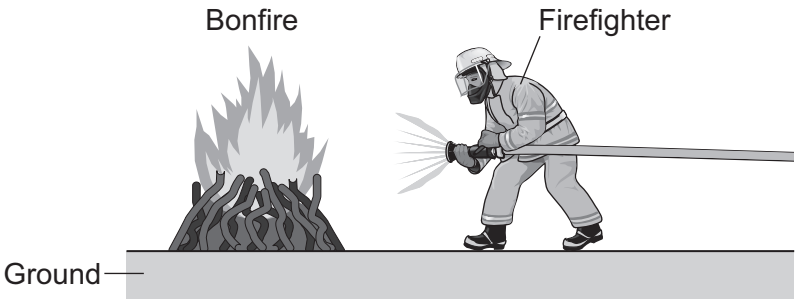
4.1.2.1 Energy transfers in a system

Question 32

November 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The drawing shows a firefighter putting out a bonfire. The firefighter wears thick, woollen clothing. The clothing has a light-coloured, shiny surface.



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

A conduction

B insulation

C radiation

D reflection

Heat is transferred from the fire to the firefighter's clothing by . . . **1** . . . .

The ground underneath the fire will get hot when heat is transferred to it by . . . **2** . . . .

The thick, woollen clothing provides good heat . . . **3** . . . .

The light-coloured, shiny surface of the clothing provides good . . . **4** . . . of infra red.

4.1.2.1 Energy transfers in a system

Question 33

November 2010 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

An inventor has designed a way of charging a mobile phone battery as a person is walking. The charger unit contains a generator. The unit is strapped to a leg.



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

A chemical

B electrical

C heat

D kinetic

As the person walks, . . . **1** . . . energy from food is transformed to . . . **2** . . . energy of the moving legs.

The generator produces useful . . . **3** . . . energy.

Some energy is wasted as . . . **4** . . . .

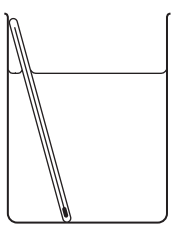
4.1.2.1 Energy transfers in a system

Question 34

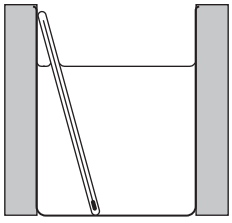
November 2010 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

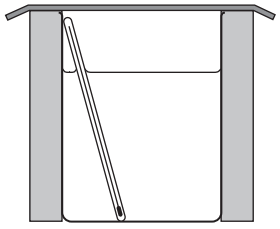
A student investigated the cooling of a hot liquid. She used three identical beakers that contained equal volumes of water. Two of the beakers were insulated and one beaker also had a lid. The water temperature in each beaker started at 90 °C.



No insulation



Insulation



Insulation and lid

She recorded the temperature decrease of the water in each beaker after 10 minutes.

Her results are shown in the table.

Method of insulation	Temperature decrease in °C
no insulation	30
insulation	25
insulation and lid	10

7A The method of insulation is a . . .

1 categoric variable.

2 continuous variable.

3 control variable.

4 ordered variable.

7B The best way to display the results in the table would be a . . .

1 bar chart.

2 line graph.

3 pie chart.

4 scattergram.

4.1.2.1 Energy transfers in a system

Question 34 · continued

7C She repeated the experiment with a starting temperature of 70 °C instead of 90 °C.

The temperature decrease after 10 minutes was smaller than before in . . .

1 only the beaker with no insulation.

2 only the beaker with insulation.

3 only the beaker with insulation and lid.

4 all three beakers.

7D The lid stopped hot air rising.

This reduced heat loss by . . .

1 conduction only.

2 convection only.

3 radiation only.

4 conduction, convection and radiation.

4.1.2.1 Energy transfers in a system

Question 35

January 2011 | PHY1F | Original Q4 | Legacy

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

conduction	convection	radiation

4 (a) (i) The transfer of thermal energy (heat) by the movement of hot liquids

is called ..... .

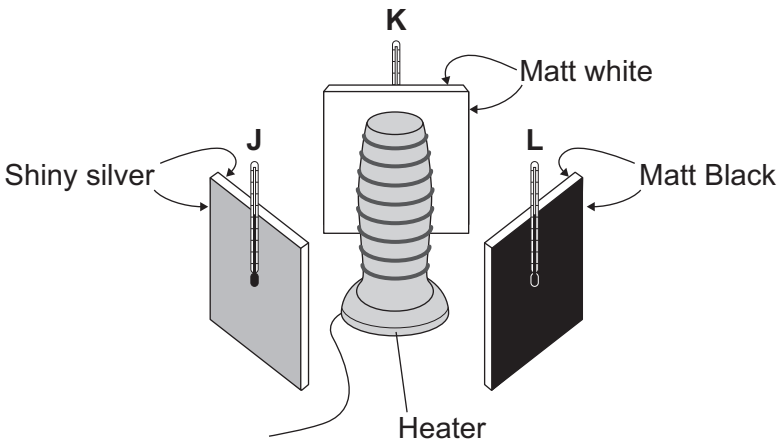
(1 mark)

4 (a) (ii) The transfer of thermal energy (heat) from one particle to another

is called ..... .

(1 mark)

4 (b) A student set up the following equipment. The 3 metal plates are the same distance from the heater. The surfaces of each of the 3 metal plates are different colours.



The student switched the heater on for 10 minutes. The thermometers were read before the heater was switched on. The thermometers were read again just after the heaters were switched off.
The readings are shown in the table.

	Temperature before switching on in °C	Temperature after switching on in °C
1	19	21
2	19	29
3	19	23

4.1.2.1 Energy transfers in a system

Question 35 · continued

4 (b) (i) Which set of readings, **1**, **2** or **3**, is most likely to have been taken from the thermometer labelled **L**?

.....

Give a reason for your answer.

.....

.....

(2 marks)

4 (b) (ii) Which **one** of the following was **not** a control variable in this experiment?

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

the distance between the heater and the metal plates ☐

the power of the heater ☐

the temperature before the heater was switched on ☐

the colour of the metal plates ☐

(1 mark)

4 (b) (iii) Suggest **one** advantage of using a temperature sensor, data logger and computer, rather than a thermometer to carry out this experiment.

.....

.....

(1 mark)

Question 4 continues on the next page

4.1.2.1 Energy transfers in a system

Question 35 · continued

4 (c) The picture shows a fire fighter putting out a forest fire. The fire fighter's clothing has thick thermal padding inside and a light coloured, fire proof, shiny layer outside.



4 (c) (i) What is the main way that heat is transferred through the air from the fire to the fire fighter?

.....

.....

(1 mark)

4 (c) (ii) Why is the outside layer of the clothing shiny?

.....

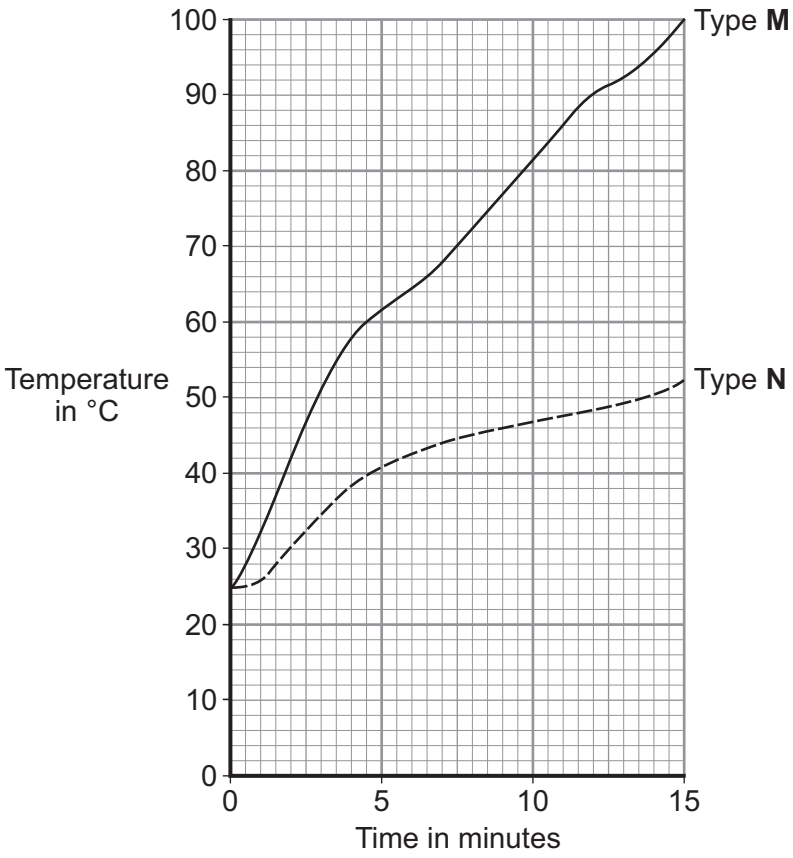
.....

(1 mark)

4.1.2.1 Energy transfers in a system

Question 35 · continued

4 (d) The graph shows the result of a laboratory test on two types of thermal padding. Each type of padding was put onto a very hot metal surface and the temperature inside the padding was taken every minute.



Which type of padding, **M** or **N**, would it be best to use inside the fire fighter's clothing?

.....

Give a reason for your answer.

.....

.....

(1 mark)

9

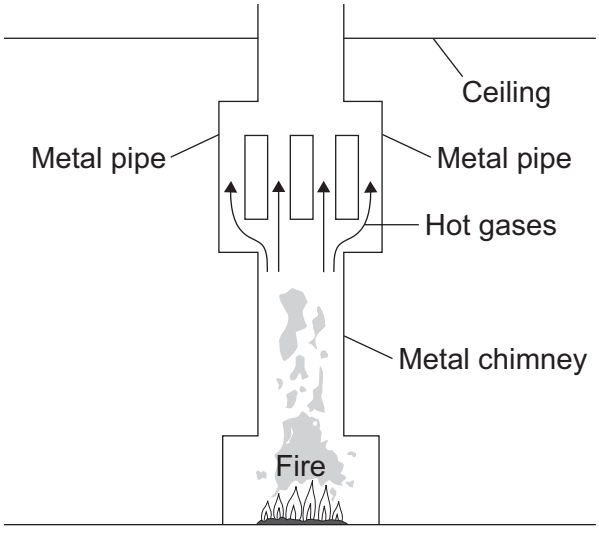
4.1.2.1 Energy transfers in a system

Question 36

March 2011 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

The diagram shows a special design of chimney inside a house.



The metal chimney divides into four thinner pipes. These thinner pipes join up again just below the ceiling.

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

A conduction

B convection

C insulation

D radiation

The chimney is made of metal and this helps to transfer heat by . . . **1**. . . .

Hot gases from the fire rise up the chimney by . . . **2** . . . .

The chimney is split into four pipes to increase the surface area.

The large surface area increases the rate of heat transfer from the metal surface by . . . **3** . . . .

The transfer of heat to the room is helped because there is no . . . **4** . . . on the outside of the metal chimney.

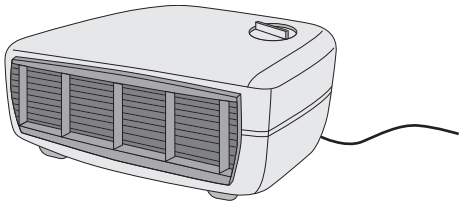
4.1.2.1 Energy transfers in a system

Question 37

March 2011 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

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



Fan heater

9A 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.

9B 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.

9C 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 37 · continued

9D 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

END OF TEST

4.1.2.1 Energy transfers in a system

Question 38

June 2011 | PHY2F | Original Q6 | Legacy

6 **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.

