version 1.0

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics

Specimen Papers and Mark Schemes

Contents

Physics (4451)

ISAs

Contents continued

Surname		Other Names	
Centre Number						Candidate Number				
Candidate signature										

General Certificate of Secondary Education
Specimen Paper

SCIENCE A
Energy and Electricity (Unit Physics 1a)

Date and Time

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

You may use a calculator.

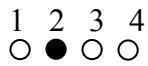
Time allowed: 30 minutes

Instructions

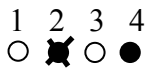
- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title 'Energy and Electricity' printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or**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

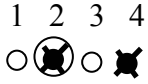
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown:



- 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 A

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

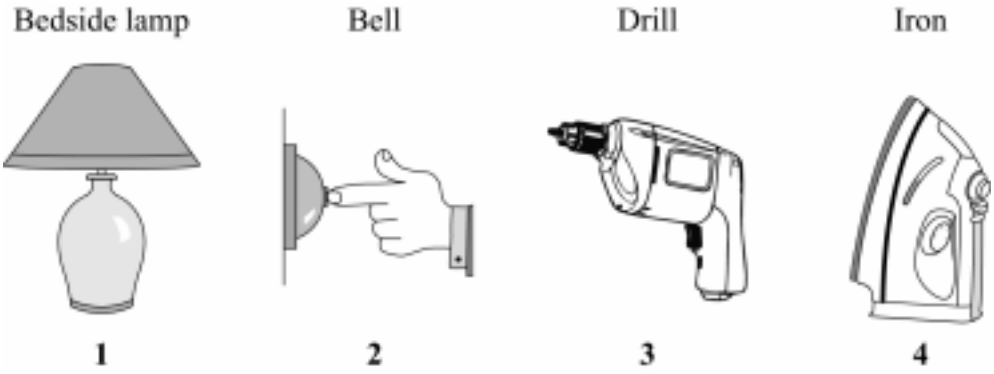
In these questions match the letters with the numbers.

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

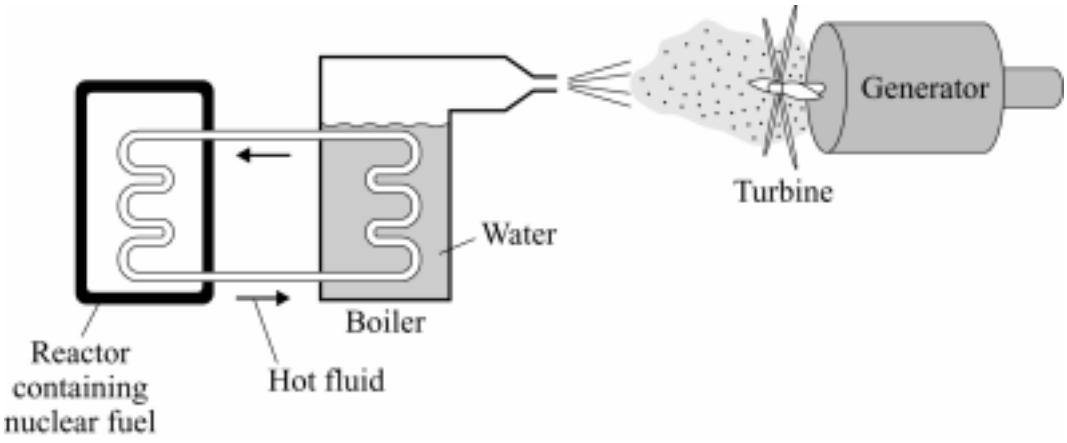
C Movement (kinetic energy)

D Sound

[6]

QUESTION TWO

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



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

A Electricity

B Movement (kinetic)

C Steam

D Uranium

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

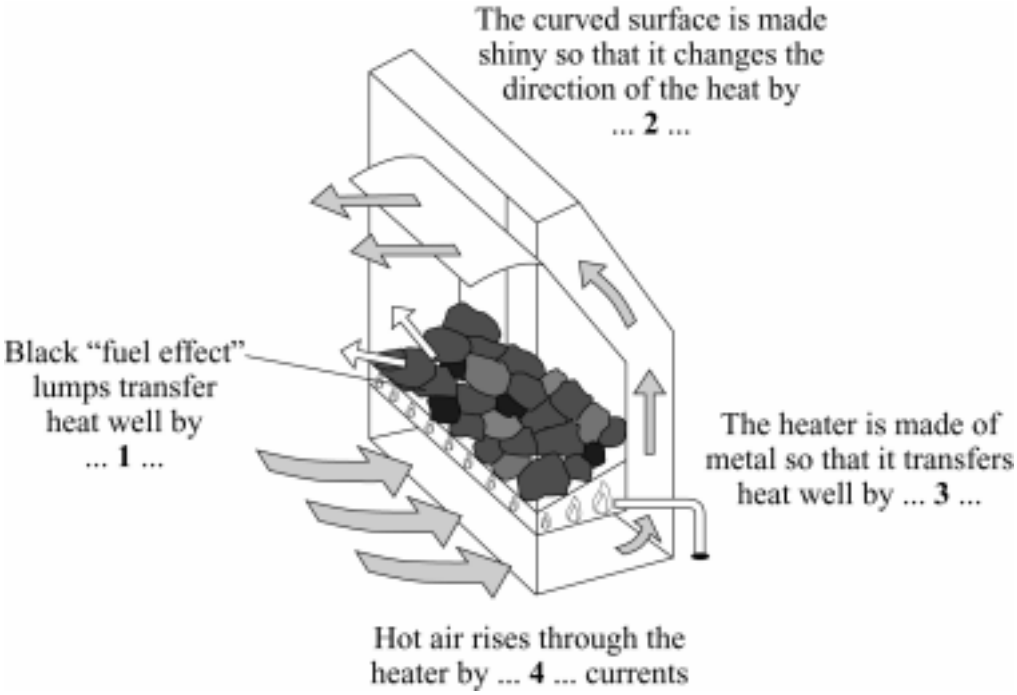
The turbine is driven by …**2**… .

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

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

QUESTION THREE

A heater transfers energy to a room in various ways.



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

A Conduction

B Convection

C Radiation

D Reflection

[8]

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 spaces **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**… .

[10]

QUESTION SIX

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

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

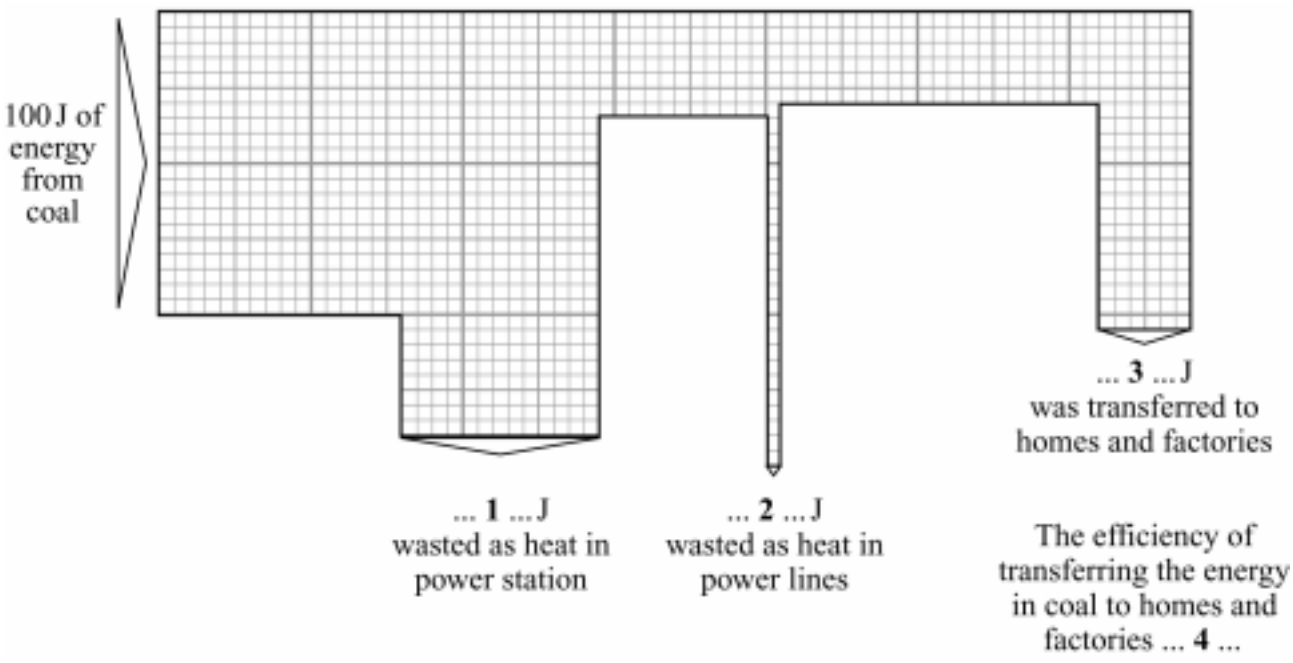
Match numbers, **A**, **B**, **C** and **D**, with the spaces **1 – 4** in the diagram.

