Version 1.0

Surname		Other Names	
Centre Number			Candidate Number				
Candidate signature									

General Certificate of Secondary Education
Specimen Paper

SCIENCE A **PHY1A**
Unit 1a Physics (Energy and Electricity)

PHYSICS
Unit 1a Physics (Energy and Electricity)

Date and Time

For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

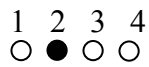
Time allowed: 30 minutes

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.
- Do all rough work in this book, **not** on your answer sheet.

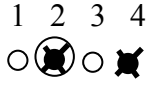
Instructions for recording answers

- 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 ONE

Questions **ONE** to **SIX**.

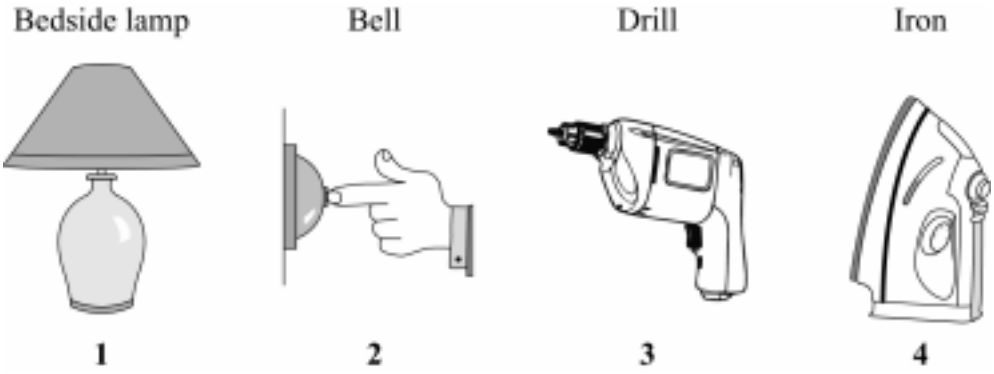
In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1 – 4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

The devices shown transfer electrical energy in different ways.



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

Match words, **A**, **B**, **C** and **D**, with the devices numbered **1 – 4**.

A heat (thermal energy)

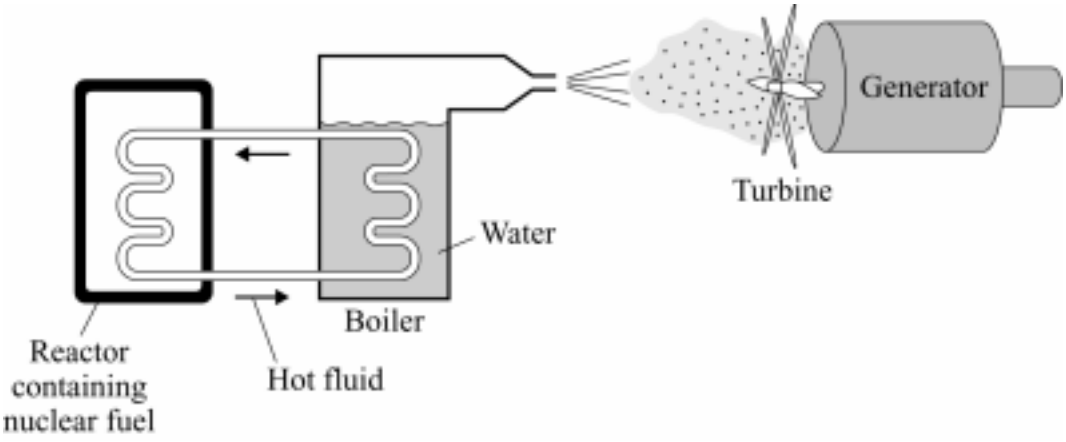
B light

C movement (kinetic energy)

D sound

QUESTION TWO

The diagram shows the main parts of a nuclear power station.



Match words, **A**, **B**, **C** and **D**, with the numbers **1 – 4** in the sentences.

A electricity

B movement (kinetic)

C steam

D uranium

The energy source for this power station is . . . **1** . . . .

The turbine is driven by . . . **2** . . . .

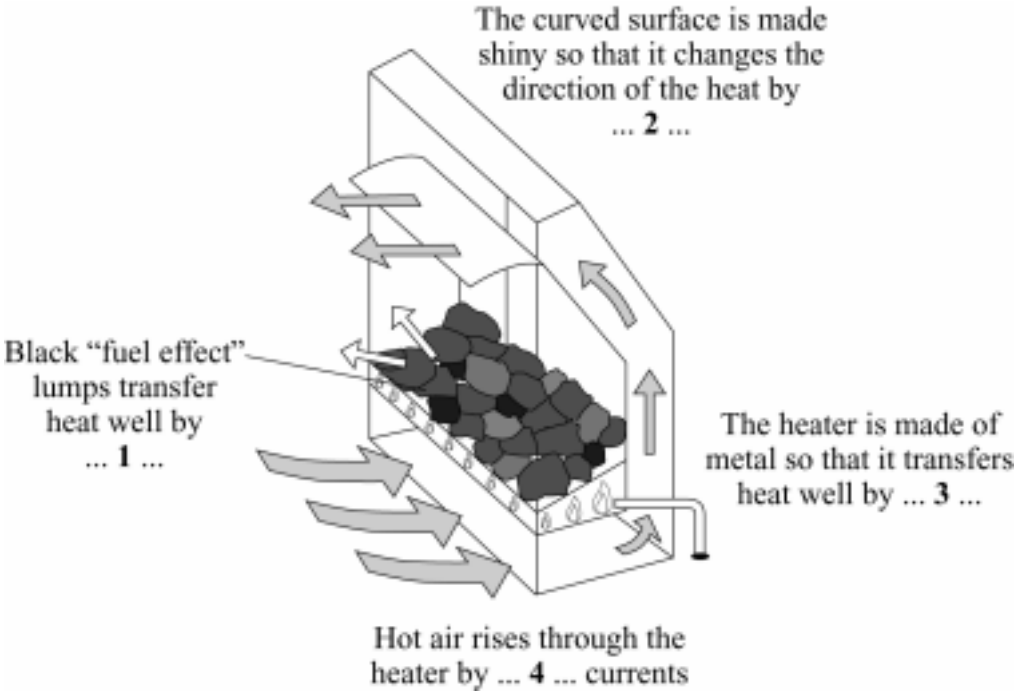
The turbine transfers . . . **3** . . . energy to the generator.

