Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
June 2003

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

Tuesday 24 June 2003   Morning Session

In addition to this paper you will require:
- an HB pencil and a rubber;
- 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.
- Answer **all** the questions for the Tier you are attempting.
- 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.
- Mark your responses on the separate answer sheet only. Rough work may be done on the question paper.
- Mark the best responses by using a thick pencil stroke to fill in the box. Use an HB pencil. Make sure the pencil stroke does **not** extend beyond the box. Do **not** use ink or ball-point pen. If you wish to change your answer, rub out your first answer completely.
  See below.

Examples:

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 rub 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

A CD player gets its energy from a battery. The battery supplies electrical energy.

The CD player transfers this electrical energy in different ways.

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

heat (thermal energy)

light

movement (kinetic energy)

sound

The earphones contain tiny loudspeakers. The loudspeakers transfer energy mainly as . . . . . **4** . . . .

An electric motor makes the CD go round. The motor transfers energy mainly as . . . . . **1** . . . . . .
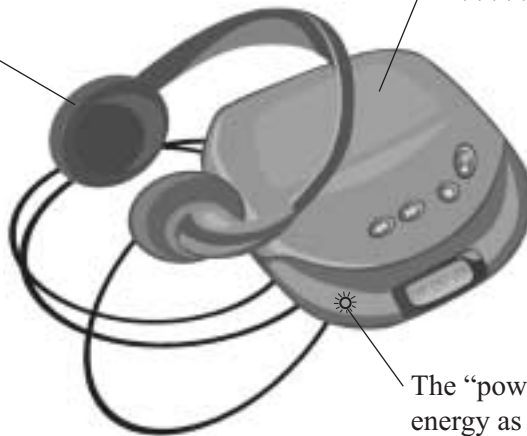
The "power on" indicator transfers energy as . . . . . **2** . . . .

When the CD player is on, it becomes warm. This is because some energy is transferred as . . . . . **3** . . . . . .

QUESTION TWO

Different types of power station use different energy sources.

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

> **fossil fuels**
>
> **nuclear fuels**
>
> **Sun's radiation**
>
> **tides**

In Britain, many power stations burn . . . . . **1** . . . .

Other power stations use uranium or plutonium, which are . . . . . **2** . . . .

Renewable resources can also be used to produce electricity.

In some schemes, barrages are built across river estuaries. These schemes use energy from the . . . . . **3** . . . . . .

Solar cells use energy directly from the . . . . . **4** . . . . . .

TURN OVER FOR THE NEXT QUESTION

QUESTION THREE

The photograph shows a wind turbine on a farm.

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

    air

    electricity

    movement (kinetic energy)

    sound

The turbine is driven by moving . . . . . **1** . . . . . .

The turbine transfers . . . . . **2** . . . . . to the generator.

The generator transfers energy to the farm as . . . . . **3** . . . . . .

Some energy is wasted as . . . . . **4** . . . . . .

QUESTION FOUR

The photograph shows a motorcycle engine which has a black surface.
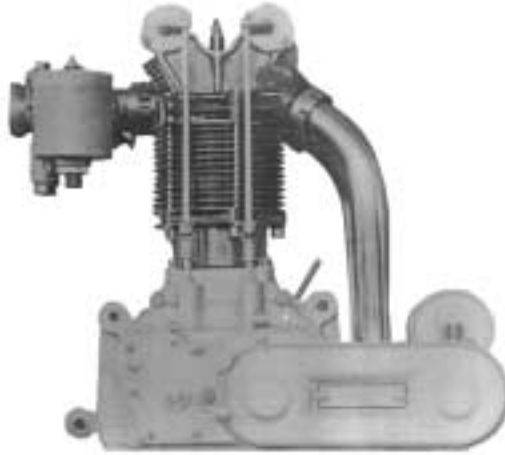
Match words from the list with the numbers **1– 4** in the sentences.

black surface

infra red radiation

particles

temperature

The engine becomes very hot, so it emits mainly . . . . . **1** . . . . . .

This process does not involve . . . . . **2** . . . . . .

