

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education  
Winter 2003



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

**346017**

Thursday 27 November 2003 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.

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

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**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**.

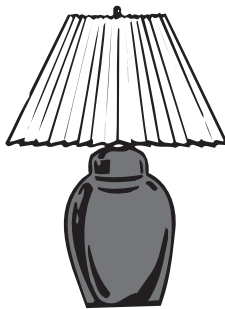
Mark your choices on the answer sheet.

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**QUESTION ONE**

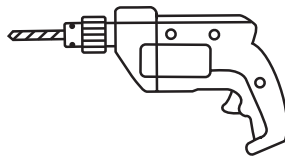
The devices shown below transfer electrical energy in different ways.

Bedside lamp



1

Drill



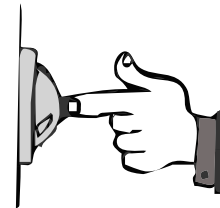
2

Iron



3

Bell



4

The list gives the useful form of energy the devices are designed to produce.

Match words from the list with the devices numbered **1–4**.

**heat (thermal energy)**

**light**

**movement (kinetic energy)**

**sound**

**QUESTION TWO**

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

**conduction**

**convection**

**insulation**

**radiation**

Energy travels from the Sun to the Earth by . . . . . **1** . . . . .

In a kettle hot water rises by . . . . . **2** . . . . .

Thermal energy passes through the walls of a room by . . . . . **3** . . . . .

To reduce heat loss from a house, the cavity walls are fitted with . . . . . **4** . . . . .

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION THREE**

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

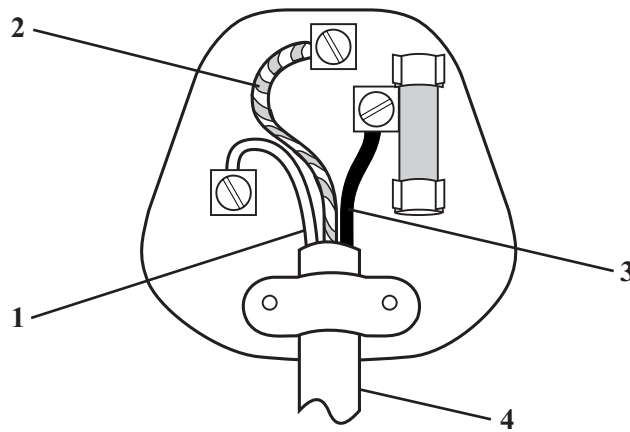
Match words from the list with the numbers 1–4 on the diagram.

**blue plastic**

**brown plastic**

**green and yellow plastic**

**white plastic**



**QUESTION FOUR**

Different types of power station affect the environment in different ways.

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

**gas-fired**

**hydroelectric**

**nuclear**

**tidal**

Type of power station	Effect on environment
<b>1</b>	may destroy the habitat of wading birds
<b>2</b>	increases global warming
<b>3</b>	produces radioactive waste
<b>4</b>	may destroy farmland and forest

**QUESTION FIVE**

Different energy sources are used to produce electricity in different places.

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

**geothermal**

**hydroelectric**

**solar cells**

**tidal**

Energy source	Best place to use
<b>1</b>	mountainous area
<b>2</b>	remote location
<b>3</b>	river estuary
<b>4</b>	volcanic area

Turn over ►

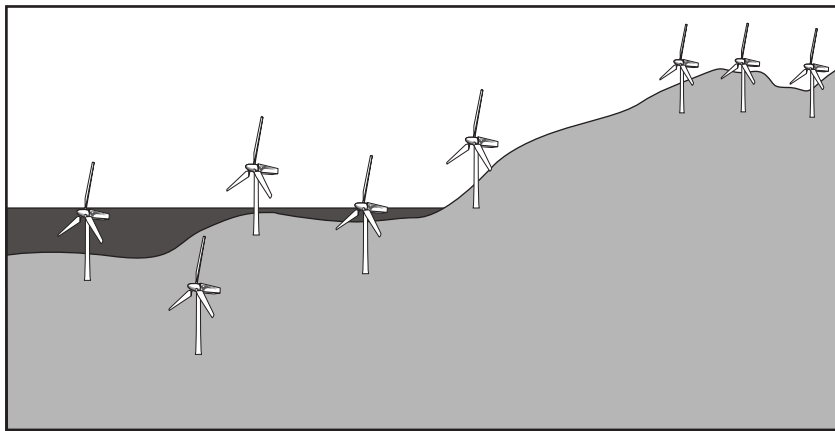
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**SECTION B**Questions **SIX** and **SEVEN**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

