

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
March 2007

SCIENCE: DOUBLE AWARD A (MODULAR)
PHYSICS A (MODULAR)
Energy (Module 09)

346009



Wednesday 7 March 2007 Morning Session

For this paper you must have:

- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

Time allowed: 30 minutes

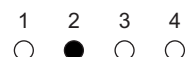
Instructions

- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title 'Energy' printed on it.
- Attempt **one Tier only**, either the Foundation Tier **or** the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only.
- Do all rough work in this book, **not** on your answer sheet.

Instructions for recording answers

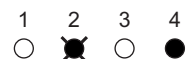
- Use a **black ball-point pen**.

- For each answer **completely fill in the circle** as shown:

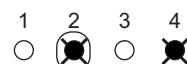


- Do **not** extend beyond the circles.

- If you want to change your answer, **you must** cross out your original answer, as shown:



- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown:



Information

- The maximum mark for this paper is 36.

Advice

- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 14 of this booklet.

FOUNDATION TIER

SECTION A

Questions **ONE** to **FIVE**.

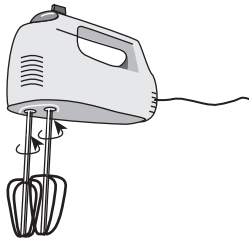
In these questions match words from the list with the numbers.

Use **each** answer only **once**.

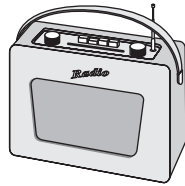
Mark your choices on the answer sheet.

QUESTION ONE

The devices shown each transfer electrical energy to another useful form of energy.



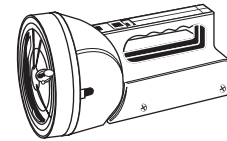
Food mixer



Radio



Toaster



Torch

Match the devices with the numbers **1–4** in the table.

Useful energy transfer	Device
electrical → heat	1
electrical → light	2
electrical → movement	3
electrical → sound	4

QUESTION TWO

The diagram shows a metal casserole dish and its contents. It is being heated on the top of a stove.

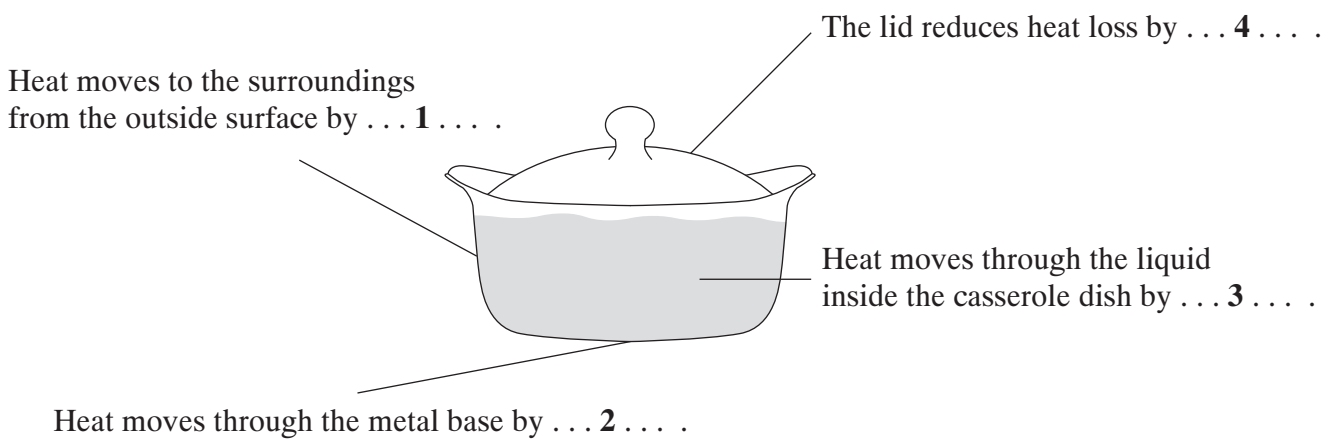
Match words from the list with the numbers 1–4 in the sentences.

conduction

convection

evaporation

radiation

**QUESTION THREE**

Power stations generate electricity and can harm the environment.

Match words from the list with the numbers 1–4 in the table.

hydroelectric scheme

nuclear power station

tidal barrage

wind farm

Harm done to environment	Power station
causes noise pollution	1
destroys the habitat of wading birds	2
floods farmland	3
produces radioactive waste	4

Turn over ►

QUESTION FOUR

Match words from the list with the numbers **1–4** in the sentences.

electrical

geothermal

kinetic

heat

In some places near volcanoes, hot water and steam rise naturally to the surface of the Earth.