The generator transfers energy to homes and factories as . . . **4** . . . .

Turn over for the next question

QUESTION THREE

A heater transfers energy to a room in various ways.



Match words, **A**, **B**, **C** and **D**, with the numbers **1 – 4** in the diagram.

A conduction

B convection

C radiation

D reflection

QUESTION FOUR

If we use renewable energy sources, we will not need to burn so much fossil fuel.
However, capturing renewable energy sources can also cause problems.

Match words, **A**, **B**, **C** and **D**, with the statements **1 – 4** in the table.

A dams (for hydroelectricity)

B solar cells

C tidal barrages

D wind farms

What is used to capture energy	Problem caused
1	can often be seen from a long way away and look unsightly to some people
2	destroys muddy areas in river estuaries where wading birds feed
3	land that could be used for farming or forests is flooded
4	very high cost for each kilowatt hour of electricity is generated during lifetime

Turn over for the next question

QUESTION FIVE

The energy resource used to generate electricity depends on the location.

Match words, **A**, **B**, **C** and **D**, with the numbers **1 – 4** in the sentences.

A nuclear fuel

B solar energy

C tides

D wind

The best energy resource to use in a submarine which has to spend months under water is . . . **1** . . . .

The best energy resource to use in a calculator is . . . **2** . . . .

Generators sited on hills in the UK are most likely to use . . . **3** . . . .

A power station that includes a barrage across an estuary uses . . . **4** . . . .

QUESTION SIX

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

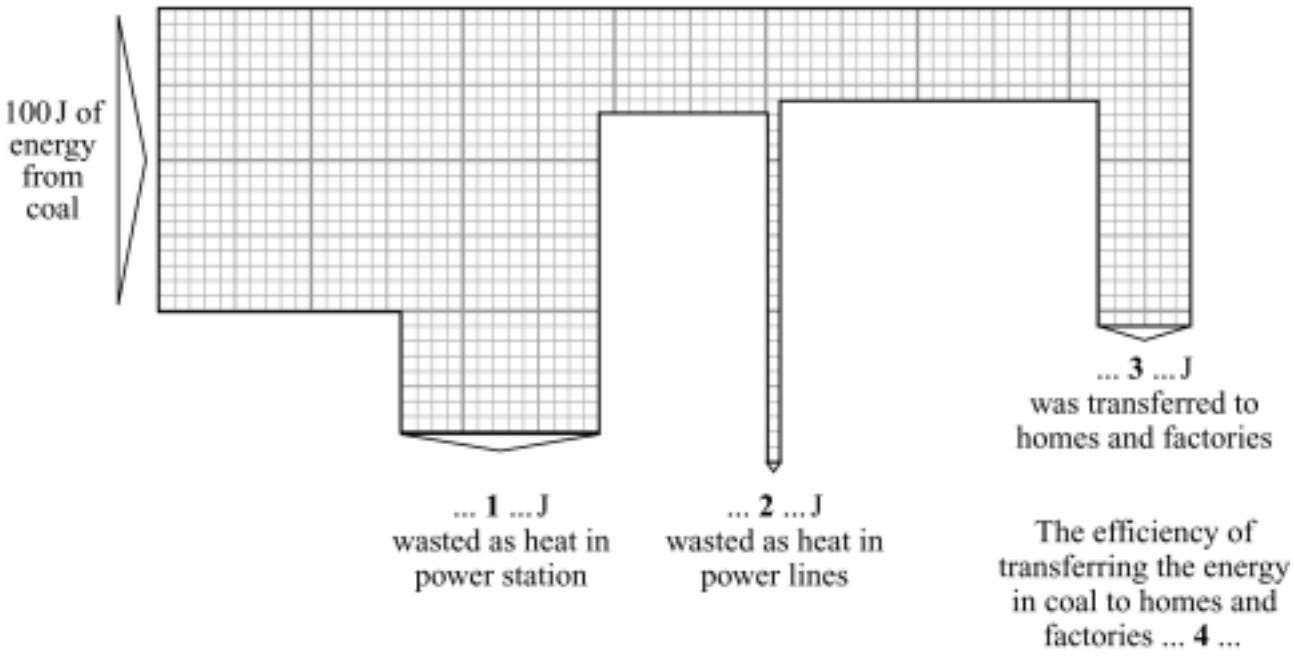
Match numbers, **A**, **B**, **C** and **D**, with the spaces **1 – 4** in the diagram.