A 0.3

B 5

C 30

D 65



SECTION B

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

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

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

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

A 37

B 47

C 63

D 89

[12]

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

How much would this electricity cost?

A 21p

B 37p

C £2.10

D £21.00

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

How much energy was transferred by the heater?

A 2.5 kWh

B 4.5 kWh

C 10.5 kWh

D 22.5 kWh

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

A 30 minutes (half an hour)

B 2 hours

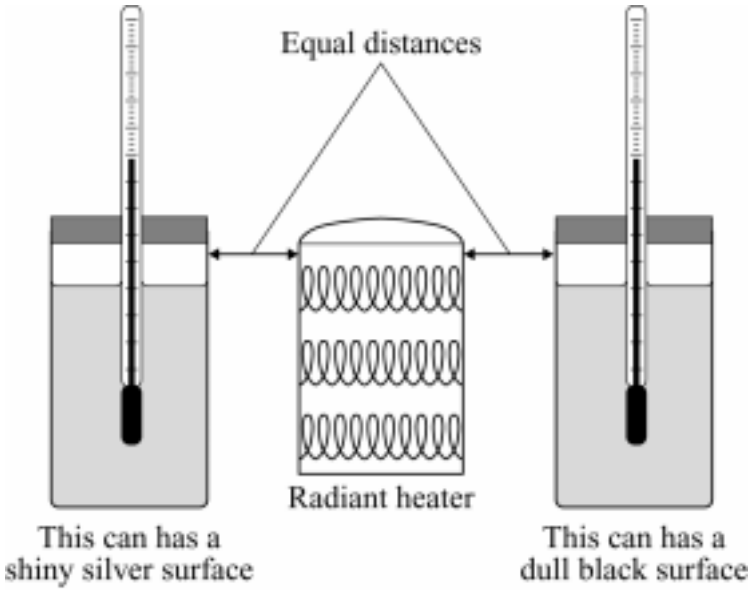
C 3.5 hours

D 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

[14]

8.1 Which was an independent variable in the two experiments?

A The final temperature of the water

B The initial temperature of the water

C The time the water was left

D The volume of the water

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

A Distance from heater to cans

B Final temperature of water

C Power of radiant heater

D Volume of water

8.3 **Experiment 1** shows that a shiny silver surface . . .

A is a good absorber of radiation.

B is a good conductor of radiation.

C is a good emitter of radiation.

D is a good reflector of radiation.

8.4 **Experiment 2** shows that a dull black surface . . .

A is a good absorber of radiation.

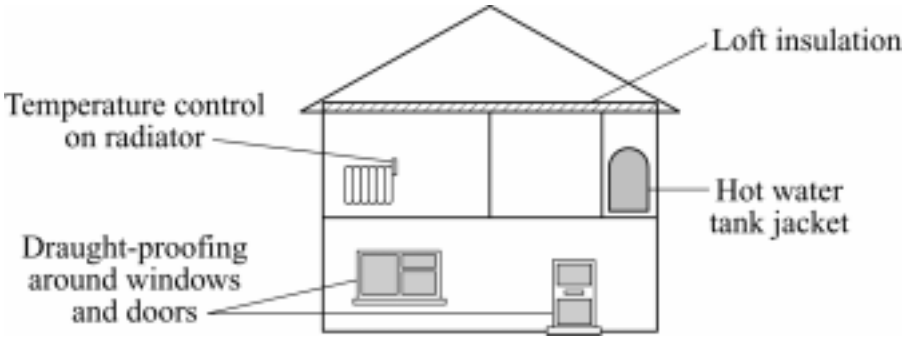
B is a good conductor of radiation.

C is a good emitter of radiation.

D 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

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

A Draught-proofing

B Hot water tank jacket

C Loft insulation

D Temperature controls on radiators

[16]

9.2 Which method reduces energy loss by the smallest amount?

A Draught-proofing

B Hot water tank jacket

C Loft insulation

D Temperature controls on radiators

9.3 Which method pays for itself in the shortest time?

A Draught-proofing

B Hot water tank jacket

C Loft insulation

D Temperature controls on radiators

9.4 What is the pay-back time on loft insulation?

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

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

C 2 years

D 4 years

END OF TEST

[17]

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** to **TWO**.

In these questions match the letters with the numbers.

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

Mark your choices on the answer sheet.

QUESTION ONE

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

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

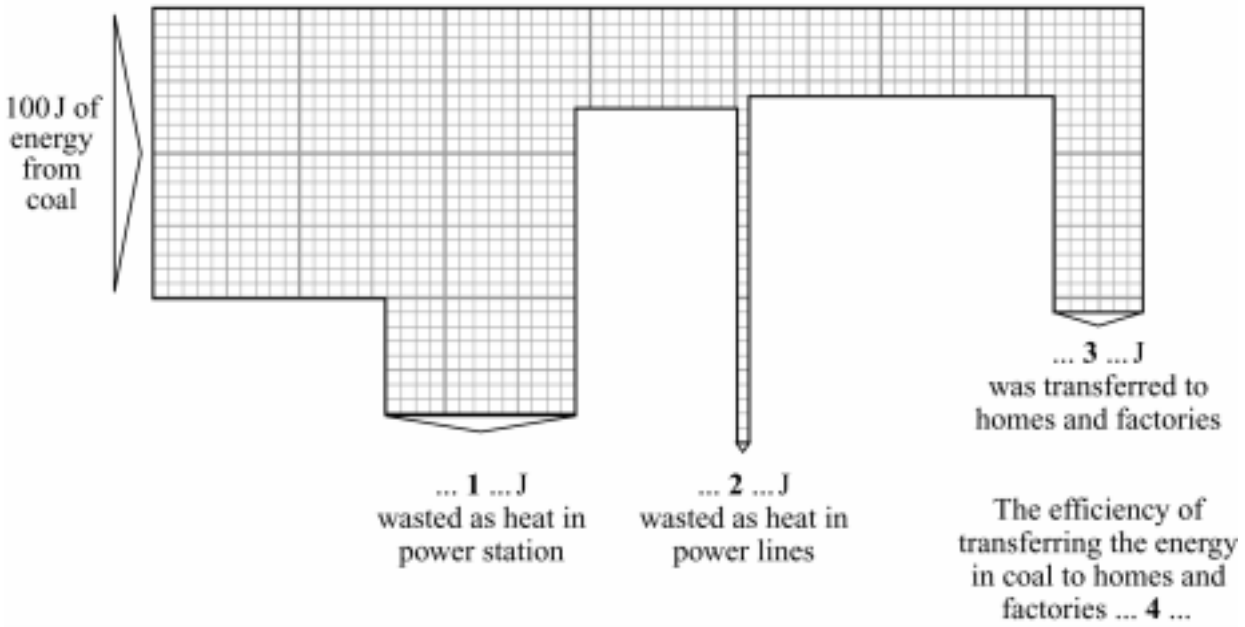
Match numbers, **A**, **B, C** and **D**, with the spaces **1 – 4** in the diagram.

A 0.3

B 5

C 30

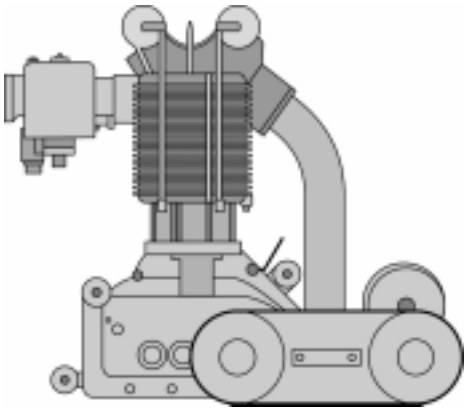
D 65



[18]

QUESTION TWO

The picture shows a motorcycle engine.



Match words, **A**, **B**, **C**, and **D**, with the spaces **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**… .

SECTION B

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

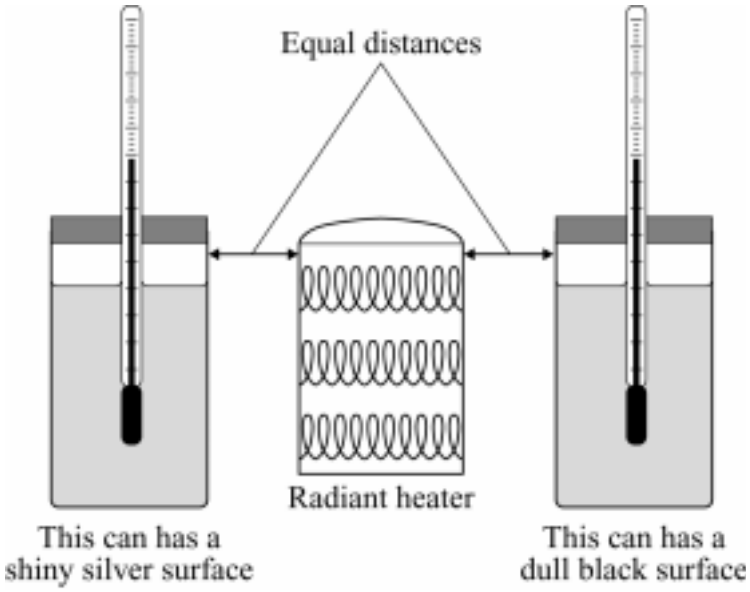
Each of these questions has four parts.