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**QUESTION SIX**

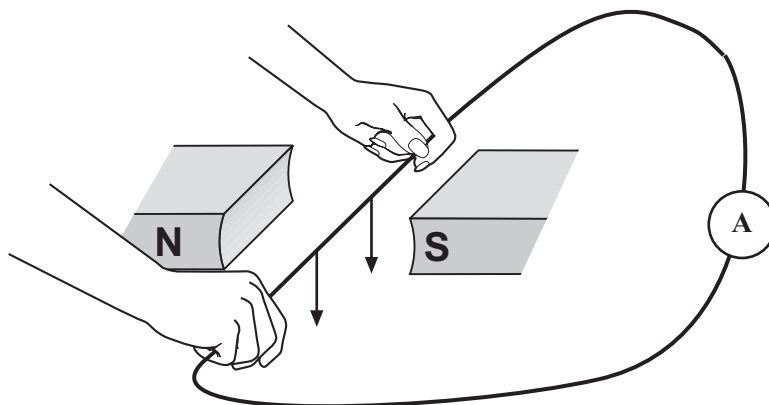
The diagram shows a wind farm.

Which **two** of the following statements about wind farms are true?**electricity can always be generated****no fuel is used****no sulphur dioxide is produced****steam is produced****the electricity generated is free**

**QUESTION SEVEN**

A wire is moving downwards between the poles of a magnet.

The ammeter gives a positive reading.



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

**if the wire moves upwards, the ammeter will give a negative reading**

**if the wire moves upwards, the ammeter will give a positive reading**

**if the wire moves upwards, the ammeter will read zero**

**if the wire stops, the ammeter will give a negative reading**

**if the wire stops, the ammeter will read zero**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

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**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.

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**QUESTION EIGHT**

All types of power stations have advantages and disadvantages.

**8.1** Which type of power station is **most** likely to cause acid rain?

- A A coal-fired power station
- B A hydroelectric power station
- C A nuclear power station
- D A wind farm

**8.2** Which type of power station will produce the **least** atmospheric pollution?

- A A coal-fired power station
- B A gas-fired power station
- C A geothermal power station
- D An oil-fired power station

**8.3** Which type of power station can be used in reverse, so that energy from surplus electricity can be stored?

- A A gas-fired power station
- B A hydroelectric power station
- C A solar power station
- D A wind farm



**8.4** Which type of power station will cause the **least** noise pollution?

- A A gas-fired power station
- B A hydroelectric power station
- C A solar power station
- D A wind farm

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

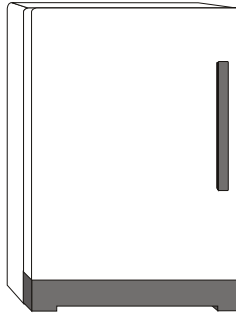
**QUESTION NINE**

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

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

$$\text{total cost} = \text{number of Units} \times \text{cost per Unit}$$

The electricity supplied to a refrigerator costs 8p per Unit.



**9.1** One Unit of electricity is . . . . .

- A one kilojoule (kJ)
- B one kilojoule-hour (kJh)
- C one kilowatt (kW)
- D one kilowatt-hour (kWh)

**9.2** When the cooling circuit is running, the refrigerator transfers electrical energy at a rate of 0.8 kW. During the summer the cooling circuit runs for an average 5 hours per day.

How many Units of electricity does the refrigerator use in an average day in summer?

- A 1.3
- B 4.0
- C 4.8
- D 24.0

**9.3** During one month in the winter the refrigerator uses 104 Units of electricity.

How much does this electricity cost?