A 0.3

B 5

C 30

D 65



Turn over for the next question

SECTION TWO

Questions **SEVEN** to **NINE**.

Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION SEVEN

energy transferred	=	power	×	time
(kilowatt hour, kWh)		(kilowatt, kW)		(hour, h)

total cost = number of kilowatt hours × cost per kilowatt hour

The diagram shows the readings on a household electricity meter at the beginning and at the end of a day.

Each kilowatt hour (kWh) of electricity costs 7p.

At the start of the day At the end of the day

7A How many kilowatt hours of electricity were used during the day?

1 37

2 47

3 63

4 89

7B On the following day, 30 kilowatt hours of electricity were used.

How much would this electricity cost?

1 .21p

2 .37p

3 £2.10

4 £21.00

7C During one week, a 7.5 kW shower heater was used for 3 hours.

How much energy was transferred by the heater?

1 2.5 kWh

2 4.5 kWh

3 10.5 kWh

4 22.5 kWh

7D For how long can a 2 kW kettle be used at a cost of 7p?

1 30 minutes (half an hour)

2 2 hours

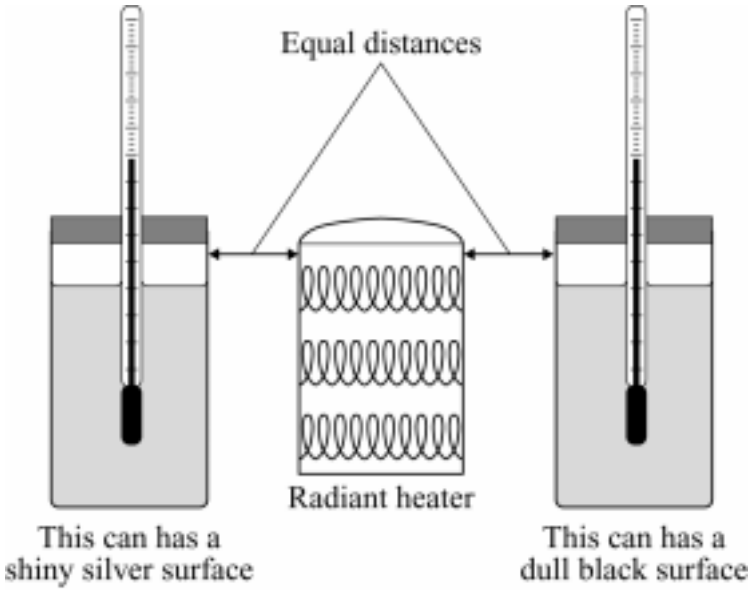
3 3.5 hours

4 5 hours

Turn over for the next question

QUESTION EIGHT

Anne did two experiments on radiation. The apparatus she used is shown in the diagram.



Experiment 1

- Anne put the same volume of cold water into the two cans.
- She then switched on the heater.
- Ten minutes later, she measured the temperature of the water in each can.

Experiment 2

- The student filled both cans with boiling water.
- This time she left the heater off.
- Ten minutes later, she measured the temperature of the water in the two cans.

The table shows her results.

Experiment 1				**Experiment 2**			
Initial temperature of water in °C		**Final temperature of water in °C**		**Initial temperature of water in °C**		**Final temperature of water in °C**	
Shiny silver can	Dull black can	Dull black can	Shiny silver can	Shiny silver can	Dull black can	Dull black can	Shiny silver can
15	15	27	19	100	100	84	95

8A Which was an independent variable in the two experiments?

1 the final temperature of the water

2 the initial temperature of the water

3 the time the water was left

4 the volume of the water

8B Which of these was **not** a control variable in Anne's **Experiment 1**?

1 distance from heater to cans

2 final temperature of water

3 power of radiant heater

4 volume of water

8C **Experiment 1** shows that a shiny silver surface . . .

1 is a good absorber of radiation.

2 is a good conductor of radiation.

3 is a good emitter of radiation.

4 is a good reflector of radiation.

8D **Experiment 2** shows that a dull black surface . . .

1 is a good absorber of radiation.

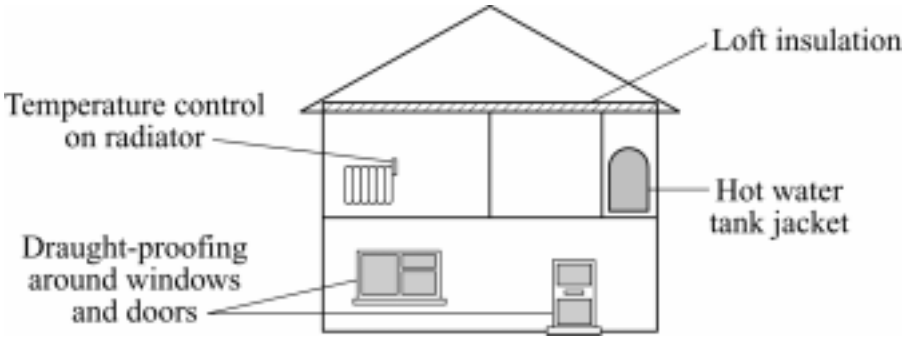
2 is a good conductor of radiation.