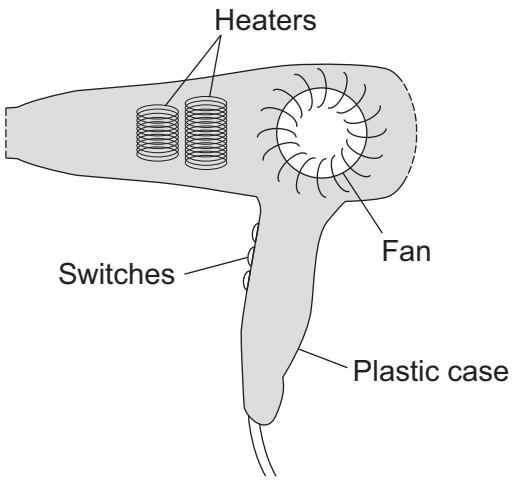


Diagram 1

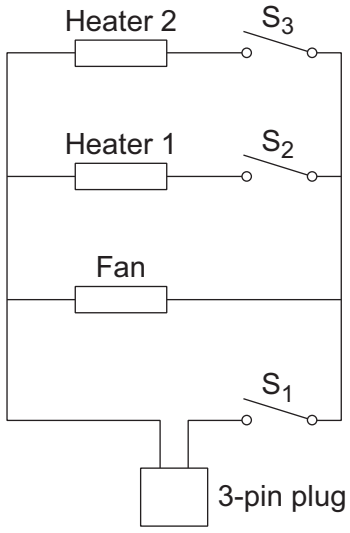


Diagram 2

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

.....

(1 mark)

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

.....

.....

(1 mark)

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

6 (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 38 · continued

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

Explain why.

.....

.....

.....

.....

.....

(2 marks)

6 (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 39

November 2011 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

A gym uses exercise bikes to generate electricity.



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

A chemical

B electrical

C heat (thermal energy)

D kinetic

The bike riders transform . . . **1** . . . energy from food into . . . **2** . . . energy of the pedals.

A generator produces . . . **3** . . . energy.

Some energy is wasted as . . . **4** . . . .

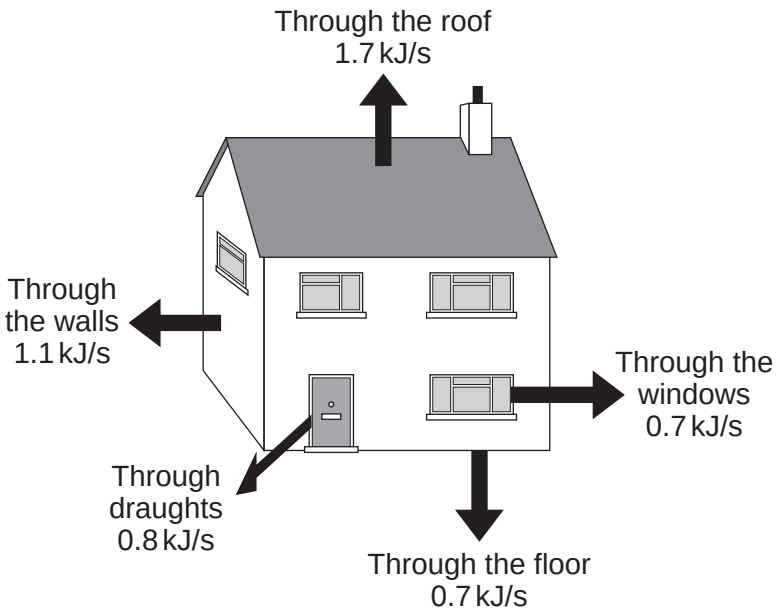
4.1.2.1 Energy transfers in a system

Question 40

January 2013 | PH1FP | Original Q9 | Legacy

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

Diagram 1



9 (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 40 · continued

9 (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)

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

Calculate the cost of heating the house for one day.

.....

Cost = ...

(1 mark)

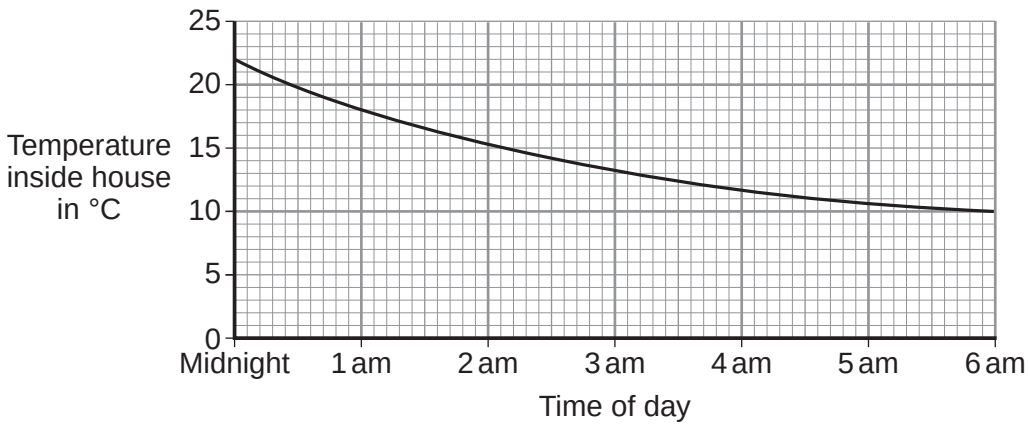
Question 9 continues on the next page

4.1.2.1 Energy transfers in a system

Question 40 · continued

9 (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.

.....

.....

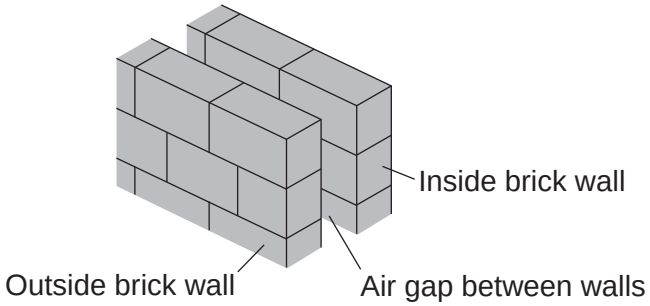
(2 marks)

4.1.2.1 Energy transfers in a system

Question 40 · continued

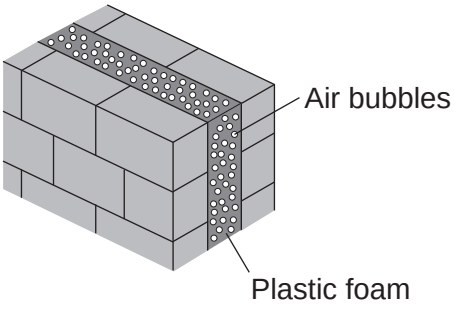
9 (b) **Diagram 2** shows how the walls of the house are constructed.
Diagram 3 shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

Diagram 2



U-value of the wall = 0.7

Diagram 3



U-value of the wall = 0.3

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

Explain why.

.....

.....

.....

.....

(2 marks)

9 (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 9 continues on the next page

4.1.2.1 Energy transfers in a system

Question 40 · continued

9 (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)

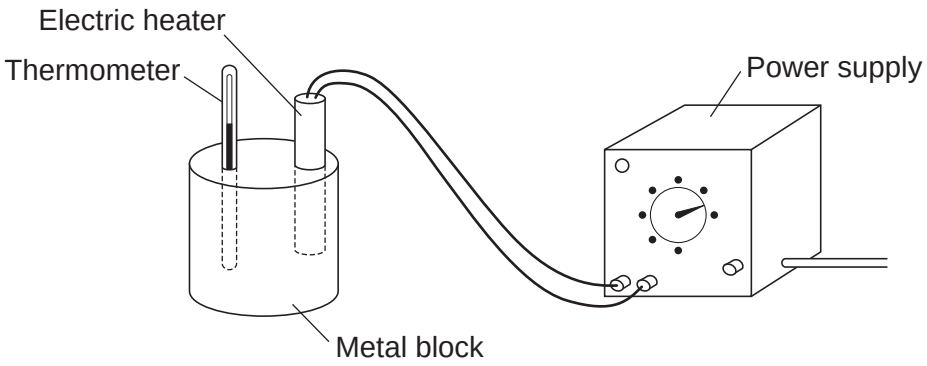
11

4.1.2.1 Energy transfers in a system

Question 41

June 2013 | PH1FP | Original Q6 | Legacy

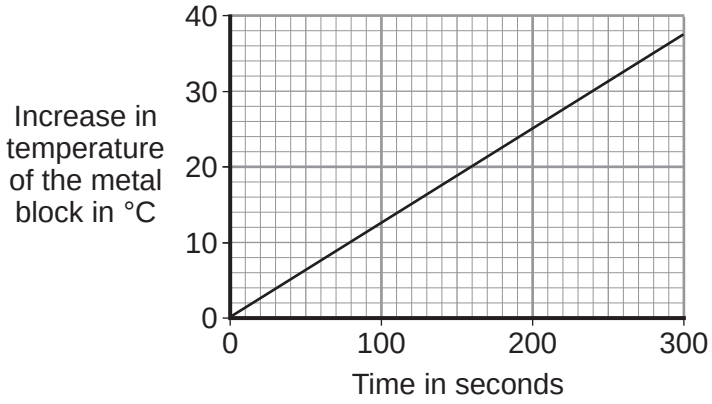
6 (a) A student used the apparatus drawn below to investigate the heating effect of an electric heater.



6 (a) (i) Before starting the experiment, the student drew **Graph A**.

Graph A shows how the student expected the temperature of the metal block to change after the heater was switched on.

Graph A



Describe the pattern shown in **Graph A**.

.....

.....

.....

.....

(2 marks)

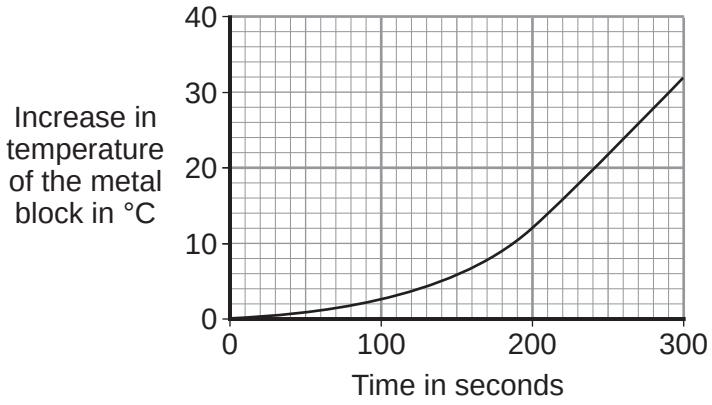
4.1.2.1 Energy transfers in a system

Question 41 · continued

6 (a) (ii) The student measured the room temperature. He then switched the heater on and measured the temperature of the metal block every 50 seconds.

The student calculated the increase in temperature of the metal block and plotted **Graph B**.

Graph B



After 300 seconds, **Graph B** shows the increase in temperature of the metal block is lower than the increase in temperature expected from **Graph A**.

Suggest **one** reason why.

.....

.....

(1 mark)

6 (a) (iii) The power of the electric heater is 50 watts.

Calculate the energy transferred to the heater from the electricity supply in 300 seconds.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Energy transferred = ... J

(2 marks)

Question 6 continues on the next page

4.1.2.1 Energy transfers in a system

Question 41 · continued

6 (b) The student uses the same heater to heat blocks of different metals. Each time the heater is switched on for 300 seconds.

Each block of metal has the same mass but a different specific heat capacity.