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

- 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

[20]

3.1 Which was an independent variable in the two experiments?

A The final temperature of the water

B The initial temperature of the water

C The time the water was left

D The volume of the water

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

A Distance from heater to cans

B Final temperature of water

C Power of radiant heater

D Volume of water

3.3 **Experiment 1** shows that a shiny silver surface . . .

A is a good absorber of radiation.

B is a good conductor of radiation.

C is a good emitter of radiation.

D is a good reflector of radiation.

3.4 **Experiment 2** shows that a dull black surface . . .

A is a good absorber of radiation.

B is a good conductor of radiation.

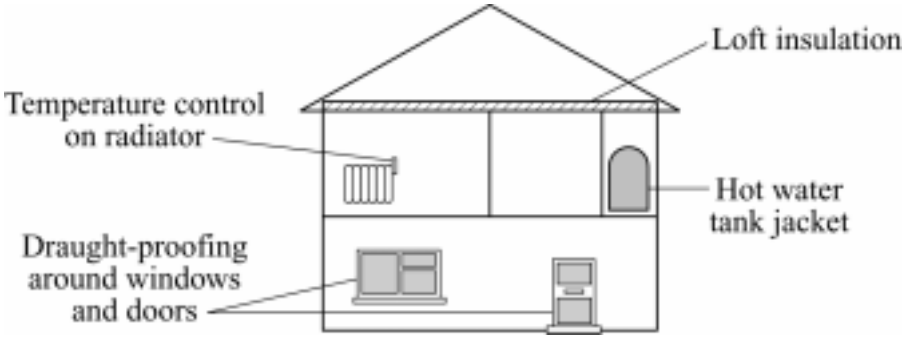
C is a good emitter of radiation.

D is a good reflector of radiation.

.

QUESTION FOUR

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

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

A Draught-proofing

B Hot water tank jacket

C Loft insulation

D Temperature controls on radiators

4.2 Which method reduces energy loss by the smallest amount?

A Draught-proofing

B Hot water tank jacket

C Loft insulation

D Temperature controls on radiators

4.3 Which method pays for itself in the shortest time?

A Draught-proofing

B Hot water tank jacket

C Loft insulation

D Temperature controls on radiators

4.4 What is the pay-back time on loft insulation?

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

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

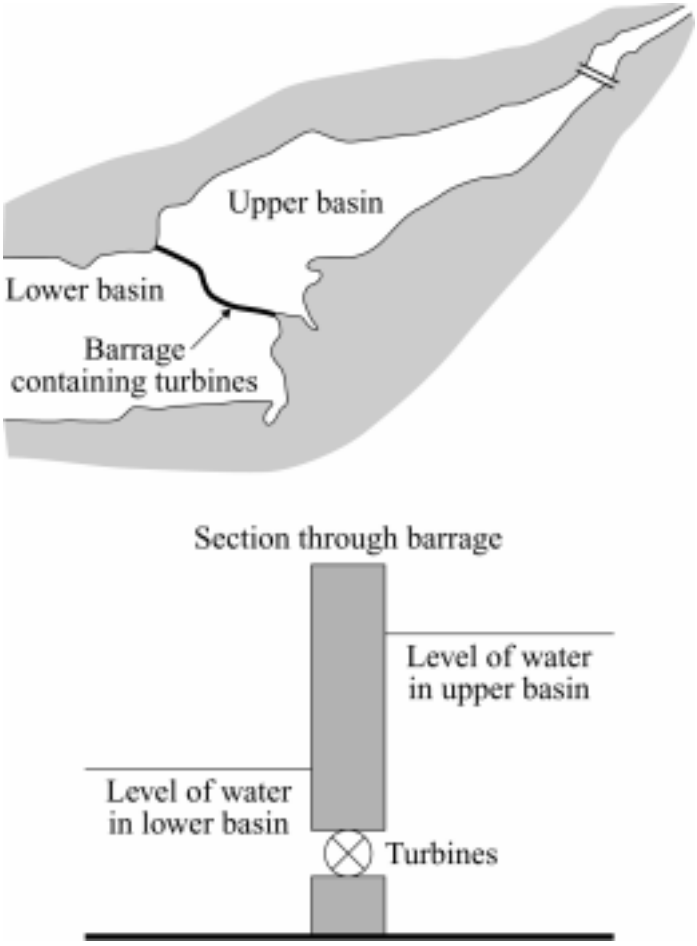
C 2 years

D 4 years

Turn over for the next question

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.



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

A electrical energy.

B gravitational potential energy.

C sound energy.

D thermal energy.

[24]

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

A Electrical energy to gravitational potential energy

B Electrical energy to kinetic energy

C Gravitational potential energy to kinetic energy

D Kinetic energy to gravitational potential energy

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

A costs more to build.

B has a more concentrated energy supply.

C has higher fuel costs.

D has higher maintenance costs.

5.4 One disadvantage of this tidal barrage is that . . .

A it cannot be used in summer.

B it has high decommissioning costs.

C its output depends on the weather.

D 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.

6.1 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.

6.2 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.

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

A free electrons colliding with ions.

B infra red waves passing through the air.

C metal atoms gaining energy and escaping into the air.

D the air contracting and falling as it is heated.

[26]

6.4 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.

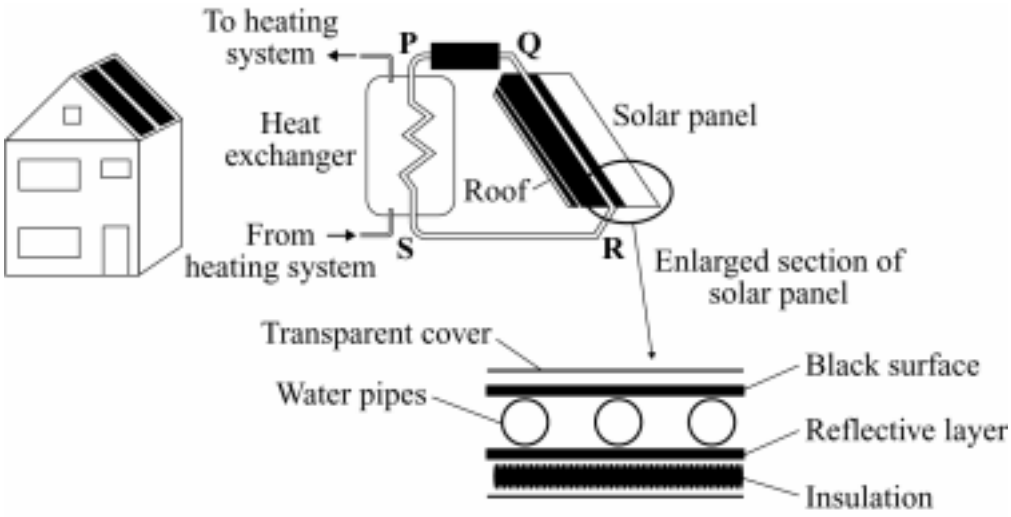
C expands and rises due to decreased density.

D expands and rises due to increased density.

Turn over for the next question

QUESTION SEVEN

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



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

Which row of the table, **A**, **B**, **C** or **D**, shows how each layer helps this?

	Black top surface covering water pipes	**Insulation**
A	Absorbs radiant energy	Stops heat conduction to roof
B	Absorbs radiant energy	Protects water pipes from frost
C	Emits radiant energy	Conducts heat to the water pipes
D	Reflects radiant energy	Conducts heat to roof space

7.2 When the system is operating . . .

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

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

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

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

[28]

7.3 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 . . .

A conducted quickly to the water in the narrow tubing.

B distributed evenly between the top surface and the tubing.

C reflected from the top surface.

D transferred by convection.

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

A Large surface area for the panel

B Short distance between the copper tubing loops

C Well insulated copper tubing

D 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.]

8.1 Which of the following statements is true?

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

B A petrol generator has a higher initial capital cost.

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

D A petrol generator needs less maintenance.

8.2 An advantage of the petrol generator is . . .

A that it has no moving parts.

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

C that it will cause less air pollution.

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

[30]

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

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

B that they have a high initial capital cost.

C that they require no maintenance.

D that they will not work during the night.

8.4 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?

A 2.5 times more expensive

B 5 times more expensive

C 10 times more expensive

D 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.

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

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

B They have high decommissioning costs.

C They have high fuel costs.

D They produce gases that pollute the atmosphere.

9.2 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?

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

B Large wind farms can be unsightly and noisy.

