

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
June 2004



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

Tuesday 29 June 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:

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

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

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

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

- 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:

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

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**.

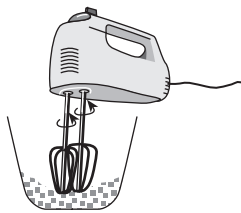
In these questions match the words in the list with the numbers.

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

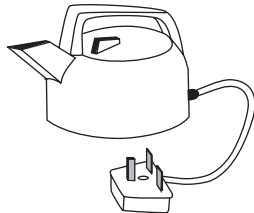
Mark your choices on the answer sheet.

QUESTION ONE

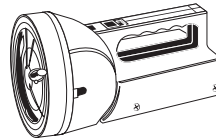
The devices shown transfer electrical energy in different ways.



Food mixer



Kettle



Torch



Radio

Match the devices **1–4** with the energy transfers in the table.

Device	Designed to transfer electrical energy as
1	heat (thermal energy)
2	light
3	movement (kinetic energy)
4	sound

QUESTION TWO

A vacuum flask keeps drinks hot.

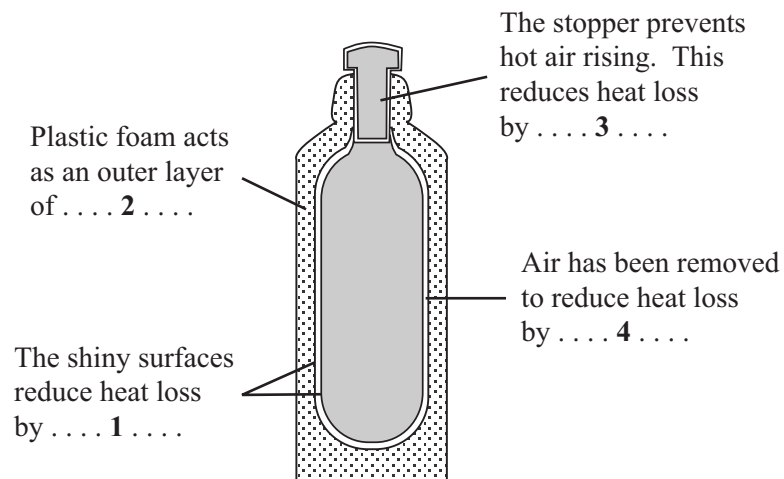
Match words from the list with the numbers 1–4 in the sentences.

conduction

convection

insulation

radiation



TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION THREE

Generators produce electricity. They are driven by turbines.

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

geothermal schemes

hydroelectric schemes

solar cells

wind farms

..... 1 use moving air to drive the turbines.

..... 2 use water flowing down a hillside to drive the turbines.

..... 3 use steam from below the Earth's surface to drive the turbines.

..... 4 produce electricity without using turbines.

QUESTION FOUR

The various methods of producing electricity affect the environment in different ways.

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

fossil fuels

hydroelectric schemes

nuclear fuels

wind farms

Polluting gases are released into the air by using 1

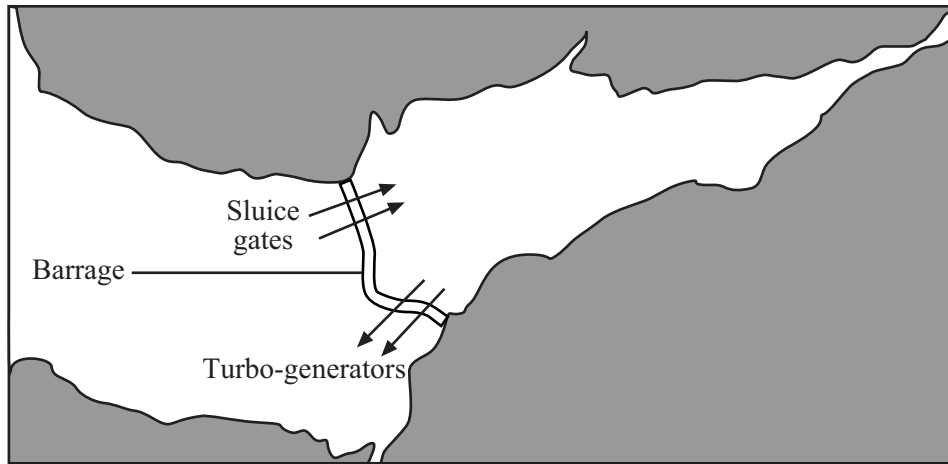
Upland river valleys are dammed when building 2

