Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

General Certificate of Secondary Education
Winter 2004

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

Thursday 18 November 2004 Morning Session

In addition to this paper you will require:
- a black ball-point pen;
- an answer sheet.

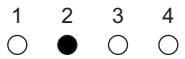
You may use a calculator.

Time allowed: 30 minutes

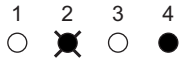
Instructions
- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title "Energy" printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or** the Higher Tier.
- 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. Rough work may be done on the question paper.

Instructions for recording answers

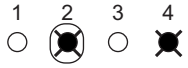
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 16 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

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

black

increase

reduce

white

In hot countries, houses are often painted . . . . . **1** . . . . . .

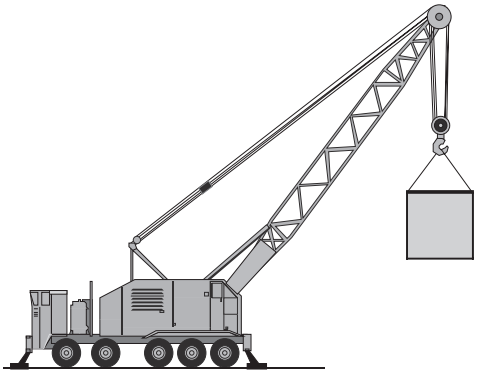
This is done to . . . . . **2** . . . . . absorption of the Sun's energy.

Pipes at the back of a freezer are painted . . . . . **3** . . . . . .

This is done to . . . . . **4** . . . . . radiation of energy.

QUESTION TWO

The diagram shows a crane lifting a heavy load.



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

gravitational potential energy

heat (thermal energy)

movement (kinetic energy)

sound energy

The load is lifted, so it gains . . . . . **1** . . . . . .

If the load falls from the crane, it gains . . . . . **2** . . . . . .

The crane motor becomes warm because some energy is wasted as . . . . . **3** . . . . . .

Wasted energy is also transferred as . . . . . **4** . . . . . .

TURN OVER FOR THE NEXT QUESTION

QUESTION THREE

Electricity can be generated from different energy sources.
These energy sources have different effects on the environment.

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

nuclear power station

oil-fired power station

tidal barrage

wind farm

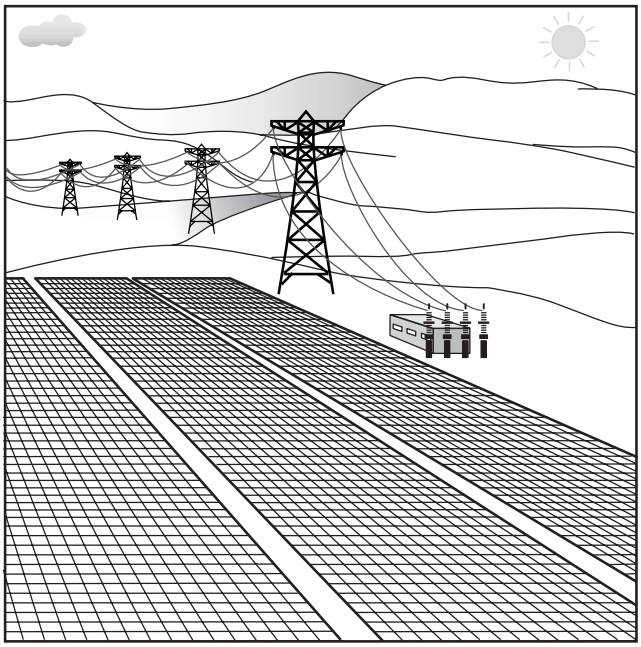
Energy source	Effect on the environment
1	causes visual pollution and noise pollution
2	destroys the habitat of wading birds
3	increases the greenhouse effect
4	makes dangerous waste which must be stored for thousands of years