The higher the . . . . . **3** . . . . . , the more heat is lost.

To make the loss of heat occur more quickly, the engine has a . . . . . **4** . . . . . .

QUESTION FIVE

We can use renewable energy sources to generate electricity.

These energy sources do have disadvantages.

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

geothermal sites

solar cells

tidal barrages

wind farms

Energy source	Disadvantage
1	occur mainly in volcanic areas
2	destroy habitats of mud-living organisms
3	are usually on hills and may be unsightly
4	have a very high cost per Unit of electricity produced

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

An electric kettle has a power of 2.4 kW.

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

the kettle has a power of 240 watts

the kettle has a power of 2400 watts

the kettle transfers 2.4 joules of energy every hour

the kettle transfers 240 joules of energy every second

the kettle transfers 2400 joules of energy every second

TURN OVER FOR THE NEXT QUESTION

QUESTION SEVEN

The diagram shows a room in a house.
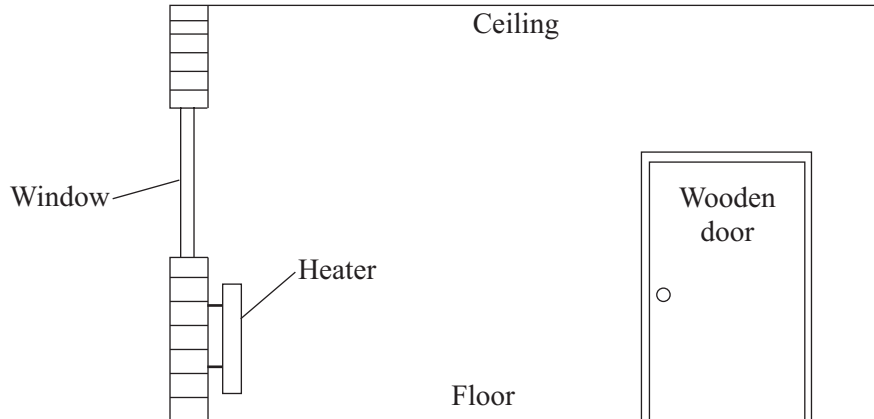
Choose **two** things from the following list which would reduce the rate at which energy is lost from the room.

fit a metal door

fix shiny metal foil behind the heater

improve the ventilation in the room

increase the temperature in the room

lay a thick carpet on the floor

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 photographs show a 100 W filament lamp and a 20 W low energy lamp.

Filament lamp   Low energy lamp

8.1   A lamp **usefully** transfers energy as light. Some energy is **wasted** as . . . . .

    A   heat (thermal energy).

    B   light.

    C   movement (kinetic energy).

    D   sound.

8.2   Which of the following does **not** eventually happen to all of the energy transferred by a lamp?

    A   It becomes difficult to use for other energy transfers

    B   It ends up very spread out

    C   It makes the surroundings a little warmer

    D   It no longer exists

8.3   When the 100 W filament lamp is switched on for an hour, it transfers . . . . .

    A   100 J

    B   1000 J

    C   6000 J

    D   360 000 J

8.4   The 20 W low energy lamp gives the same amount of light per second as the 100 W filament lamp.

This means that the 20 W lamp . . . . .

    A   costs more per minute to run.

    B   is less efficient.

    C   is more efficient.

    D   transfers energy at a faster rate.

TURN OVER FOR THE NEXT QUESTION

QUESTION NINE

The following extract is taken from a recent newspaper article.

> *With global warming menacing us and fossil fuels due to run out in 40 years,*
> *new energy sources are vital. As a start, many more wind farms are needed.*

9.1 Which of the following types of power station increases global warming?

    A   Coal-fired

    B   Hydroelectric

    C   Tidal barrage

    D   Wind farm

9.2 Carbon dioxide emissions lead to increased global warming.

Which of the following types of power station produces most carbon dioxide for the same amount of energy released?

    A   Coal-fired

    B   Gas-fired

    C   Nuclear

    D   Oil-fired

9.3 Nuclear power stations were first built about 50 years ago.

Which of the following statements is **true**?