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

D Wind farms use large areas of land.

9.3

You may find this formula useful when answering this question.

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

Using 1 tonne of uranium in a nuclear power station produces 1600 000 000 kWh of energy.
How much uranium would be needed to fuel a 2400 MW nuclear power station for 24 hours?
(1 MW = 1000 kW)

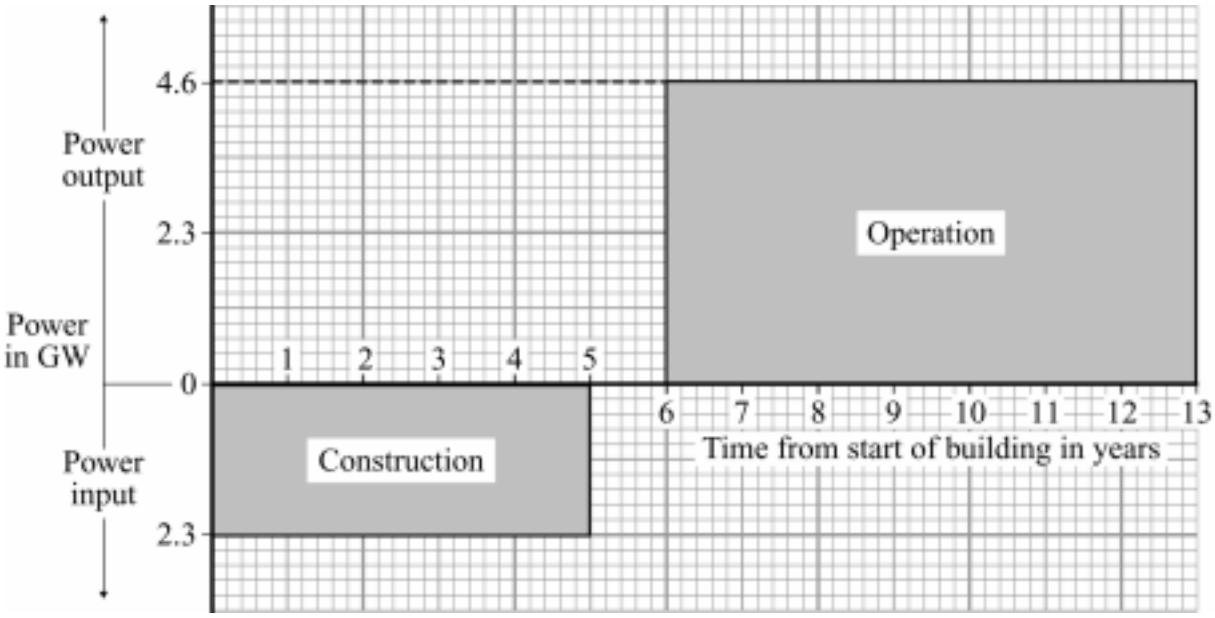
A 0.00036 tonnes

B 0.000625 tonnes

C 0.36 tonnes

D 2.78 tonnes

9.4 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?

A 7 years

B 7.5 years

C 8 years

D 8.5 years

END OF TEST

GCSE SCIENCE A

OBJECTIVE TEST ANSWER KEY

UNIT PHYSICS 1a - FOUNDATION TIER

Question No.	KEY
One	1 – B 2 – D 3 – C 4 – A
Two	1 – D 2 – C 3 – B 4 – A
Three	1 – C 2 – D 3 – A 4 – B
Four	1 – D 2 – C 3 – A 4 – B
Five	1 – A 2 – B 3 – D 4 – C
Six	1 – D 2 – B 3 – C 4 – A
Seven	7.1 – A, 7.2 – C, 7.3 – D, 7.4 – A
Eight	8.1 – B, 8.2 – B, 8.3 – D, 8.4 – C
Nine	9.1 – D, 9.2 – B, 9.3 – A, 9.4 – D
	Overall marks = 36

GCSE SCIENCE A

OBJECTIVE TEST ANSWER KEY

UNIT PHYSICS 1a - HIGHER TIER

Question No.	KEY
One	1 – D 2 – B 3 – C 4 – A
Two	1 – A 2 – B 3 – D 4 – C
Three	3.1 – B, 3.2 – B, 3.3 – D, 3.4 – C
Four	4.1 – D, 4.1 – B, 4.3 – A, 4.4 – D
Five	5.1 – B, 5.2 – C, 5.3 – A, 5.4 – D
Six	6.1 – D, 6.2 – A, 6.3 – B, 6.4 – C
Seven	7.1 – A, 7.2 – C, 7.3 – B, 7.4 – A
Eight	8.1 – C, 8.2 – B, 8.3 – D, 8.4 – D
Nine	9.1 – B, 9.2 – C, 9.3 – C, 9.4 – D
	Overall marks = 36

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Surname		Other Names	
Centre Number						Candidate Number				
Candidate signature										

General Certificate of Secondary Education
Specimen Paper

SCIENCE A
Radiation and the Universe (Unit Physics 1b)

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 'Radiation and the Universe' 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: 1 2 3 4
- 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
- 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

Information

- The maximum mark for this paper is 36.

Advice

- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

You must do **one Tier** only, **either** the Foundation tier **or** the Higher Tier.
The Higher Tier starts on page 16 of this booklet.

FOUNDATION TIER

SECTION A

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

In these questions match the letters with the numbers.

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

Mark your choices on the answer sheet.

QUESTION ONE

We use electromagnetic radiation for many different jobs.

Match words, **A**, **B**, **C** and **D**, with the drawings labelled **1 – 4**.

A Gamma rays

B Infra red waves

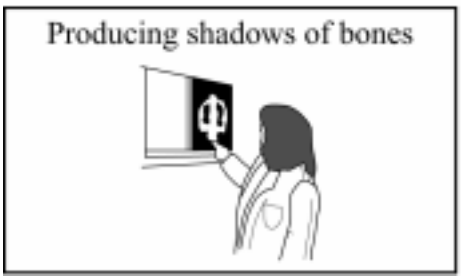
C Ultraviolet waves

D X-rays

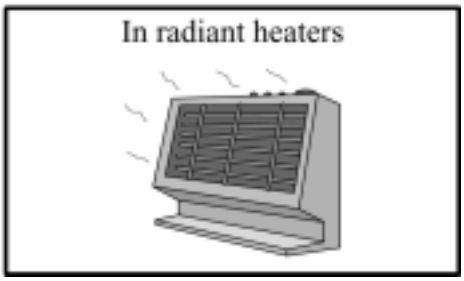
1

2

3



4



QUESTION TWO

Electromagnetic waves can be grouped into types with different wavelengths.

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

A Infra red waves

B Microwaves

C Ultraviolet waves

D X-rays

Increasing wavelength ⟶

gamma rays	**1**	**2**	visible light	**3**	**4**	radio waves

QUESTION THREE

The diagram shows a mobile phone.

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

A A digital

B A microphone

C An analogue

D Microwave radiation

When we talk into the phone, the sound is detected by … **1** … .

Sound is … **2** … signal.

The phone converts this type of signal into … **3** …signal.

The signal is then transmitted from the antenna in the form of … **4** … .

[40]

QUESTION FOUR

The table gives information about five radioactive isotopes.

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

A The isotope which does not damage the body from the outside

B The isotope which gives off the most penetrating type of radiation

C The isotope with the longest half-life

D The isotope with the smallest mass

	Isotope	**Type of radiation emitted**	**Half-life**
1	Californium-241	alpha (α)	4 minutes
2	Cobalt-60	gamma (γ)	5 years
3	Hydrogen-3	beta (β)	12 years
4	Strontium-90	beta (β)	28 years

Turn over for the next question

QUESTION FIVE

Electromagnetic radiation can damage our bodies if it is not used correctly.

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

A Infra red radiation

B Microwaves

C Ultraviolet radiation

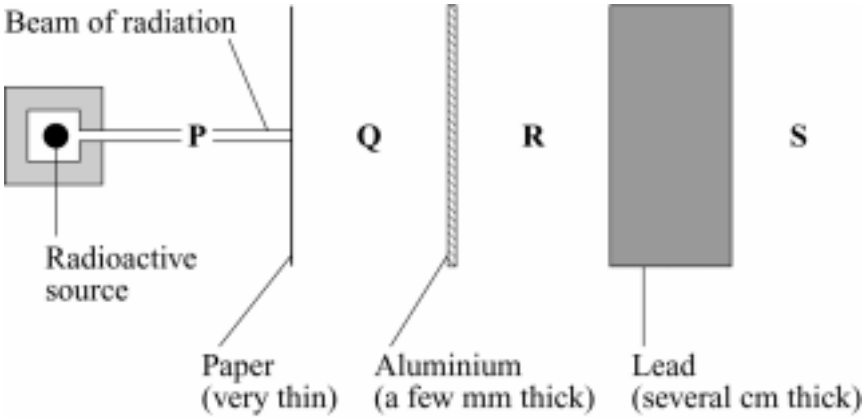
D X-rays

	Damage caused to body
1	Burns
2	Damages cells by heating water inside them
3	Damage to unborn children by causing mutations
4	Skin cancer

[42]

QUESTION SIX

A radioactive source gives out a narrow beam of radiation.
Barriers are placed in front of the source as shown in the diagram.



