Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
Spring 2003

SCIENCE: DOUBLE AWARD (MODULAR) 346009
SCIENCE: PHYSICS (MODULAR)
Energy (Module 09)

Wednesday 5 March 2003 Morning Session

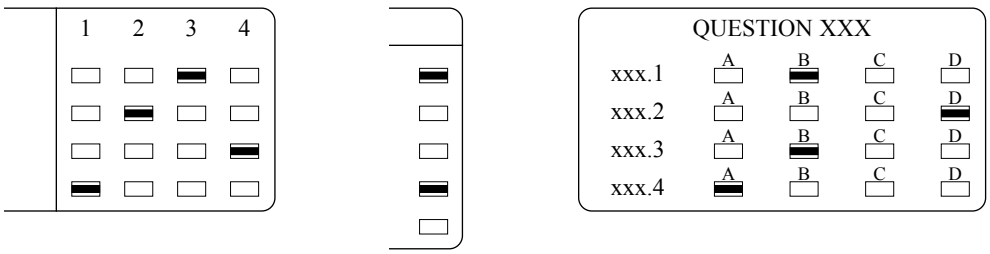
In addition to this paper you will require:
- an HB pencil and a rubber;
- an answer sheet.

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.
- Answer **all** the questions for the Tier you are attempting.
- 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.
- Mark your responses on the separate answer sheet only. Rough work may be done on the question paper.
- Mark the best responses by using a thick pencil stroke to fill in the box. Use an HB pencil. Make sure the pencil stroke does **not** extend beyond the box. Do **not** use ink or ball-point pen. If you wish to change your answer, rub out your first answer completely.
  See below.

Examples:



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 rub 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 the words in the list with the numbers.

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

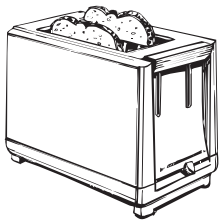
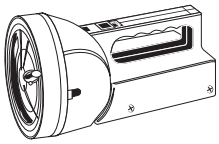
Mark your choices on the answer sheet.

QUESTION ONE

These devices are designed to transfer electrical energy.

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



heat (thermal energy)

light

movement (kinetic energy)

sound

The drill is designed to transfer electrical energy as . . . . . **1** . . . . . .

The radio is designed to transfer electrical energy as . . . . . **2** . . . . . .

The toaster is designed to transfer electrical energy as . . . . . **3** . . . . . .

The torch is designed to transfer electrical energy as . . . . . **4** . . . . . .

QUESTION TWO

Match words from the list with each of the spaces **1–4** in the sentences.

infra red

matt surfaces

particles

shiny surfaces

The best absorbers of radiation are . . . . . **1** . . . . . .

The best reflectors of radiation are . . . . . **2** . . . . . .

Transfer of energy by radiation does not involve . . . . . **3** . . . . . .

Hot bodies emit . . . . . **4** . . . . . radiation.

TURN OVER FOR THE NEXT QUESTION

QUESTION THREE

Using energy resources to generate electricity can harm the environment.

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

hydroelectric scheme

tidal barrage

uranium

wind farm

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

QUESTION FOUR

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

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

total cost = number of Units × cost per Unit

An electric kettle has a power of 2750 watts.

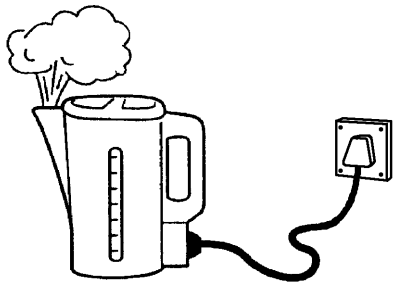
Match numbers from the list with the spaces **1–4** in the sentences.

2.75

8.25

108

2750



The power of the kettle in kilowatts is . . . . . **1** . . . . . .

The number of kilowatt-hours transferred by the kettle in 3 hours is . . . . . **2** . . . . . .

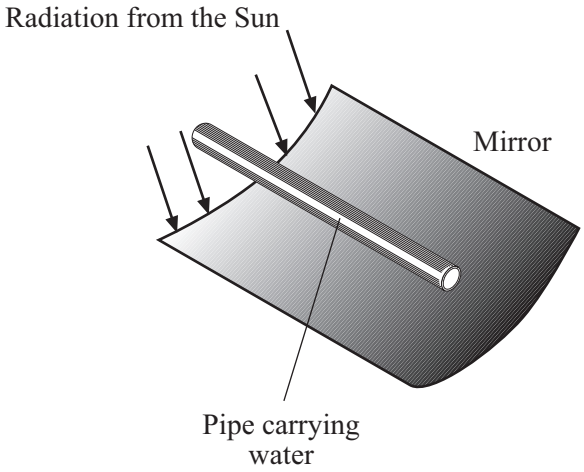
The kettle transfers 12 Units of electricity per week. One Unit of electricity costs 9p.
The total cost of this electricity is . . . . . **3** . . . . . p.