3 is a good emitter of radiation.

4 is a good reflector of radiation.

QUESTION NINE

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

9A Which method of reducing energy loss saves money by preventing the house becoming too warm?

1 draught-proofing

2 hot water tank jacket

3 loft insulation

4 temperature controls on radiators

9B Which method reduces energy loss by the smallest amount?

1 draught-proofing

2 hot water tank jacket

3 loft insulation

4 temperature controls on radiators

9C Which method pays for itself in the shortest time?

1 draught-proofing

2 hot water tank jacket

3 loft insulation

4 temperature controls on radiators

9D What is the pay-back time on loft insulation?

1 $\frac{1}{4}$ year

2 $\frac{1}{2}$ year

3 2 years

4 4 years

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 ONE

Questions **ONE** to **TWO**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1 – 4**.

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

Mark your choices on the answer sheet.

QUESTION ONE

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

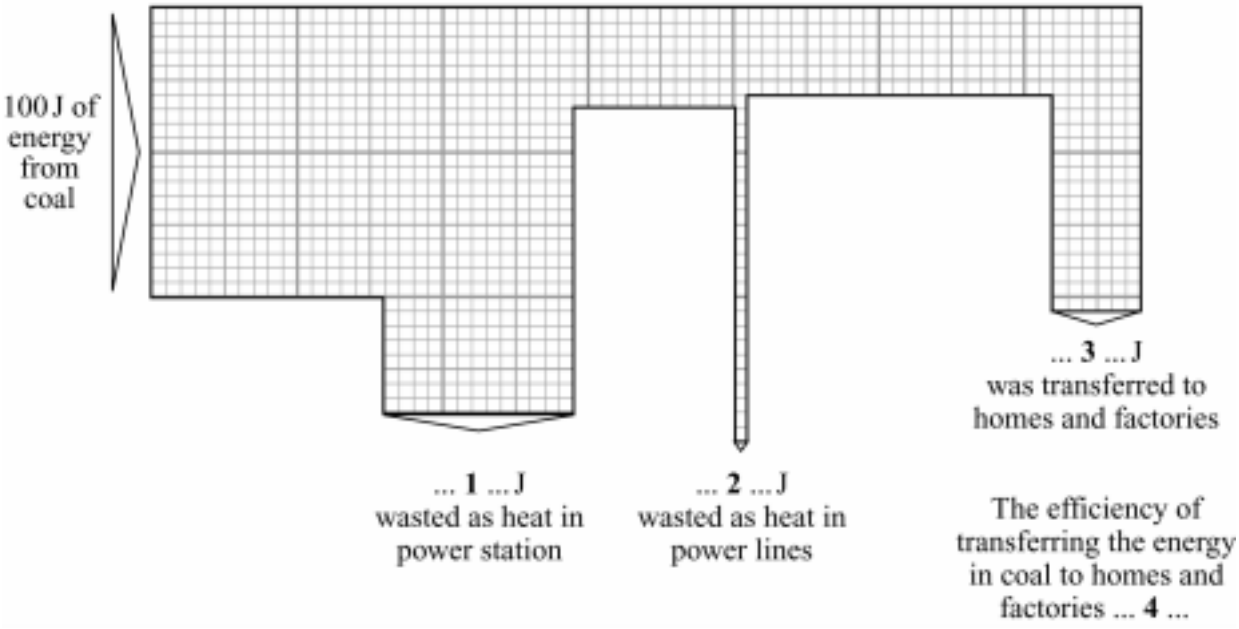
Match numbers, **A**, **B**, **C** and **D**, with the spaces **1 – 4** in the diagram.

A 0.3

B 5

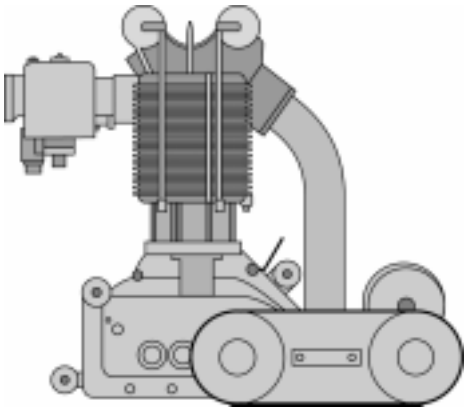
C 30

D 65



QUESTION TWO

The picture shows a motorcycle engine.



Match words, **A**, **B**, **C**, and **D**, with the numbers **1 – 4** in the sentences.

A infra red radiation

B particles

C surface area

D 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 'fins' to increase its . . . **4** . . . .

Turn over for the next question

SECTION TWO

Questions **THREE** to **NINE**.