NO QUESTIONS APPEAR ON THIS PAGE

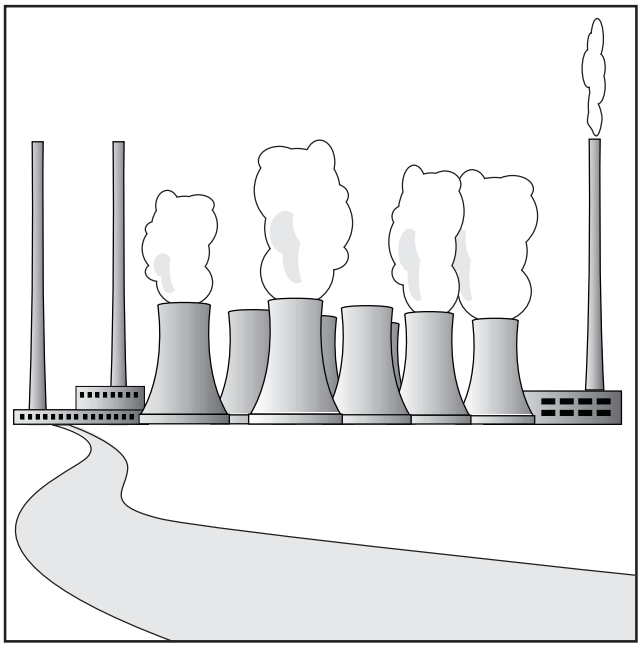
TURN OVER FOR THE NEXT QUESTION

QUESTION FOUR

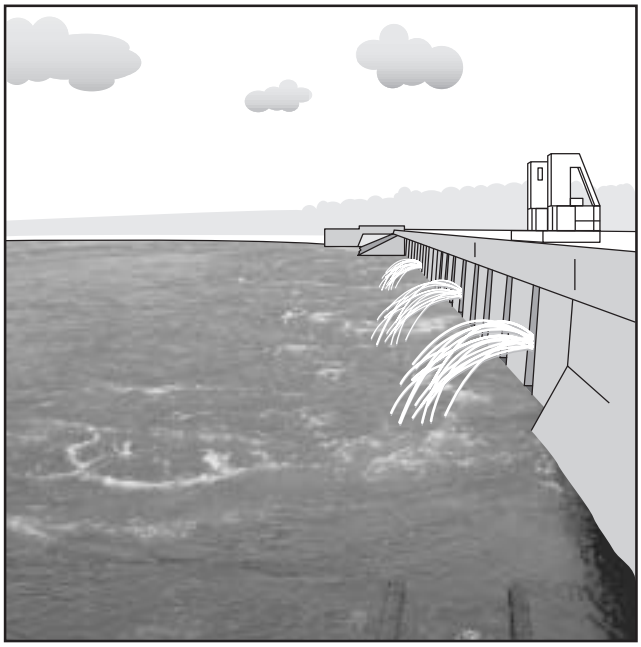
The drawings show four types of power station, **J**, **K**, **L** and **M**. Each one uses a different energy source to produce electricity.