The number of joules of energy transferred by the kettle in one second is . . . . . **4** . . . . . .

TURN OVER FOR THE NEXT QUESTION

QUESTION FIVE

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



Match words from the list to fill the boxes **1–4**, to explain how the power station works.

a turbine turns a generator

radiation is reflected onto the pipe

steam drives a turbine

water absorbs radiation

radiation from the Sun falls on the mirror

↓

1

↓

2

↓

hot water turns to steam

↓

3

↓

4

↓

electricity is produced

SECTION B

Questions **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

Power stations use energy sources to generate electricity.

Which **two** types of power station use fossil fuels to generate electricity?

coal-fired

hydroelectric

nuclear

oil-fired

tidal barrage

QUESTION SEVEN

Most house walls are built of a double layer of brick with an air gap in between the two layers.

Choose from the list the **two** main processes that let heat (thermal energy) escape through house walls.

conduction through the air

conduction through the brick

convection through the air

convection through the brick

radiation through the brick

SECTION C

Questions **EIGHT** to **TEN**.

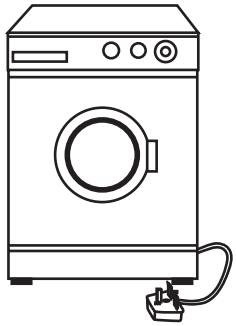
Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION EIGHT

A washing machine is designed to transfer electrical energy as other useful forms of energy. Some of the energy is wasted.



8.1 The washing machine is designed to transfer energy usefully as . . . . .

A movement (kinetic energy) and sound.

B movement (kinetic energy) and heat (thermal energy).

C movement (kinetic energy), sound and heat (thermal energy).

D sound and heat (thermal energy).

8.2 Which **one** of the following is a wasted energy transfer in the washing machine?

A Heating the water

B Rinsing the clothes

C Spinning the clothes

D Vibrating the machine casing

8.3 All of the energy transferred by the washing machine eventually goes to the surroundings.

When this happens, the energy . . . . .

A can easily be used for other transfers.

B cleans clothes.

C disappears.

D is too spread out to be useful.

8.4 Another washing machine is more efficient. This means that the more efficient washing machine . . . . .

A cleans clothes more quickly.

B makes clothes cleaner.

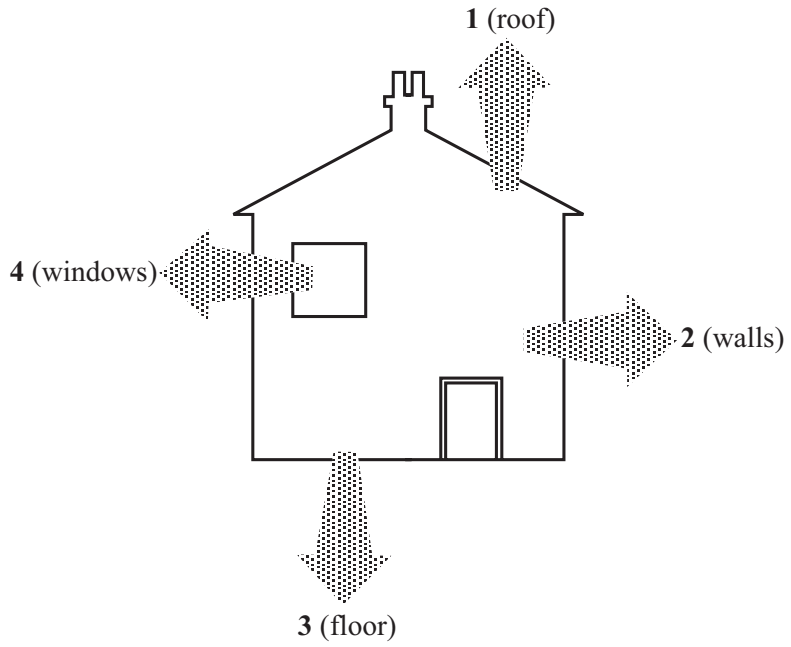
C transfers less energy.

