

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
June 2004



SCIENCE: SINGLE AWARD (MODULAR)
Energy and Electricity (Module 17)

346017

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 and Electricity” 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 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

We use symbols for components used in circuits.


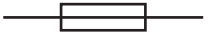

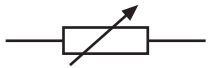
Match words from the list with the numbers **1–4** in the table.

fuse

lamp

thermistor

variable resistor

Component	Symbol
1	
2	
3	
4	

QUESTION TWO

The diagram shows the inside of a 3-pin plug.

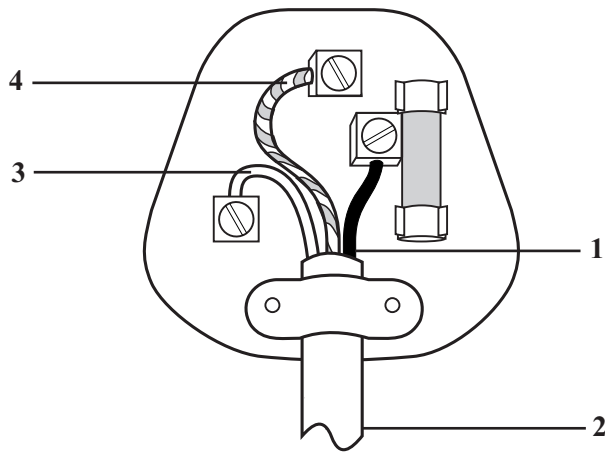
Match words from the list with the labels 1–4 on the diagram.

blue

brown

green and yellow

white



TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION THREE

A vacuum flask keeps drinks hot.

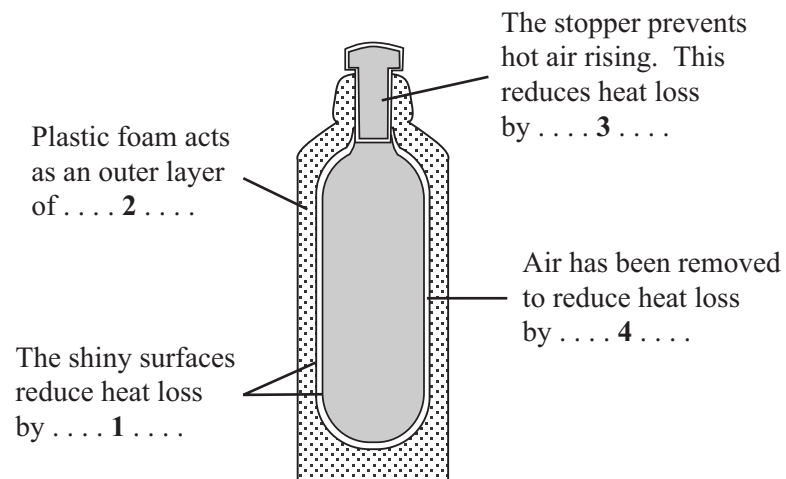
Match words from the list with the numbers 1–4 in the sentences.

conduction

convection

insulation

radiation



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**

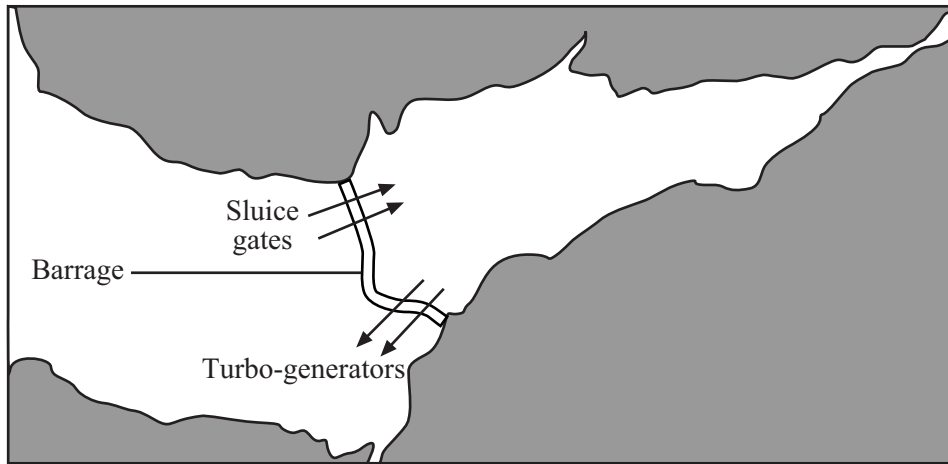
Dangerous radioactive waste is produced by using **4**