    A   Nuclear power stations emit a lot of radiation into the air, when running normally

    B   Nuclear power stations produce gases which increase the greenhouse effect

    C   Nuclear power stations produce gases which make acid rain

    D   Nuclear power stations produce radioactive waste

9.4 Many new wind farms are planned for the east coast of England.

Which of the following is a disadvantage of wind farms?

    A   Their output depends on weather conditions

    B   They do not produce polluting gases

    C   They start up quite quickly

    D   They use a renewable energy resource

TURN OVER FOR THE NEXT QUESTION

QUESTION TEN

> You may find the following formulae useful when answering some parts of this question.
>
> | energy transferred | = | power | × | time |
> |---|---|---|---|---|
> | (kilowatt-hour, kWh) | | (kilowatt, kW) | | (hour, h) |
>
> | total cost | = | number of Units | × | cost per Unit |
> |---|---|---|---|---|

10.1 During one day, a 2.5 kW appliance was used for 8 hours.

How many Units of electricity were used?

A   2.5

B   20.0

C   200.0

D   2000.0

10.2 During one day, a 3000 W appliance was used for 10 hours.

How many Units of electricity were used?

A   5

B   30

C   300

D   30 000

10.3 Each Unit of electricity costs 8 p.

How much does it cost to run a 500 W appliance for 4 hours?

A   16 p

B   £1.60

C   £10

D   £160

10.4 The diagram shows the reading in Units on a household electricity meter at the start of a day.

0	7	3	8	1

During the day, the following appliances are used.

a 2 kW kettle for 30 minutes

a 100 W lamp for 20 hours

a 3 kW heater for 4 hours

a 1.5 kW oven for 2 hours

What is the reading on the electricity meter at the end of the day?

A   07363

B   07399

C   07458

D   09456

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

We can use renewable energy sources to generate electricity.

These energy sources do have disadvantages.

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

geothermal sites

solar cells

tidal barrages

wind farms

Energy source	Disadvantage
1	occur mainly in volcanic areas
2	destroy habitats of mud-living organisms
3	are usually on hills and may be unsightly
4	have a very high cost per Unit of electricity produced

QUESTION TWO

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

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

gas

nuclear

water behind a dam (hydroelectricity)

wind

| Energy source	Description
1	fuel costs are zero, and energy can usually be made available when needed
2	fuel costs are zero, but the energy source is unreliable
3	fuel costs are low, but costs of building and decommissioning are very high
4	fuel costs are medium, but using this source releases carbon dioxide

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

The diagram shows a room in a house.
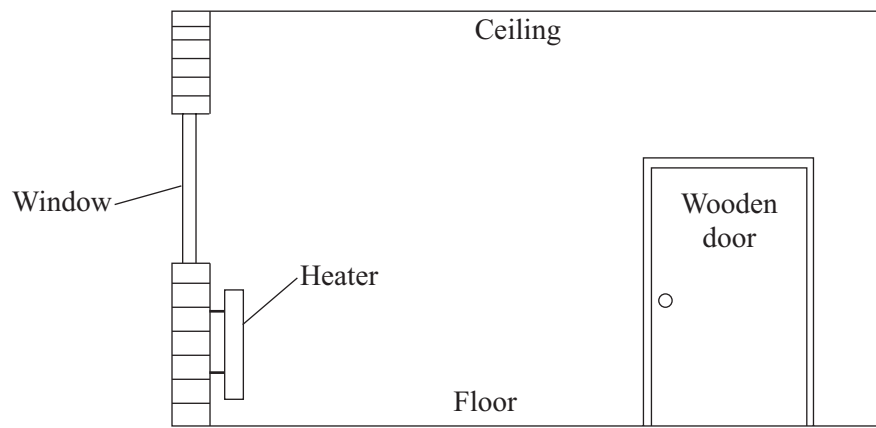
Choose **two** things from the following list which would reduce the rate at which energy is lost from the room.

fit a metal door

fix shiny metal foil behind the heater

improve the ventilation in the room

increase the temperature in the room

lay a thick carpet on the floor

QUESTION FOUR

A diver climbs some steps to a diving board.