Metal	Specific heat capacity in J/kg°C
Aluminium	900
Iron	450
Lead	130

Which **one** of the metals will heat up the most?

Draw a ring around the correct answer.

aluminium **iron** **lead**

Give, in terms of the amount of energy needed to heat the metal blocks, a reason for your answer.

.....

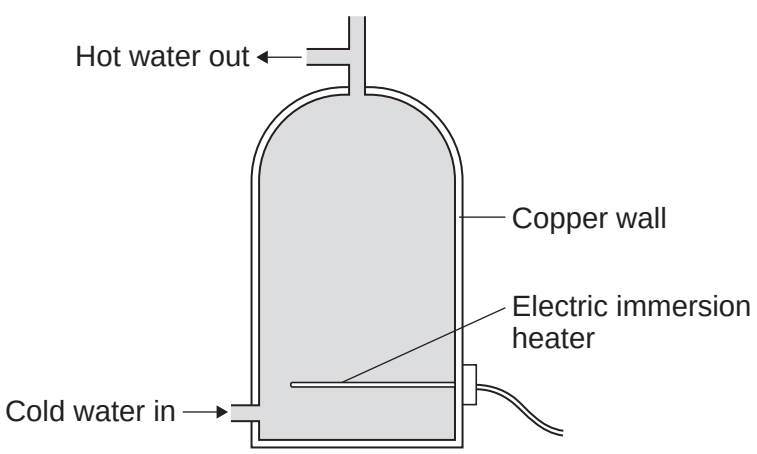
.....

.....

.....

(2 marks)

6 (c) A homeowner uses an electric immersion heater to heat the water in his hot water tank. The hot water tank has no insulation.



4.1.2.1 Energy transfers in a system

Question 41 · continued June 2013 | PH1FP | Original Q6 | Legacy

6 (c) (i) Draw a ring around the correct answer to complete each sentence.

Energy is transferred through the water by

conduction.
convection.
evaporation.

Energy is transferred through the copper wall of the hot water tank by

conduction.
convection.
evaporation.

(2 marks)

6 (c) (ii) To keep the water in the tank hot for longer, the homeowner fits an insulating jacket around the tank. The insulating jacket costs £12 to buy.

The homeowner expects to save £16 each year from reduced energy bills.

Calculate the pay-back time for the insulating jacket.

.....

.....

Pay-back time = ... years
(2 marks)

11

4.1.2.1 Energy transfers in a system

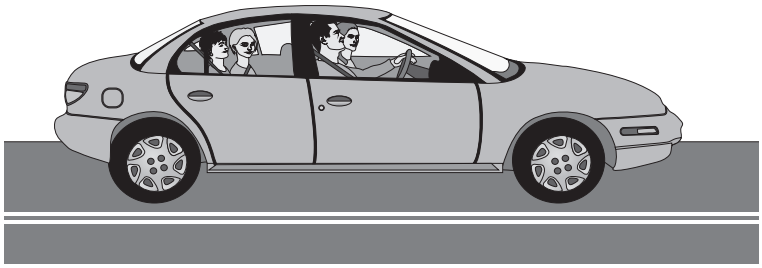
Question 42

June 2014 | PH1FP | Original Q1 | Legacy

1 **Figure 1** shows a car with an electric motor.

The car is moving along a flat road.

Figure 1



1 (a) (i) Use the correct answers from the box to complete each sentence.

[3 marks]

light	electrical	kinetic	potential	sound

The car's motor transfers ..... energy

into useful ..... energy as the car moves.

Some energy is wasted as ..... energy.

1 (a) (ii) What happens to the wasted energy?

[1 mark]

.....

.....

4.1.2.1 Energy transfers in a system

Question 42 · continued

1 (b) The electric motor has an input energy of 50 000 joules each second.

The motor transfers 35 000 joules of useful energy each second.

Calculate the efficiency of the electric motor.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Efficiency = ...

6

Turn over for the next question

4.1.2.1 Energy transfers in a system

Question 43

June 2014 | PH1FP | Original Q3 | Legacy

3 Energy can be transferred through some materials by convection.

3 (a) Use the correct answer from the box to complete the sentence.

[1 mark]

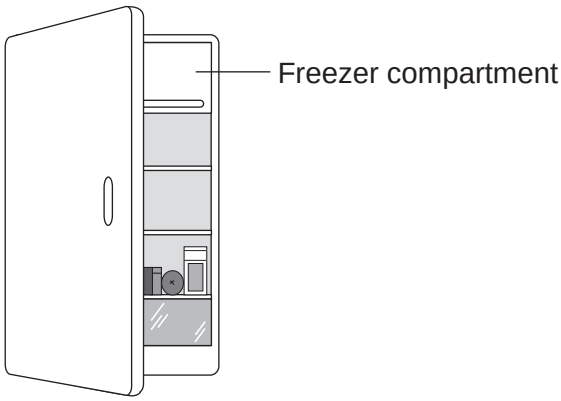
gas	liquid	solid

Energy **cannot** be transferred by convection through a ..... .

3 (b) **Figure 4** shows a fridge with a freezer compartment.

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

Figure 4



Use the correct answer from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

[3 marks]

decreased	unchanged	increased

When the air near the freezer compartment is cooled, the energy of the air particles is ..... .

The spaces between the air particles are ..... .

The density of the air is ..... .

4.1.2.1 Energy transfers in a system

Question 43 · continued

3 (c) **Table 1** shows some information about three fridges, **A**, **B** and **C**.

The efficiency of each fridge is the same.

Table 1

Fridge	Volume in litres	Energy used in one year in kWh
A	232	292
B	382	409
C	622	524

3 (c) (i) Which fridge, **A**, **B** or **C**, would cost the least to use for 1 year?

[2 marks]

Give **one** reason for your answer.

.....

.....

3 (c) (ii) A householder looks at the data in **Table 1**.

What should she conclude about the pattern linking the volume of the fridge and the energy it uses in one year?

[1 mark]

.....

.....

3 (c) (iii) The householder could not be certain that her conclusion is correct for all fridges.

Suggest **one** reason why not.

[1 mark]

.....

.....

8

4.1.2.1 Energy transfers in a system

Question 44

June 2014 | PH1FP | Original Q5 | Legacy

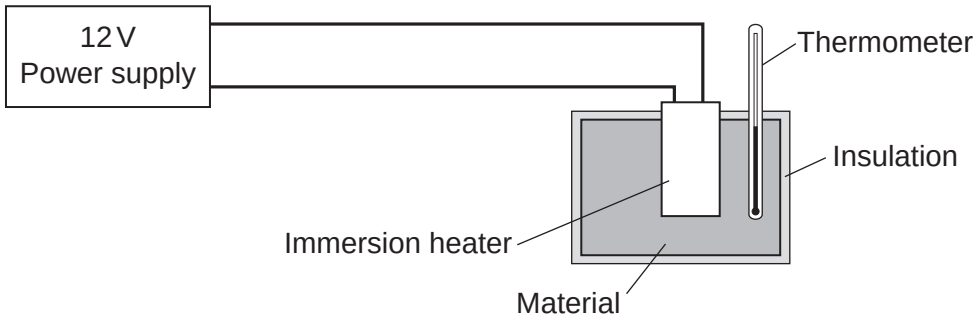
5 A student used the apparatus in **Figure 5** to compare the energy needed to heat blocks of different materials.

Each block had the same mass.

Each block had holes for the thermometer and the immersion heater.

Each block had a starting temperature of 20 °C.

Figure 5



The student measured the time taken to increase the temperature of each material by 5 °C.

5 (a) (i) State **two** variables the student controlled.

[2 marks]

1 .....

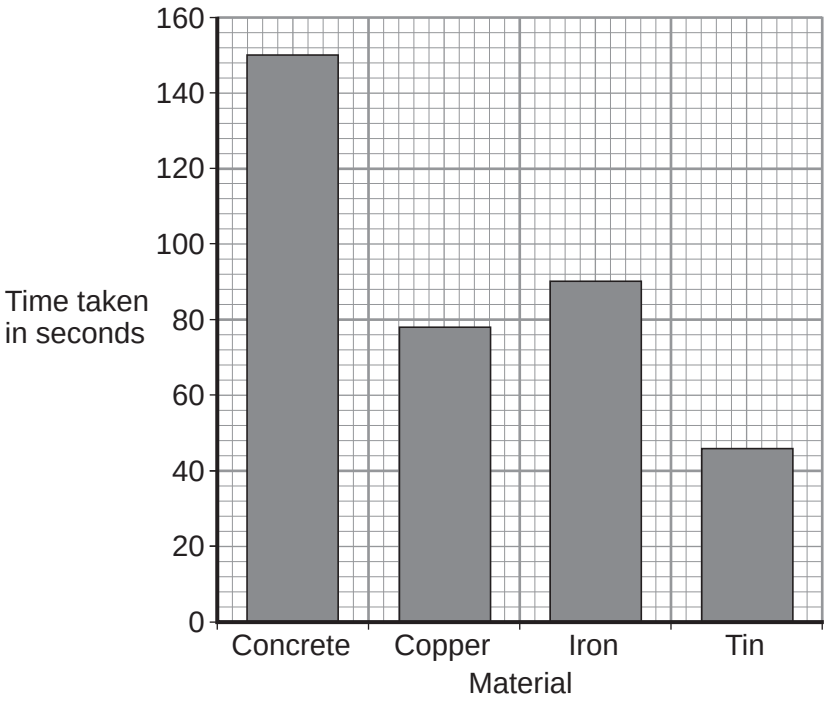
2 .....

4.1.2.1 Energy transfers in a system

Question 44 · continued

Figure 6 shows the student's results.

Figure 6



5 (a) (ii) Why was a bar chart drawn rather than a line graph?

[1 mark]

.....

.....

5 (a) (iii) Which material was supplied with the most energy?

.....

Give the reason for your answer.

[2 marks]

.....

.....

Question 5 continues on the next page

4.1.2.1 Energy transfers in a system

Question 44 · continued

5 (a) (iv) The iron block had a mass of 2 kg.

Calculate the energy transferred by the heater to increase the temperature of the iron block by 5 °C.

Use the correct equation from the Physics Equations Sheet.

The specific heat capacity of iron is 450 J/kg °C.

[2 marks]

.....

.....

.....

Energy transferred = ... J

4.1.2.1 Energy transfers in a system

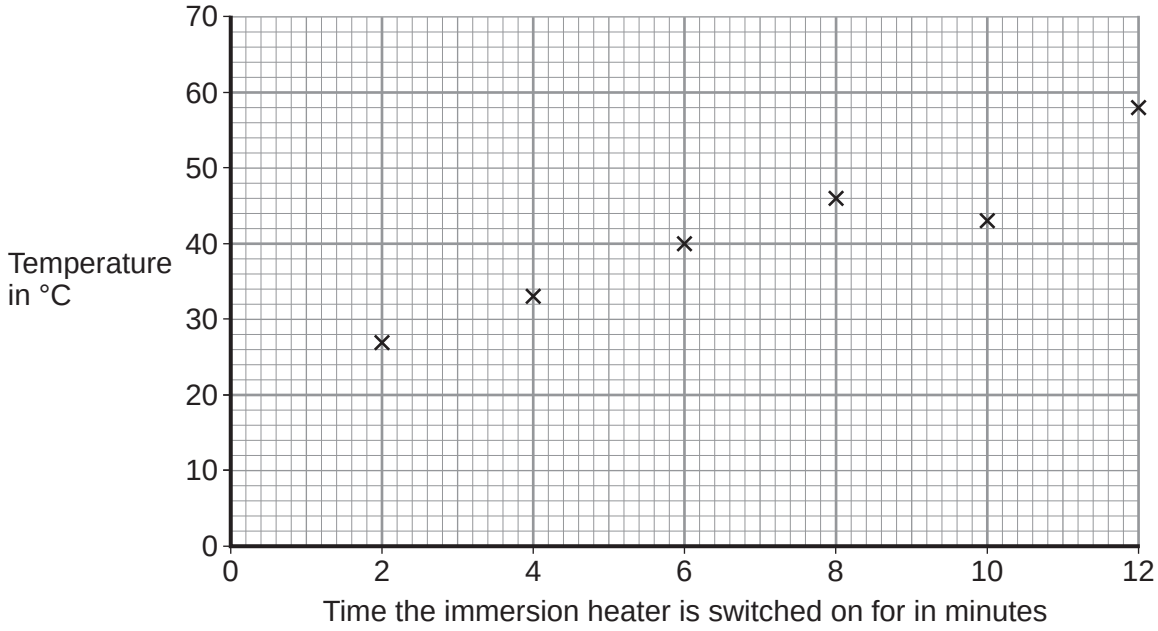
Question 44 · continued

5 (b) The student used the same apparatus to heat a 1 kg block of aluminium.