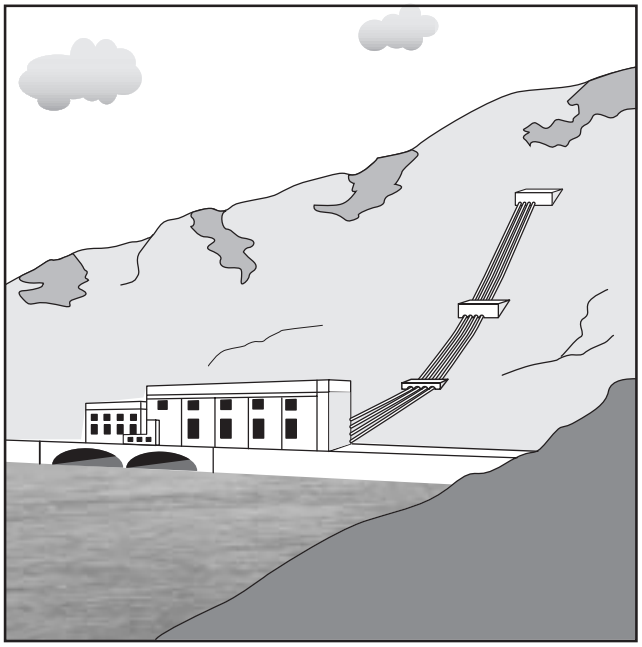
J



K



L



M

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

coal

solar energy

tides

water pumped to a high level

Energy source	Power station
1	**J**
2	**K**
3	**L**
4	**M**

TURN OVER FOR THE NEXT QUESTION

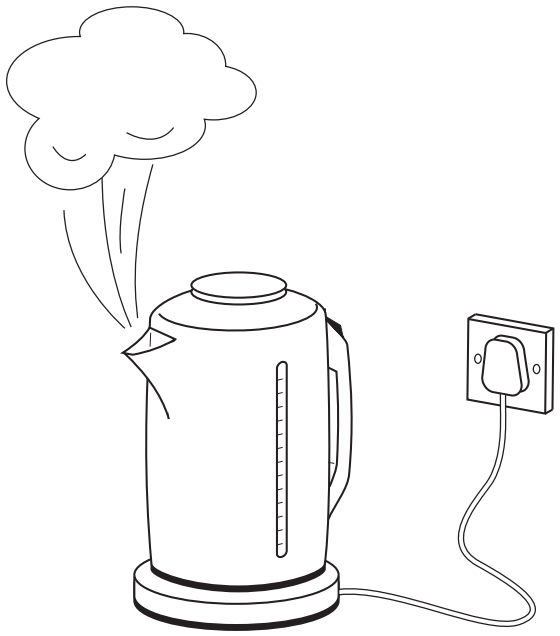
QUESTION FIVE

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

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

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

The diagram shows an electric kettle being used to boil some water.
The kettle is rated at 2.5 kW and it takes 2.4 minutes to boil the water.



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

0.7

2.5

252

360

The amount of energy transferred by the kettle every second is . . . . . **1** . . . . . kJ.

The amount of energy transferred by the kettle in 2.4 minutes is . . . . . **2** . . . . . kJ.

The amount of useful energy used for heating the water to boiling point is . . . . . **3** . . . . . kJ.

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

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

When energy is transferred in devices, only part of it is transferred in a useful form. The rest of the energy is wasted.

Which **two** of the following statements are correct?

all energy which is transferred eventually ends up as heat

most of the wasted energy appears as electricity

some of the wasted energy is destroyed

the wasted energy becomes spread out

the wasted energy is always available for further useful transfers

QUESTION SEVEN

An electric fan has a power of 50 watts.

Which **two** of the following statements are correct?

the fan has a power of 0.05 kilowatts

the fan has a power of 0.5 kilojoules per second

the fan has a power of 5 kilowatts

the fan transfers electrical energy to movement (kinetic energy)

the fan transfers heat (thermal energy) to electrical energy

SECTION C

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

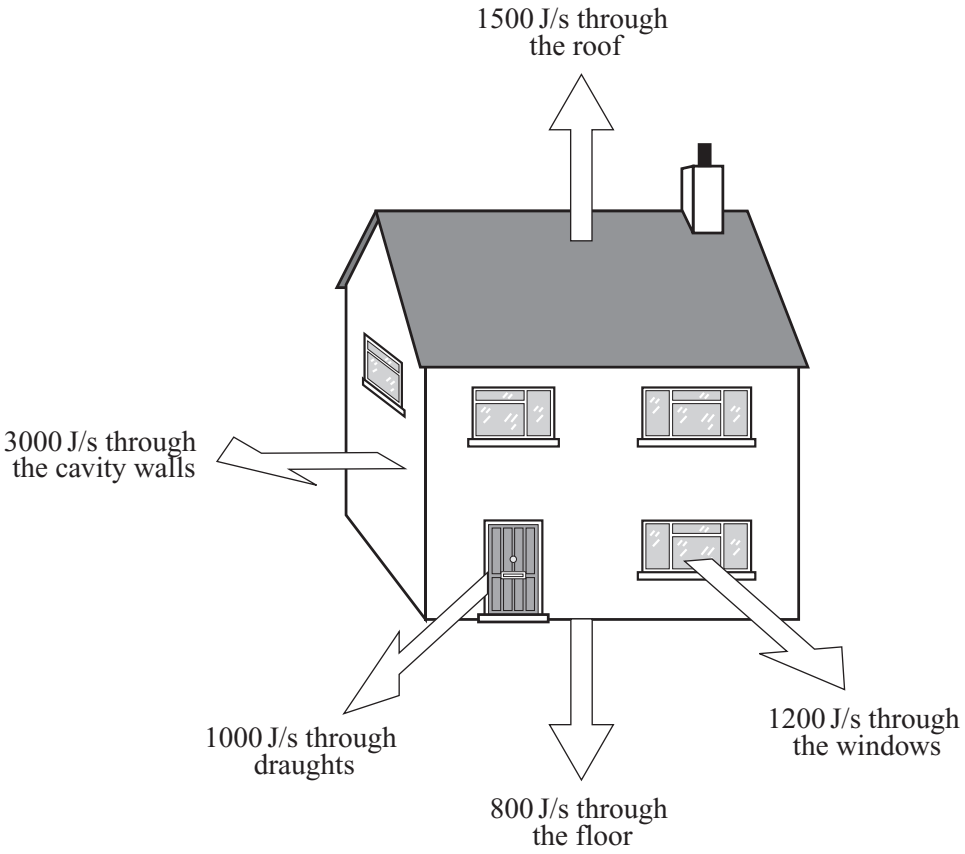
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