Noise and visual pollution of hills and coasts can be caused by 3

Dangerous radioactive waste is produced by using 4

QUESTION FIVE

The map shows the proposed barrage across the Severn estuary. It could produce 6% of the electricity used in Britain.



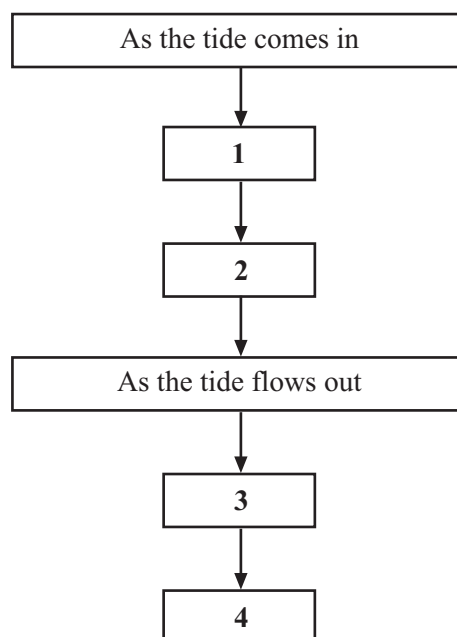
Match the statements in the list with the boxes 1–4 to explain how the barrage would work.

electricity is supplied to the National Grid

water flows through the sluice gates

water flows through the turbo-generators

water is trapped behind the barrage



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** of the following 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**Which **two** of the following statements are true of hydroelectric schemes?**they are not very reliable****they are usually built in mountainous areas****they can be used in reverse to store energy from surplus electricity****they take a long time to start up****they use the power generated by waves**

NO QUESTIONS APPEAR ON THIS PAGE

TURN OVER FOR THE NEXT QUESTION

Turn over ►

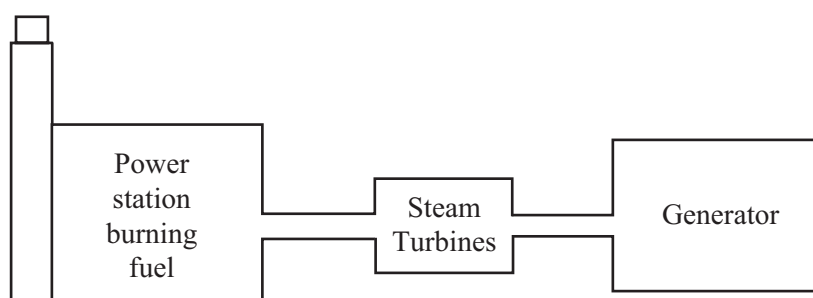
SECTION CQuestions **EIGHT** to **TEN**.

Each of these questions has four parts.

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

QUESTION EIGHT

Some power stations produce electricity from fuels. The fuels are burned to produce heat. The heat is used to produce steam to drive turbines.



8.1 Which fuel does **not** have to be burned to produce heat?

- A Coal
- B Gas
- C Oil
- D Uranium

8.2 Which fuel releases most carbon dioxide per unit of energy produced?

- A Coal
- B Gas
- C Oil
- D Uranium

8.3 Governments are trying to reduce the amount of carbon dioxide released by power stations. This is because carbon dioxide

- A contains radioactive carbon.
- B increases global warming.
- C makes plants grow too fast.
- D makes the ocean acidic.

