Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
Winter 2003

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Thursday 27 November 2003 Morning Session

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

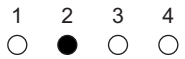
You may use a calculator.

Time allowed: 30 minutes

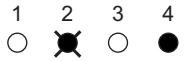
Instructions
- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title "Energy" printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or**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

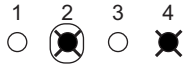
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 14 of this booklet.

FOUNDATION TIER

SECTION A

Questions **ONE** to **FIVE**.

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

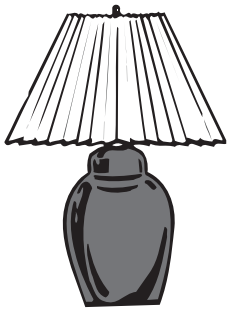
Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

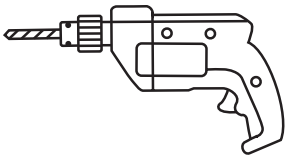
The devices shown below transfer electrical energy in different ways.

Bedside lamp



1

Drill

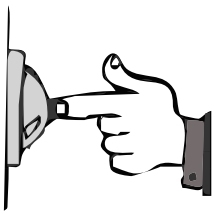


2

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** . . . . . .

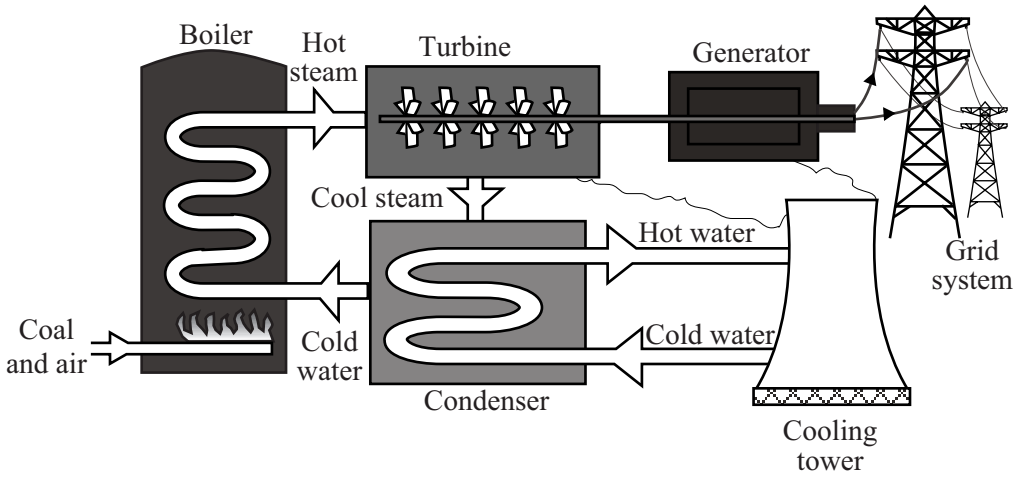
Thermal energy passes through the walls of a room by . . . . . **3** . . . . . .

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

TURN OVER FOR THE NEXT QUESTION

QUESTION THREE

The diagram shows a coal-fired power station.



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

fossil

generator

turbine

water

The power station burns a . . . . . **1** . . . . . fuel.

The energy produced is used to heat . . . . . **2** . . . . . in the boiler to make steam.

The steam drives a . . . . . **3** . . . . . .

The electricity is produced by a . . . . . **4** . . . . . .

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
1	may destroy the habitat of wading birds
2	increases global warming
3	produces radioactive waste
4	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
1	mountainous area
2	remote location
3	river estuary
4	volcanic area

Turn over ▶

SECTION B

Questions **SIX** and **SEVEN**.

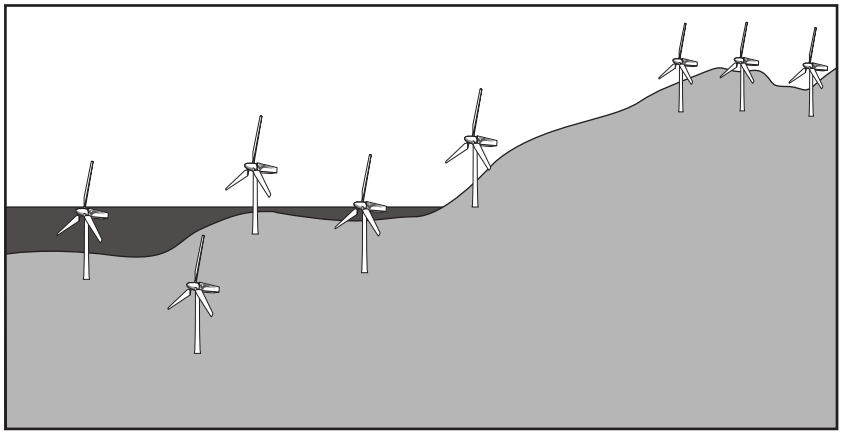
In these questions choose the best **two** answers.