QUESTION EIGHT

The diagram shows some of the ways that heat can be lost from a house.



8.1 Heat escapes through the floor by . . . . .

A conduction only.

B convection only.

C radiation only.

D conduction, convection and radiation.

8.2 Heat escapes through draughts by . . . . .

A conduction only.

B convection only.

C conduction and radiation.

D conduction, convection and radiation.

The table gives some energy saving methods.
For each method, it shows the cost and how much energy is saved.

Energy saving method	Cost	Energy saved
Carpets	£1000	$\frac{3}{4}$ of energy lost through the floor
Cavity-wall insulation	£450	$\frac{2}{3}$ of energy lost through the walls
Double glazing	£4000	$\frac{1}{2}$ of energy lost through the windows
Loft insulation	£150	$\frac{1}{2}$ of energy lost through the roof

8.3 Which energy saving method saves most energy?

A Carpets

B Cavity-wall insulation

C Double glazing

D Loft insulation

8.4 Which energy saving method saves most energy for each £1 spent?

A Carpets

B Cavity-wall insulation

C Double glazing

D Loft insulation

QUESTION NINE

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

In the home, electricity is used for many purposes.

9.1 Why is electricity used as an energy source in our homes?

A Electrical energy is easily transferred

B Electrical energy is completely safe

C Electrical energy is cheaper than other energy sources

D Electrical energy produces no waste heat

9.2 The diagram shows the reading on an electricity meter in a house.

5	3	1	7	2

If only a 3 kW heater is switched on for 6 hours, what will the new meter reading be?

A

5	3	1	7	4

B

5	3	1	9	0

C

5	3	1	9	2

D

5	3	3	5	2

9.3 Electricity costs 8 p per Unit.

How much will it cost to run a 2 kW electric fire for 15 minutes?

A 4 p

B 16 p

C 32 p

D 64 p

9.4 Electricity is used outside the home.

Which of the following is designed to transfer electrical energy to gravitational potential energy?

A An aircraft engine

B An electric fan

C A horizontal moving pavement

D A moving staircase (escalator)

TURN OVER FOR THE NEXT QUESTION

QUESTION TEN

The table gives some information about burning different fuels.

Fuel	Energy obtained by burning 1 g of fuel, in kJ	Mass of carbon dioxide released by burning 1 g of fuel, in grams
Coal	27	3.5
Gas	55	2.8
Oil	42	3.1
Wood	20	2.6

10.1 Which fuel produces most energy for each gram of carbon dioxide released?

A Coal

B Gas

C Oil

D Wood

10.2 It is important to produce as little carbon dioxide as possible, because it . . . . .

A causes increased global warming.

B causes holes in the ozone layer.

C kills trees in the rainforests.

D is the main cause of acid rain.