8.4 Nuclear power stations are only shut down to service them.

What is the main reason for this?

- A It is dangerous to shut them down
- B It takes a long time to start up a nuclear power station
- C People are afraid of radiation from nuclear power stations
- D Uranium is very expensive

TURN OVER FOR THE NEXT QUESTION

Turn over ►

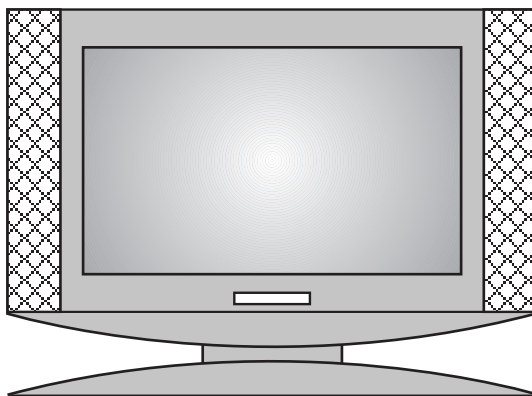
QUESTION NINE

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

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

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

The picture shows a television. The electrical energy is transferred in different ways. Some of the transfers are useful, others are not.



9.1 Which line of the table, **A**, **B**, **C** or **D**, is correct for a television?

	Useful energy	Wasted energy
A	heat and light	sound
B	heat and sound	light
C	light and kinetic energy	sound
D	light and sound	heat

9.2 What happens eventually to all of the electrical energy supplied to the television?

- A** It fades away and finally disappears
- B** It gets so spread out it is difficult to use again
- C** It increases the greenhouse effect
- D** It is recycled

The television transfers 4800 J of electrical energy every minute.
The energy wasted every minute is 3200 J.

9.3 What is the efficiency of the television?

- A 0.33 (33 %)
- B 0.66 (66 %)
- C 0.99 (99 %)
- D 1.50 (150 %)

9.4 What is the power of the television?

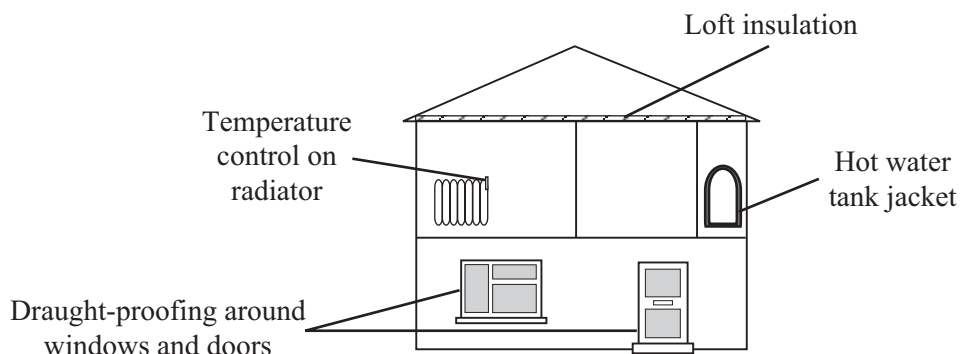
- A 27 W
- B 53 W
- C 80 W
- D 80 kW

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION TEN

The diagram shows some ways of reducing energy loss from a house.



The table gives information about ways of reducing energy loss from a house.

Method of reducing energy loss	Cost of fitting	Annual saving
Draught-proofing	£50	£50
Hot water tank jacket	£20	£15
Loft insulation	£200	£50
Temperature controls on radiators	£100	£20

10.1 Which method of reducing energy loss saves money by preventing the house becoming too warm?

- A Draught-proofing
- B Hot water tank jacket
- C Loft insulation
- D Temperature controls on radiators

10.2 Which method reduces energy loss by the smallest amount?

- A Draught-proofing
- B Hot water tank jacket
- C Loft insulation
- D Temperature controls on radiators