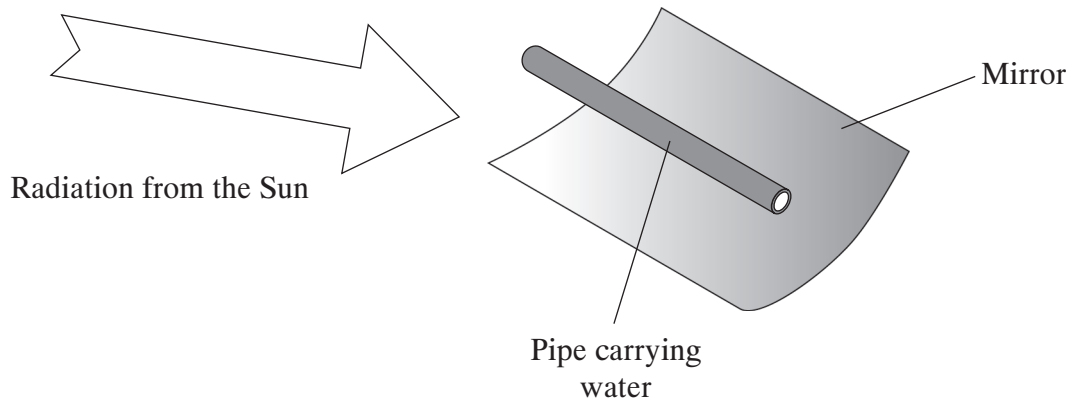
This kind of energy from under the ground is called . . . **1** . . . energy.

This energy has been transferred from . . . **2** . . . energy released by the decay of radioactive elements within the Earth.

The . . . **3** . . . energy of the steam can be used to generate . . . **4** . . . energy.

QUESTION FIVE

The diagram shows part of a solar-powered power station.



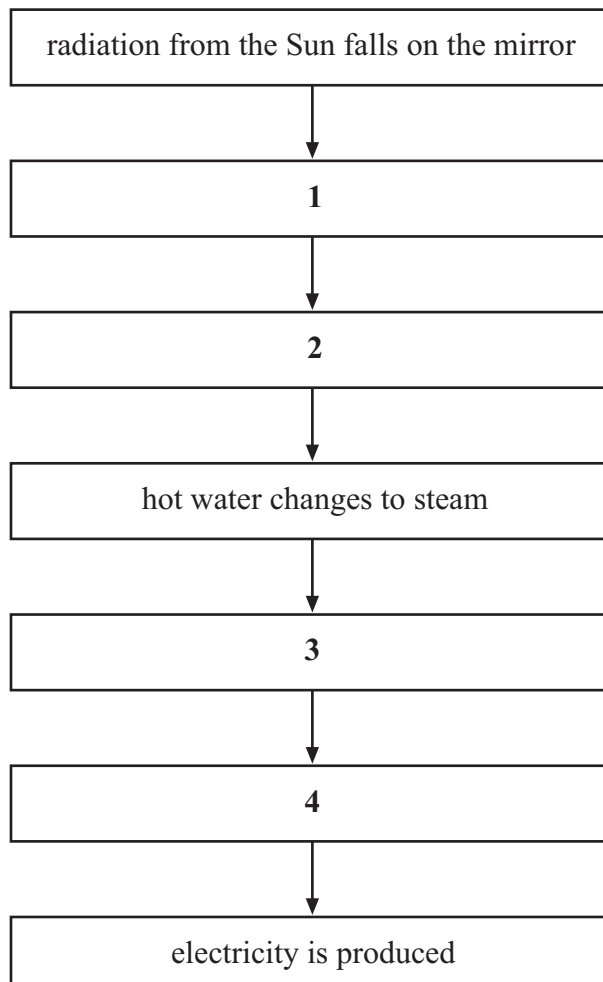
Match words from the list with the numbers 1–4 in the flow chart to explain how the power station works.

a turbine turns a generator

radiation is reflected onto the pipe

steam drives a turbine

water in the pipe absorbs energy



Turn over ►

SECTION BQuestions **SIX** and **SEVEN**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

QUESTION SIX

Satellites use solar cells instead of non-rechargeable batteries.

Which **two** statements are the main reasons why solar cells are used?**batteries contain chemicals that would pollute space****it is not practical to replace batteries on a satellite****satellites need a lot of power****solar cells are very cheap****there is an almost continuous supply of solar energy in space****QUESTION SEVEN**

Power stations use energy sources to generate electricity.