10.3 What is the main advantage of wood over the other fuels?

A Cutting down trees provides land for growing food

B It is cheap to transport

C It is renewable

D It produces least carbon dioxide

10.4 Which type of power station has the longest start-up time?

A Coal-fired

B Gas-fired

C Nuclear

D Oil-fired

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

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

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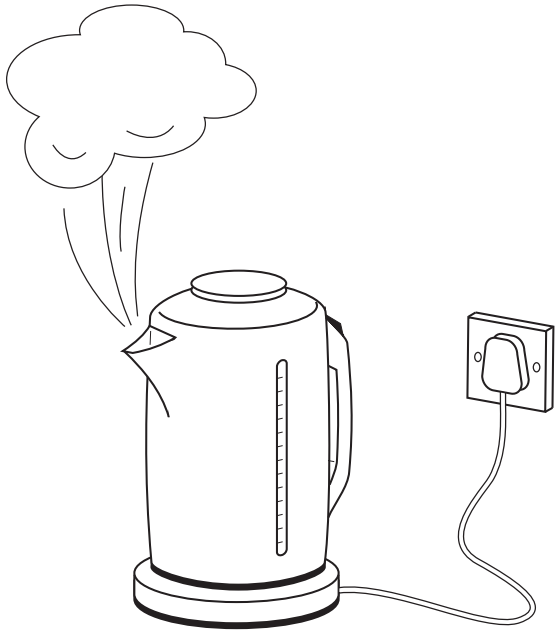

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The efficiency of the kettle is . . . . . **4** . . . . . .

TURN OVER FOR THE NEXT QUESTION

QUESTION TWO

This question is about the transfer of thermal energy.

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

conduction

convection

radiation

vibration

Thermal . . . . . **1** . . . . . is the transfer of energy by waves.

When the hotter parts of a liquid expand and become less dense, thermal energy is transferred by . . . . . **2** . . . . . .

Heating increases the kinetic energy of metal ions. This is because the . . . . . **3** . . . . . of each metal ion increases.

When electrons move through a metal and collide with metal ions, thermal energy is transferred by . . . . . **4** . . . . . .

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

An electric fan has a power of 50 watts.

Which **two** of the following statements are correct?

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QUESTION FOUR

When the first nuclear power station was built, people thought that electricity from uranium would be cheaper than electricity from coal.

Which **two** reasons explain why this did **not** happen?

costly safety features make a nuclear power station expensive to build

decommissioning a nuclear power station is expensive

supplies of uranium are running out

there have been many accidents at nuclear power stations

uranium is an expensive fuel

SECTION C

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

Each of these questions has four parts.

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QUESTION FIVE

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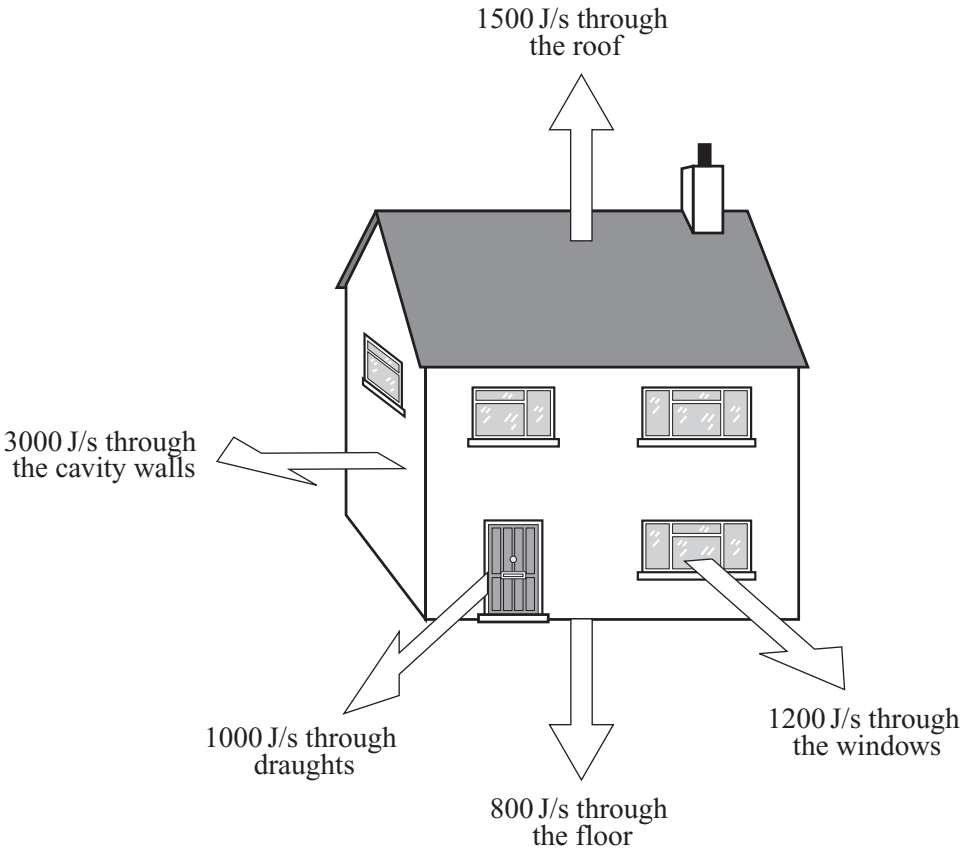