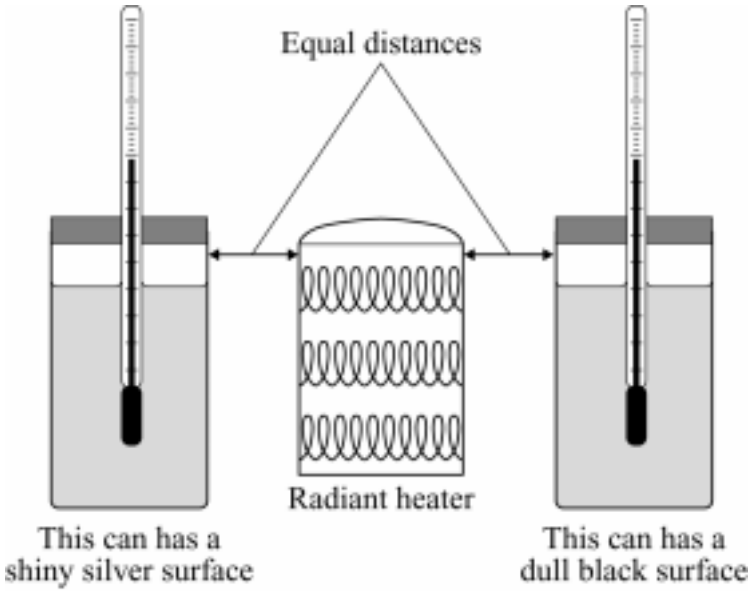
Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

Anne did two experiments on radiation. The apparatus she used is shown in the diagram.



Experiment 1

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- She then switched on the heater.
- Ten minutes later, she measured the temperature of the water in each can.

Experiment 2

- The student filled both cans with boiling water.
- This time she left the heater off.
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The table shows her results.

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Shiny silver can	Dull black can	Dull black can	Shiny silver can	Shiny silver can	Dull black can	Dull black can	Shiny silver can
15	15	27	19	100	100	84	95

3A Which was an independent variable in the two experiments?

1 the final temperature of the water

2 the initial temperature of the water

3 the time the water was left

4 the volume of the water

3B Which of these was **not** a control variable in Anne's **Experiment 1**?

1 distance from heater to cans

2 final temperature of water

3 power of radiant heater

4 volume of water

3C **Experiment 1** shows that a shiny silver surface . . .

1 is a good absorber of radiation.

2 is a good conductor of radiation.

3 is a good emitter of radiation.

4 is a good reflector of radiation.

3D **Experiment 2** shows that a dull black surface . . .

1 is a good absorber of radiation.

2 is a good conductor of radiation.

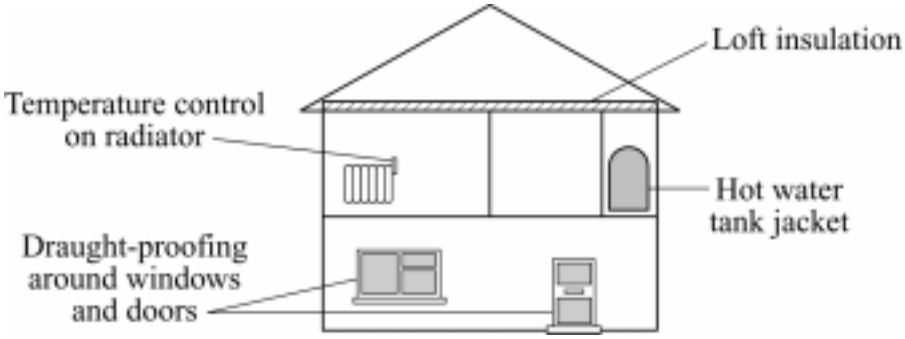
3 is a good emitter of radiation.

4 is a good reflector of radiation.

.

QUESTION FOUR

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



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4A Which method of reducing energy loss saves money by preventing the house becoming too warm?

1 draught-proofing

2 hot water tank jacket

3 loft insulation

4 temperature controls on radiators

4B Which method reduces energy loss by the smallest amount?

1 draught-proofing

2 hot water tank jacket

3 loft insulation

4 temperature controls on radiators

4C Which method pays for itself in the shortest time?

1 draught-proofing

2 hot water tank jacket

3 loft insulation

4 temperature controls on radiators

4D What is the pay-back time on loft insulation?