TURN OVER FOR THE NEXT QUESTION

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QUESTION FIVE

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



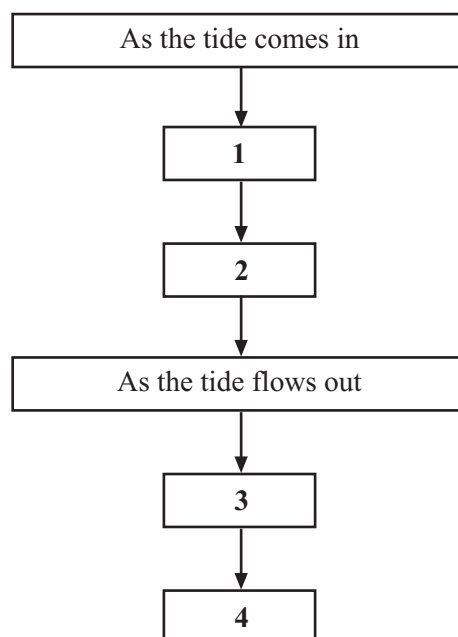
Match the statements in the list with the boxes 1–4 to explain how the barrage would work.

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



NO QUESTIONS APPEAR ON THIS PAGE

TURN OVER FOR THE NEXT QUESTION

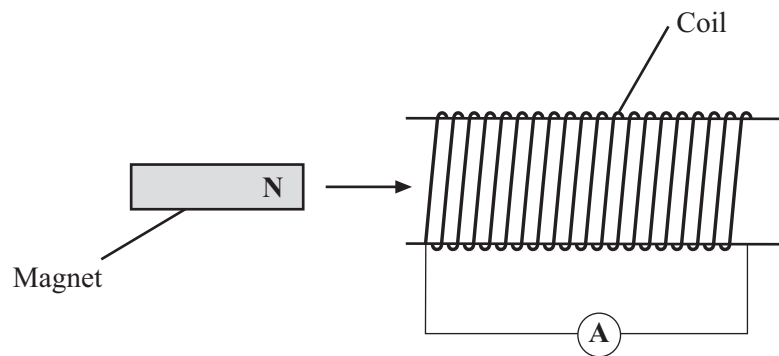
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SECTION BQuestions **SIX** and **SEVEN**.In these questions choose the best **two** answers.Do **not** choose more than two.

Mark your choices on the answer sheet.

QUESTION SIX

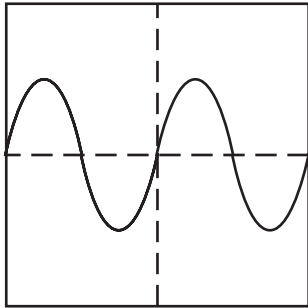
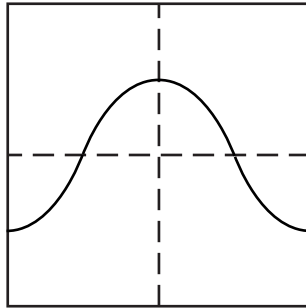
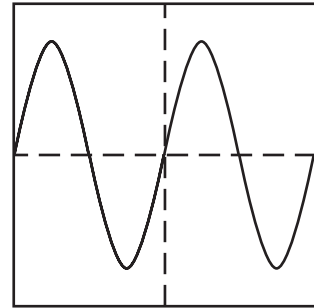
The diagram shows a magnet moving into a coil of wire.
The ammeter gives a positive reading.