He recorded the temperature of the block as it was heated from room temperature.

The results are shown in **Figure 7.**

Figure 7



5 (b) (i) One of the student's results is anomalous.

Draw a ring around the anomalous result.

[1 mark]

5 (b) (ii) Draw the line of best fit for the points plotted in **Figure 7**.

[1 mark]

5 (b) (iii) What was the temperature of the room?

[1 mark]

Temperature = ... °C

5 (b) (iv) What was the interval of the time values used by the student?

[1 mark]

Interval = ... minutes

11

4.1.2.1 Energy transfers in a system

Question 45

June 2015 | PH1FP | Original Q3 | Legacy

3 **Figure 4** shows a black metal casserole dish that is put inside a hot oven. Food is cooked inside the casserole dish.

Figure 4



3 (a) Energy is transferred quickly from the inside of the hot oven, through the metal casserole dish to the food.

3 (a) (i) Why are metals good conductors of energy?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
because they contain free atoms	
because they contain free electrons	
because they contain free ions	

Question 3 continues on the next page

4.1.2.1 Energy transfers in a system

Question 45 · continued

3 (a) (ii) Why do black surfaces become hot quickly?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
Because they are good absorbers of infrared radiation.	
Because they are good absorbers of ultraviolet radiation.	
Because they are good absorbers of visible light.	

3 (b) **Figure 5** shows a person removing a hot casserole dish from an oven, using oven gloves.

Figure 5



3 (b) (i) Use the correct answer from the box to complete the sentence.

[1 mark]

conductors	insulators	radiators

The oven gloves are good ..... .

4.1.2.1 Energy transfers in a system

Question 45 · continued

3 (b) (ii) How would wearing oven gloves affect the rate of energy transfer to a person's hands compared with not wearing oven gloves?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
The rate of energy transfer would be higher.	
The rate of energy transfer would be lower.	
The rate of energy transfer would stay the same.	

3 (c) What **two** factors determine the amount of energy transferred by an electric oven?

[2 marks]

1 .....

2 .....

3 (d) A company has invented an 'app' that allows householders to control the electric oven in their home using their mobile phone.
The mobile phone can be used to switch the electric oven on and off.

Suggest **one** benefit of using a mobile phone to switch an electric oven on and off.

[1 mark]

.....

.....

7

4.1.2.1 Energy transfers in a system

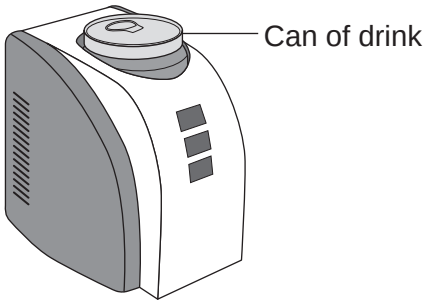
Question 46

June 2015 | PH1FP | Original Q4 | Legacy

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

Figure 6 shows a can-chiller.

Figure 6



4 (a) The can-chiller decreases the temperature of the liquid in the can by 15 °C.
The mass of liquid is 0.33 kg.
The specific heat capacity of the liquid is 4200 J/kg °C.

Calculate the energy transferred from the liquid as it cools.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Energy = ... J

4 (b) Complete the following sentence.

[1 mark]

The specific heat capacity of a substance is the amount of energy required to change the ..... of one kilogram of the substance by one degree Celsius.

4.1.2.1 Energy transfers in a system

Question 46 · continued

4 (c) To calculate the specific heat capacity of a material, the mass of the material needs to be measured.

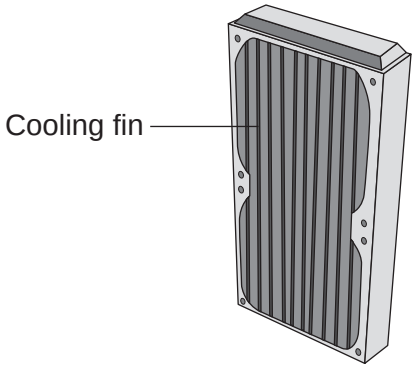
State the name of a measuring instrument used to measure mass.

[1 mark]

.....

4 (d) The back of the can-chiller has cooling fins, as shown in **Figure 7**.

Figure 7



The cooling fins increase the rate of energy transfer from the can-chiller to the surroundings.

Complete the following sentences.

[2 marks]

The cooling fins are a ..... colour because that makes them good emitters of infrared radiation.

The large surface area of the cooling fins allows the air around the can-chiller to gain energy quickly and rise, transferring energy by ..... .

Question 4 continues on the next page

4.1.2.1 Energy transfers in a system

Question 46 · continued

4 (e) (i) The energy input to the can-chiller is the same as the energy output. This shows that energy is conserved.

Complete the following sentence.

[1 mark]

Energy can be transferred usefully, stored or dissipated, but cannot be

..... or destroyed.

4 (e) (ii) The temperature of the can of drink decreases while it is in the can-chiller.

What happens to the temperature of the air around the cooling fins?

[1 mark]

.....

8

4.1.2.1 Energy transfers in a system

Question 47

June 2015 | PH1FP | Original Q7 | Legacy

7 (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]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

4.1.2.1 Energy transfers in a system

Question 47 · continued

Extra space .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

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

[1 mark]

.....

.....

.....

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

[1 mark]

.....

8

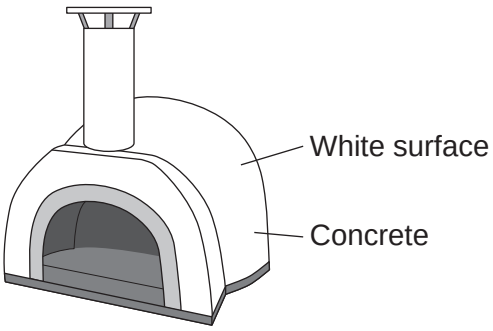
4.1.2.1 Energy transfers in a system

Question 48

June 2017 | PH1FP | Original Q1 | Legacy

1 **Figure 1** shows an outdoor pizza oven.

Figure 1



1 (a) The pizza oven is designed to stay hot for a long time.

Use the correct answer from the box to complete each sentence. Each answer may be used once, more than once or not at all.

[2 marks]

conduction	**convection**	**radiation**

The white surface reduces energy transfer by _____ .

The concrete has a low U-value which means energy is transferred

slowly by _____ .

1 (b) The pizza oven is heated by burning wood.

What type of fuel is wood?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
biofuel	
fossil fuel	
non-renewable fuel	

4.1.2.1 Energy transfers in a system

Question 48 · continued

1 (c) The concrete used to make the pizza oven has a specific heat capacity of 880 J/kg °C
The mass of the concrete is 250 kg

Calculate the energy transferred to the concrete to increase its temperature by 380 °C

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Energy transferred = _____ J

5

Turn over for the next question

4.1.2.1 Energy transfers in a system

Question 49

June 2017 | PH1FP | Original Q9 | Legacy

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

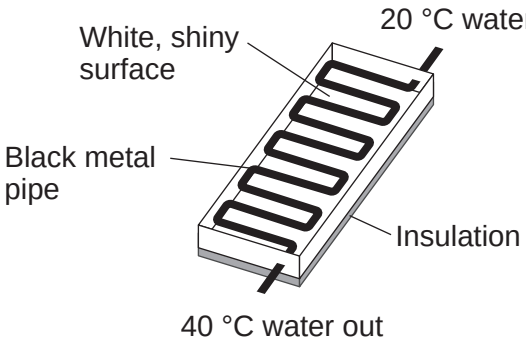
Solar panels use energy from the Sun to heat water.

Two different designs of solar panel are shown in **Figure 14**.

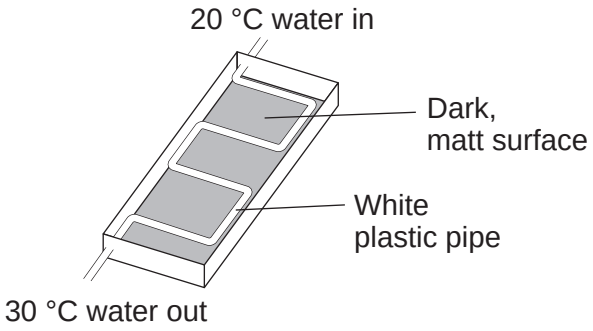
Both designs have the same water flow rate.

Figure 14

Design A



Design B



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

[6 marks]

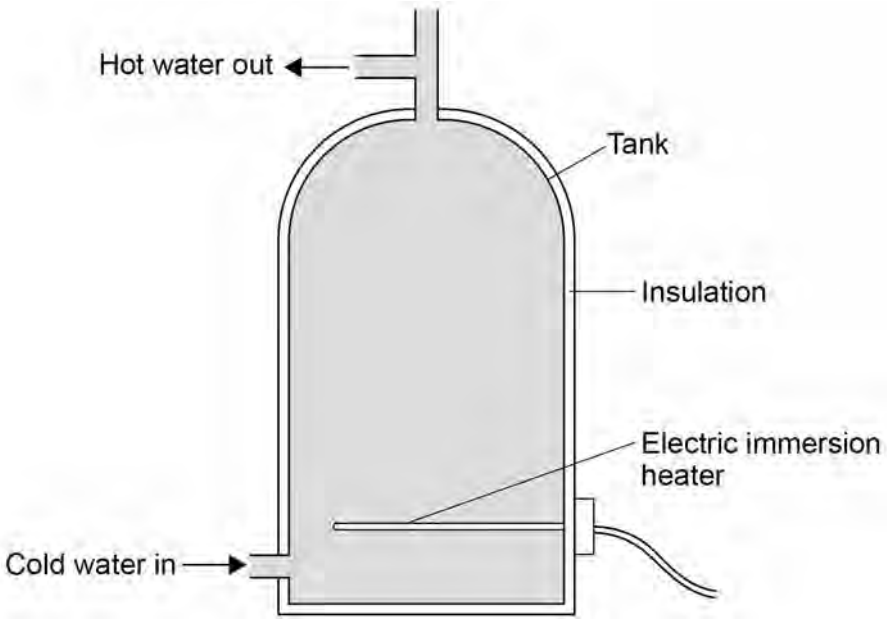
4.1.2.1 Energy transfers in a system

Question 50

June 2018 | 8463/1F | Original Q8

0 8 **Figure 10** shows a hot water tank made of copper.