The diagram shows the diver about to leave the diving board.
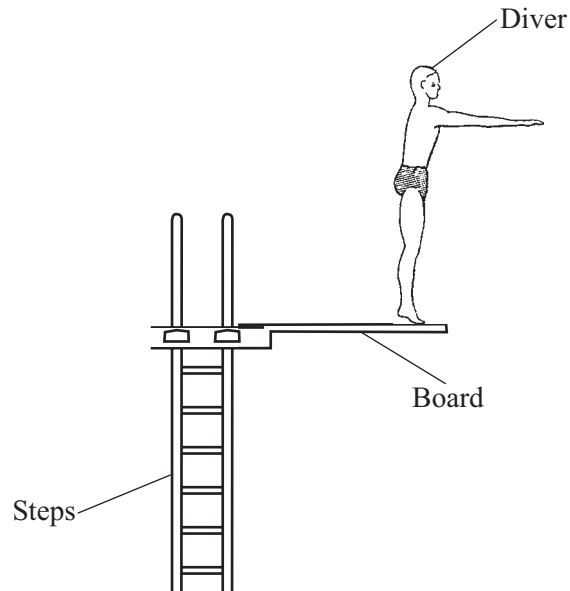
Which **two** of the statements **P**, **Q**, **R**, **S** and **T** are true?

P	as the diver falls, gravitational potential energy is transferred to kinetic energy
Q	as the diver falls, kinetic energy is transferred to gravitational potential energy
R	the gravitational potential energy of the diver on the board is equal to the energy transferred to the diver when climbing the steps
S	the kinetic energy of the diver on the board is equal to the energy transferred to the diver when climbing the steps
T	when the diver hits the water, all the gravitational potential energy is regained

Turn over ▶

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

The photographs show a 100 W filament lamp and a 20 W low energy lamp.

Filament lamp   Low energy lamp

5.1 A lamp **usefully** transfers energy as light. Some energy is **wasted** as . . . . .

    A   heat (thermal energy).

    B   light.

    C   movement (kinetic energy).

    D   sound.

5.2 Which of the following does **not** eventually happen to all of the energy transferred by a lamp?

    A   It becomes difficult to use for other energy transfers

    B   It ends up very spread out

    C   It makes the surroundings a little warmer

    D   It no longer exists

5.3   When the 100 W filament lamp is switched on for an hour, it transfers . . . . .

A   100 J

B   1000 J

C   6000 J

D   360 000 J

5.4   The 20 W low energy lamp gives the same amount of light per second as the 100 W filament lamp.

This means that the 20 W lamp . . . . .

A   costs more per minute to run.

B   is less efficient.

C   is more efficient.

D   transfers energy at a faster rate.

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

QUESTION SIX

The following extract is taken from a recent newspaper article.

With global warming menacing us and fossil fuels due to run out in 40 years,
new energy sources are vital. As a start, many more wind farms are needed.

6.1   Which of the following types of power station increases global warming?

A   Coal-fired

B   Hydroelectric

C   Tidal barrage

D   Wind farm

6.2   Carbon dioxide emissions lead to increased global warming.

Which of the following types of power station produces most carbon dioxide for the same amount of energy released?

A   Coal-fired

B   Gas-fired

C   Nuclear

D   Oil-fired

6.3   Nuclear power stations were first built about 50 years ago.

Which of the following statements is **true**?

A   Nuclear power stations emit a lot of radiation into the air, when running normally

B   Nuclear power stations produce gases which increase the greenhouse effect

C   Nuclear power stations produce gases which make acid rain

D   Nuclear power stations produce radioactive waste

6.4 Many new wind farms are planned for the east coast of England.

Which of the following is a disadvantage of wind farms?

A   Their output depends on weather conditions

B   They do not produce polluting gases

C   They start up quite quickly

D   They use a renewable energy resource

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

QUESTION SEVEN

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

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
total cost	=	number of Units	×	cost per Unit

7.1 During one day, a 2.5 kW appliance was used for 8 hours.

How many Units of electricity were used?