Which **two** types of power station use a renewable source of energy?**coal-fired****hydroelectric****nuclear****oil-fired****tidal barrage**

Turn over for the next question

Turn over ►

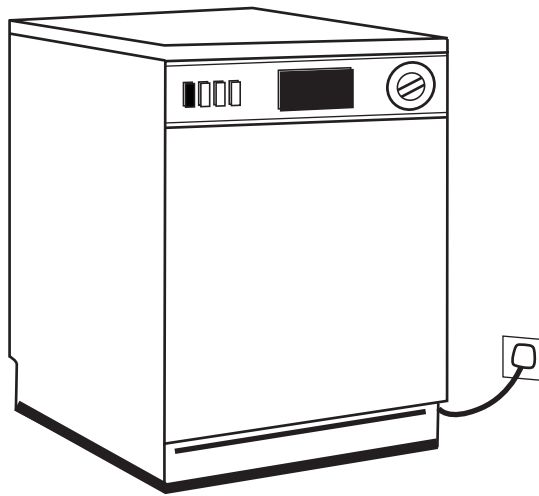
SECTION CQuestions **EIGHT** to **TEN**.

Each of these questions has four parts.

In each part choose only **ONE** answer.Mark your choices on the answer sheet.

QUESTION EIGHT

A dishwasher is designed to transfer electrical energy to useful energy. Some energy is wasted.



- 8.1** The dishwasher is designed to transfer electrical energy usefully as . . .
- A** movement and sound.
 - B** movement and heat.
 - C** movement, sound and heat.
 - D** sound and heat.
- 8.2** Which one of these wastes energy in the dishwasher?
- A** Drying the dishes
 - B** Heating the water
 - C** Rinsing the dishes
 - D** Vibrating the dishwasher

8.3 All the energy transferred to the dishwasher eventually goes to the surroundings.

When this happens, the energy . . .

- A can easily be used for other transfers.
- B cleans the dishes.
- C disappears.
- D is too spread out to be useful.

8.4 Another design of dishwasher is more efficient.

The more efficient dishwasher . . .

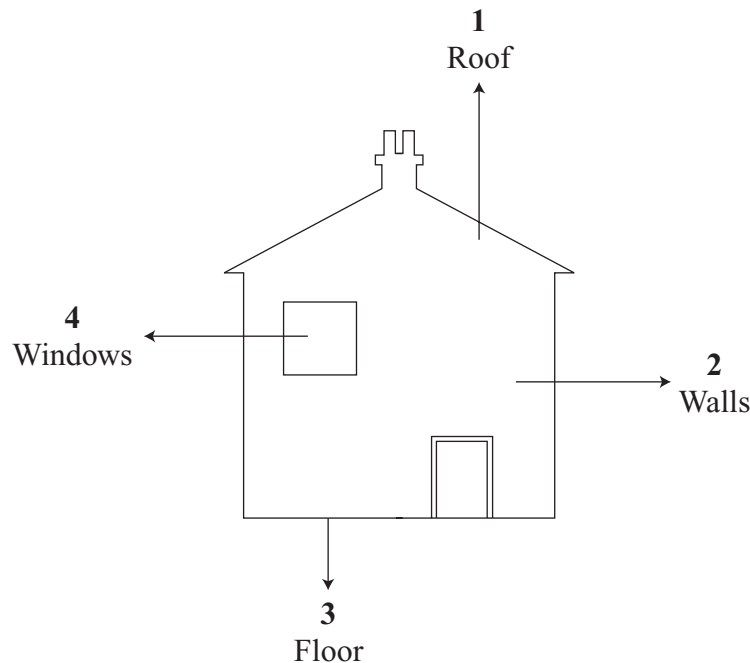
- A makes the dishes cleaner.
- B transfers less energy.
- C washes the dishes more quickly.
- D wastes a smaller proportion of the energy supplied to it.

Turn over for the next question

Turn over ►

QUESTION NINE

The diagram shows the main energy losses from a house.



9.1 Energy passes through a roof tile by . . .

- A conduction.
- B convection.
- C radiation.
- D conduction, convection and radiation.

9.2 The energy loss through the roof can be reduced by fitting loft insulation. The insulating material has an effect on the heat transfer from the house by both conduction and convection.

Which row in the table is correct for the loft insulation?

	Effect on heat transfer by conduction	Effect on heat transfer by convection
A	Decreased because the material is a good insulator	Decreased because the air in the material is trapped
B	Decreased because the material is a good insulator	Increased because the air in the material is trapped
C	Increased because the material is a good insulator	Decreased because the air in the material is trapped
D	Increased because the material is a good insulator	Increased because the air in the material is trapped

9.3 Energy loss from the house can be reduced by laying carpets.

This reduction in energy loss is mainly because . . .