10.3 Which method pays for itself in the shortest time?

- A Draught-proofing
- B Hot water tank jacket
- C Loft insulation
- D Temperature controls on radiators

10.4 What is the pay-back time on loft insulation?

- A $\frac{1}{4}$ year
- B $\frac{1}{2}$ year
- C 2 years
- D 4 years

END OF TEST

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

HIGHER TIER

SECTION A

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

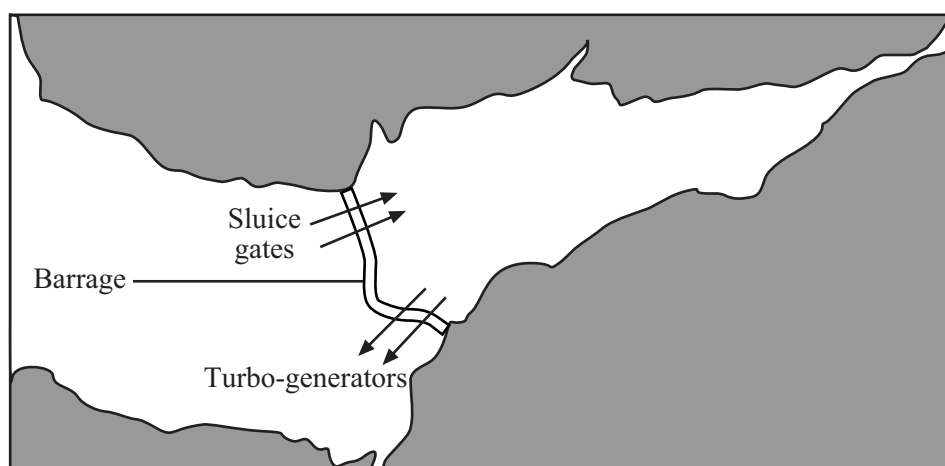
In these questions match the words in the list with the numbers.

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QUESTION ONE

The map shows the proposed barrage across the Severn estuary. It could produce 6% of the electricity used in Britain.



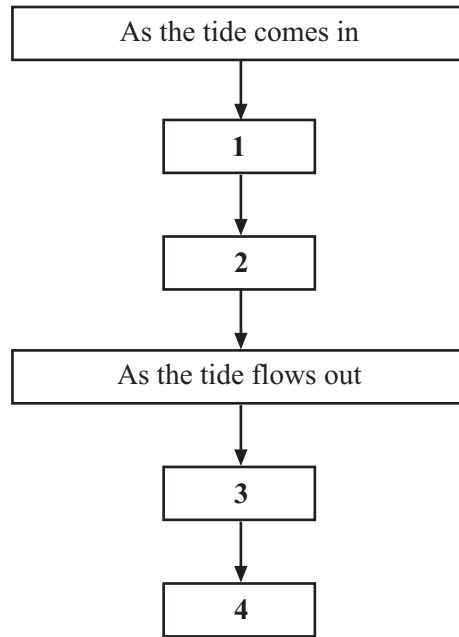
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electricity is supplied to the National Grid

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TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION TWO

This question is about some of the energy sources used to generate electricity.

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

coal

nuclear

solar

wind

Energy source	Main types of pollution produced	Time taken to start up power station	Cost of fuel
1	radioactive waste	long	low
2	noise and visual	short	zero
3	carbon dioxide and sulphur dioxide	long	high
4	none	—	zero

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 THREEWhich **two** of the following statements are true of hydroelectric schemes?**they are not very reliable****they are usually built in mountainous areas****they can be used in reverse to store energy from surplus electricity****they take a long time to start up****they use the power generated by waves****QUESTION FOUR**Which **two** of the following statements describe heat transfer by convection?**changes in density result in energy transfer****collisions result in energy transfer****free electrons transfer energy****warm regions expand and rise****waves transfer energy**