A 2.5

B 20.0

C 200.0

D 2000.0

7.2 During one day, a 3000 W appliance was used for 10 hours.

How many Units of electricity were used?

A 5

B 30

C 300

D 30 000

7.3 Each Unit of electricity costs 8 p.

How much does it cost to run a 500 W appliance for 4 hours?

A 16 p

B £1.60

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D £160

7.4 The diagram shows the reading in Units on a household electricity meter at the start of a day.

0	7	3	8	1

During the day, the following appliances are used.

a 2 kW kettle for 30 minutes

a 100 W lamp for 20 hours

a 3 kW heater for 4 hours

a 1.5 kW oven for 2 hours

What is the reading on the electricity meter at the end of the day?

A   07363
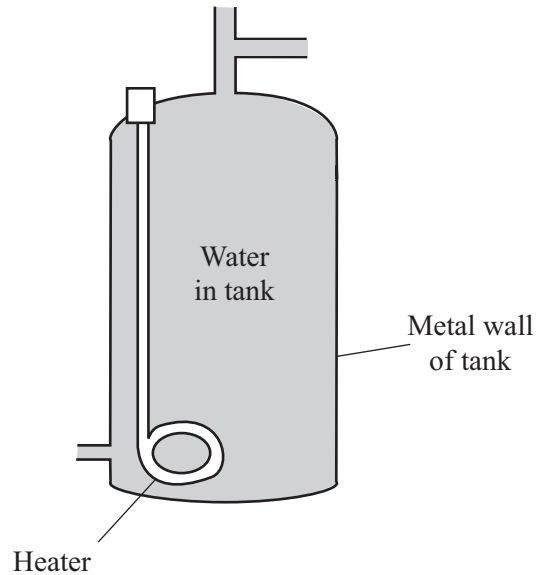
B   07399

C   07458

D   09456

TURN OVER FOR THE NEXT QUESTION

QUESTION EIGHT

Many homes have hot-water tanks. An electric heater is used to heat the water.

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

8.1   The energy spreads through the water by . . . . .

    A   heated water contracting and falling.

    B   heated water expanding and rising.

    C   heat rising.

    D   the movement of free electrons.

8.2   The energy is transferred through the metal walls by . . . . .

    A   heated metal expanding and rising.

    B   infra red waves passing through the metal.

    C   the atoms gaining energy and moving faster through the metal.

    D   the movement of free electrons.

8.3   The metal walls of the tank transfer energy to the surroundings by . . . . .

    A   heated air contracting and falling.

    B   infra red waves passing through the air.

    C   metal atoms gaining energy and escaping into the air.

    D   the movement of free electrons.

8.4   The air in contact with the metal walls . . . . .

    A   contracts and falls due to decreased density.

    B   contracts and falls due to increased density.

    C   expands and rises due to decreased density.
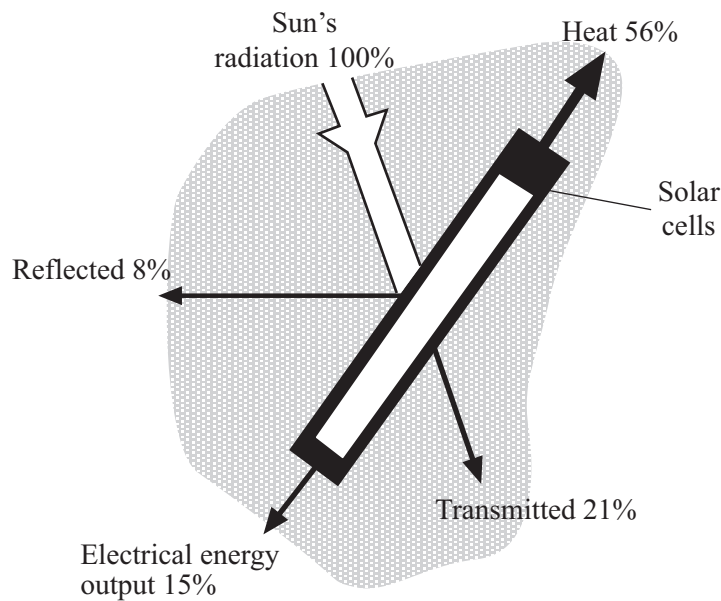
    D   expands and rises due to increased density.