Do **not** choose more than two.

Mark your choices on the answer sheet.

QUESTION SIX

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

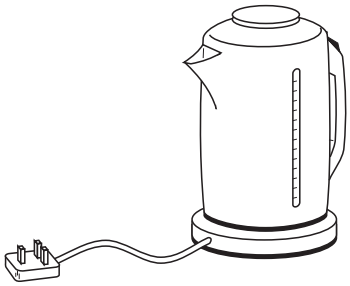
QUESTION SEVEN

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

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

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

It takes 90 seconds to boil water in an electric kettle.
In this time the kettle transfers 180 000 joules of energy.
It wastes 18 000 joules of the supplied energy.



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

the efficiency of the kettle is 0.1 (10%)

the efficiency of the kettle is 0.9 (90%)

the power of the kettle is 1800 W

the power of the kettle is 2000 W

the power of the kettle is 18 000 W

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

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

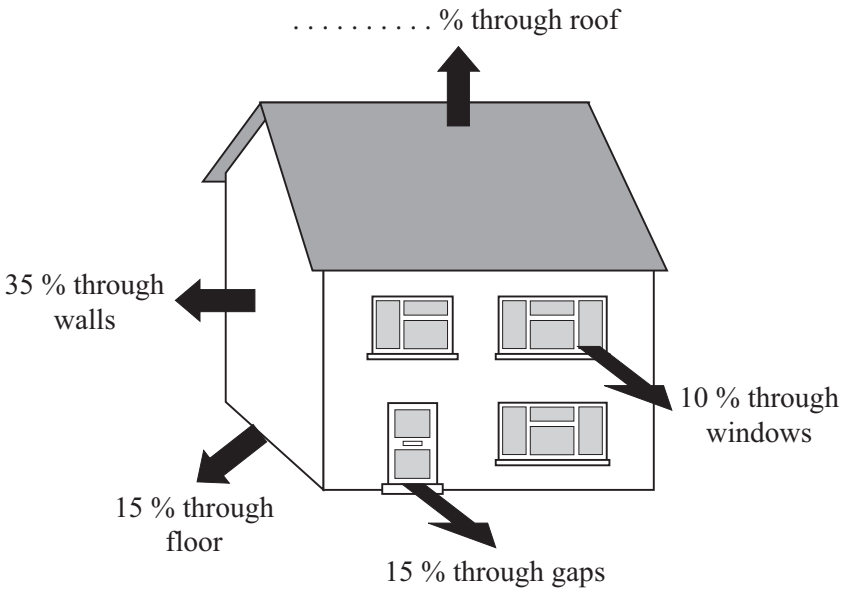
C A solar power station

D A wind farm

TURN OVER FOR THE NEXT QUESTION

QUESTION NINE

The diagram shows the ways in which heat can be lost from a house.



9.1 What percentage of heat is lost through the roof ?

A 10%

B 15%

C 25%

D 35%

9.2 Which of the following would **not** reduce the amount of heat lost through the roof ?

A Fitting loft insulation

B Fitting thicker roof tiles

C Painting the roof black

D Reducing the temperature in the house

9.3 Warm air rises to the top of the house by . . . . .

A conduction.

B convection.

C evaporation.

D radiation.

9.4 In order to keep the house warm, the central heating system has to transfer 8 kilowatts. The energy is transferred at a rate of . . . . .

A 8 joules per second.

B 8 joules per hour.

C 8000 joules per second.

D 8000 joules per hour.

TURN OVER FOR THE NEXT QUESTION

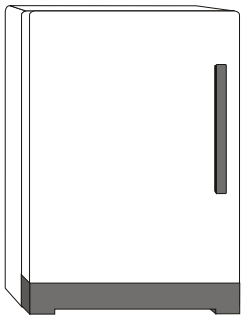
QUESTION TEN

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

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



10.1 One Unit of electricity is . . . . .

A one kilojoule (kJ)

B one kilojoule-hour (kJh)

C one kilowatt (kW)

D one kilowatt-hour (kWh)

10.2 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

10.3 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

10.4 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

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

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
1	mountainous area
2	remote location
3	river estuary
4	volcanic area

QUESTION TWO

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

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

coal

hydroelectric

nuclear

wind

Energy source	Feature
1	has the highest decommissioning costs
2	causes noise pollution, and the supply is not constant
3	produces carbon dioxide and sulphur dioxide
4	no fuel costs, and can be used to meet sudden demands for electricity