Figure 10



0 8 . 1 Copper has a higher thermal conductivity than most metals.

How does the rate of energy transfer through copper compare with the rate of energy transfer through most metals?

Tick **one** box.

[1 mark]

Higher ☐

Lower ☐

The same ☐

4.1.2.1 Energy transfers in a system

Question 50 · continued

0 8 . 2 The tank is insulated. When the water is hot, the immersion heater switches off.

Complete the sentences.

[2 marks]

Compared to a tank with no insulation, the rate of energy transfer from the water in an insulated tank is _____ .

This means that the water in the insulated tank stays _____ for longer.

Question 8 continues on the next page

Question 50 · continued

Figure 11 shows how temperature varies with time for water in a tank heated with an immersion heater.

Figure 12 shows how temperature varies with time for water in a tank heated with a solar panel.

Figure 11

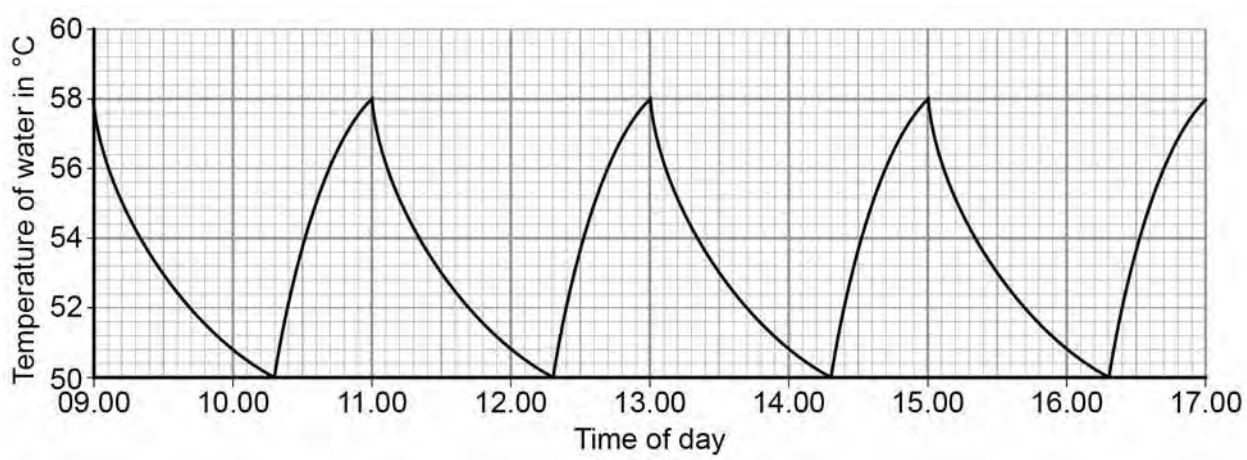
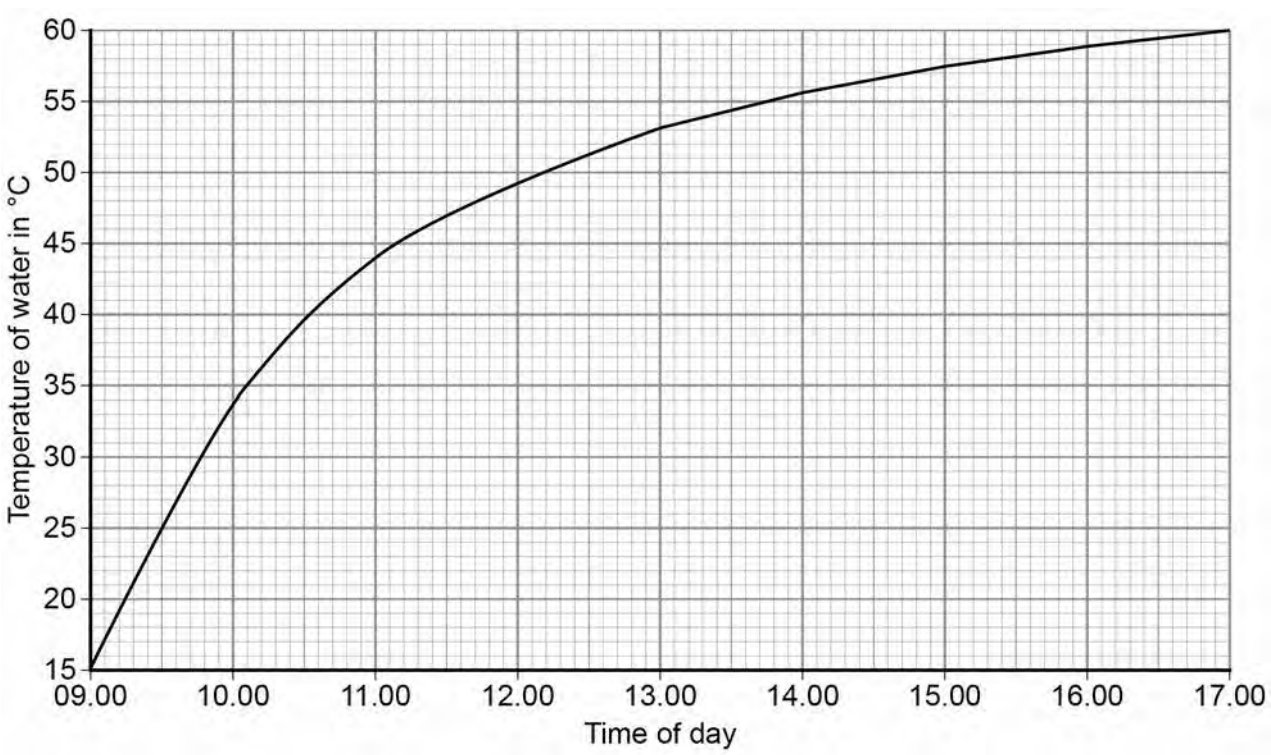


Figure 12



4.1.2.1 Energy transfers in a system

Question 50 · continued

0 8 . 3 Give **one** advantage and **one** disadvantage of heating the water using solar panels rather than an immersion heater.

Use only information from **Figure 11** and **Figure 12**.

[2 marks]

Advantage of solar panels _____

_____

_____

Disadvantage of solar panels _____

_____

_____

0 8 . 4 During one morning, a total of 4 070 000 J of energy is transferred from the electric immersion heater.

4 030 000 J of energy are transferred to the water.

Calculate the proportion of the total energy transferred to the water.

[2 marks]

_____

_____

_____

_____

Proportion of total energy = _____

Question 8 continues on the next page

4.1.2.1 Energy transfers in a system

Question 50 · continued

0 8 . 5 Write down the equation that links energy transferred, power and time.

[1 mark]

0 8 . 6 The power output of the immersion heater is 5000 W.

Calculate the time taken for the immersion heater to transfer 4 070 000 J of energy.

Give the unit.

[4 marks]

Time = _____ Unit _____

1

4.1.2.1 Energy transfers in a system

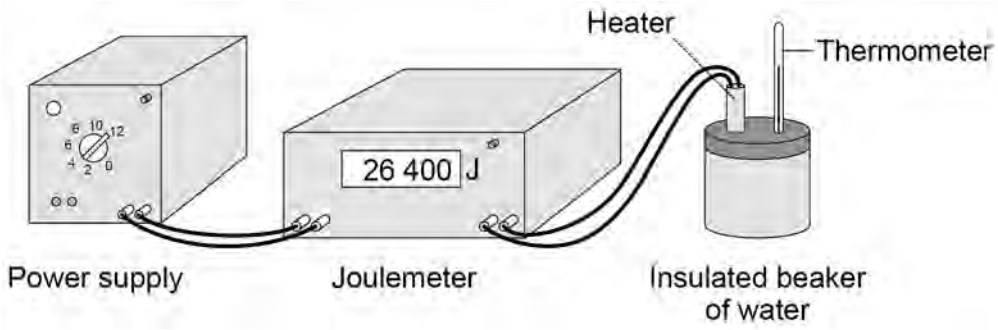
Question 51

June 2019 | 8463/1F | Original Q8

0 8 A student carried out an experiment to determine the specific heat capacity of water.

Figure 12 shows the equipment the student used to heat the water.

Figure 12



0 8 . 1 Why did the student insulate the beaker of water?

[1 mark]

Tick (✓) **one** box.

To increase energy transfer to the surroundings. ☐

To reduce energy transfer to the surroundings. ☐

To stop energy transfer to the surroundings. ☐

0 8 . 2 One hazard in this experiment is the hot water.

Give **one** risk to the student caused by this hazard.

[1 mark]

_____

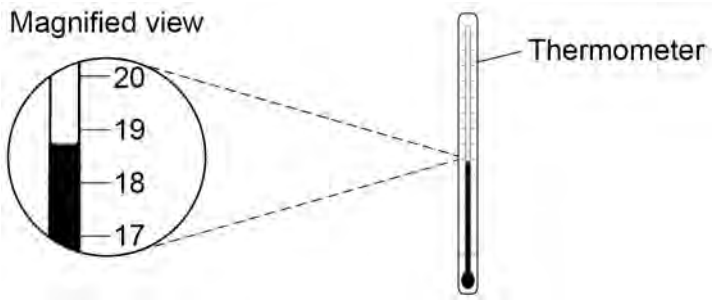
_____

4.1.2.1 Energy transfers in a system

Question 51 · continued

0 8 . 3 **Figure 13** shows the thermometer that the student used.

Figure 13



What is the resolution of the thermometer?

[1 mark]

Tick (✓) **one** box.

1 °C ☐

3 °C ☐

19 °C ☐

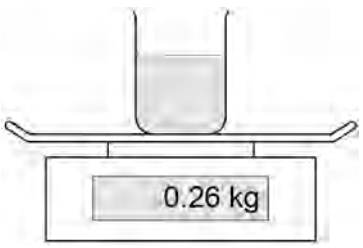
Question 8 continues on the next page

4.1.2.1 Energy transfers in a system

Question 51 · continued

0 8 . 4 **Figure 14** shows the beaker of water on a balance.

Figure 14



The mass of the water was 0.20 kg

What was the mass of the beaker?

[1 mark]

Tick (✓) **one** box.

0.06 kg ☐

0.20 kg ☐

0.26 kg ☐

0.46 kg ☐

4.1.2.1 Energy transfers in a system

Question 51 · continued

0 8 . 5 The energy transferred to the water was 26 400 J

The mass of water was 0.20 kg

The temperature increase of the water was 30 °C

Calculate the specific heat capacity of water using the data from this experiment.

Use the Physics Equations Sheet.

Choose the unit from the box.

[4 marks]

J/kg	J/kg°C	J/°C

Specific heat capacity = _____ Unit _____

8

4.1.2.1 Energy transfers in a system

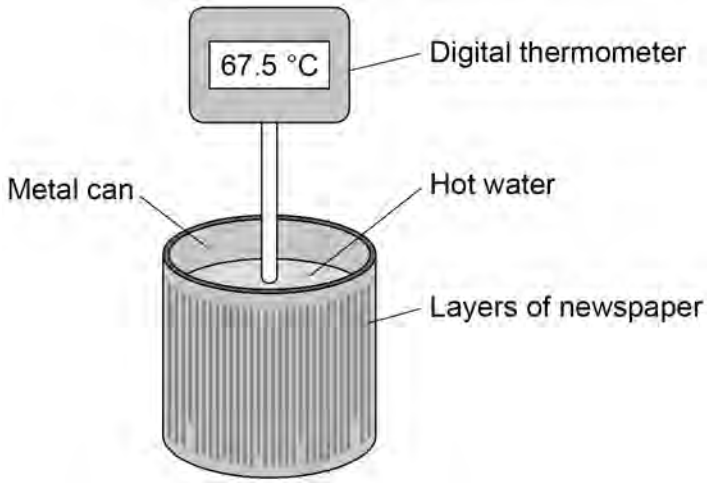
Question 52

June 2019 | 8463/1F | Original Q10

1 0 A student investigated the insulating properties of newspaper.