- A** a carpet is a poor conductor.
- B** a carpet is warm.
- C** a carpet reduces convection.
- D** a carpet reduces radiation.

9.4 The table shows the cost of insulating different parts of a house and the reduction in total energy loss achieved by each type of insulation.

Which type of insulation, **A**, **B**, **C** or **D**, is the most cost-effective?

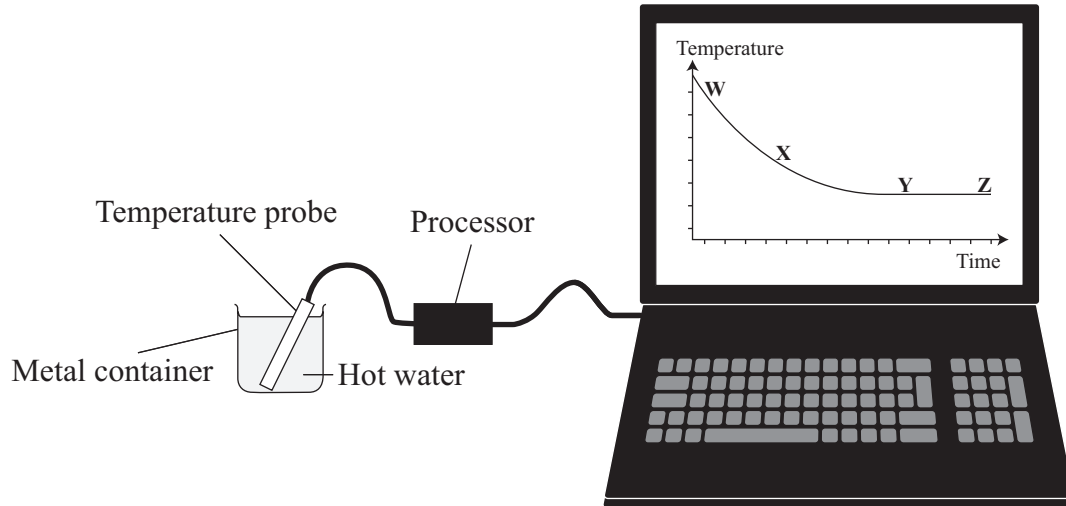
	Type of insulation	Installation cost	Percentage reduction in total energy loss from house
A	Double-glazing	£6000	5
B	Floor insulation	£320	8
C	Loft insulation	£300	20
D	Wall cavity insulation	£1000	24

Turn over for the next question

Turn over ►

QUESTION TEN

A shiny metal container has hot water in it. A temperature probe is put into the water. The water is left to cool. The temperature changes are measured and displayed on the screen as a graph of temperature against time.



10.1 Why is section **XY** less steep than section **WX**?

- A The rate of heat loss is greater during section **XY**.
- B The rate of heat loss is less during section **WX**.
- C The temperature difference between the water and its surroundings is greater during section **WX**.
- D The temperature difference between the water and its surroundings is greater during section **XY**.

10.2 In a second experiment the container is insulated.

Now, section . . .

- A **WX** becomes less steep.
- B **WX** becomes steeper.
- C **YZ** remains constant at a higher temperature.
- D **YZ** remains constant at a lower temperature.

10.3 The uninsulated container is painted black, and the experiment is repeated.

Which row in the table is correct?

	Section WX	Section YZ
A	becomes less steep	remains at the same temperature
B	becomes more steep	remains at the same temperature
C	becomes more steep	is at a higher temperature
D	remains the same steepness	is at a higher temperature

10.4 The water loses heat by . . .

- A** conduction only.
- B** convection only.
- C** conduction and convection only.
- D** conduction, convection and radiation.

END OF TEST

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Foundation Tier is earlier in this booklet.

HIGHER TIER

SECTION A

Questions **ONE** and **TWO**.

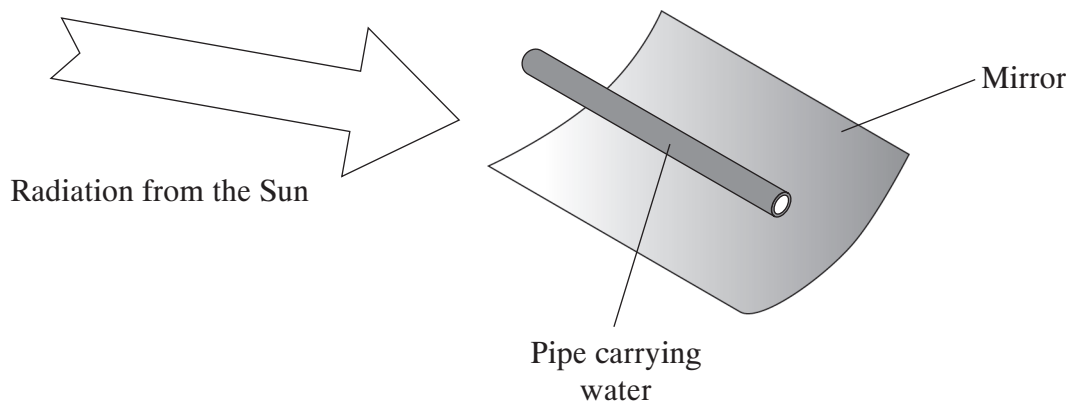
In these questions match words from the list with the numbers.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