1 $\frac{1}{4}$ year

2 $\frac{1}{2}$ year

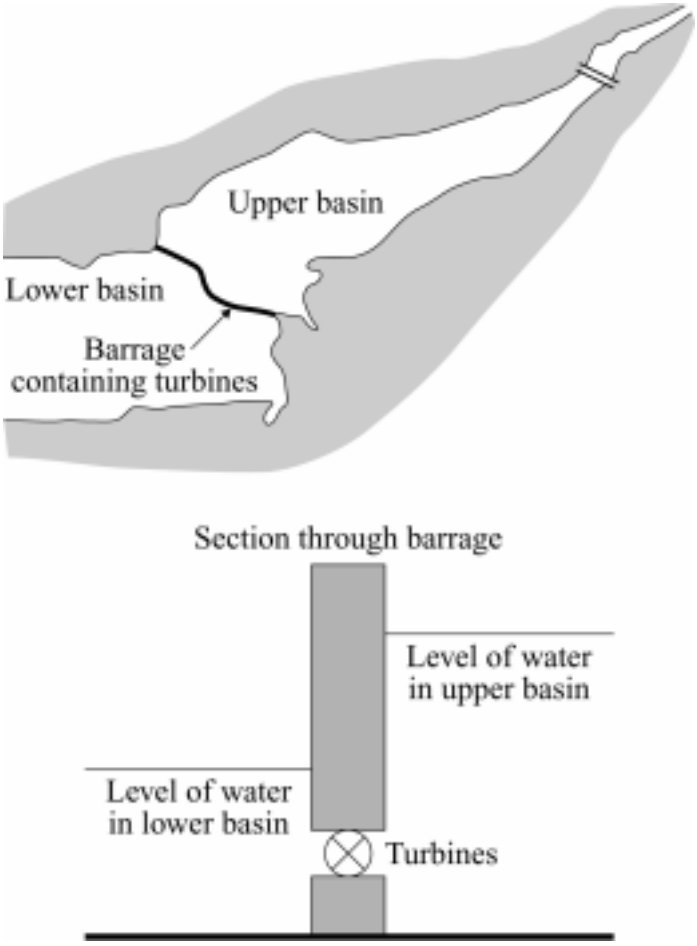
3 2 years

4 4 years

Turn over for the next question

QUESTION FIVE

The diagram shows a tidal barrage used to generate electricity.
Before the barrage was built, the mud flats on the estuary were repeatedly covered with sea water as the tide came in and went out again.
Wading birds feed on organisms that live in mud.



5A As water moves from the lower basin into the upper basin it gains mainly . . .

1 electrical energy.

2 gravitational potential energy.

3 sound energy.

4 thermal energy.

5B Which is the principal energy transfer as water flows from the upper basin through the turbine?

1 electrical energy to gravitational potential energy

2 electrical energy to kinetic energy

3 gravitational potential energy to kinetic energy

4 kinetic energy to gravitational potential energy

5C Compared to a coal-fired power station with a similar generating capacity, a tidal barrage usually . . .

1 costs more to build.

2 has a more concentrated energy supply.

3 has higher fuel costs.

4 has higher maintenance costs.

5D One disadvantage of this tidal barrage is that . . .

1 it cannot be used in summer.

2 it has high decommissioning costs.

3 its output depends on the weather.

4 wading birds lose a food source.

Turn over for the next question

QUESTION SIX

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.

6A The energy spreads through the soup by . . .

1 free electrons colliding with ions.

2 heat rising.

3 the soup contracting and falling as it is heated.

4 the soup expanding and rising as it is heated.

6B The energy is transferred through the metal walls of the saucepan by . . .

1 free electrons colliding with ions.

2 heated metal expanding and rising.

3 infra red waves passing through the metal.

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

6C The outer walls of the saucepan transfer energy to the surroundings by . . .

1 free electrons colliding with ions.

2 infra red waves passing through the air.

3 metal atoms gaining energy and escaping into the air.

4 the air contracting and falling as it is heated.

6D The air in contact with the outer walls of the saucepan . . .

1 contracts and falls due to decreased density.

2 contracts and falls due to increased density.

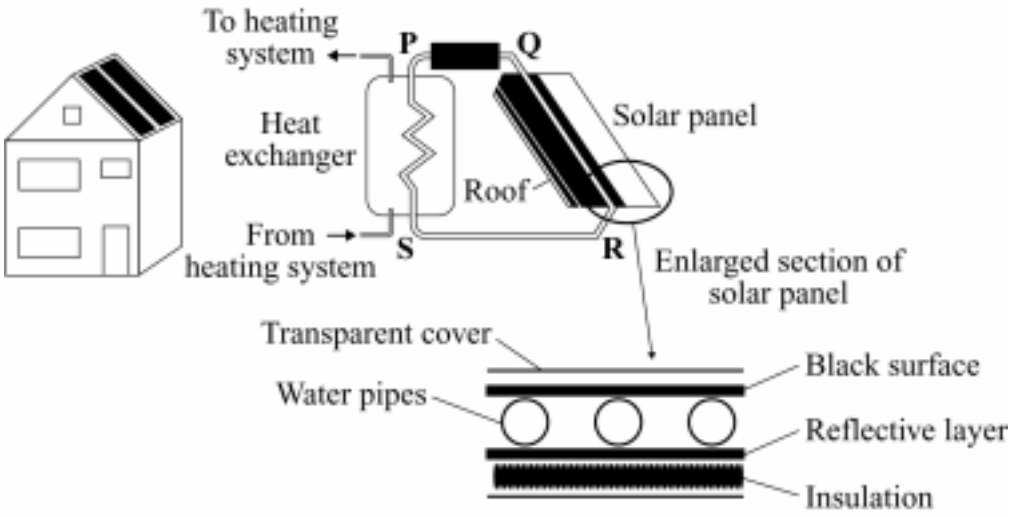
3 expands and rises due to decreased density.

4 expands and rises due to increased density.

Turn over for the next question

QUESTION SEVEN

Solar panels transfer solar energy to heat water.
This water then moves through a heat exchanger.



7A The different layers of the solar panel make the panel transfer solar energy in the most effective way.

Which row of the table shows how each layer helps this?

	Black top surface covering water pipes	**Insulation**
1	absorbs radiant energy	stops heat conduction to roof
2	absorbs radiant energy	protects water pipes from frost
3	emits radiant energy	conducts heat to the water pipes
4	reflects radiant energy	conducts heat to roof space

7B When the system is operating . . .

1 the water in tube **PS** becomes colder and moves from **S** towards **P**.