Turn over ►

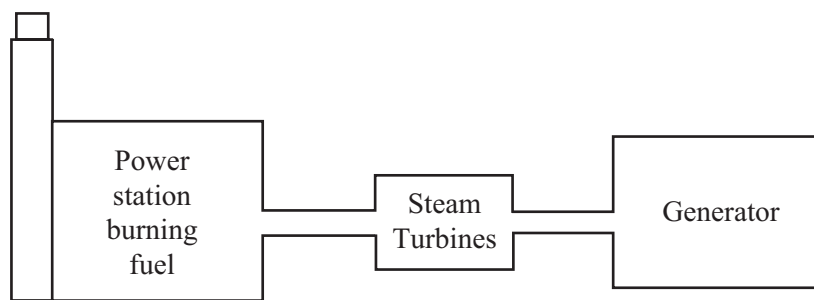
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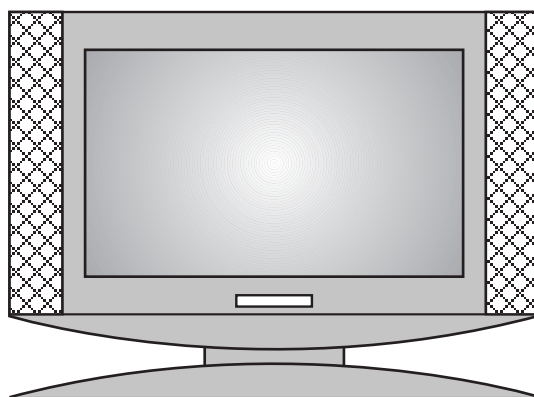
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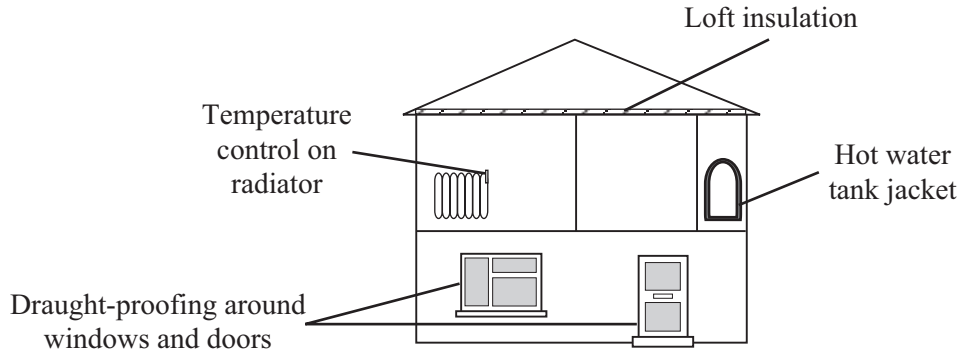
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TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION SEVEN

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7.4 What is the pay-back time on loft insulation?

- A $\frac{1}{4}$ year
- B $\frac{1}{2}$ year
- C 2 years
- D 4 years

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION EIGHT

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

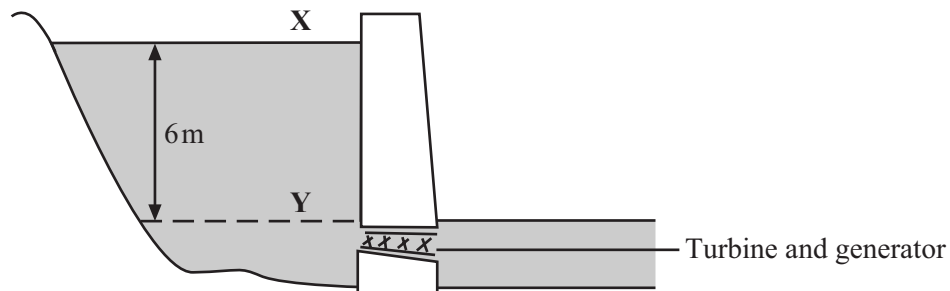
$$\begin{array}{l} \text{energy transferred} \\ \text{(kilowatt-hour, kWh)} \end{array} = \begin{array}{l} \text{power} \\ \text{(kilowatt, kW)} \end{array} \times \begin{array}{l} \text{time} \\ \text{(hour, h)} \end{array}$$

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

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

1 cubic metre of water weighs 10 000 N

The diagram shows an arrangement for generating electricity using falling water. The energy of the water is used to drive the turbine and generator.