D wastes a smaller proportion of the energy supplied to it.

TURN OVER FOR THE NEXT QUESTION

QUESTION NINE

The diagram shows the main energy transfers 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 Double-glazing helps to reduce energy transfer from the house.

In some double-glazing units there is air between the two layers of glass.

The reduction in energy transfer by double-glazing is mainly due to . . . . .

A air being a poor conductor.

B air preventing convection.

C glass being a poor conductor.

D glass preventing radiation.

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

This reduction in energy transfer is mainly due to . . . . .

A a carpet being a poor conductor.

B a carpet being warm.

C a carpet preventing convection.

D a carpet preventing 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 in £s	Percentage reduction in total energy loss from house
A Double-glazing	3000	5
B Floor insulation	160	8
C Loft insulation	150	20
D Wall cavity insulation	500	24

TURN OVER FOR THE NEXT QUESTION

QUESTION TEN

This question is about the energy resources used in power stations.

10.1 The source of energy for geothermal power stations is . . . . .

A combustion.

B decay of radioactive elements.

C movement of air.

D movement of water.

10.2 The gas mainly responsible for producing acid rain is . . . . .

A natural gas.

B nitrogen.

C oxygen.

D sulphur dioxide.

10.3 What is the main advantage of a tidal barrage over a wind farm?

A More power is produced at times of high demand

B More power is produced in winter than in summer

C There are no environmental impacts

D The times and outputs for each day can be forecast

10.4 700 000 kilowatts of power are produced when 100 tonnes of coal are burned in 1 hour.

How quickly must the coal be burned to produce 7 000 000 kilowatts?

A 10 tonnes / hour

B 70 tonnes / hour

C 100 tonnes / hour

D 1000 tonnes / hour

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**.

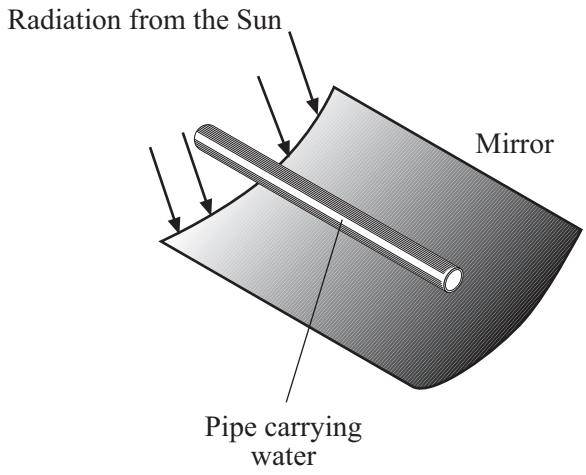
In these questions match the words in the list with the numbers.

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

Mark your choices on the answer sheet.

QUESTION ONE

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



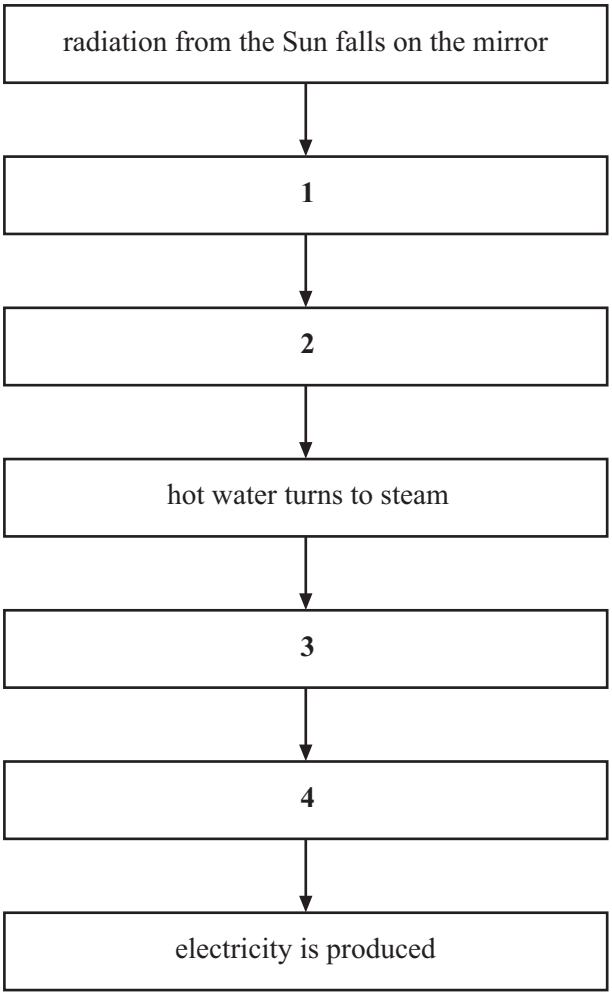
Match words from the list to fill the boxes **1–4**, to explain how the power station works.

a turbine turns a generator

radiation is reflected onto the pipe

steam drives a turbine

water absorbs radiation



TURN OVER FOR THE NEXT QUESTION

QUESTION TWO

A swimmer climbs up to a diving board, then dives into the water.