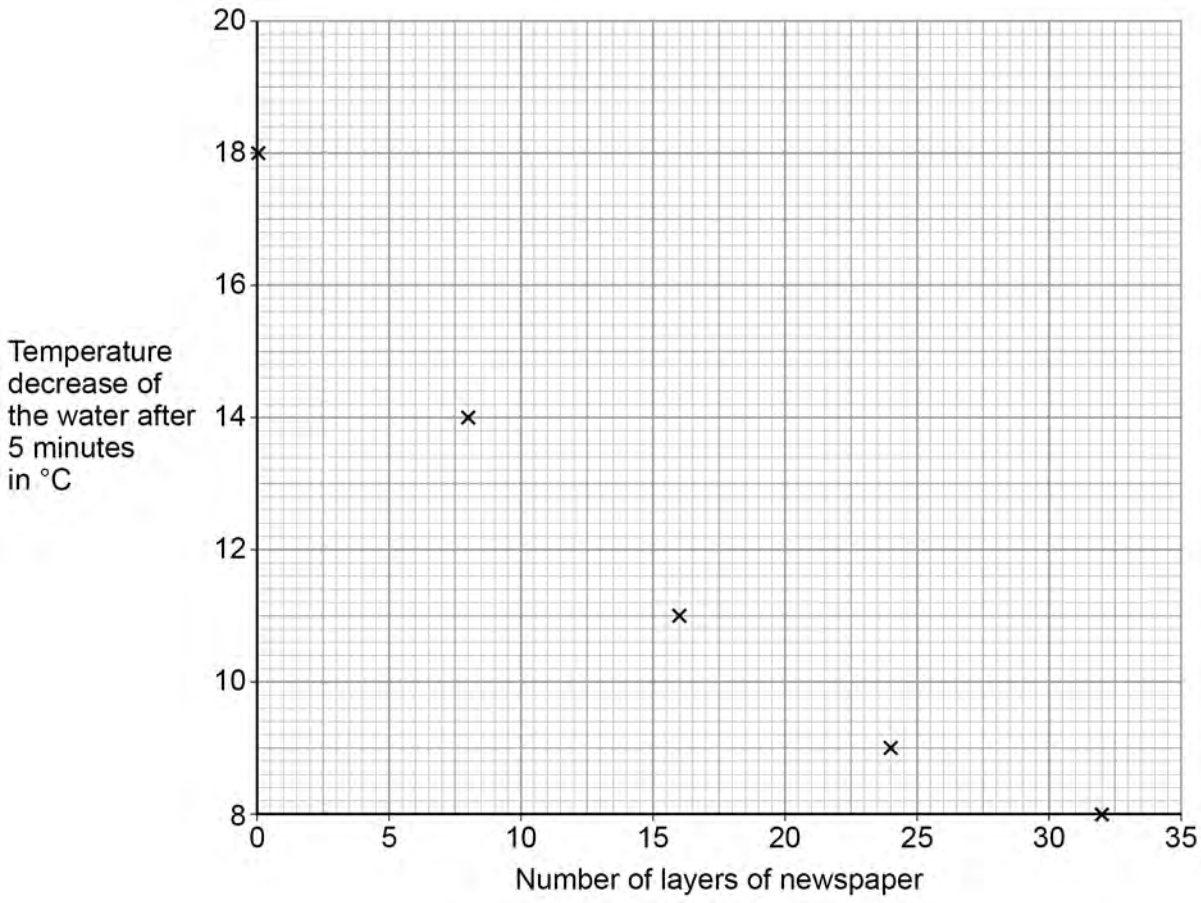
Figure 15 shows the apparatus the student used.

Figure 15



The student's results are shown in **Figure 16**.

Figure 16



4.1.2.1 Energy transfers in a system

Question 52 · continued

June 2019 | 8463/1F | Original Q10

10.1 Describe a method the student could have used to obtain the results shown in **Figure 16**.

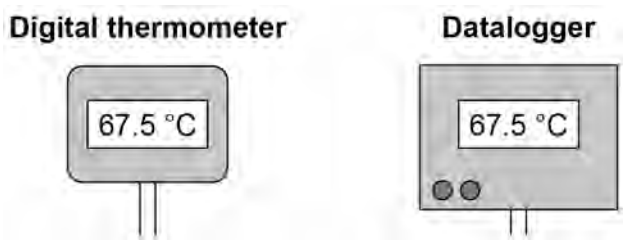
[6 marks]

Question 10 continues on the next page

1 0 . 2 The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 17 shows the readings on the digital thermometer and the datalogger.

Figure 17



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

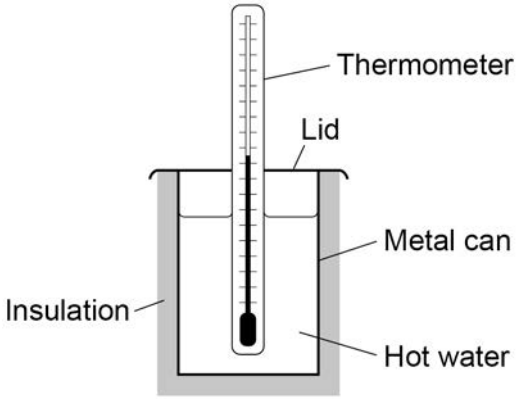
Question 53

0 8 A student investigated the insulating properties of two different materials.

The same thickness of each material was used.

Figure 9 shows some of the equipment used by the student.

Figure 9



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

Figure 10 shows a reading on each thermometer.

Figure 10



0 8 . 1 What is the resolution of thermometer **B**?

[1 mark]

Tick (✓) **one** box.

- 0.1 °C ☐
- 0.4 °C ☐
- 67.0 °C ☐
- 67.4 °C ☐

4.1.2.1 Energy transfers in a system

Question 53 · continued

0 8 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

a smaller	**the same**	**a bigger**

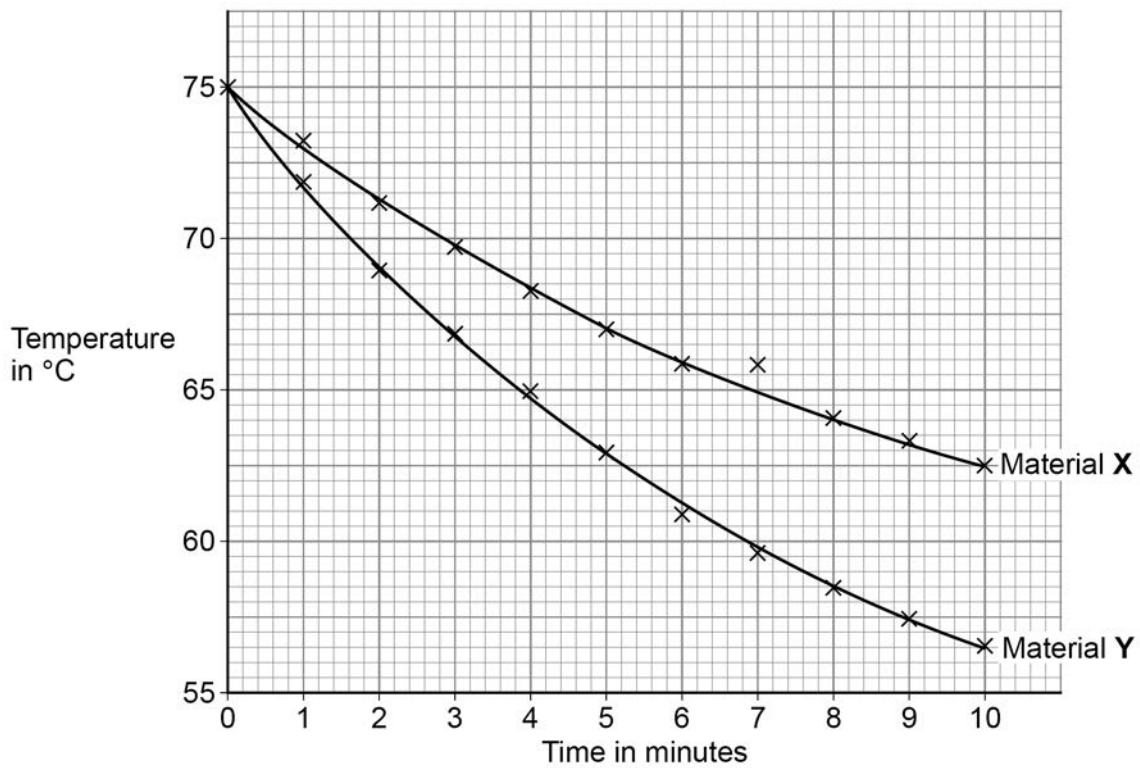
Thermometer **A** has _____ chance of being misread than thermometer **B**.

Question 8 continues on the next page

Question 53 · continued

Figure 11 shows the results.

Figure 11



0 8 . 3 The mass of water used was 0.12 kg.

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

Determine the total change in thermal energy of the water when Material **X** was used.

Use values from **Figure 11**.

Use the Physics Equations Sheet.

[4 marks]

Total change in thermal energy = _____ J

4.1.2.1 Energy transfers in a system

Question 53 · continued

0 8 . 4 There is an anomalous result on **Figure 11**.

Draw a ring around the anomalous result.

[1 mark]

0 8 . 5 Give **two** conclusions that can be made from **Figure 11**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

Question 8 continues on the next page

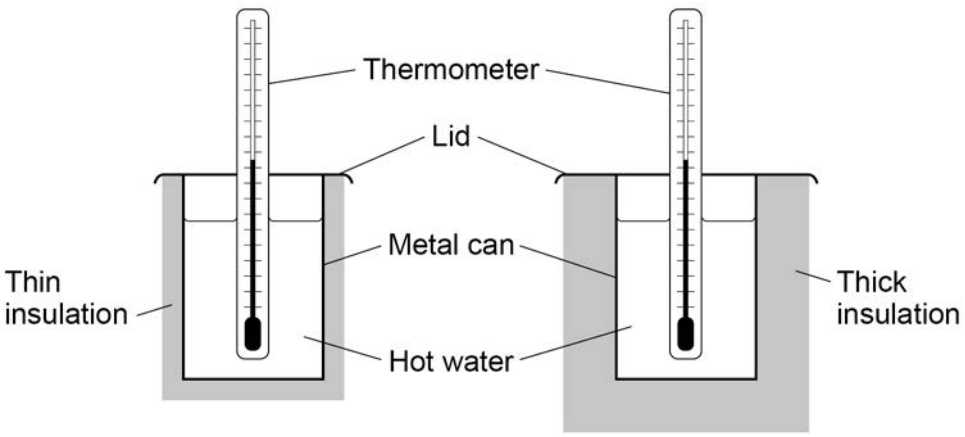
4.1.2.1 Energy transfers in a system

Question 53 · continued

Another student investigated how the thickness of the insulation affected the rate of cooling of hot water.

Figure 12 shows some of the equipment used.

Figure 12



0 8 . 6 How would using thick insulation affect the rate of cooling of hot water compared with using thin insulation?

[1 mark]

Tick (✓) **one** box.

The rate of cooling would be higher. ☐

The rate of cooling would be lower. ☐

The rate of cooling would not change. ☐

0 8 . 7 Predict how using thick insulation would affect the temperature of the water after 10 minutes compared with using thin insulation.