The diagram shows part of a solar-powered power station.



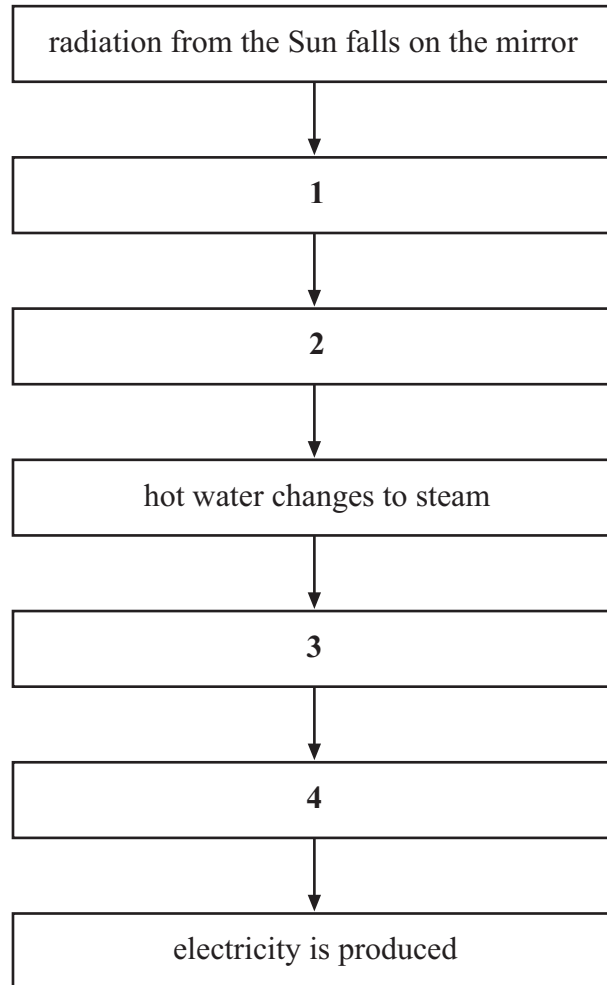
Match words from the list with the numbers **1–4** in the flow chart on the next page to explain how the power station works.

a turbine turns a generator

radiation is reflected onto the pipe

steam drives a turbine

water in the pipe absorbs energy



Turn over for the next question

Turn over ►

QUESTION TWO

This question is about some of the energy sources that we can use to generate electricity.

In the table, the column headed **Reliability** indicates whether electricity can always be supplied when it is needed.

Match words from the list with the numbers **1–4** in the table.

coal

nuclear fuel

water behind a dam (hydroelectricity)

wind

Energy source	Capital cost of equipment (per kWh)	Fuel cost (per kWh)	Decommissioning cost (per kWh)	Reliability
1	high	low	high	good
2	high	zero	medium	good
3	medium	medium	low	good
4	high	zero	low	poor

SECTION BQuestions **THREE** and **FOUR**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

QUESTION THREE

Power stations use energy sources to generate electricity.

Which **two** types of power station use a renewable source of energy?**coal-fired****hydroelectric****nuclear****oil-fired****tidal barrage****QUESTION FOUR**

Heat transfer by conduction occurs in metals.

When this happens, which **two** statements are correct?**energy is transferred by free electrons****energy is transferred by free neutrons****energy is transferred by free protons****ions collide with other ions****the hotter the metal, the more kinetic energy the vibrating ions will have****Turn over ►**

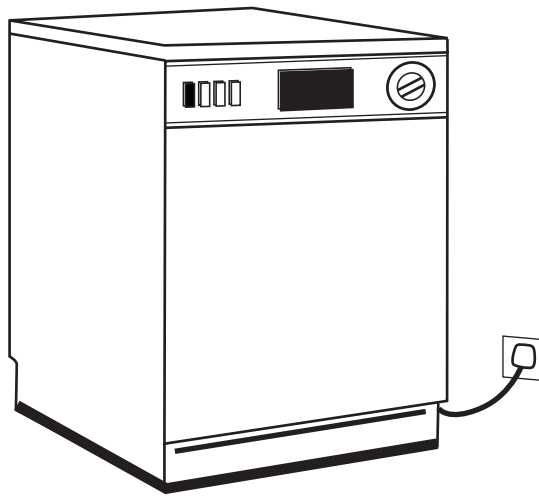
SECTION CQuestions **FIVE** to **TEN**.