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

gravitational potential energy

kinetic energy

thermal energy

weight

As the swimmer climbs steadily up to the board, her . . . . . **1** . . . . . increases but her . . . . . **2** . . . . . remains constant.

When she dives off the board, her . . . . . **3** . . . . . increases. This is transferred mainly to . . . . . **4** . . . . . as she enters the water.

SECTION B

Questions **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

Most house walls are built of a double layer of brick with an air gap in between the two layers.

Choose from the list the **two** main processes that let heat (thermal energy) escape through house walls.

conduction through the air

conduction through the brick

convection through the air

convection through the brick

radiation through the brick

QUESTION FOUR

Thermal energy can be transferred by convection.

Which **two** of the following explain this method of energy transfer in a gas?

cooler regions in the gas rise up through warmer regions

electrons gain kinetic energy when the gas is heated

gas particles are not involved in the transfer of thermal energy

gas particles move faster when the gas is heated

warm regions of gas are less dense than cooler regions

SECTION C

Questions **FIVE** to **TEN**.

Each of these questions has four parts.

In each part choose only **one** answer.

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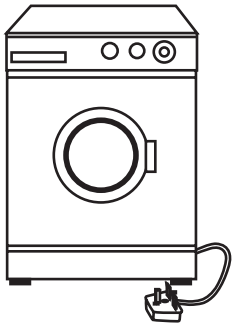
QUESTION FIVE

A washing machine is designed to transfer electrical energy as other useful forms of energy. Some of the energy is wasted.



5.1 The washing machine is designed to transfer energy usefully as . . . . .

A movement (kinetic energy) and sound.

B movement (kinetic energy) and heat (thermal energy).

C movement (kinetic energy), sound and heat (thermal energy).

D sound and heat (thermal energy).

5.2 Which **one** of the following is a wasted energy transfer in the washing machine?

A Heating the water

B Rinsing the clothes

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D Vibrating the machine casing

5.3 All of the energy transferred by the washing machine eventually goes to the surroundings.

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TURN OVER FOR THE NEXT QUESTION

QUESTION SIX

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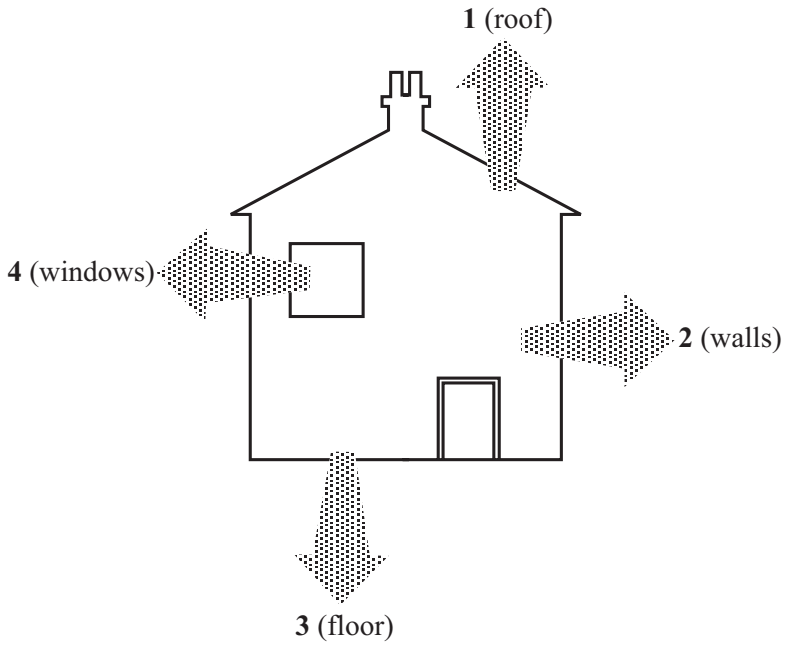

6.1 Energy passes through a roof tile by . . . . .

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TURN OVER FOR THE NEXT QUESTION

QUESTION SEVEN

This question is about the energy resources used in power stations.