Readings are taken from a radiation detector at **P**, **Q**, **R** and **S**.

These readings are shown in the table.

Position of detector	Reading on detector
P	280
Q	136
R	98
S	0

Match the counts **P**, **Q**, **R** and **S** with the words **1 – 4** in the table.

	Types of radiation
1	Gamma radiation only
2	Gamma radiation and beta particles
3	Gamma radiation, alpha particles and beta particles
4	No radiation

SECTION B

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

We have obtained evidence for the origin of the Universe by studying light coming to us from bodies in the Universe.

7.1 From which bodies do we get light that gives evidence for the origin of the Universe?

A Comets

B Galaxies

C Moons

D Planets

7.2 The light coming from these bodies changes wavelength. This change is known as . . .

A blue shift.

B green shift.

C red shift.

D yellow shift.

7.3 This shift shows us that distant galaxies . . .

A are moving away from us.

B are moving in orbits.

C are moving towards us.

D are stationary.

7.4 This shift gives evidence for . . .

A global warming.

B life on other planets.

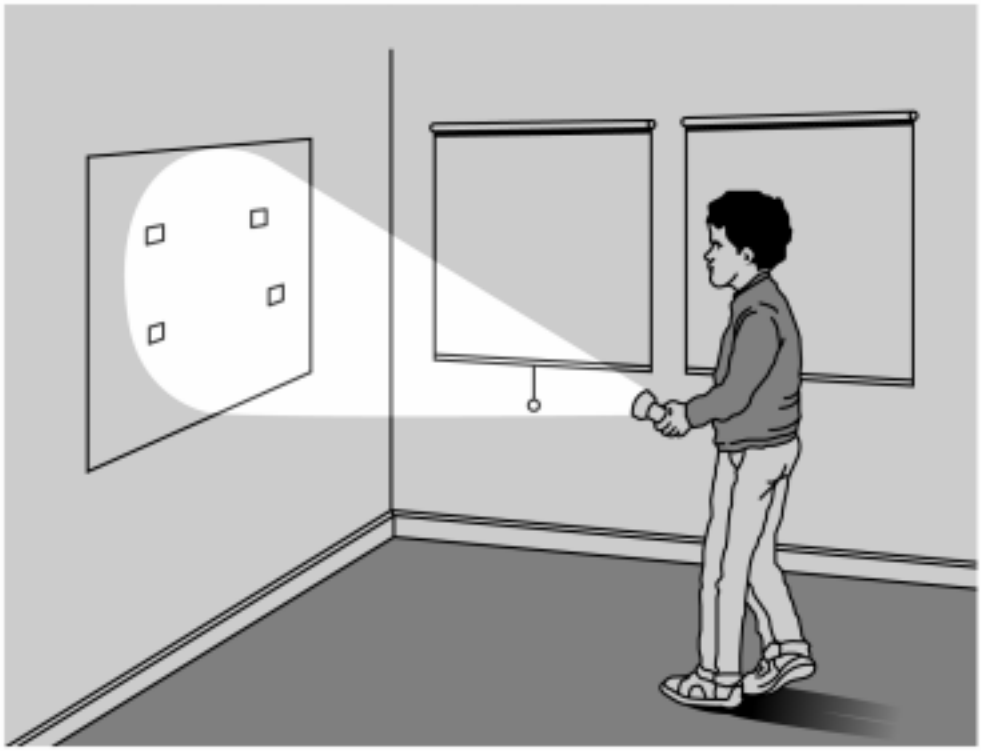
C the Big Bang theory.

D the theory of evolution.

Turn over for the next question

QUESTION EIGHT

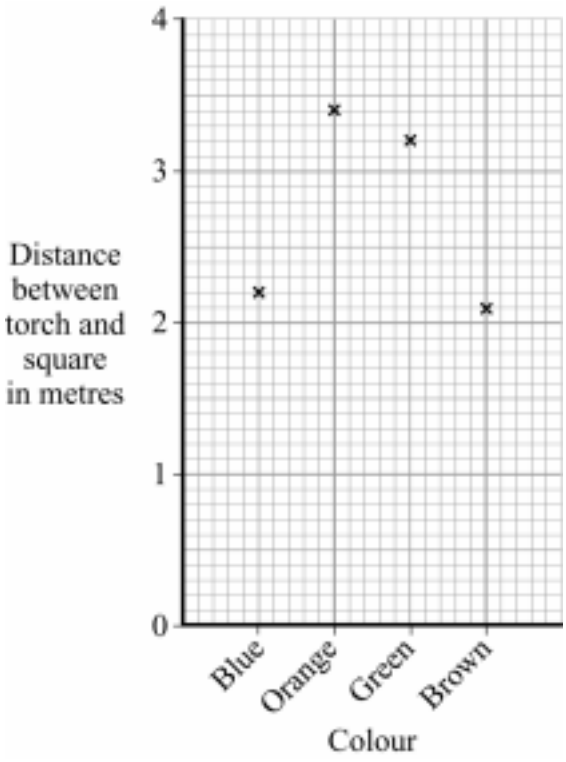
To be seen walking along the road on a dark night, it is important to wear clothing which will reflect light from car headlamps. Isaac investigated which colours are best at reflecting light.



- He stuck small squares of different coloured material on to a black card.
- He hung the card at one end of a darkened laboratory.
- He switched on his torch and moved towards the coloured squares.
- When he could clearly see a coloured square, he measured the distance between the torch and that coloured square with a measuring tape graduated to 2 cm.
- He then repeated the technique to find the distance for the other coloured squares.

[46]

The graph shows Isaac's results.



8.1 Which of these colours would it be best to use for a reflective coat?

A Blue

B Brown

C Green

D Orange

8.2 Why did Isaac do the investigation in a darkened room?

A Because colours show up better in torchlight

B Because reflective clothing is used at night

C So that only the light from the torch lit up the coloured squares

D To make it a fair test

8.3 Which of the following is a control variable in this experiment?

A The distance between the torch and the board

B The length of time the torch was switched on

C The colour of the coloured squares

D The size of the coloured squares

8.4 Isaac could have got more reliable results by using . . .

A a light meter.

B a metre rule graduated to 1 mm.

C a stop clock.

D binoculars.

Turn over for the next question

QUESTION NINE

Read the passage below about mobile phones.

> The number of mobiles in Britain has doubled to 50 million since the first government-sponsored report in 2000. The number of children aged between five and nine using mobiles has increased fivefold in the same period.
>
> Four studies have caused concern.
> A Swedish study suggests that heavy mobile users are more likely to get cancer in the ear and brain.
> A Dutch study suggests that there are changes in brain function in heavy mobile phone users. A German study found some evidence of an increase in cancer around transmitter masts.
> An EU study has shown evidence of cell damage from waves similar to those transmitted by mobile phones.
>
> A British scientist, Sir William Stewart, said, "All of these studies have yet to be replicated but we can't dismiss them out of hand. If there was a health risk it would have a greater effect on the young than on older people".

9.1 How has the number of mobile phones used by children aged between five and nine changed since 2000?

A It has doubled.

B It has risen fivefold.

C It has risen by 50 million.

D It has risen to 50 million.

9.2 What is a possible effect of waves from mobile phone masts on people living near them?

A Cancer

B Changes in brain function

C Non-malignant brain tumours

D Non-malignant ear tumours

[50]

9.3 Why has Sir William advised that children under eight should not use mobiles phones?

A Mobile phones affect the brain.

B Mobile phones cause brain tumours.

C Mobile phones cause cancer.

D Mobile phones might have a greater effect on young people than on older people.

9.4 The link between mobile phones and health risk . . .

A cannot be proved.

B has been proved.

C needs research results to be replicated to be more certain.

D will never be proved.

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**

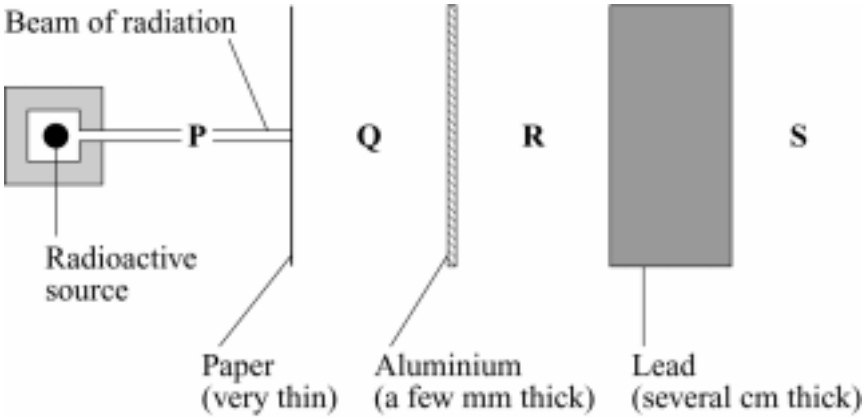
In these questions match the letters with the numbers.