[1 mark]

Tick (✓) **one** box.

The temperature would be higher. ☐

The temperature would be lower. ☐

The temperature would be the same. ☐

11

4.1.2.1 Energy transfers in a system

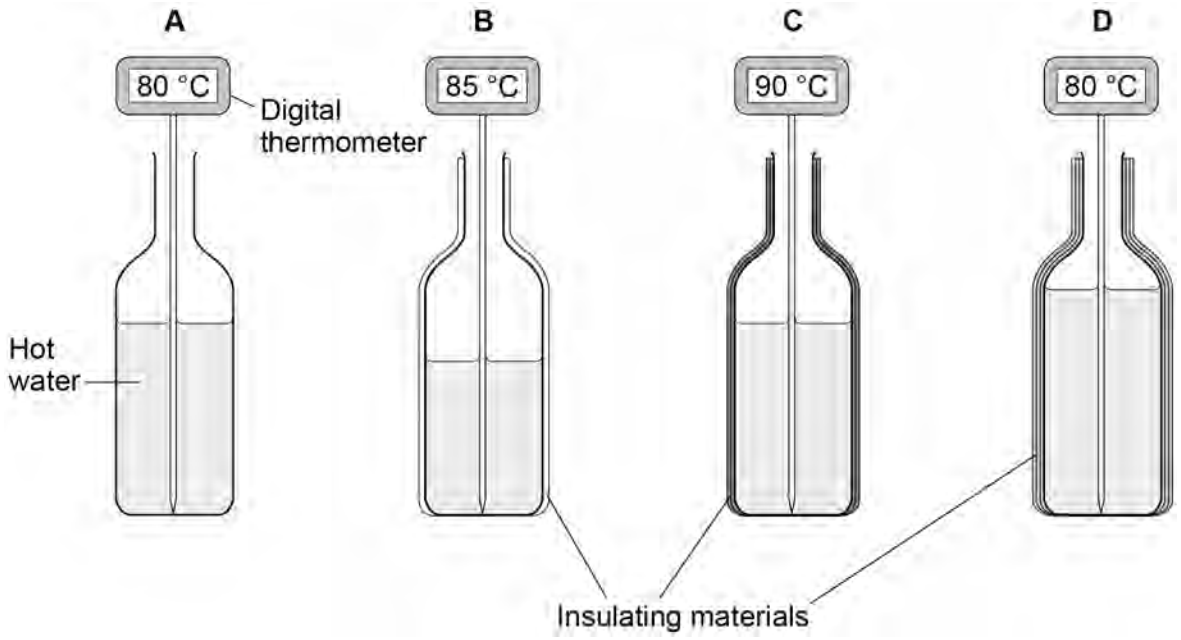
Question 54

June 2023 | 8463/1F | Original Q5

0 5 A student investigated how different insulating materials affect the energy transfer from bottles of very hot water.

Figure 6 shows some of the equipment used.

Figure 6



0 5 . 1 To prevent spillages the student used a funnel to pour very hot water into each bottle.

Why did the student use the funnel?

[1 mark]

Tick (✓) **one** box.

Preventing spillages was a control variable. ☐

To make the investigation valid. ☐

Using the funnel was a safety precaution. ☐

4.1.2.1 Energy transfers in a system

Question 54 · continued

0 5 . 2 Why did the student **not** use insulation for bottle **A**?

[1 mark]

Tick (✓) **one** box.

Bottle **A** was the control. ☐

Bottle **A** was the fair test. ☐

Bottle **A** was the independent variable. ☐

Question 5 continues on the next page

4.1.2.1 Energy transfers in a system

Question 54 · continued

The student recorded how much the temperature of the water in each bottle changed in five minutes.

0 5 . 3 What equipment could the student use to measure time?

[1 mark]

0 5 . 4 **Table 4** shows the results.

Table 4

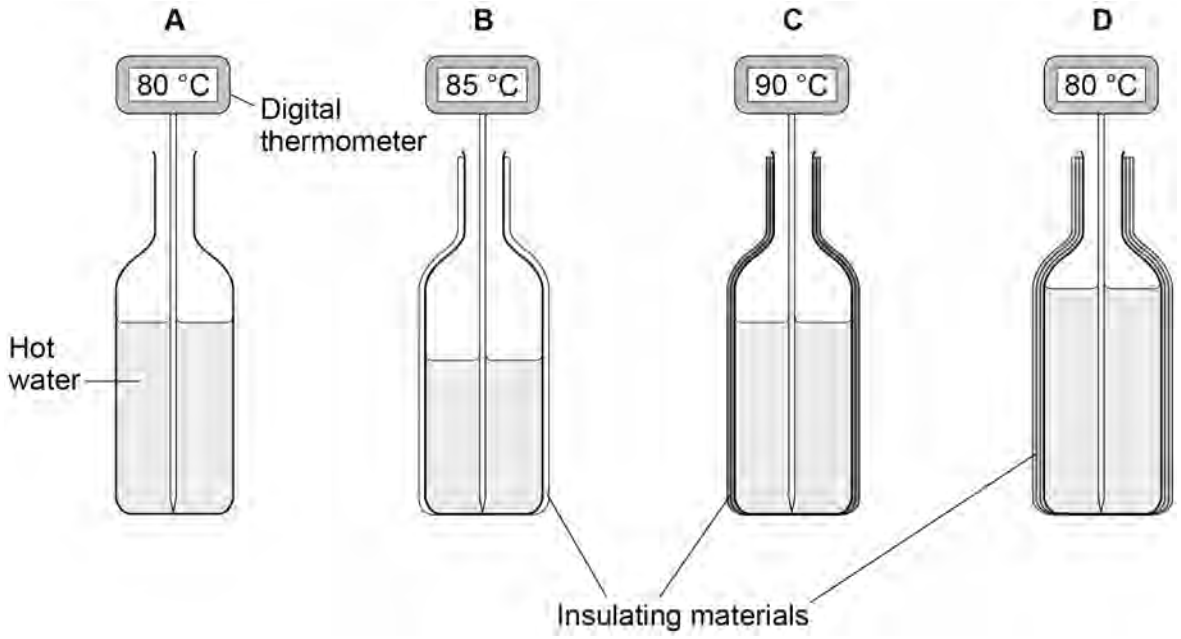
Bottle	Insulation	Start temperature in °C	Final temperature in °C	Temperature change in °C
A	None	80	60	20
B	1 layer of paper	85	70	15
C	2 layers of card	90	75	15
D	3 layers of bubble wrap	80	70	10

4.1.2.1 Energy transfers in a system

Question 54 · continued

Figure 6 is repeated below.

Figure 6



The student could **not** make a valid conclusion from the results about how different insulating materials affect the energy transfer.

Explain **two** ways that the student could improve the investigation to be able to make a valid conclusion.

Use **Figure 6** and **Table 4**.

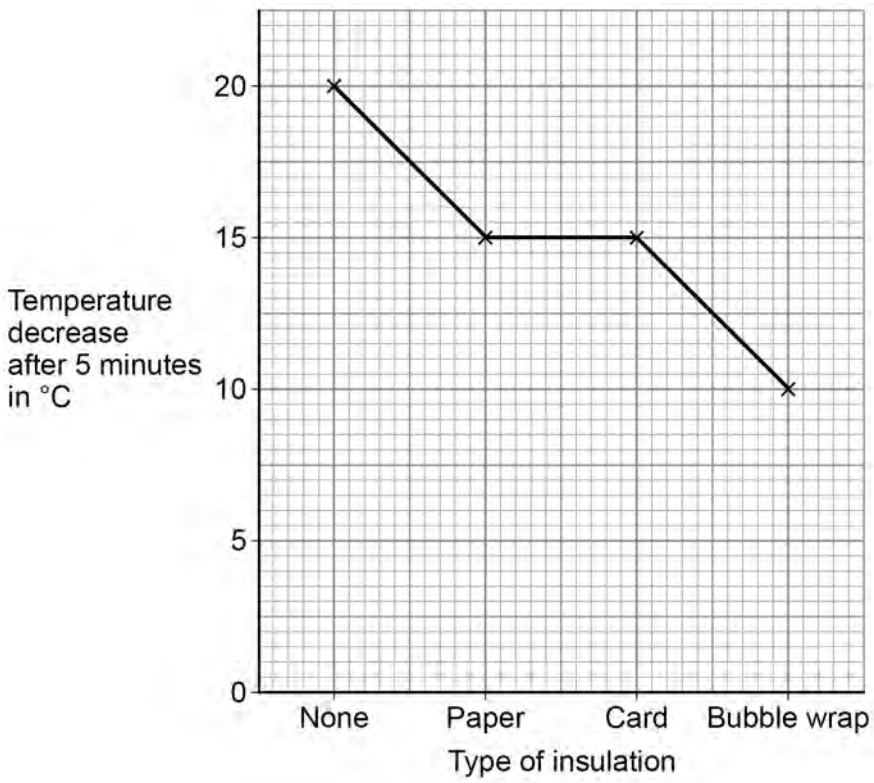
[4 marks]

4.1.2.1 Energy transfers in a system

Question 54 · continued

0 5 . 5 **Figure 7** shows the graph plotted by the student.

Figure 7



The student should **not** have plotted a line graph.

What type of graph should the student have plotted?

Give a reason for your answer.

[2 marks]

Type of graph _____

Reason _____

_____

_____

9

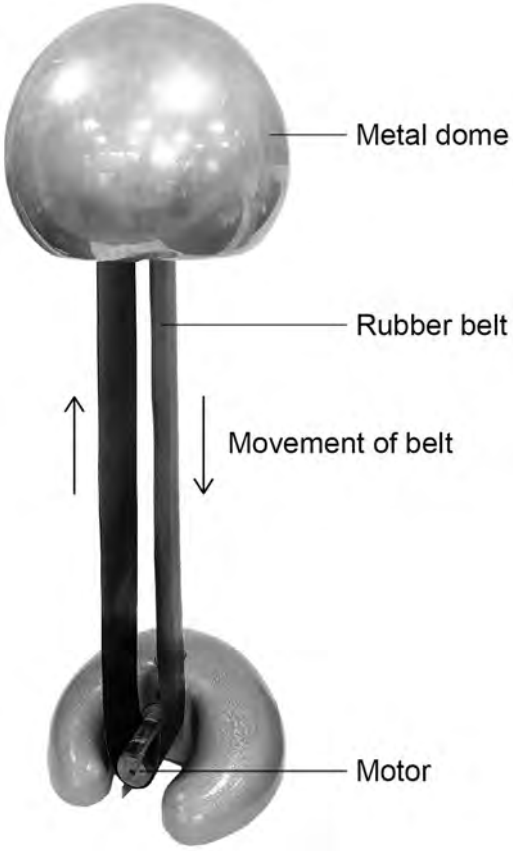
4.1.2.1 Energy transfers in a system

Question 55

June 2024 | 8463/1F | Original Q1

0 1 **Figure 1** shows a static electricity generator.

Figure 1



The rubber belt is turned by a motor.

As the rubber belt moves, charge is transferred from the rubber belt to the metal dome.

4.1.2.1 Energy transfers in a system

Question 55 · continued

Figure 2 shows a student touching the metal dome of the static electricity generator.

The dome is negatively charged.

Figure 2



0 1 . 1 Complete the sentence.

Choose the answer from the box.

[1 mark]

negative	**neutral**	**positive**

When the student touches the negatively charged metal dome the student's hair gains a _____ charge.