Which **two** of the statements, **P**, **Q**, **R**, **S** and **T** are correct?

- P** if the magnet stops, the ammeter will give a negative reading
- Q** if the magnet stops, the ammeter will read zero
- R** if the magnet is moved out of the coil, the ammeter will give a negative reading
- S** if the magnet is moved out of the coil, the ammeter will give a positive reading
- T** if the magnet is reversed and moved out of the coil, the ammeter will give a negative reading

QUESTION SEVEN

The diagrams show the traces produced when three different a.c. supplies, **A**, **B** and **C**, were tested with an oscilloscope. The settings of the oscilloscope were kept the same throughout.

**A****B****C**

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

A has the same frequency as B

A has the same frequency as C

B has a higher frequency than C

B has the same peak voltage as A

C has the same peak voltage as A

TURN OVER FOR THE NEXT QUESTION

Turn over ►

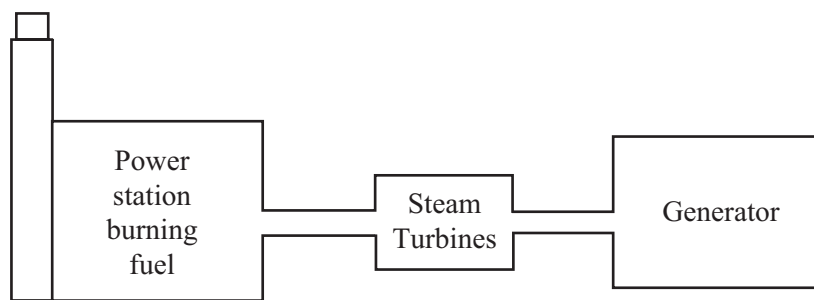
SECTION CQuestions **EIGHT** to **TEN**.

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?

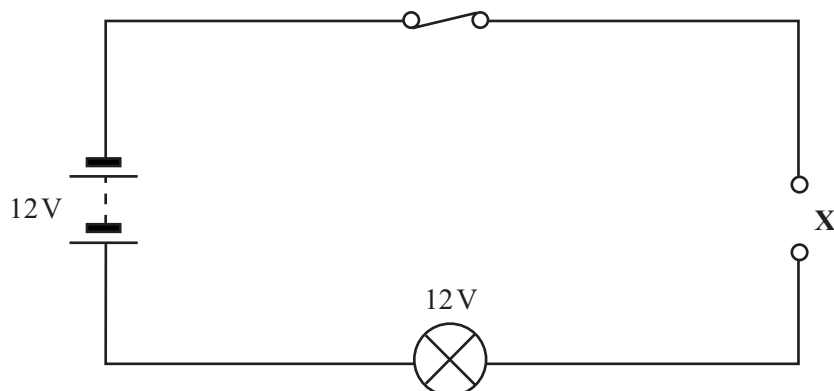
- A It is dangerous to shut them down
- B It takes a long time to start up a nuclear power station
- C People are afraid of radiation from nuclear power stations
- D Uranium is very expensive

TURN OVER FOR THE NEXT QUESTION

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QUESTION NINE

The diagram shows part of a circuit. The circuit can be completed by putting different components in the gap marked **X**.



- 9.1** With a diode in the gap **X**, the lamp
- A** does not light at all.
 - B** flickers slowly.
 - C** flickers very quickly.
 - D** lights only if the diode is the right way round.
- 9.2** With an LDR in the gap **X**, the lamp
- A** does not light at all.
 - B** lights more brightly when the lights in the room are off.
 - C** lights more brightly when the lights in the room are on.
 - D** lights only if the LDR is the right way round.
- 9.3** With a thermistor in the gap **X**, the lamp
- A** does not light at all.
 - B** lights more brightly if you cool the thermistor.
 - C** lights more brightly if you heat the thermistor.
 - D** lights only if the thermistor is the right way round.