7.1 The source of energy for geothermal power stations is . . . . .

A combustion.

B decay of radioactive elements.

C movement of air.

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7.2 The gas mainly responsible for producing acid rain is . . . . .

A natural gas.

B nitrogen.

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7.3 What is the main advantage of a tidal barrage over a wind farm?

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7.4 700 000 kilowatts of power are produced when 100 tonnes of coal are burned in 1 hour.

How quickly must the coal be burned to produce 7 000 000 kilowatts?

A 10 tonnes / hour

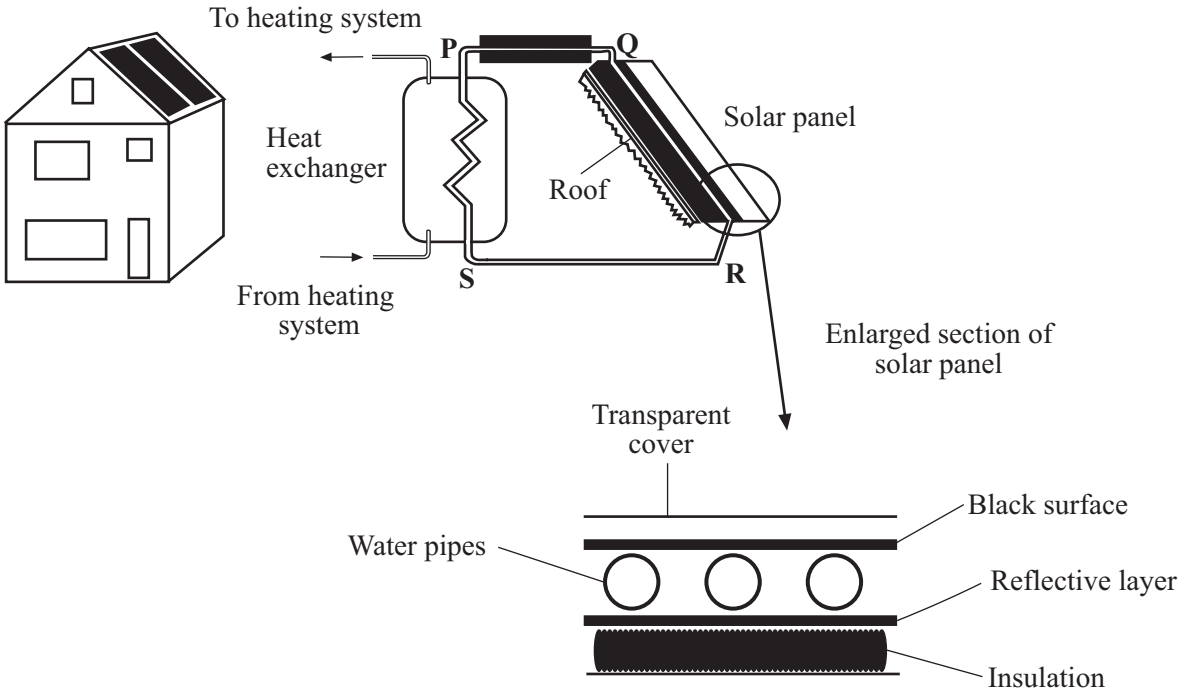
B 70 tonnes / hour

C 100 tonnes / hour

D 1000 tonnes / hour

QUESTION EIGHT

Solar panels transfer solar energy to heat water. This water then moves through a heat exchanger.



8.1 The different layers of the solar panel make the panel transfer solar energy in the most effective way.

Which row of the table, **A**, **B**, **C** or **D**, shows how each layer helps this?

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

8.2 When the system is operating . . . . .

A the water in tube **QR** becomes less dense and moves from **R** towards **Q**.

B the water in tube **QR** becomes more dense and moves from **Q** towards **R**.

C the water in tube **PS** becomes colder and moves from **S** towards **P**.

D the water in tube **PS** becomes warmer and moves from **S** towards **P**.

8.3 The water pipes are made of long narrow copper tubing laid on the underside of the black top surface.

This arrangement ensures that heat energy is . . . . .

A conducted quickly to the water in the narrow tubing.

B distributed evenly between the top surface and the tubing.

C reflected from the top surface.

D transferred by convection.