- A 13p
- B 28p
- C £8.32
- D £13

**9.4** Part of an electricity bill is shown below.

Present reading	Previous reading	Units	Pence per Unit	Amount
01685	01511		8.00	

How many Units are used during the period of the bill?

- A 174
- B 1337
- C 1869
- D 3196

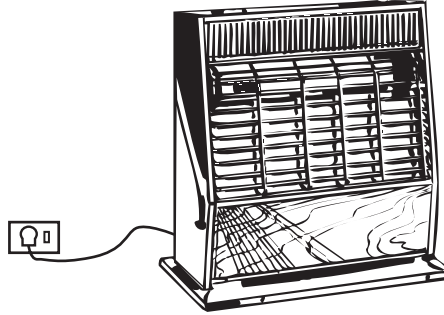
**TURN OVER FOR THE NEXT QUESTION**

Turn over ►

**QUESTION TEN**

The diagram shows an electric fire which is used on the mains supply.

A current of 4 A flows through the fire when it is connected.



**10.1** The mains supply is . . . . .

- A 50 V a.c. with a frequency of 230 Hz.
- B 50 V d.c. with a frequency of 230 Hz.
- C 230 V a.c. with a frequency of 50 Hz.
- D 230 V d.c. with a frequency of 50 Hz.

**10.2** Which is the best fuse for the fire?

- A 1 A
- B 3 A
- C 5 A
- D 13 A

**10.3** A fuse works by melting when the . . . . .

- A current becomes too high.
- B earth wire touches the metal case.
- C live wire becomes too hot.
- D neutral wire becomes too hot.

**10.4** The fire has a metal case. It needs to be earthed because . . . . .

- A** if there is a fault, the fuse may not work.
- B** if there is a fault, the live wire may touch the case.
- C** the metal case may act as an insulator.
- D** the metal case may become too hot.

**END OF TEST**

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

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**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**

Different energy sources are used to produce electricity in different places.

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

**geothermal**

**hydroelectric**

**solar cells**

**tidal**

<b>Energy source</b>	<b>Best place to use</b>
<b>1</b>	mountainous area
<b>2</b>	remote location
<b>3</b>	river estuary
<b>4</b>	volcanic area

**QUESTION TWO**

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

**earth**

**live**

**negative**

**neutral**

In the mains electricity supply, the . . . . . **1** . . . . . terminal stays at zero volts with respect to . . . . . **2** . . . . .

The . . . . . **3** . . . . . terminal alternates between positive and . . . . . **4** . . . . . voltage with respect to the neutral terminal.

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

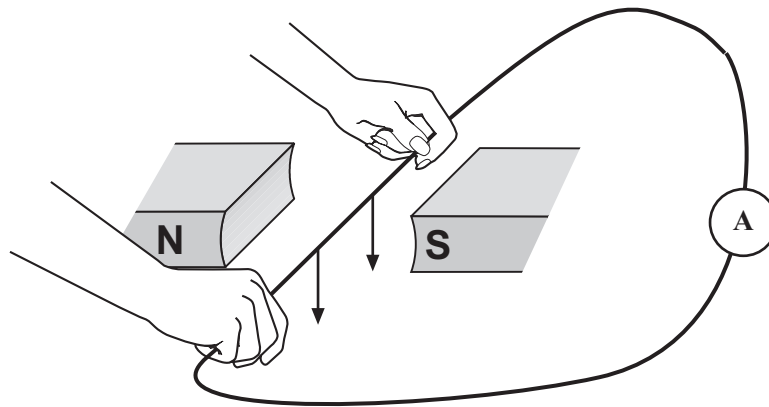
**SECTION B**Questions **THREE** and **FOUR**.In these questions choose the best **two** answers.Do **not** choose more than two.

Mark your choices on the answer sheet.

**QUESTION THREE**

A wire is moving downwards between the poles of a magnet.