9.4 With a large value resistor in the gap **X**, the lamp

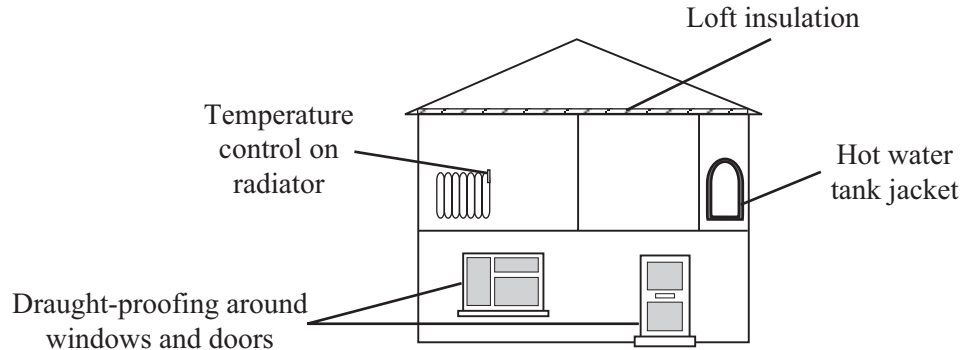
- A** flickers.
- B** lights brightly.
- C** lights dimly.
- D** lights only if the resistor is the right way round.

TURN OVER FOR THE NEXT QUESTION

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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**.

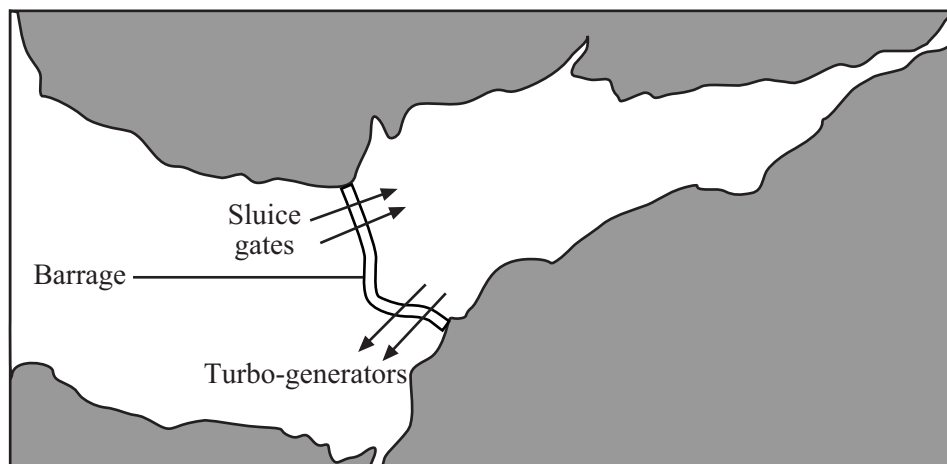
In these questions match the words in the list with the numbers.

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

Mark your choices on the answer sheet.

QUESTION ONE

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



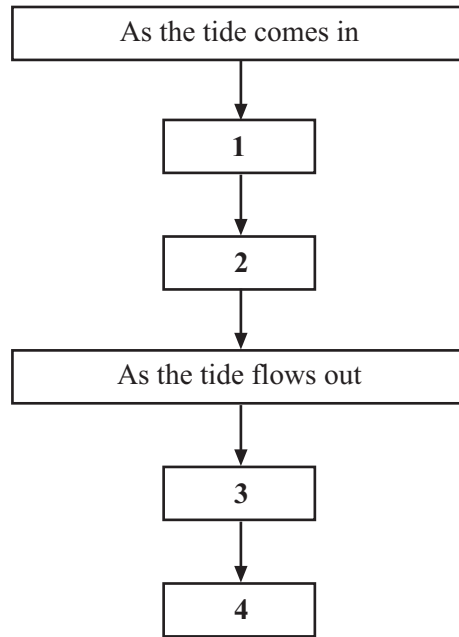
Match the statements in the list with the boxes **1–4** to explain how the barrage would work.