TURN OVER FOR THE NEXT QUESTION

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

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

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

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

It takes 90 seconds to boil water in an electric kettle.
In this time the kettle transfers 180 000 joules of energy.
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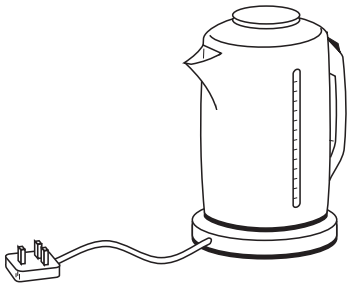


Which **two** of the following statements are correct?

the efficiency of the kettle is 0.1 (10%)

the efficiency of the kettle is 0.9 (90%)

the power of the kettle is 1800 W

the power of the kettle is 2000 W

the power of the kettle is 18 000 W

QUESTION FOUR

The diagram shows an athlete making a high jump.

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

P **as the athlete falls, gravitational potential energy is transferred to kinetic energy**

Q **as the athlete falls, kinetic energy is transferred to gravitational potential energy**

R **the gravitational potential energy of the athlete in the position shown in the diagram is equal to the energy transferred as he rises above the ground**

S **the kinetic energy of the athlete in the position shown in the diagram is equal to the energy transferred as he rises above the ground**

T **when the athlete hits the ground all the gravitational potential energy is regained**

TURN OVER FOR THE NEXT QUESTION

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

B A hydroelectric power station

C A solar power station

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

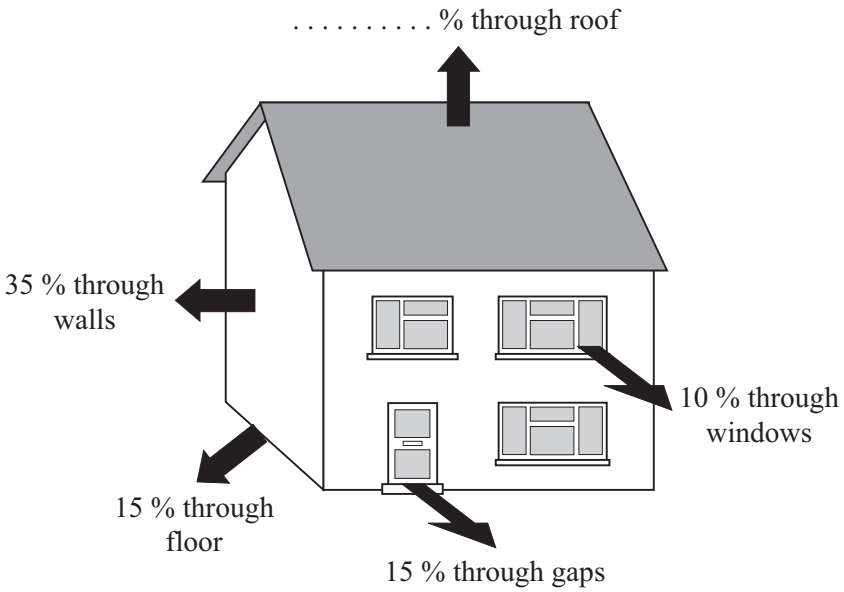
C A solar power station

D A wind farm

TURN OVER FOR THE NEXT QUESTION

QUESTION SIX

The diagram shows the ways in which heat can be lost from a house.



6.1 What percentage of heat is lost through the roof ?

A 10%

B 15%

C 25%

D 35%

6.2 Which of the following would **not** reduce the amount of heat lost through the roof ?

A Fitting loft insulation

B Fitting thicker roof tiles

C Painting the roof black

D Reducing the temperature in the house

6.3 Warm air rises to the top of the house by . . . . .

A conduction.

B convection.

C evaporation.

D radiation.

6.4 In order to keep the house warm, the central heating system has to transfer 8 kilowatts. The energy is transferred at a rate of . . . . .

A 8 joules per second.

B 8 joules per hour.

C 8000 joules per second.

D 8000 joules per hour.

TURN OVER FOR THE NEXT QUESTION

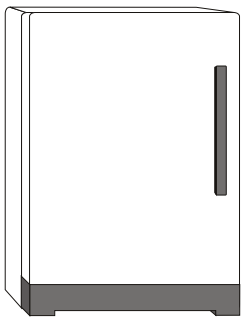
QUESTION SEVEN

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

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



7.1 One Unit of electricity is . . . . .

A one kilojoule (kJ)

B one kilojoule-hour (kJh)

C one kilowatt (kW)

D one kilowatt-hour (kWh)

7.2 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

7.3 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

7.4 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

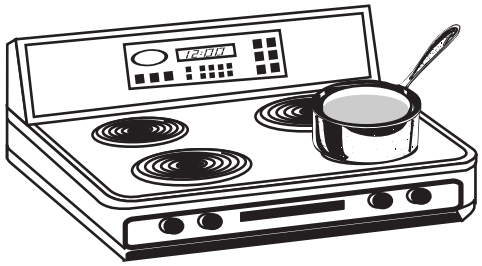
C 1869

D 3196

TURN OVER FOR THE NEXT QUESTION

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.