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QUESTION FIVE

A dishwasher is designed to transfer electrical energy to useful energy. Some energy is wasted.



- 5.1** The dishwasher is designed to transfer electrical energy usefully as . . .
- A** movement and sound.
 - B** movement and heat.
 - C** movement, sound and heat.
 - D** sound and heat.
- 5.2** Which one of these wastes energy in the dishwasher?
- A** Drying the dishes
 - B** Heating the water
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5.3 All the energy transferred to the dishwasher eventually goes to the surroundings.

When this happens, the energy . . .

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5.4 Another design of dishwasher is more efficient.

The more efficient dishwasher . . .

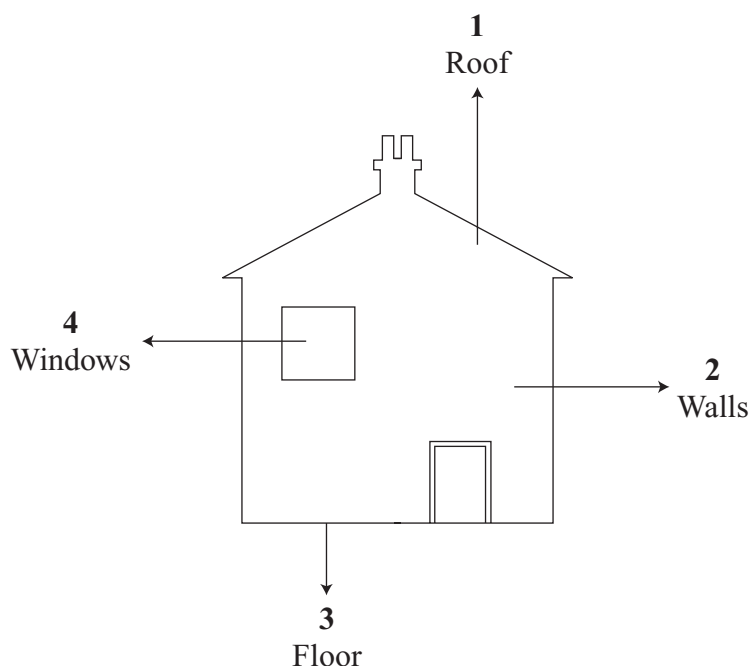
- A makes the dishes cleaner.
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Turn over for the next question

Turn over ►

QUESTION SIX

The diagram shows the main energy losses from a house.



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6.3 Energy loss from the house can be reduced by laying carpets.

This reduction in energy loss is mainly because . . .

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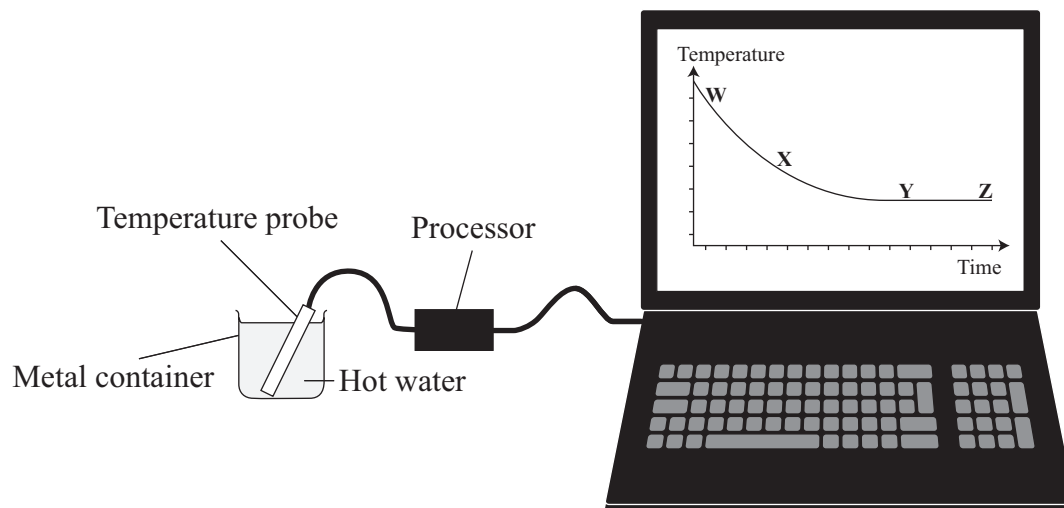
	Type of insulation	Installation cost	Percentage reduction in total energy loss from house
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Turn over for the next question

Turn over ►

QUESTION SEVEN

A shiny metal container has hot water in it. A temperature probe is put into the water. The water is left to cool. The temperature changes are measured and displayed on the screen as a graph of temperature against time.