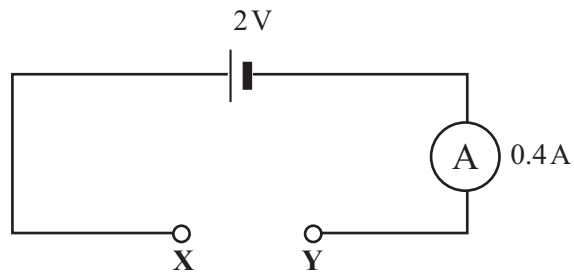
The ammeter gives a positive reading.

Which **two** of the following statements are correct?**if the wire moves upwards, the ammeter will give a negative reading****if the wire moves upwards, the ammeter will give a positive reading****if the wire moves upwards, the ammeter will read zero****if the wire stops, the ammeter will give a negative reading****if the wire stops, the ammeter will read zero**

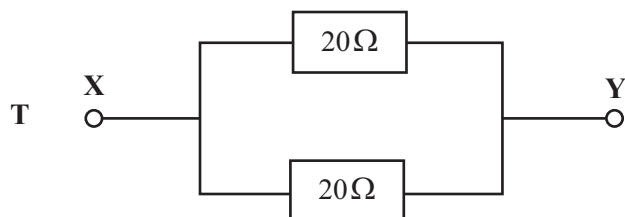
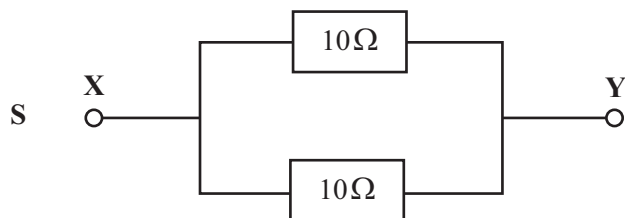
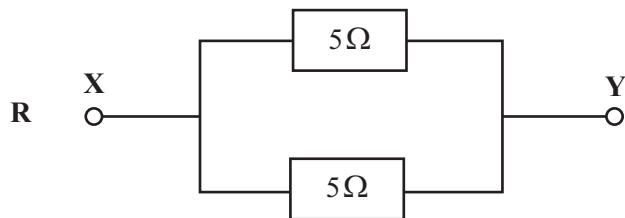


### QUESTION FOUR

The diagram shows a circuit with a gap in it between **X** and **Y**.



Which **two** of the arrangements, **P**, **Q**, **R**, **S** and **T**, connected between **X** and **Y**, will allow a current of 0.4 A to flow through the ammeter?



Turn over ►

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**SECTION C**Questions **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**

All types of power stations have advantages and disadvantages.

**5.1** Which type of power station is **most** likely to cause acid rain?

- A A coal-fired power station
- B A hydroelectric power station
- C A nuclear power station
- D A wind farm

**5.2** Which type of power station will produce the **least** atmospheric pollution?

- A A coal-fired power station
- B A gas-fired power station
- C A geothermal power station
- D An oil-fired power station

**5.3** Which type of power station can be used in reverse, so that energy from surplus electricity can be stored?

- A A gas-fired power station
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- D A wind farm

**5.4** Which type of power station will cause the **least** noise pollution?

- A** A gas-fired power station
- B** A hydroelectric power station
- C** A solar power station
- D** A wind farm

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

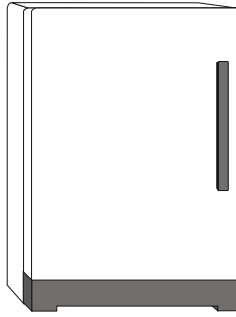
**QUESTION SIX**

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

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

$$\text{total cost} = \text{number of Units} \times \text{cost per Unit}$$

The electricity supplied to a refrigerator costs 8p per Unit.



- 6.1** One Unit of electricity is . . . . .
- A** one kilojoule (kJ)
  - B** one kilojoule-hour (kJh)
  - C** one kilowatt (kW)
  - D** one kilowatt-hour (kWh)
- 6.2** When the cooling circuit is running, the refrigerator transfers electrical energy at a rate of 0.8 kW. During the summer the cooling circuit runs for an average 5 hours per day.
- How many Units of electricity does the refrigerator use in an average day in summer?
- A** 1.3
  - B** 4.0
  - C** 4.8
  - D** 24.0

**6.3** During one month in the winter the refrigerator uses 104 Units of electricity.

How much does this electricity cost?