8.4 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 loops

C Well insulated copper tubing

D Wide diameter for the copper tubing

TURN OVER FOR THE NEXT QUESTION

QUESTION NINE

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

9.1 Which **one** of the following is a valid argument **against** nuclear power stations?

A For maximum efficiency, they have to be in nearly constant use

B They have high decommissioning costs

C They have high fuel costs

D They produce gases that pollute the atmosphere

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

Which statement supports this view?

A Fossil fuel and nuclear power stations are needed when the wind drops

B Large wind farms can be unsightly and noisy

C Wind farms have zero fuel costs to offset high capital cost

D Wind farms use large areas of land

9.3

You may find this formula useful when answering this question.

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

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

How much uranium would be needed to fuel a 2400 MW nuclear power station for 24 hours?

(1 MW = 1000 kW)

A 0.000 36 tonnes

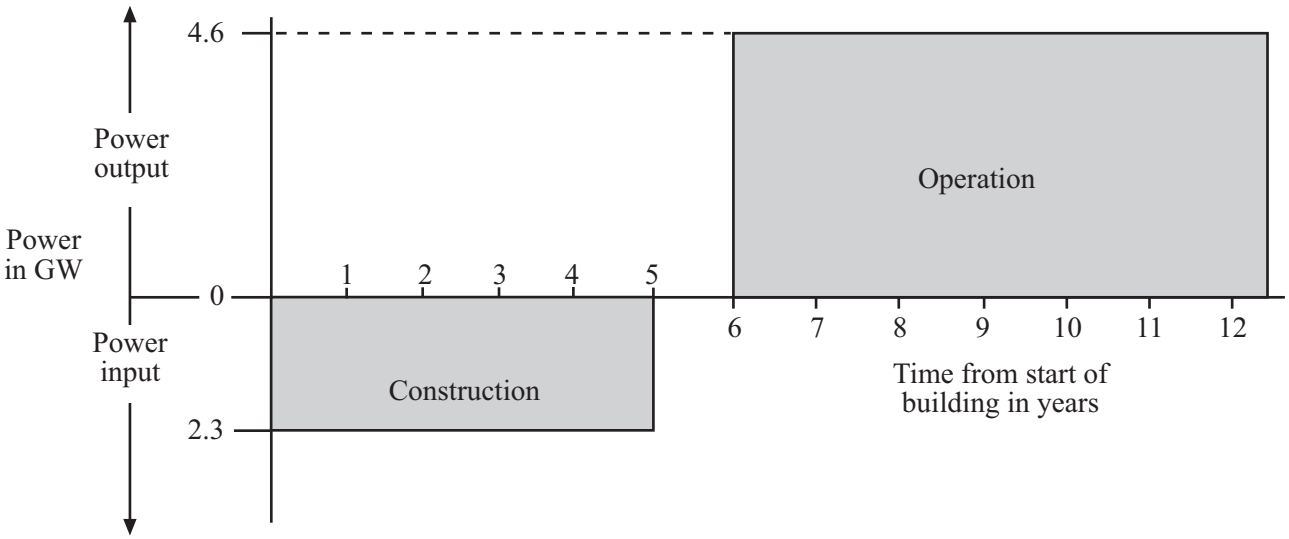
B 0.000 625 tonnes

C 0.36 tonnes

D 2.78 tonnes

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

The area under the graph represents the energy used or produced in GWh (1 GWh = 1 million kWh).



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

A 7 years

B 7.5 years

C 8 years

D 8.5 years

TURN OVER FOR THE NEXT QUESTION

QUESTION TEN

Senegal is a poor, developing country. It has no large power stations. Small, local schemes for generating power are used. Solar cells are used to generate electricity for pumping water from wells in remote locations.

10.1 The main reason for using solar cells in such locations is that . . . . .

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

B solar cells are cheap to make.

C solar cells provide a constant supply of electricity.

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

10.2 Many solar cells are used in such locations because . . . . .

A the decommissioning costs are low.

B the energy supply is dilute.

C the installation costs are low.

D there will be less pollution.

An electrical pump is powered by the solar panels. It pumps 4 litres of water to a height of 10 metres in 30 seconds.

1 litre of water has a weight of 10 newtons.

10.3 How much gravitational potential energy is gained by the water in 30 seconds?

A 13.3 J

B 40 J

C 400 J

D 12 000 J

10.4

You may find this equation useful when answering this part of the question.

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

On a different day, the water from the well gains 20 joules of energy per second.

3200 watts of solar energy fall on the solar cells.

What is the efficiency of the whole system?

A 0.006 25 (0.625%)

B 0.04 (4%)

C 0.062 5 (6.25%)

D 0.4 (40%)

END OF TEST