7.1 Why is section **XY** less steep than section **WX**?

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- D The temperature difference between the water and its surroundings is greater during section **XY**.

7.2 In a second experiment the container is insulated.

Now, section . . .

- A **WX** becomes less steep.
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7.3 The uninsulated container is painted black, and the experiment is repeated.

Which row in the table is correct?

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A	becomes less steep	remains at the same temperature
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D	remains the same steepness	is at a higher temperature

7.4 The water loses heat by . . .

- A** conduction only.
- B** convection only.
- C** conduction and convection only.
- D** conduction, convection and radiation.

Turn over for the next question

Turn over ►

QUESTION EIGHT

Various types of power station are used to generate electricity.

- 8.1** In some countries, where it is usually very sunny, solar energy is used to generate electricity. One design of power station uses mirrors to reflect heat radiation from the Sun. This is used to heat oil to a temperature of about 400 °C.

Suggest how hot oil is used to drive the turbines.

- A** It is allowed to flow from a high level to a low level.
 - B** It is burned to heat water to make steam.
 - C** It is passed through pipes and heats water to make steam.
 - D** It is pumped through the turbines.
- 8.2** One type of power station uses a tidal barrage. One disadvantage is that it does not give a constant output. This is because the state of the tide varies during each day.

The height of the tide also varies . . .

- A** on a monthly cycle only.
- B** on a yearly cycle only.
- C** on both a monthly and a yearly cycle.
- D** randomly.

8.3 The time to start up power stations varies according to the fuel used.

Starting with the shortest time for start-up, which order is correct?

- A** coal oil natural gas nuclear
- B** oil nuclear natural gas coal
- C** natural gas oil coal nuclear
- D** oil coal natural gas nuclear

8.4 The electricity from some power stations is used during the night to pump water uphill into lakes. Later, the water is released and used to drive turbines.

What is the reason for this?

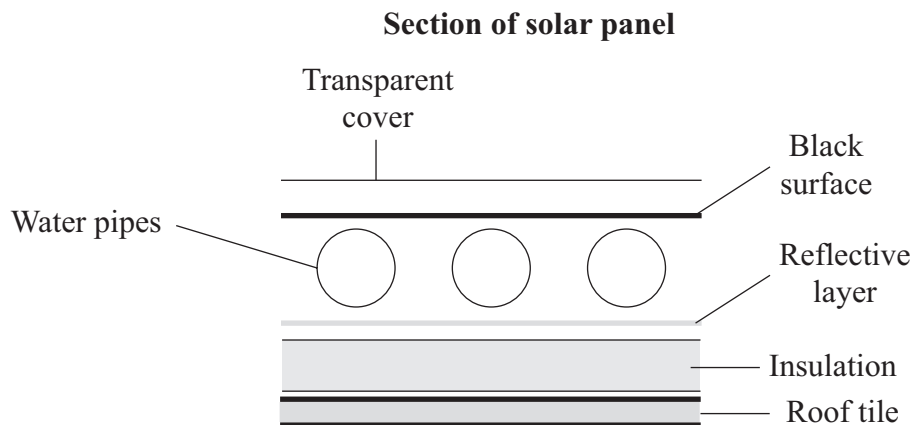
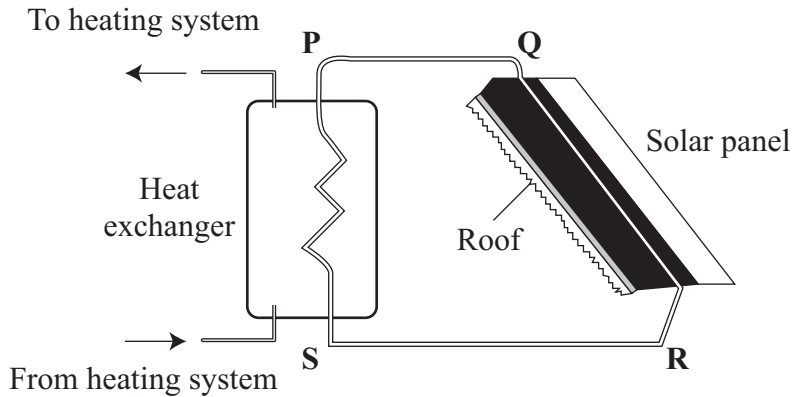
- A** At night the electricity is cheaper to produce.
- B** At night the demand for electricity is less and the water stores energy until it is needed.
- C** It prevents the lakes from becoming empty.
- D** There is a high demand for electricity at night and water can be released to meet the demand.