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B Cavity-wall insulation

C Double glazing

D Loft insulation

5.4 Which energy saving method saves most energy for each £1 spent?

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C Double glazing

D Loft insulation

QUESTION SIX

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

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TURN OVER FOR THE NEXT QUESTION

QUESTION SEVEN

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7.1 Which fuel produces most energy for each gram of carbon dioxide released?

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B Gas

C Oil

D Wood

7.2 It is important to produce as little carbon dioxide as possible, because it . . . . .

A causes increased global warming.

B causes holes in the ozone layer.

C kills trees in the rainforests.

D is the main cause of acid rain.

7.3 What is the main advantage of wood over the other fuels?

A Cutting down trees provides land for growing food

B It is cheap to transport

C It is renewable

D It produces least carbon dioxide

7.4 Which type of power station has the longest start-up time?

A Coal-fired

B Gas-fired

C Nuclear

D Oil-fired

TURN OVER FOR THE NEXT QUESTION

QUESTION EIGHT

By 2020, the UK hopes to supply 20 % of its electricity using wind power.
Thousands of wind turbines will need to be erected. Very large turbines may be located out at sea.
Some people hope that the electricity from these wind turbines will allow nuclear power stations to be shut down.

This question is about arguments put forward by supporters of wind power and by supporters of nuclear power.

8.1 Which statement describes an advantage of wind power over nuclear power?

A Wind power causes no pollution

B Wind power does not make any dangerous waste

C Wind power puts less carbon dioxide into the atmosphere

D Wind power puts less sulphur dioxide into the atmosphere

8.2 Large wind turbines may be set up out at sea because . . . . .

A there is less air pollution out at sea.

B they are cheaper to set up out at sea.

C they cause less visual pollution out at sea.

D the wind is more reliable out at sea.

8.3 Why does a nuclear power station take up less space than a wind farm producing the same amount of electricity?

A It produces less electricity than a wind farm

B The energy in the wind is more spread out than in nuclear fuels

C Nuclear power stations are usually built near the coast

D Nuclear power stations produce radioactive waste which must be contained

8.4 Which statement describes an advantage of nuclear power over wind power?

A Electricity can be produced from nuclear power at any time and in any weather

B Fuel costs for nuclear power are very low

C Nuclear power does not cause atmospheric pollution

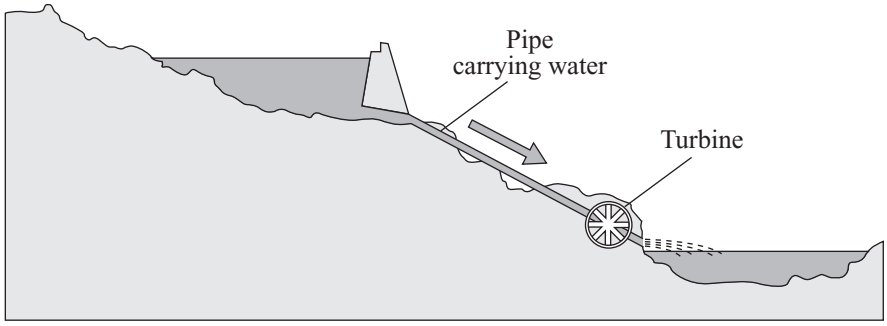
D Nuclear power does not damage river estuaries

NO QUESTIONS APPEAR ON THIS PAGE

TURN OVER FOR THE NEXT QUESTION

QUESTION NINE

The diagram shows a hydroelectric power station.



Electrical energy can be generated using the gravitational potential energy of water at a high level.