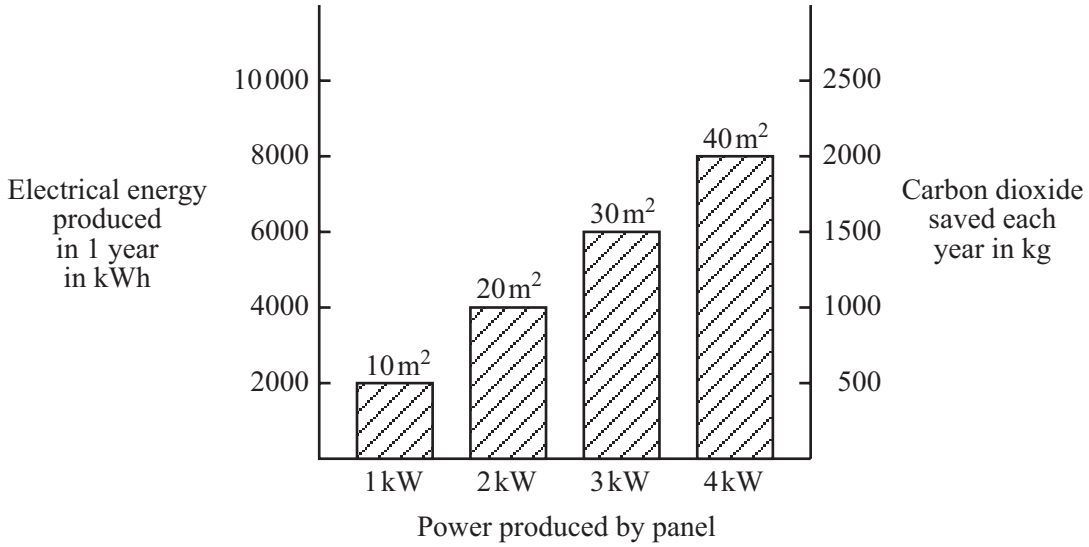
D expands and rises due to increased density.

TURN OVER FOR THE NEXT QUESTION

QUESTION NINE

The chart gives information about solar cell panels used for producing electricity.
The chart shows:

- the area of the panels
- the power produced by the panels
- the electrical energy produced each year by using the panels
- the mass of carbon dioxide saved each year by using the panels



9.1 What area of panel would be needed to power a 2500 W heater?

A 20 m^2

B 25 m^2

C 30 m^2

D 35 m^2

9.2 Solar cells do not produce polluting gases.

How much carbon dioxide could be saved each year by using a 15 m^2 panel?

A 500 kg

B 750 kg

C 1000 kg

D 1750 kg

9.3 A typical household uses 5000 kWh of electricity each year.

What area of panel would a typical household need?

A 20 m^2

B 25 m^2

C 30 m^2

D 35 m^2

9.4 Electricity supplied from the National Grid costs 8 p per Unit.
A householder is considering installing solar cell panels.
The household uses 4000 kWh of electricity each year.
The cost of installing each kW panel is £ 6400.

What is the payback time?

A 4 years

B 8 years

C 40 years

D 400 years

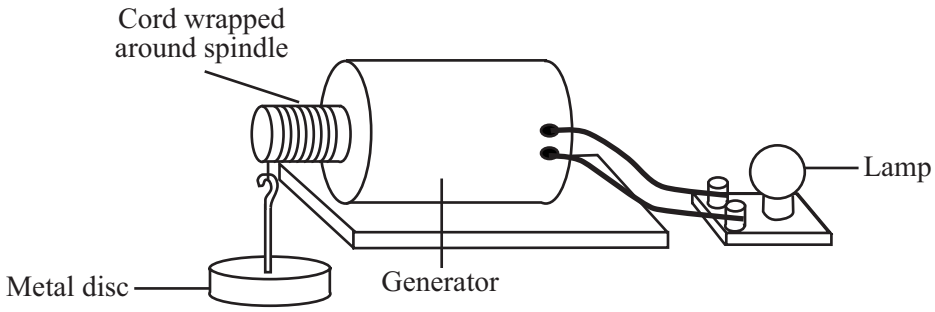
TURN OVER FOR THE NEXT QUESTION

QUESTION TEN

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

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

The drawing 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.

10.1 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

10.2 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

10.3 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

10.4 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

END OF TEST

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