Turn over for the next question

Turn over ►

QUESTION NINE

Solar panels can be used on buildings to transfer solar energy to heat water. This water then moves through a heat exchanger.



- 9.1** The different layers of the solar panel make the panel transfer solar energy in the most effective way.

Which row in the table shows how the different layers help this?

	Black top surface covering water pipes	Insulation
A	absorbs radiant energy	stops heat conduction to roof tiles
B	absorbs radiant energy	protects water pipes from frost
C	emits radiant energy	conducts heat to the water pipes
D	reflects radiant energy	conducts heat to roof space

- 9.2** When the system is operating, . . .
- A** the water in the tube **PS** becomes colder and moves from **S** towards **P**.
 - B** the water in the tube **PS** becomes warmer and moves from **S** towards **P**.
 - C** the water in the tube **QR** becomes less dense and moves from **R** towards **Q**.
 - D** the water in the tube **QR** becomes more dense and moves from **Q** towards **R**.
- 9.3** The water pipes in the solar panel are made of long narrow copper tubing laid underneath the black surface.
- This arrangement ensures that heat energy is . . .
- A** conducted quickly to the water in the narrow tubing.
 - B** distributed evenly between the black surface and the tubing.
 - C** reflected from the black surface.
 - D** transferred by convection.
- 9.4** Which design feature is most important for capturing maximum energy from the Sun's radiation?
- A** Large surface area for the panel
 - B** Short distance between the copper tubing bends
 - C** Well-insulated copper tubing
 - D** Wide diameter for the copper tubing

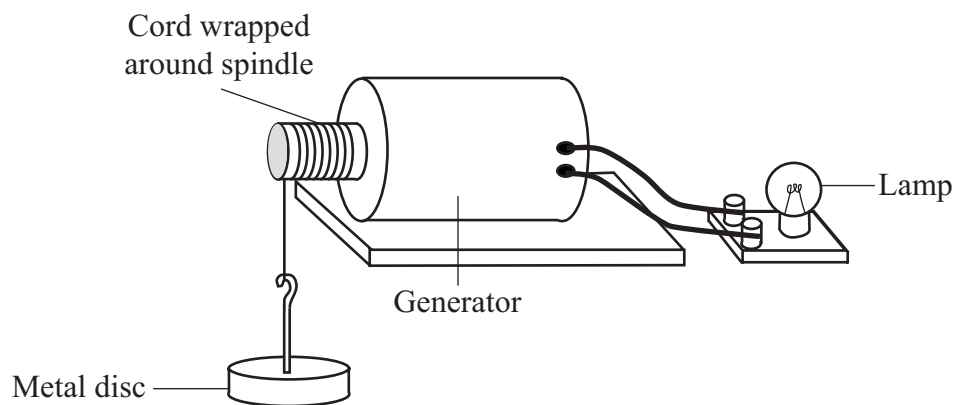
QUESTION TEN

You may find the following formulae useful when answering this question.

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

$$\text{power (watt, W)} = \frac{\text{energy transferred (joule, J)}}{\text{time taken (second, s)}}$$

The diagram shows an experiment to demonstrate energy transfers.



The metal disc has gravitational potential energy.
When the metal disc falls, it causes the spindle of the generator to turn.
The generator produces electricity which lights the lamp.

10.1 When the metal disc falls 2 metres, 20 joules of gravitational potential energy are transferred.

What is the weight of the metal disc?

- A 0.1 N
- B 1 N
- C 10 N
- D 40 N

10.2 Another metal disc falls 2 metres in 4 seconds.
The generator receives energy at a rate of 20 W.

What is the weight of this metal disc?

- A 0.1 N
- B 1 N
- C 10 N
- D 40 N

10.3 The efficiency of the generator is 40 %.

What input does the generator need for it to transfer 180 W to the lamp?

- A 72 W
- B 360 W
- C 450 W
- D 7200 W

10.4 A lamp has an efficiency of 20 %.
The power of the lamp is 36 W.

How much light energy does the lamp transfer in 1 second?

- A 7.2 J
- B 14.4 J
- C 28.8 J
- D 36.0 J

END OF TEST

There are no questions printed on this page

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