You may find the following formula useful when answering this question.				
energy transferred	=	power	×	time
(joule, J)		(watt, W)		(second, s)

9.1 Water weighing 100 000 N is pumped through a vertical height of 20 metres.

What is the change in gravitational potential energy of the water?

A 20 J

B 2000 J

C 100 000 J

D 2 000 000 J

9.2 What weight of water must be pumped through a height of 32 metres for 16 kJ of gravitational potential energy to be gained?

A 2 N

B 500 N

C 512 N

D 512 000 N

9.3 The gravitational potential energy of the water is used to drive a turbine to generate electricity. When 200 000 J of gravitational potential energy are used, the power input to the turbine is 2 kW.

How long does it take for the water to pass through the turbine?

A 10 s

B 100 s

C 1000 s

D 100 000 s

9.4 Which statement about hydroelectric power stations is correct?

A Both the capital costs and fuel costs are high

B Farmland is often destroyed when they are built and they cause air pollution

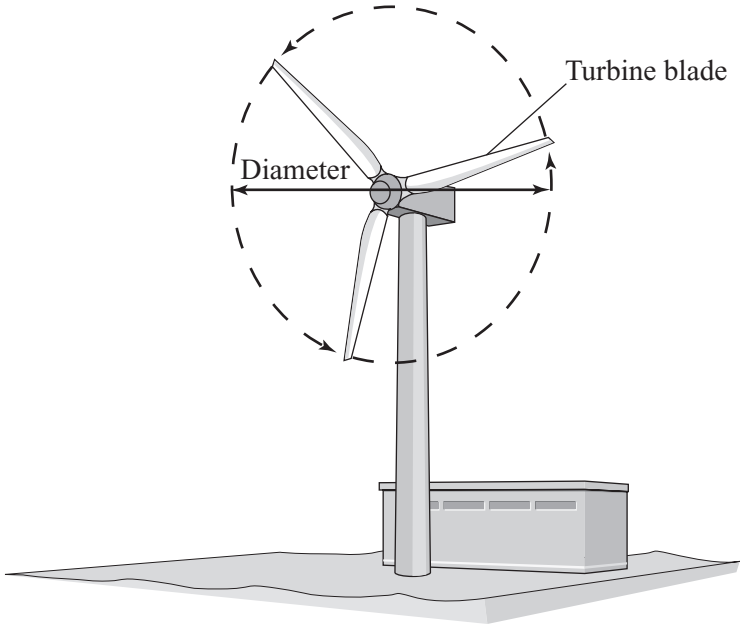
C Their start-up time is very short, so they can be used to top up the supply when the demand for electricity is high

D When run in reverse they store electricity, so they can be used when the demand for electricity is low

TURN OVER FOR THE NEXT QUESTION

QUESTION TEN

The diagram shows a wind turbine.



You may find the following formula useful when answering parts of this question.

The power delivered to a turbine blade by the wind is given by the formula:

$$\text{power (in watts)} = 0.5\,Mv^2$$

where M is the mass of air (in kilograms) hitting a blade each second, and
v is the wind speed (in metres per second).

10.1 At a certain wind speed, a wind turbine transfers 2500 kW from the wind.

How many wind turbines would be needed to replace a 1000 MW power station?
(1 MW = 1000 kW)

A 100

B 200

C 400

D 800

10.2 When the wind speed is 12 m/s, the mass of air hitting a blade in one second is 33 000 kg.

What is the power delivered to a blade?

A 198 000 W

B 396 000 W

C 2 376 000 W

D 4 752 000 W

10.3 The power delivered to a different turbine blade is 49 500 W.

What is the wind speed if M is 11 000 kg/s?

A 0.2 m/s

B 2.1 m/s

C 3.0 m/s

D 4.5 m/s

10.4 The table gives information about some wind turbines.

Turbine diameter in metres	Electrical power output in watts for a wind speed of 5 m/s
2	50
3	112.5
4	200
5	312.5
6	450

Which statement about wind turbines is correct?

A The electrical power is proportional to the diameter

B The electrical power is proportional to the square of the diameter

C The electrical power is inversely proportional to the diameter

D The electrical power is inversely proportional to the diameter squared

END OF TEST