Question 1 continues on the next page

4.1.2.1 Energy transfers in a system

Question 55 · continued

0 1 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

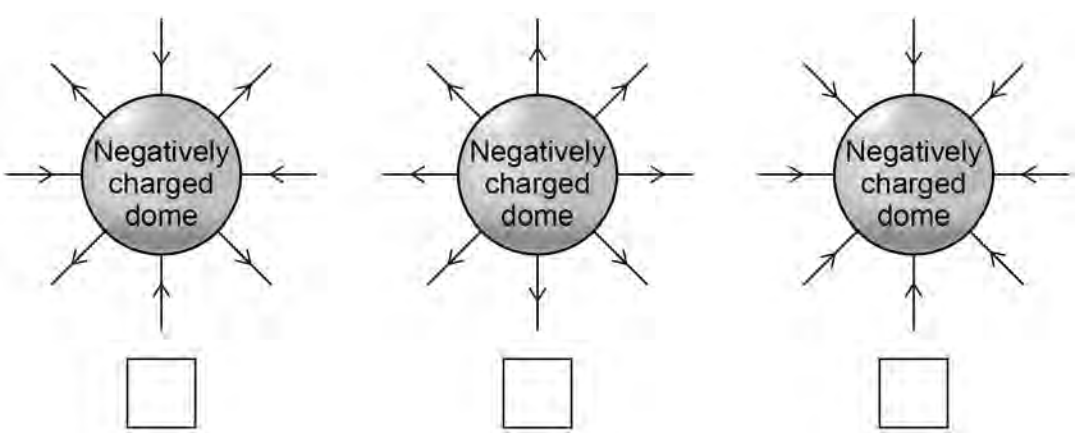
attraction	**gravity**	**repulsion**

The hair on the student's head stands up because the strands of hair experience forces of _____.

0 1 . 3 Which of the following diagrams shows the electric field pattern around the negatively charged metal dome?

[1 mark]

Tick (✓) **one** box.

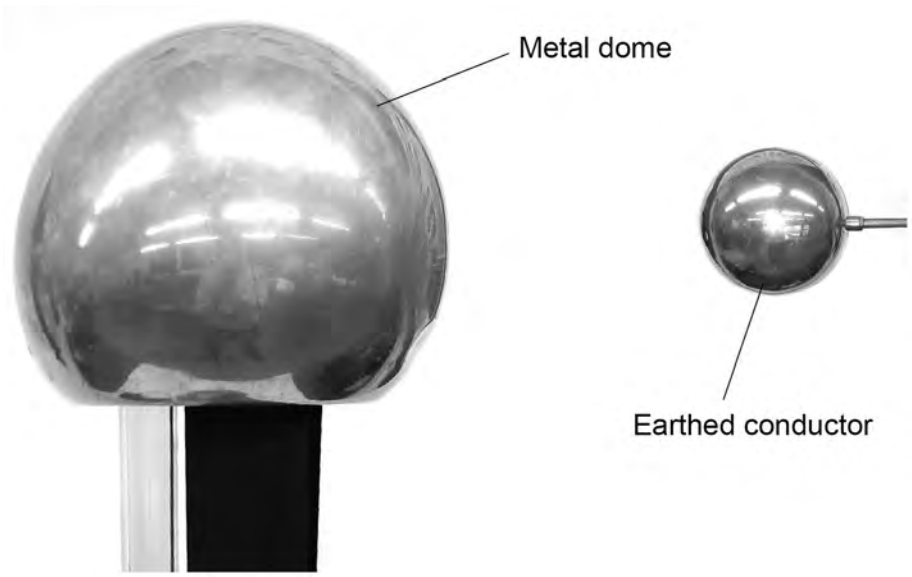


4.1.2.1 Energy transfers in a system

Question 55 · continued

Figure 3 shows the negatively charged metal dome and an earthed conductor.

Figure 3



0 1 . 4 The air between the dome and the earthed conductor is an insulator.

Complete the sentence.

Choose the answer from the box.

[1 mark]

efficiency	**resistance**	**temperature**

The air between the dome and the earthed conductor has

a high _____.

Question 1 continues on the next page

4.1.2.1 Energy transfers in a system

Question 55 · continued

The earthed conductor is moved closer to the metal dome.

A spark jumps from the dome to the earthed conductor.

0 1 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

earthed	**ionised**	**neutral**

The spark jumps because the air around the charged dome has

become _____.

0 1 . 6 Which particles are transferred when the spark jumps from the negatively charged metal dome to the earthed conductor?

[1 mark]

Tick (✓) **one** box.

- Electrons ☐
- Neutrons ☐
- Protons ☐

4.1.2.1 Energy transfers in a system

Question 55 · continued

0 1 . 7 The potential difference between the metal dome and earth is 300 000 V.

When the spark jumps there is a charge flow of 0.000 002 C.

Calculate the energy transferred by the spark.

Use the equation:

energy transferred = charge flow × potential difference

[2 marks]

Energy transferred = _____ J

8

Turn over for the next question

4.1.2.1 Energy transfers in a system

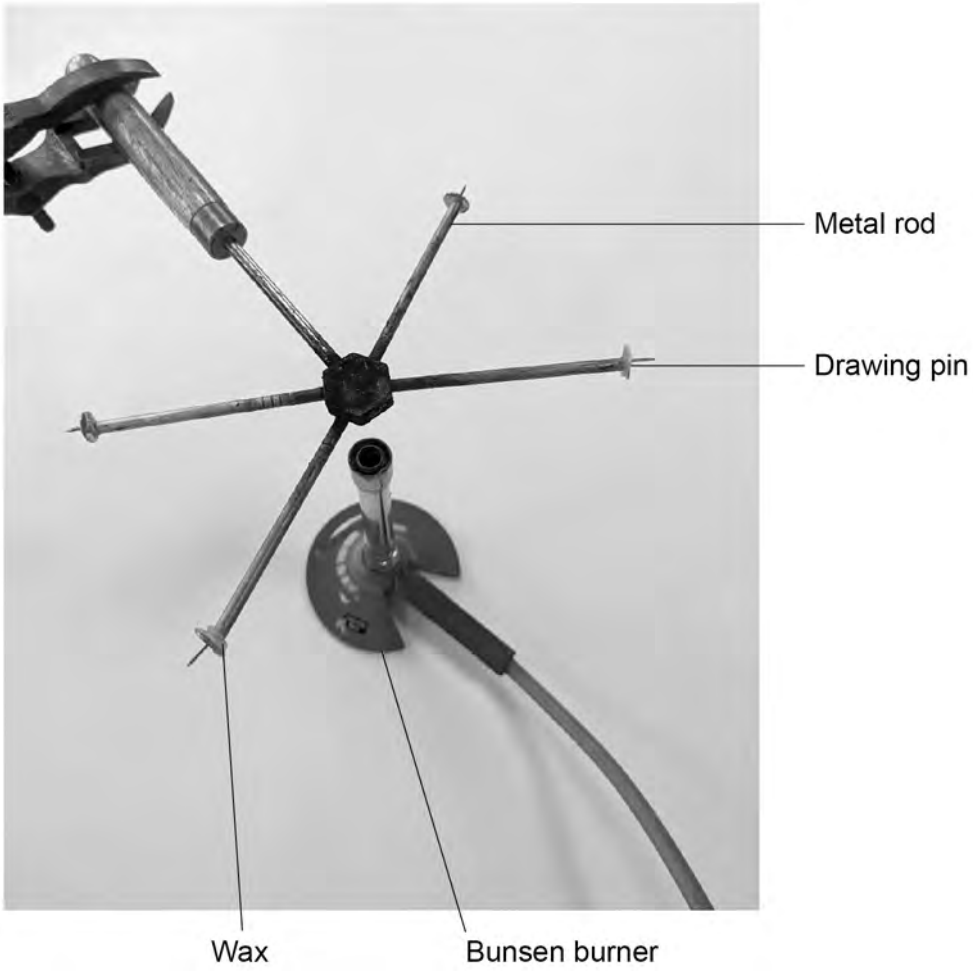
Question 56

June 2025 | 8463/1F | Original Q2

0 2 A student investigated the thermal conductivity of different metals.

Figure 2 shows some of the apparatus used.

Figure 2



Each rod was made from a different metal.

The metal rods are joined at the centre.

The size of each metal rod was the same.

This is the method used.

1. Attach a drawing pin to the end of each metal rod using wax.
2. Light the Bunsen burner.
3. Start a stopclock.
4. Record the time taken for the wax to melt and for the drawing pin to fall off each metal rod.

Table 1 shows the results.

Table 1

Type of metal	Time taken for drawing pin to fall off in seconds
Copper	10
Iron	22
Nickel	18
Steel	24

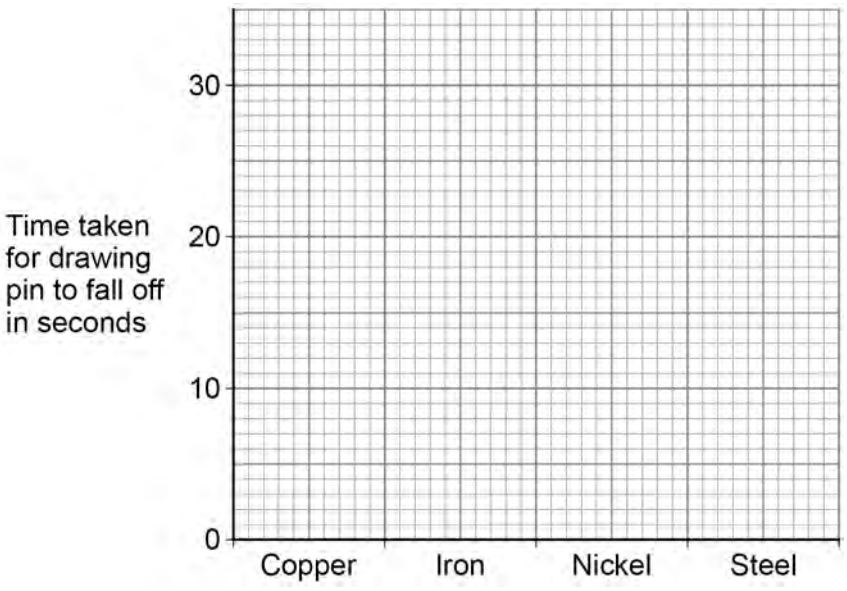
0 2 . 1 Complete **Figure 3**.

You should:

- label the *x*-axis
- plot the data from **Table 1** as a bar chart.

[3 marks]

Figure 3



Question 56 · continued

0 2 . 2 Which type of metal in **Table 1** had the greatest thermal conductivity?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Copper ☐ Iron ☐ Nickel ☐ Steel ☐

Reason _____

_____

_____

0 2 . 3 The thermal energy transferred to the nickel rod was 132 J.

The temperature change of the rod was 20 °C.

mass of the nickel rod = 0.015 kg

Calculate the specific heat capacity of nickel.

Use the equation:

$$\text{specific heat capacity} = \frac{\text{thermal energy}}{(\text{mass} \times \text{temperature change})}$$

[2 marks]

_____

_____

_____

_____

Specific heat capacity = _____ J/kg °C

4.1.2.1 Energy transfers in a system

Question 56 · continued

Use the Physics Equations Sheet to answer questions **02.4** and **02.5**.

0 2 . 4 Write down the equation which links energy transferred (*E*), power (*P*) and time (*t*).

[1 mark]

0 2 . 5 At the end of the investigation, the Bunsen burner was turned off.

As the nickel rod cooled to room temperature, the rod transferred 132 J of energy to the room.

The mean power transfer was 0.33 W.

Calculate the time taken for the energy transfer.

[3 marks]

Time taken = _____ s

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