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

Mark your choices on the answer sheet.

QUESTION ONE

A radioactive source gives out a narrow beam of radiation.
Barriers are placed in front of the source as shown in the diagram.



Readings are taken from a radiation detector at **P**, **Q**, **R** and **S**.

These readings are shown in the table.

Position of detector	Reading on detector
P	280
Q	136
R	98
S	0

[52]

Match the counts **P**, **Q**, **R** and **S** with the words **1 – 4** in the table.

	Types of radiation
1	Gamma radiation only
2	Gamma radiation and beta particles
3	Gamma radiation, alpha particles and beta particles
4	No radiation

QUESTION TWO

The table gives types of electromagnetic waves.

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

A 0.0005 mm

B 0.1 mm

C 10 cm

D 1000 m

	Electromagnetic wave
1	Infra red
2	Light
3	Microwaves
4	Radio

SECTION B

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

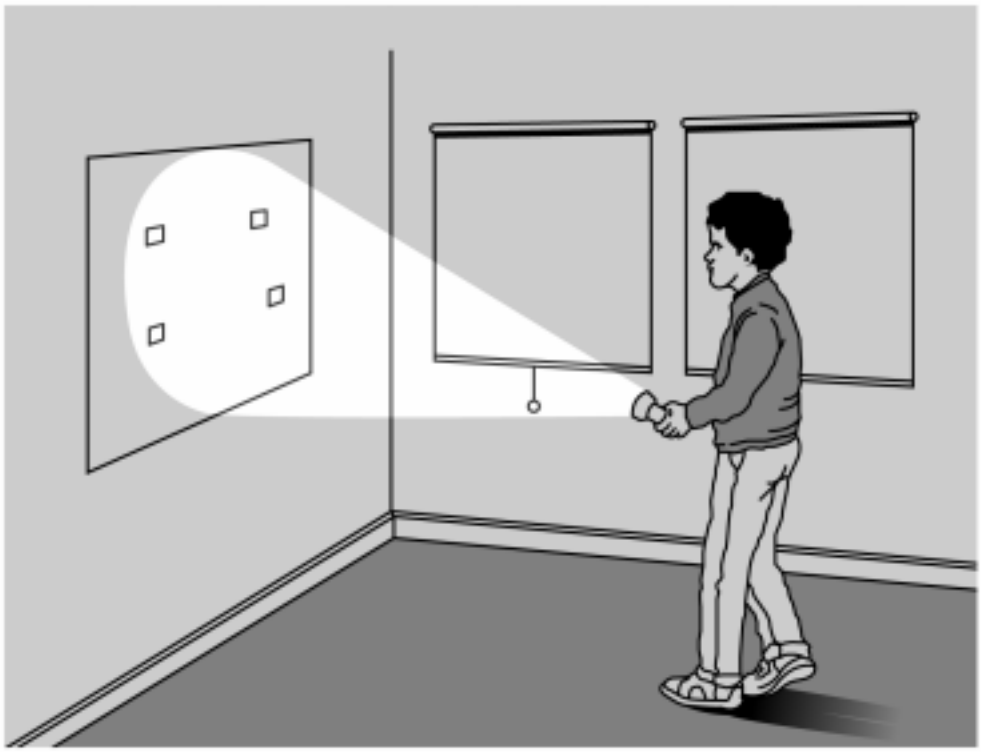
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

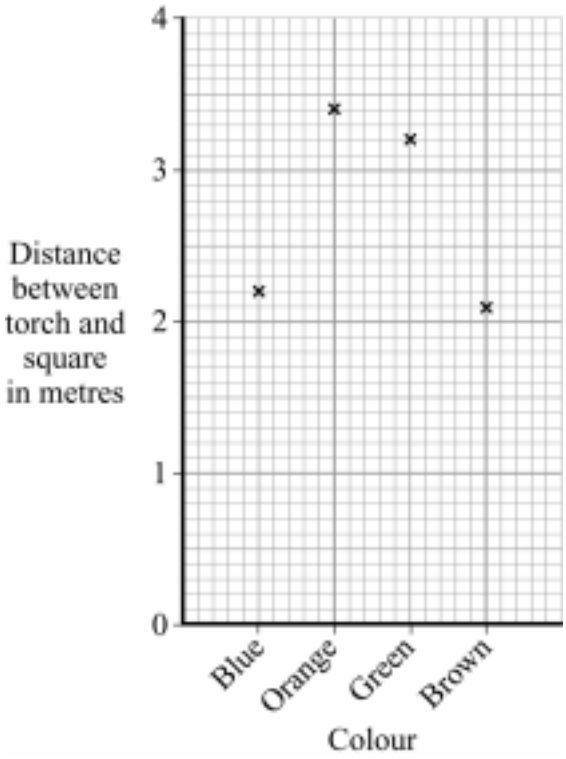
QUESTION THREE

To be seen walking along the road on a dark night, it is important to wear clothing which will reflect light from car headlamps. Isaac investigated which colours are best at reflecting light.



- He stuck small squares of different coloured material on to a black card.
- He hung the card at one end of a darkened laboratory.
- He switched on his torch and moved towards the coloured squares.
- When he could clearly see a coloured square, he measured the distance between the torch and that coloured square with a measuring tape graduated to 2 cm.
- He then repeated the technique to find the distance for the other coloured squares.

The graph shows Isaac's results.



3.1 Which of these colours would it be best to use for a reflective coat?

A Blue

B Brown

C Green

D Orange

3.2 Why did Isaac do the investigation in a darkened room?

A Because colours show up better in torchlight

B Because reflective clothing is used at night

C So that only the light from the torch lit up the coloured squares

D To make it a fair test

3.3 Which of the following is a control variable in this experiment?

A The distance between the torch and the board

B The length of time the torch was switched on

C The colour of the coloured squares

D The size of the coloured squares

3.4 Isaac could have got more reliable results by using . . .

A a light meter.

B a metre rule graduated to 1 mm.

C a stop clock.

D binoculars.

Turn over for the next question

QUESTION FOUR

Read the passage below about mobile phones.

> The number of mobiles in Britain has doubled to 50 million since the first government-sponsored report in 2000. The number of children aged between five and nine using mobiles has increased fivefold in the same period.
>
> Four studies have caused concern.
> A Swedish study suggests that heavy mobile users are more likely to get cancer in the ear and brain.
> A Dutch study suggests that there are changes in brain function in heavy mobile phone users. A German study found some evidence of an increase in cancer around transmitter masts.
> A EU study has shown evidence of cell damage from waves similar to those transmitted by mobile phones.
>
> A British scientist, Sir William Stewart, said, "All of these studies have yet to be replicated but we can't dismiss them out of hand. If there was a health risk it would have a greater effect on the young than on older people".

4.1 How has the number of mobile phones used by children aged between five and nine changed since 2000?

A It has doubled.

B It has risen fivefold.

C It has risen by 50 million.

D It has risen to 50 million.

4.2 What is a possible effect of waves from mobile phone masts on people living near them?

A Cancer

B Changes in brain function

C Non-malignant brain tumours

D Non-malignant ear tumours

4.3 Why has Sir William advised that children under eight should not use mobiles phones?

A Mobile phones affect the brain.

B Mobile phones cause brain tumours.

C Mobile phones cause cancer.

D Mobile phones might have a greater effect on young people than on older people.

4.4 The link between mobile phones and health risk . . .

A cannot be proved.

B has been proved.

C needs research results to be replicated to be more certain.

D will never be proved.

Turn over for the next question

QUESTION FIVE

A smoke detector uses the radioactive element americium.
Americium gives radiation in the form of alpha particles.

Diagram 1 shows the position of the smoke detector in a room.

Diagram 2 shows the warning label at the back of the smoke detector.