2 the water in tube **PS** becomes warmer and moves from **S** towards **P**.

3 the water in tube **QR** becomes less dense and moves from **R** towards **Q**.

4 the water in tube **QR** becomes more dense and moves from **Q** towards **R**.

7C The water pipes are made of long, narrow, copper tubing laid on the underside of the black top surface.

This arrangement ensures that heat energy is . . .

1 conducted quickly to the water in the narrow tubing.

2 distributed evenly between the top surface and the tubing.

3 reflected from the top surface.

4 transferred by convection.

7D Which design feature is most important for capturing maximum energy from the Sun's radiation?

1 large surface area for the panel

2 short distance between the copper tubing loops

3 well insulated copper tubing

4 wide diameter for the copper tubing

Turn over for the next question

QUESTION EIGHT

An African village is many miles away from a supply of mains electricity.
The Sun shines for at least a few hours nearly every day.
The villagers want a supply of electricity to pump water up from the well for a few hours each day.

The table shows the costs of two different ways of providing the electricity.

	Capital cost	**Capital cost (per kWh*)**	**Fuel cost (per kWh*)**	**Maintenance cost (per kWh*)**
Solar cells	£1000	20p	zero	zero
Petrol generator	£250	10p	20p	10p

[*These costs are averaged out over the 20 years that the equipment is expected to last.]

8A Which of the following statements is true?

1 A petrol generator has a higher capital cost per kWh.

2 A petrol generator has a higher initial capital cost.

3 A petrol generator has a higher overall cost per kWh.

4 A petrol generator needs less maintenance.

8B An advantage of the petrol generator is . . .

1 that it has no moving parts.

2 that it is cheaper to set up the system in the first place.

3 that it will cause less air pollution.

4 that it will cost less over a 20 year period.

8C A disadvantage of the solar cells for pumping water in the African village is . . .

1 that they can work out cheaper over a 20 year period.

2 that they have a high initial capital cost.

3 that they require no maintenance.

4 that they will not work during the night.

8D If the solar cells are used in the UK, they will produce only one fifth as much electricity during a 20-year period as they do in the African village.

How much more expensive would each kilowatt hour of electricity from the solar cells then be compared to mains electricity at 8 p per kilowatt hour?

1 2.5 times more expensive

2 5 times more expensive

3 10 times more expensive

4 12.5 times more expensive

Turn over for the next question

QUESTION NINE

Electricity can be generated in various ways.
The main power stations use fossil fuels (coal, oil and gas) or nuclear fuels.
No nuclear power stations have been built in the UK for some years.

9A Which one of the following is a valid argument against nuclear power stations?

1 For maximum efficiency, they have to be in nearly constant use.

2 They have high decommissioning costs.

3 They have high fuel costs.

4 They produce gases that pollute the atmosphere.

9B Some people argue that we should make more use of wind power instead of nuclear or fossil fuel power stations.

Which statement supports this view?

1 Fossil fuel and nuclear power stations are needed when the wind drops.

2 Large wind farms can be unsightly and noisy.

3 Wind farms have zero fuel costs to offset high capital cost.

4 Wind farms use large areas of land.

9C

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour)

A nuclear power station produces 1600 000 000 kWh of energy from 1 tonne of nuclear fuel.

How much nuclear fuel would be used by a 2400 MW nuclear power station for 24 hours?
(1 MW = 1000 kW)