- A 13p
- B 28p
- C £8.32
- D £13

**6.4** Part of an electricity bill is shown below.

Present reading	Previous reading	Units	Pence per Unit	Amount
01685	01511		8.00	

How many Units are used during the period of the bill?

- A 174
- B 1337
- C 1869
- D 3196

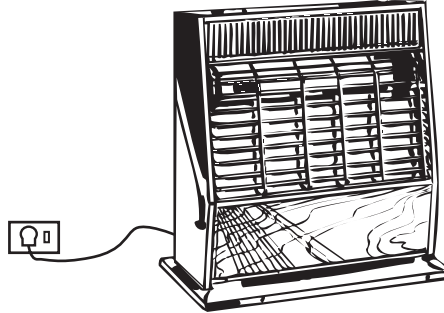
**TURN OVER FOR THE NEXT QUESTION**

Turn over ►

**QUESTION SEVEN**

The diagram shows an electric fire which is used on the mains supply.

A current of 4 A flows through the fire when it is connected.



- 7.1** The mains supply is . . . . .
- A** 50 V a.c. with a frequency of 230 Hz.
  - B** 50 V d.c. with a frequency of 230 Hz.
  - C** 230 V a.c. with a frequency of 50 Hz.
  - D** 230 V d.c. with a frequency of 50 Hz.
- 7.2** Which is the best fuse for the fire?
- A** 1 A
  - B** 3 A
  - C** 5 A
  - D** 13 A
- 7.3** A fuse works by melting when the . . . . .
- A** current becomes too high.
  - B** earth wire touches the metal case.
  - C** live wire becomes too hot.
  - D** neutral wire becomes too hot.

**7.4** The fire has a metal case. It needs to be earthed because . . . . .

- A** if there is a fault, the fuse may not work.
- B** if there is a fault, the live wire may touch the case.
- C** the metal case may act as an insulator.
- D** the metal case may become too hot.

**TURN OVER FOR THE NEXT QUESTION**

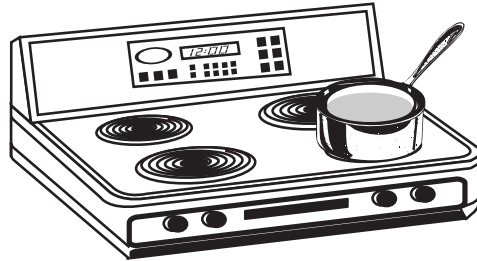
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**QUESTION EIGHT**

The diagram shows a saucepan on a hotplate.

The saucepan contains soup.

Some heat (thermal energy) is lost through the metal walls of the saucepan to the surroundings.



- 8.1** The energy spreads through the soup by . . . . .
- A free electrons colliding with ions.
  - B heat rising.
  - C the soup contracting and falling as it is heated.
  - D the soup expanding and rising as it is heated.
- 8.2** The energy is transferred through the metal walls of the saucepan by . . . . .
- A free electrons colliding with ions.
  - B heated metal expanding and rising.
  - C infra red waves passing through the metal.
  - D the atoms gaining energy and moving faster through the metal.
- 8.3** The outer walls of the saucepan transfer energy to the surroundings by . . . . .
- A free electrons colliding with ions.
  - B the air contracting and falling as it is heated.
  - C infra red waves passing through the air.
  - D metal atoms gaining energy and escaping into the air.



**8.4** The air in contact with the outer walls of the saucepan . . . . .

- A** contracts and falls due to decreased density.
- B** contracts and falls due to increased density.
- C** expands and rises due to decreased density.
- D** expands and rises due to increased density.