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

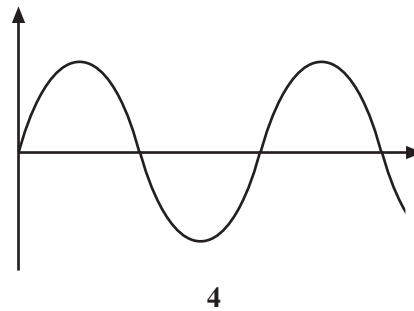
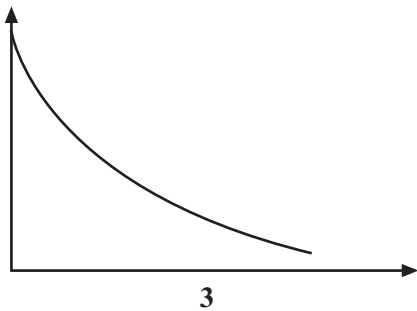
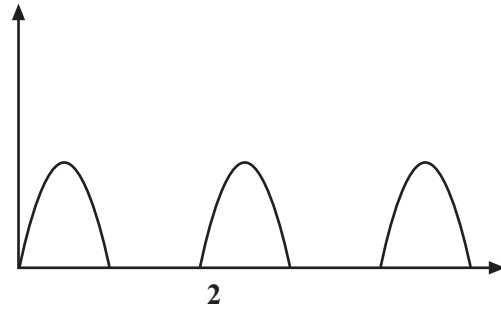


TURN OVER FOR THE NEXT QUESTION

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QUESTION TWO

Four graphs are shown below. The horizontal axis represents time or temperature.



Match statements from the list, **P**, **Q**, **R** and **S**, with the graphs **1–4**, to describe what the graph shows.

- P** how the current through a diode connected to an a.c. supply changes with time
- Q** how the potential difference across an a.c. generator changes with time
- R** how the potential difference (voltage) across a battery changes with time
- S** how the resistance of a thermistor changes with temperature

NO QUESTIONS APPEAR ON THIS PAGE

TURN OVER FOR THE NEXT QUESTION

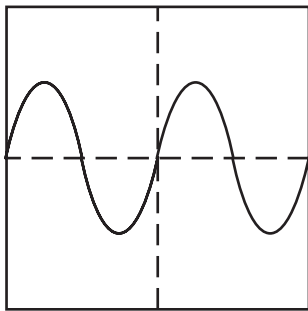
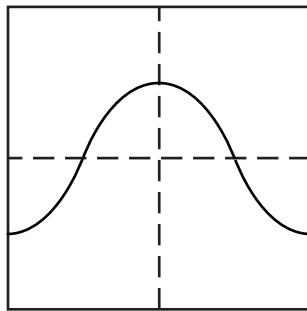
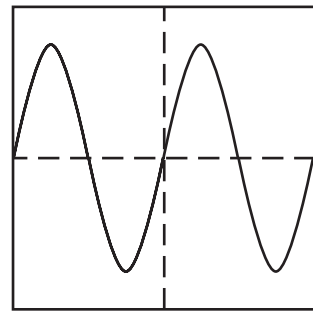
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SECTION BQuestions **THREE** and **FOUR**.In these questions choose the best **two** answers.Do **not** choose more than two.

Mark your choices on the answer sheet.

QUESTION THREE

The diagrams show the traces produced when three different a.c. supplies, **A**, **B** and **C**, were tested with an oscilloscope. The settings of the oscilloscope were kept the same throughout.