8.1 How much energy is transferred by one cubic metre of water in falling from **X** to **Y**?

- A 6 kJ
- B 10 kJ
- C 60 kJ
- D 100 kJ

The total energy transferred to the turbine and generator is 1 800 000 kJ per minute.

8.2 How much power is transferred by the turbine and generator?

- A 30 000 kW
- B 180 000 kW
- C 1 800 000 kW
- D 108 000 000 kW

8.3 The efficiency of the turbine and generator is 72%.

What is the energy output per second?

A 21 600 kJ

B 1 296 000 kJ

C 2 160 000 kJ

D 129 600 000 kJ

8.4 The average electrical output of the generator is 1 300 000 kJ every minute.

How long will it take the generator to provide 130 000 Units of electricity?

A 0.6 hours

B 6 hours

C 60 hours

D 600 hours

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION NINE

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

$$\begin{array}{ccccc} \text{energy transferred} & = & \text{power} & \times & \text{time} \\ \text{(kilowatt-hour, kWh)} & & \text{(kilowatt, kW)} & & \text{(hour, h)} \end{array}$$

The table gives data about four power stations **A**, **B**, **C** and **D**.

	A	B	C	D
Power output in kW	1 800 000	600 000	1 200 000	20 000
Efficiency of transfer of energy (fuel to electrical energy)	35%	45%	25%	–
Building cost per Unit (kWh)	2.0p	2.3p	4.2p	2.9p
Fuel cost per Unit (kWh)	0.3p	1.1p	0.4p	zero
Running cost per Unit (kWh)	0.7p	0.3p	0.6p	0.9p
Atmospheric pollution	high	medium	very low	none
Time taken to start up power station	a few hours	a few minutes	a few days	a few seconds

9.1 Which of the power stations, **A**, **B**, **C** or **D**, is nuclear?

A typical household uses 15 kWh of electricity each day.

9.2 How many households could power station **D** supply in a day?

- A** 1 250
- B** 32 000
- C** 80 000
- D** 300 000

9.3 How many power stations similar to **D** would be needed to supply the same amount of electrical energy as power station **A**?

A 30

B 60

C 90

D 18 000

9.4 Which power station, **A**, **B**, **C** or **D**, has the highest total cost shown in the table for each Unit of electricity?

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION TEN

At night, in some power stations electrical energy is used to pump water uphill into lakes. Later the water is released and is used to drive turbines.

- 10.1** Electrical energy is used at night to pump water uphill because
- A at night the electricity is cheaper to produce.
 - B at night the demand for electricity is less, and the water stores energy until needed.
 - C there is a high demand at night, and water can be released to meet the demand.
 - D it is more efficient to close down power stations at night.
- 10.2** What is the maximum weight of water that can be pumped through a vertical height of 50 m by 2000 kJ of electrical energy?
- A 40 N
 - B 400 N
 - C 40 000 N
 - D 100 000 000 N
- 10.3** Another power station releases 60 000 litres of water, from a lake 40 m above the turbine. One litre of water weighs 10 N.
- What is the kinetic energy of the water when it reaches the turbine?
- A 1500 J
 - B 15 000 J
 - C 2 400 000 J
 - D 24 000 000 J
- 10.4** The calculation in 10.3 is only correct if
- A the turbine is considered to be 100 % efficient.
 - B the generator is considered to be 100 % efficient.
 - C we assume that no energy is wasted when the water is pumped uphill.
 - D we assume that no energy is wasted as the water falls down the hill.

END OF TEST