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

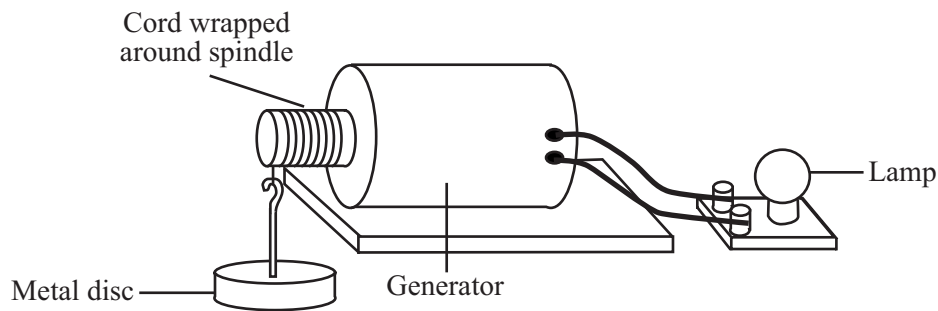
**QUESTION NINE**

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

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

$$\text{change in gravitational potential energy} = \text{weight} \times \text{change in vertical height}$$

The diagram shows an experiment to demonstrate energy transfer.



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.

**9.1** 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** 10 N
- C** 22 N
- D** 40 N

- 9.2** A different 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 10 N
  - C 22 N
  - D 40 N
- 9.3** The efficiency of the generator is 40%.

What input is needed to the generator for it to transfer 180 W to the lamp?

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

- 9.4** The lamp has an efficiency of 20%.  
The power of the lamp is 36 W.

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

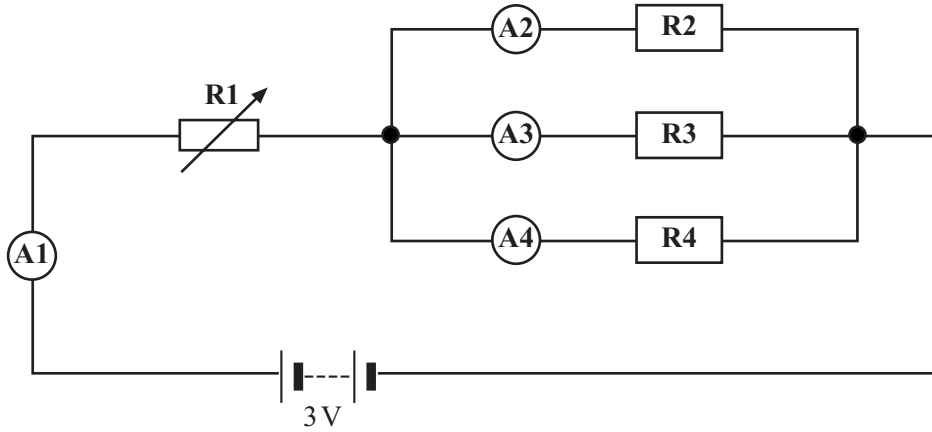
- A 7.1 J
- B 14.2 J
- C 28.8 J
- D 36.0 J

**TURN OVER FOR THE NEXT QUESTION**

Turn over ►

## QUESTION TEN

The diagram shows a circuit including four resistors labelled **R1** to **R4** with four ammeters labelled **A1** to **A4**.



**10.1** The current flowing through **A1** is 3.2 A, and through **A2** is 0.8 A.

What may ammeters **A3** and **A4** read?

	<b>A3</b>	<b>A4</b>
<b>A</b>	0.8 A	0.8 A
<b>B</b>	0.8 A	1.6 A
<b>C</b>	1.6 A	1.6 A
<b>D</b>	1.6 A	3.2 A

**10.2** The potential differences (voltages) across which two resistors are the same?

- A** **R1** and **R2**
- B** **R1** and **R3**
- C** **R1** and **R4**
- D** **R2** and **R4**

**10.3** The variable resistor is altered, and the reading on **A1** changes to 1.6 A.

Ammeter **A2** now reads . . . . .

- A** 0.4 A
- B** 0.8 A
- C** 1.2 A
- D** 1.6 A

**10.4** Which of the following statements correctly describes the changes in the potential differences when the variable resistor is altered in this way?

- A** The potential difference across **R1** is less and the potential difference across the other resistors is unchanged
- B** The potential difference across **R1** is unchanged but the potential difference across the other resistors is less
- C** The potential difference across **R1** is greater and the potential difference across the other resistors is less
- D** The potential differences across all the resistors are unchanged

**END OF TEST**

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