QUESTION NINE

> You may find the following formula useful when answering parts of this question.
>
> $$\text{efficiency} = \frac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$$

The diagram shows what happens to the Sun's radiation when it falls on a panel of solar cells.

9.1 What is the **overall** efficiency of the transfer of light energy from the Sun to electrical energy?

A 15%

B 36%

C 71%

D 100%

9.2 Each square metre of the solar panel receives 500 W.
The area of the panel is 5 m².

How much energy falls on the panel in 2 hours?

A 5 J

B 5000 J

C 3 600 000 J

D 18 000 000 J

9.3   Another panel of solar cells has an efficiency of only 6%.

What is the electrical output of this panel when the input power is 2500 W?

A   150 W

B   417 W

C   15 000 W

D   1 500 000 W

9.4   In less developed countries, where fuel is unavailable and where sunshine ratings are high, solar energy is used to drive turbines.

An array of mirrors tracks the Sun and focuses its heat on to a container of oil. This heats the oil to 400 °C.

How should the hot oil be used to drive the turbines?

A   The hot oil is burnt to heat water to make steam to drive the turbines

B   The hot oil flows from a high level to a low level to drive the turbines

C   The hot oil heats water, making steam which drives the turbines
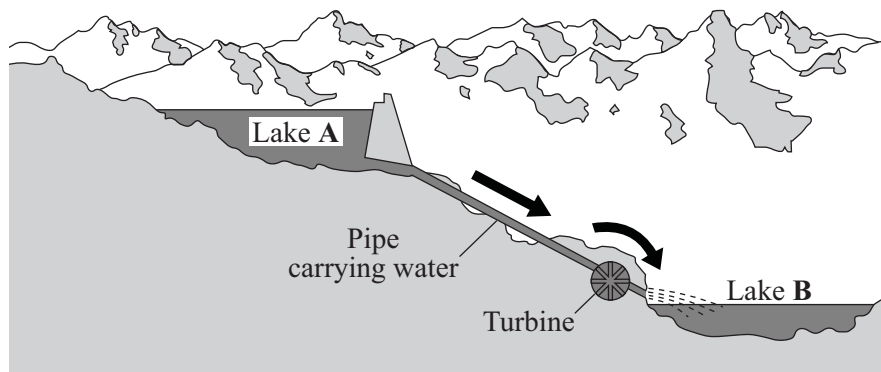
D   The hot oil is pumped through the turbines

QUESTION TEN

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

Change in gravitational potential energy = weight × change in vertical height
(joule, J)   (newton, N)   (metre, m)

On Earth, 1 litre of water weighs 10 N.

A hydroelectric power station uses two lakes, **A** and **B**.

10.1 When 6 litres of water fall from lake **A** to lake **B**, 1500 J are transferred.

How far has the water fallen?

A 2.5 m

B 25.0 m

C 250.0 m

D 2500.0 m

10.2 If the input power to the turbine is 1.5 kW, how long has it taken for the water to fall?

A 0.1 s

B 1.0 s

C 10.0 s

D 100.0 s

10.3 During the night, water can be pumped from the lower lake to the higher one.

This is useful because . . . . .

A   the power station can then store the electricity generated, and use it at times of peak demand.

B   the power station is unable to meet sudden demands, and generation costs are less at night.

C   surplus electricity is generated elsewhere at night, and this is used to pump water to be stored.

D   the demand is greater at night, and the water is needed at the top.

10.4 Another hydroelectric power station allows water to fall 20 m to the turbine.
Only 20% of the gravitational potential energy lost is transferred into electricity.

How many litres of water must fall in order to generate 4 kWh of electricity?

A   6000

B   72 000

C   360 000

D   3 600 000

END OF TEST