Diagram 1

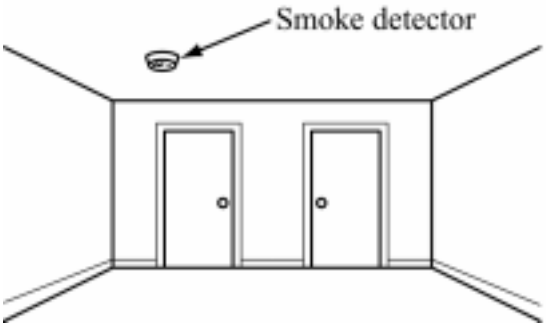
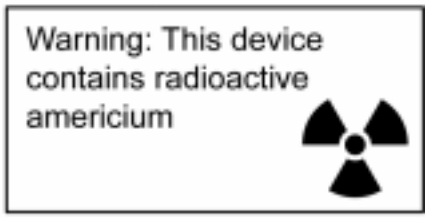


Diagram 2



5.1 The radiation from the americium in the smoke detector will not harm people in the room because . . .

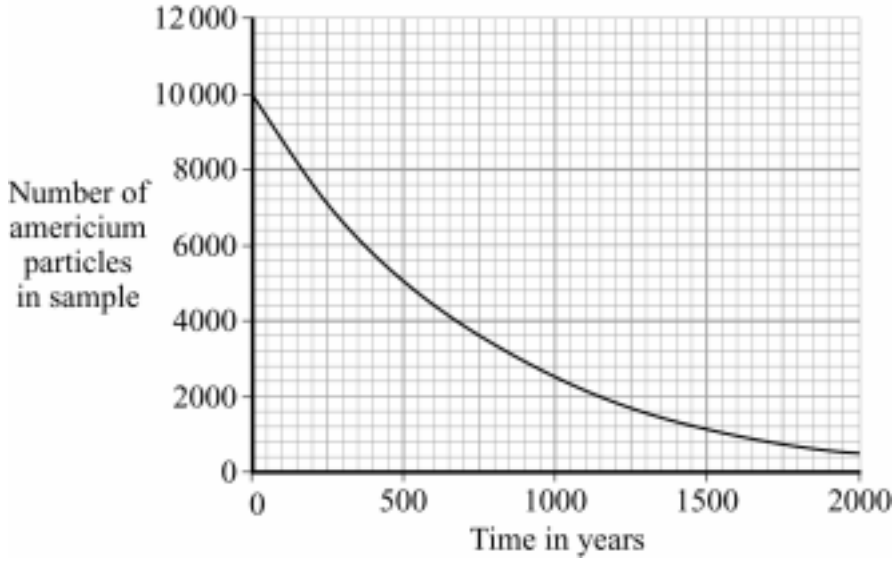
A alpha particles cannot cause mutations.

B alpha particles cannot damage human cells.

C alpha particles do not cause ionisation.

D alpha particles travel only a few centimetres in air.

The graph shows how the number of americium particles inside a source changes with time.



[60]

5.2 How long does it take for the number of americium particles to fall to 2500?

A 500 years

B 1000 years

C 1500 years

D 2000 years

5.3 What proportion of the americium particles were left after 500 years?

A one eighth

B one quarter

C a half

D three quarters

5.4 The battery in the smoke detector needs to be changed regularly, but the americium never needs to be changed. This is because . . .

A americium has a very long half-life.

B americium only gives off weak radiation.

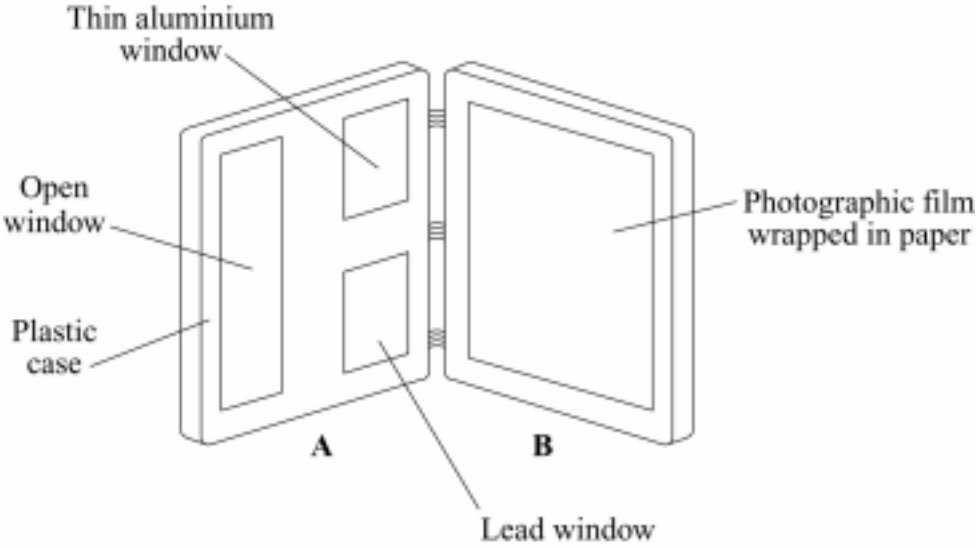
C long-life batteries cannot be used in smoke alarms.

D radiation is stronger than electricity.

Turn over for the next question

QUESTION SIX

The diagram shows a film badge worn by people who work with radioactive materials.
The badge has been opened.
The badge is used to measure the amount of radiation to which the workers have been exposed.



The detector is a piece of photographic film wrapped in paper inside part **B** of the badge.
Part **A** has "windows" as shown.

6.1 Which type(s) of radiation can pass through the open window and affect the film.

A Alpha radiation only

B Alpha radiation and beta radiation

C Beta radiation and gamma radiation

D Gamma radiation only

6.2 Which type(s) of radiation can pass through the lead window and affect the film.

A Alpha radiation only

B Alpha radiation and beta radiation

C Beta radiation and gamma radiation

D Gamma radiation only

6.3 Alpha radiation consists of . . .

A electrons only.

B helium nuclei.

C neutrons only.

D protons only.

6.4 Beta radiation consists of . . .

A electrons only.

B helium nuclei.

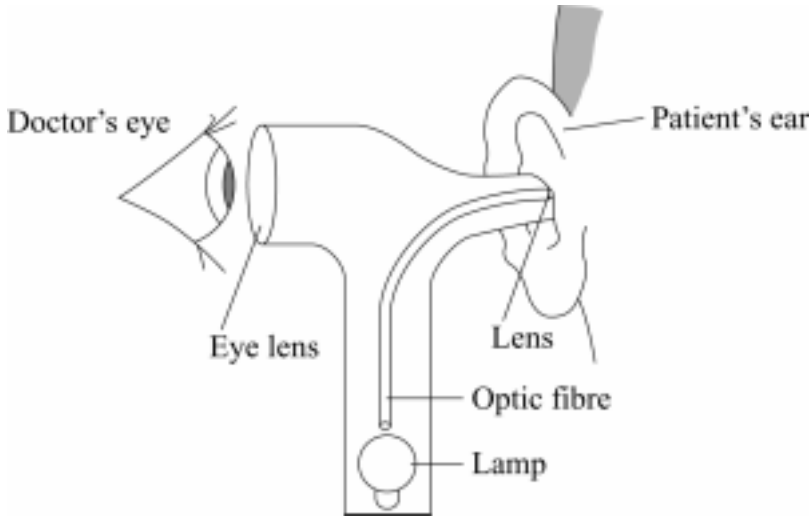
C neutrons only.

D protons only.

Turn over for the next question

QUESTION SEVEN

Doctors use endoscopes to examine the inside of the body. Endoscopes contain optical fibres.



7.1 The light wave stays inside the fibre…

A because it is absorbed.

B because it is an analogue wave.

C because it is a digital wave.

D because it is reflected.

7.2 Which other type of radiation is commonly used to transmit information along optical fibres?

A Gamma

B Infra red

C Microwaves

D Ultraviolet

7.3 A signal which varies continually in amplitude is known as . . .

A a digital signal.

B a musical signal.

C a noisy signal.

D an analogue signal.

7.4 Digital signals are less prone to interference than analogue signals because . . .

A only analogue signals get weaker as they travel.

B only analogue signals need to be amplified.

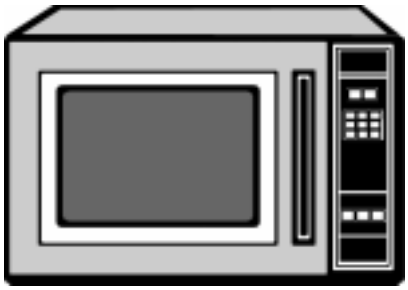
C only analogue systems pick up noise.

D only digital systems can ignore noise.

Turn over for the next question

QUESTION EIGHT

Microwave ovens can be used to heat many types of food.



8.1 When microwaves are absorbed by water in the food, the energy from the microwave is converted into . . .

A electrical energy.

B kinetic energy.

C light energy.

D sound energy.

8.2 Microwaves can be dangerous to humans because they cause . . .

A cells to heat up.

B ionisation.

C mutations.

D skin cancer.

8.3 Microwaves travel at a speed of 300 million m/s. Their wavelength is 0.03 m.

What is the frequency of these microwaves?

A 1 million Hz

B 10 million Hz

C 1 000 million Hz

D 10 000 million Hz

8.4 What speed do gamma rays travel at?

A A higher speed than microwaves

B A lower speed than microwaves

C The same speed as microwaves

D It is impossible to measure the speed of gamma rays.

Turn over for the next question

QUESTION NINE

9.1 Scientists are able to look at distant galaxies and planets due to technological advances.

Which instrument has helped them look the farthest into the Universe?

A Ground-based Observatories

B Hubble Telescope

C Space Probes

D Space Shuttle

9.2 Measurements of light from seven nearby stars were made. Red shift was observed in all the measurements.

What does this evidence suggest about the stars?

A All the stars measured are moving away from the Earth.