**A****B****C**

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

A has the same frequency as B

A has the same frequency as C

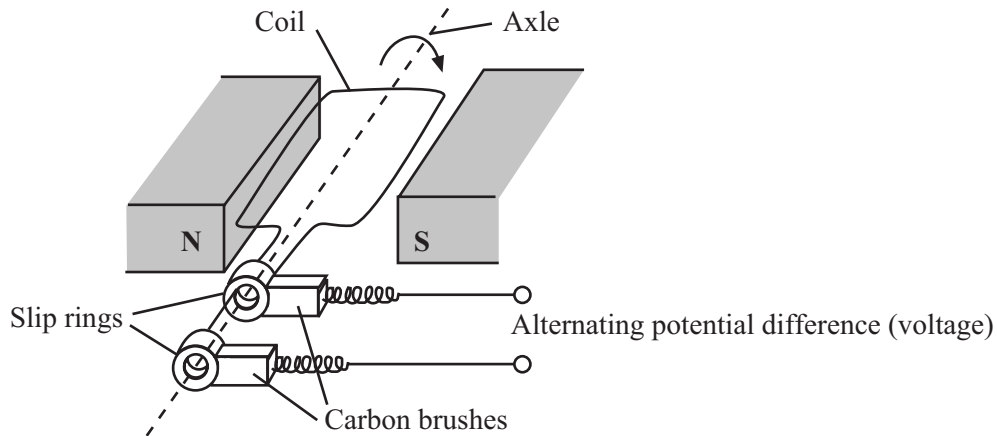
B has a higher frequency than C

B has the same peak voltage as A

C has the same peak voltage as A

QUESTION FOUR

The diagram shows a simple generator.



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

the brushes change a.c. to d.c.

the slip rings prevent the wires from getting tangled up

the stronger the magnetic field the greater the voltage produced

when the coil spins faster the frequency of the a.c. generated decreases

the voltage produced increases if the number of turns on the coil is increased

TURN OVER FOR THE NEXT QUESTION

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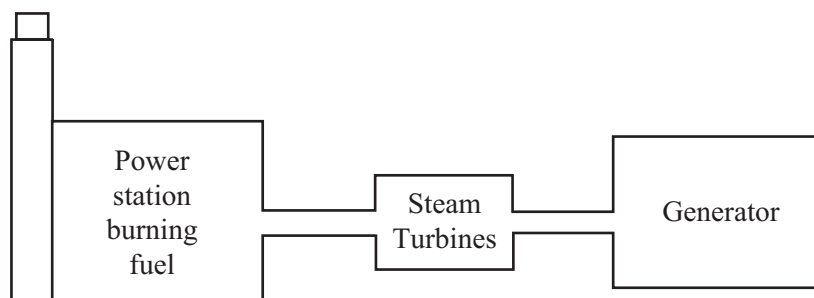
SECTION CQuestions **FIVE** to **TEN**.

Each of these questions has four parts.

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

QUESTION FIVE

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



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

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

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

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

5.3 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.

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

What is the main reason for this?

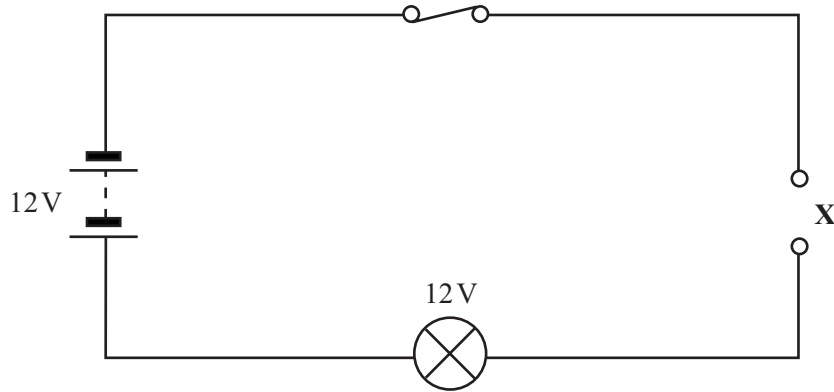
- A It is dangerous to shut them down
- B It takes a long time to start up a nuclear power station
- C People are afraid of radiation from nuclear power stations
- D Uranium is very expensive

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION SIX

The diagram shows part of a circuit. The circuit can be completed by putting different components in the gap marked **X**.