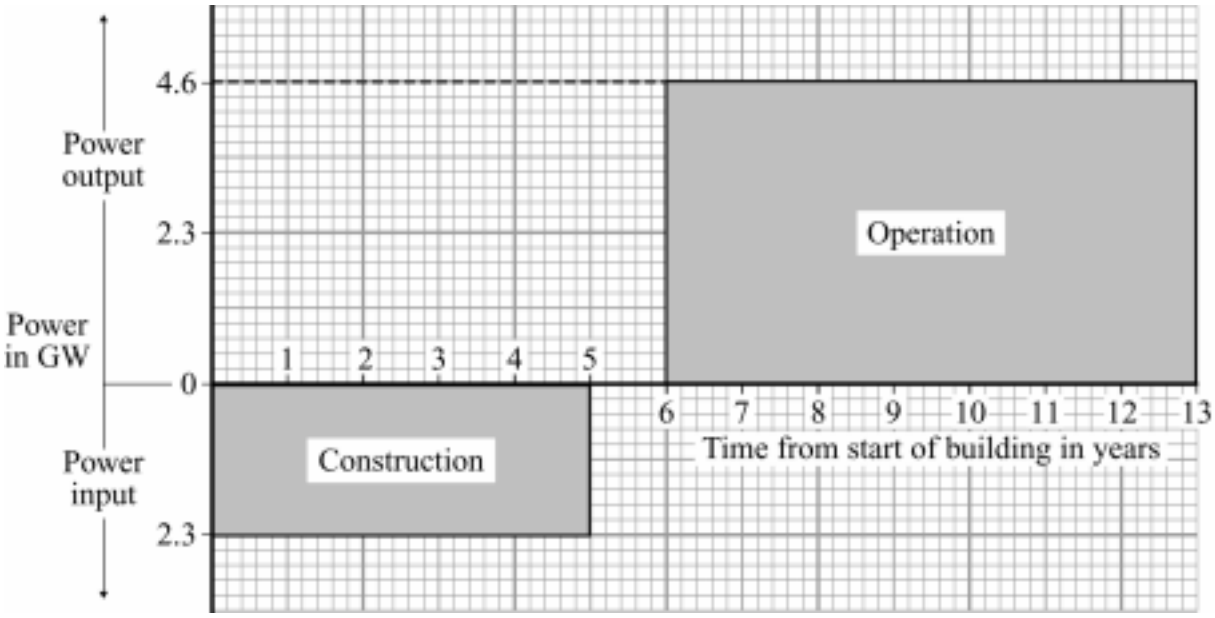
1 0.00036 tonnes

2 0.000625 tonnes

3 0.036 tonnes

4 2.78 tonnes

9D Nuclear power stations take a long time to build. Power is used in their construction and initial fuel processing. This, and the power produced by the station, are shown in the graph. The area under the graph represents the energy used or produced in GWh (1 GWh = 1 million kWh).



How many years will pass from the start of building before the power station produces more energy than was used to build it?

1 7 years

2 7.5 years

3 8 years

4 8.5 years

END OF TEST

FOUNDATION TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

QUESTION ONE	1	2	3	4
A heat (thermal energy)	○	○	○	○
B light	○	○	○	○
C movement (kinetic energy)	○	○	○	○
D sound	○	○	○	○

QUESTION TWO	1	2	3	4
A electricity	○	○	○	○
B movement (kinetic)	○	○	○	○
C steam	○	○	○	○
D uranium	○	○	○	○

QUESTION THREE	1	2	3	4
A conduction	○	○	○	○
B convection	○	○	○	○
C radiation	○	○	○	○
D reflection	○	○	○	○

QUESTION FOUR	1	2	3	4
A dams (for hydroelectricity)	○	○	○	○
B solar cells	○	○	○	○
C tidal barrages	○	○	○	○
D wind farms	○	○	○	○

QUESTION FIVE	1	2	3	4
A nuclear fuel	○	○	○	○
B solar energy	○	○	○	○
C tides	○	○	○	○
D wind	○	○	○	○

QUESTION SIX	1	2	3	4
A 0.3	○	○	○	○
B 5	○	○	○	○
C 30	○	○	○	○
D 65	○	○	○	○

QUESTION SEVEN	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

QUESTION EIGHT	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

QUESTION NINE	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

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OTQ03

GCSE SCIENCE

AQA ASSESSMENT and QUALIFICATIONS ALLIANCE

Unit : PHY1A – Physics 1a

Date/Series :

Centre :

Candidate Number : **UCI :**

Candidate Name :

For completion by the Examination Invigilator. **Please fill this oval if the candidate is absent:** ○

HIGHER TIER

Instructions on how to complete this answer sheet are given on the question paper. Please make sure you follow them carefully.

QUESTION ONE	1	2	3	4
A 0.3	○	○	○	○
B 5	○	○	○	○
C 30	○	○	○	○
D 65	○	○	○	○

QUESTION TWO	1	2	3	4
A infra red radiation	○	○	○	○
B particles	○	○	○	○
C surface area	○	○	○	○
D temperature	○	○	○	○

QUESTION THREE	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

QUESTION FOUR	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

QUESTION FIVE	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

QUESTION SIX	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

QUESTION SEVEN	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

QUESTION EIGHT	1	2	3	4
A	○	○	○	○
B	○	○	○	○
C	○	○	○	○
D	○	○	○	○

QUESTION NINE
A ○
B ○
C ○
D ○

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GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1A (Energy and Electricity)

Specimen Paper

Foundation Tier

Question			Key
One	**A**	heat (thermal energy)	**4**
	B	light	**1**
	C	movement (kinetic energy)	**3**
	D	sound	**2**
Two	**A**	electricity	**4**
	B	movement (kinetic)	**3**
	C	steam	**2**
	D	uranium	**1**
Three	**A**	conduction	**3**
	B	convection	**4**
	C	radiation	**1**
	D	reflection	**2**
Four	**A**	dams (for hydroelectricity)	**3**
	B	solar cells	**4**
	C	tidal barrages	**2**
	D	wind farms	**1**
Five	**A**	nuclear fuel	**1**
	B	solar energy	**2**
	C	tides	**4**
	D	wind	**3**
Six	**A**	0.3	**4**
	B	5	**2**
	C	30	**3**
	D	65	**1**

	A	B	C	D
Seven	**1**	**3**	**4**	**1**
Eight	**2**	**2**	**4**	**3**
Nine	**4**	**2**	**1**	**4**

GCSE

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1A (Energy and Electricity)

Specimen Paper

Higher Tier

Question	Key		
One	**A**	0.3	**4**
	B	5	**2**
	C	30	**3**
	D	65	**1**
Two	**A**	infra red radiation	**1**
	B	particles	**2**
	C	surface area	**4**
	D	temperature	**3**

	A	B	C	D
Three	**2**	**2**	**4**	**3**
Four	**4**	**2**	**1**	**4**
Five	**2**	**3**	**1**	**4**
Six	**4**	**1**	**2**	**3**
Seven	**1**	**3**	**2**	**1**
Eight	**3**	**2**	**4**	**4**
Nine	**2**	**3**	**3**	**4**