- 6.1** With a diode in the gap **X**, the lamp
- A** does not light at all.
 - B** flickers slowly.
 - C** flickers very quickly.
 - D** lights only if the diode is the right way round.
- 6.2** With an LDR in the gap **X**, the lamp
- A** does not light at all.
 - B** lights more brightly when the lights in the room are off.
 - C** lights more brightly when the lights in the room are on.
 - D** lights only if the LDR is the right way round.
- 6.3** With a thermistor in the gap **X**, the lamp
- A** does not light at all.
 - B** lights more brightly if you cool the thermistor.
 - C** lights more brightly if you heat the thermistor.
 - D** lights only if the thermistor is the right way round.

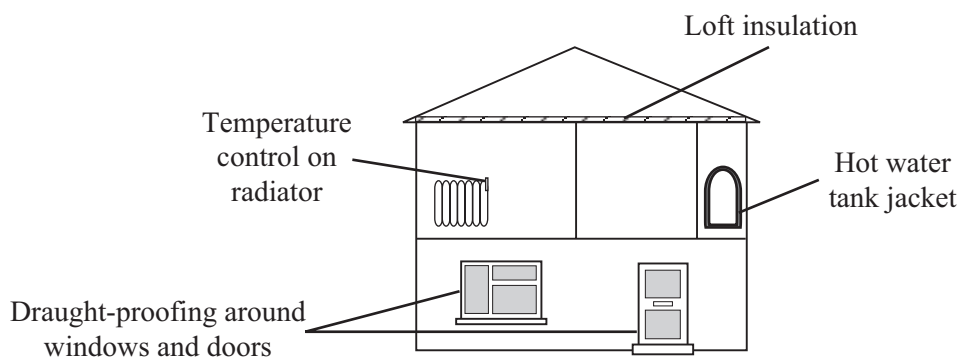
- 6.4** With a large value resistor in the gap **X**, the lamp
- A** flickers.
 - B** lights brightly.
 - C** lights dimly.
 - D** lights only if the resistor is the right way round.

TURN OVER FOR THE NEXT QUESTION

Turn over ►

QUESTION SEVEN

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

7.1 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

7.2 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

7.3 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

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.

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

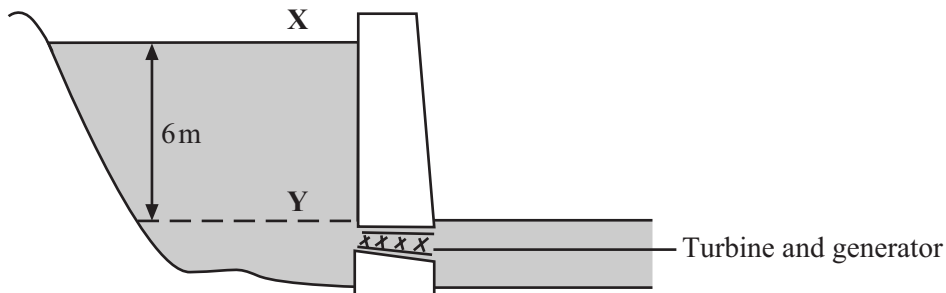
$$\text{efficiency} = \frac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$$

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

$$\begin{array}{l} \text{change in gravitational} \\ \text{potential energy} \\ \text{(joule, J)} \end{array} = \begin{array}{l} \text{weight} \\ \text{(newton, N)} \end{array} \times \begin{array}{l} \text{change in vertical height} \\ \text{(metre, m)} \end{array}$$

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

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

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.

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

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

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

$$\begin{array}{ccccc} \text{change in gravitational potential energy} & = & \text{weight} & \times & \text{change in vertical height} \\ \text{(joule, J)} & & \text{(newton, N)} & & \text{(metre, m)} \end{array}$$

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 movement (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

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