B All the stars measured are moving towards the Earth.

C None of the stars are moving relative to the Earth.

D Some stars could be moving towards the Earth and some could be moving away from the Earth.

9.3 Which of the following statements gives the best reason for the Big Bang theory being an accepted scientific theory?

A A group of people met together and decided to make it a theory.

B Distant galaxies were observed to be moving away from Earth.

C Edwin Hubble was an honest man.

D There is no other way to explain the formation of the Universe.

9.4 Why is the Big Bang theory the most accepted theory of how the Universe was formed?

A It has been proven correct by using mathematical models.

B It has not been revised or changed by scientists for many years.

C It is based on a combination of scientific and religious facts.

D It is the simplest explanation of the current scientific data.

END OF TEST

GCSE SCIENCE A

OBJECTIVE TEST ANSWER KEY

UNIT PHYSICS 1b - FOUNDATION TIER

Question No.	KEY
One	1 – C 2 – A 3 – D 4 – B
Two	1 – D 2 – C 3 – A 4 – B
Three	1 – B 2 – C 3 – A 4 – D
Four	1 – A 2 – B 3 – D 4 – C
Five	1 – A 2 – B 3 – D 4 – C
Six	1 – R 2 – Q 3 – P 4 – S
Seven	7.1 – B, 7.2 – D, 7.3 – A, 7.4 – C
Eight	8.1 – D, 8.2 – C, 8.3 – D, 8.4 – B
Nine	9.1 – A, 9.2 – A, 9.3 – D, 9.4 – C
	Overall marks = 36

GCSE SCIENCE A

OBJECTIVE TEST ANSWER KEY

UNIT PHYSICS 1b - HIGHER TIER

Question No.	KEY
One	1 – R 2 – Q 3 – P 4 – S
Two	1 – B 2 – A 3 – C 4 – D
Three	3.1 – D, 3.2 – C, 3.3 – D, 3.4 – B
Four	4.1 – A, 4.2 – A, 4.3 – D, 4.4 – C
Five	5.1 – D, 5.2 – B, 5.3 – C, 5.4 – A
Six	6.1 – C, 6.2 – D, 6.3 – B, 6.4 – A
Seven	7.1 – D, 7.2 – B 7.3 – D, 7.4 – D
Eight	8.1 – B, 8.2 – A, 8.3 – D, 8.4 – C
Nine	9.1 – B, 9.2 – A, 9.3 – B, 9.4 – D
	Overall marks = 36

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Surname		Other Names	
Centre Number						Candidate Number				
Candidate signature										

Leave blank

General Certificate of Secondary Education
Specimen Paper

SCIENCE B
Unit Physics 1

PHYSICS
Unit Physics 1

F

AQA
ASSESSMENT and QUALIFICATIONS ALLIANCE

Foundation Tier

Date and Time

For this paper you must have:
- a ruler.

You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3		7	
4			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Time allowed: 45 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

1 (a) In Britain, most power stations burn coal to produce heat.

The following sentences describe what happens to change the heat into electrical energy. The sentences are in the wrong order.

A The turbine turns an electrical generator.

B Water is heated to produce steam.

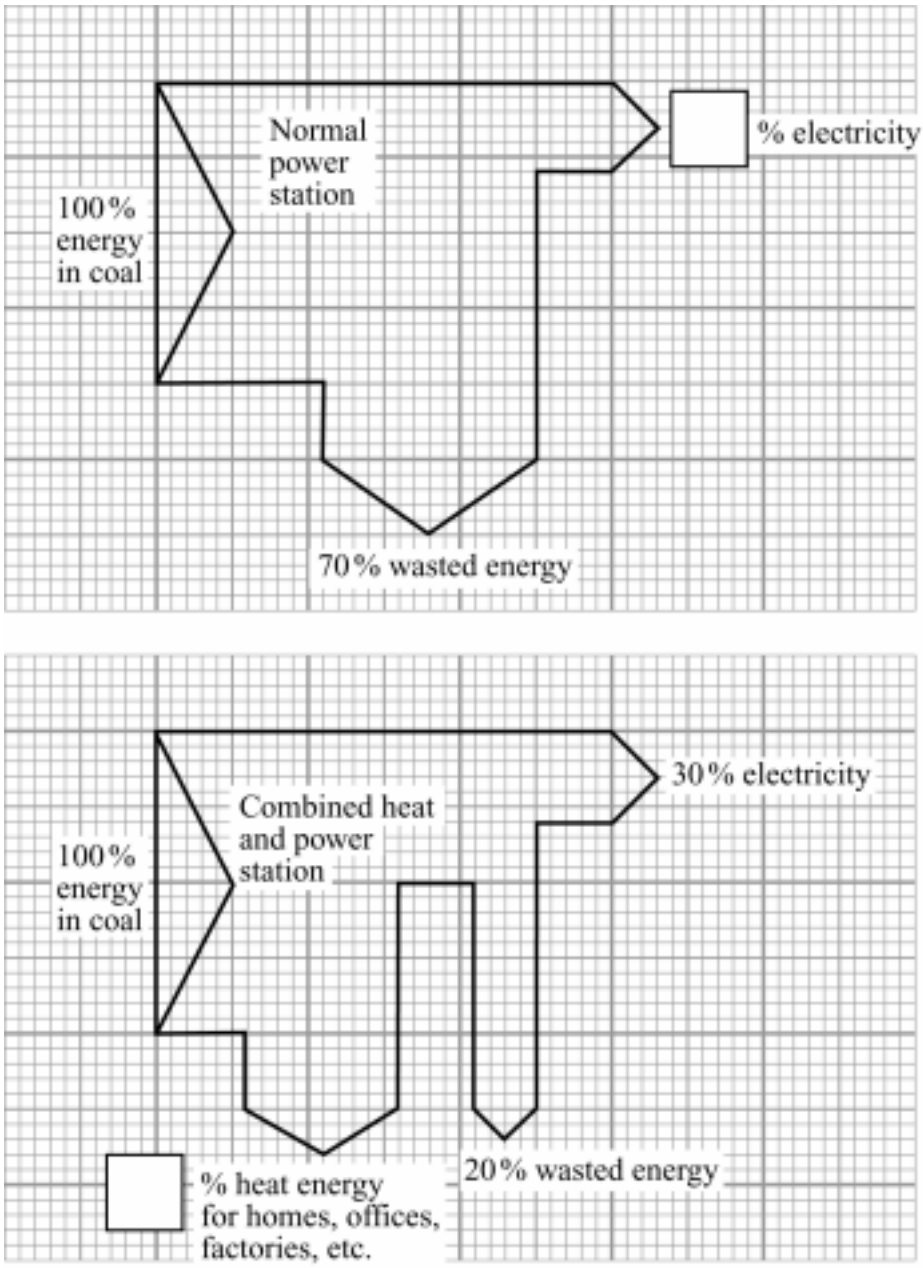
C Electricity is produced.

D Steam is used to turn a turbine.

Arrange the sentences in the right order. Start with letter **B**.

(2 marks)

(b) Power stations waste a lot of energy. The diagrams show the energy transfer in two different types of coal-burning power stations.



(i) Write the **two** missing figures in the boxes on the diagrams.

(2 marks)

(ii) Give a reason why the combined heat and power station is more efficient than the normal power station.

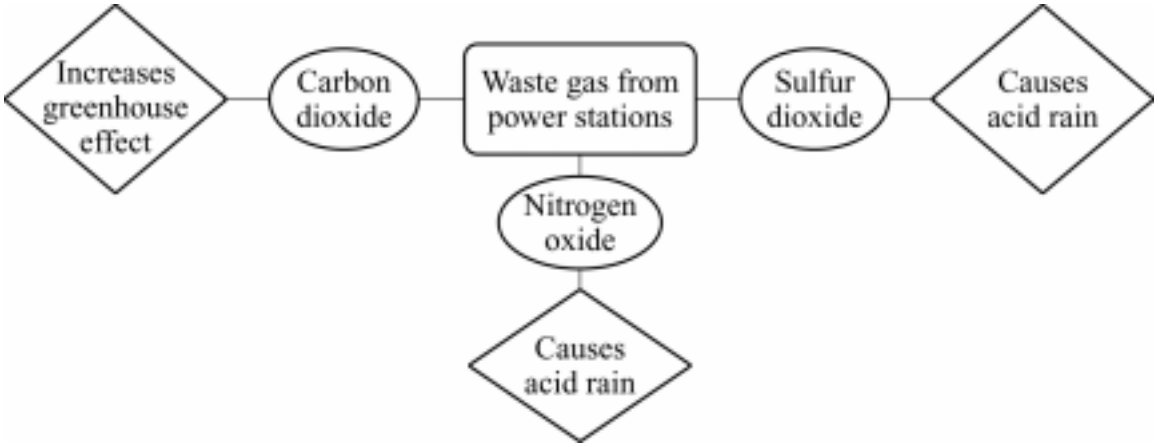
.....

.....

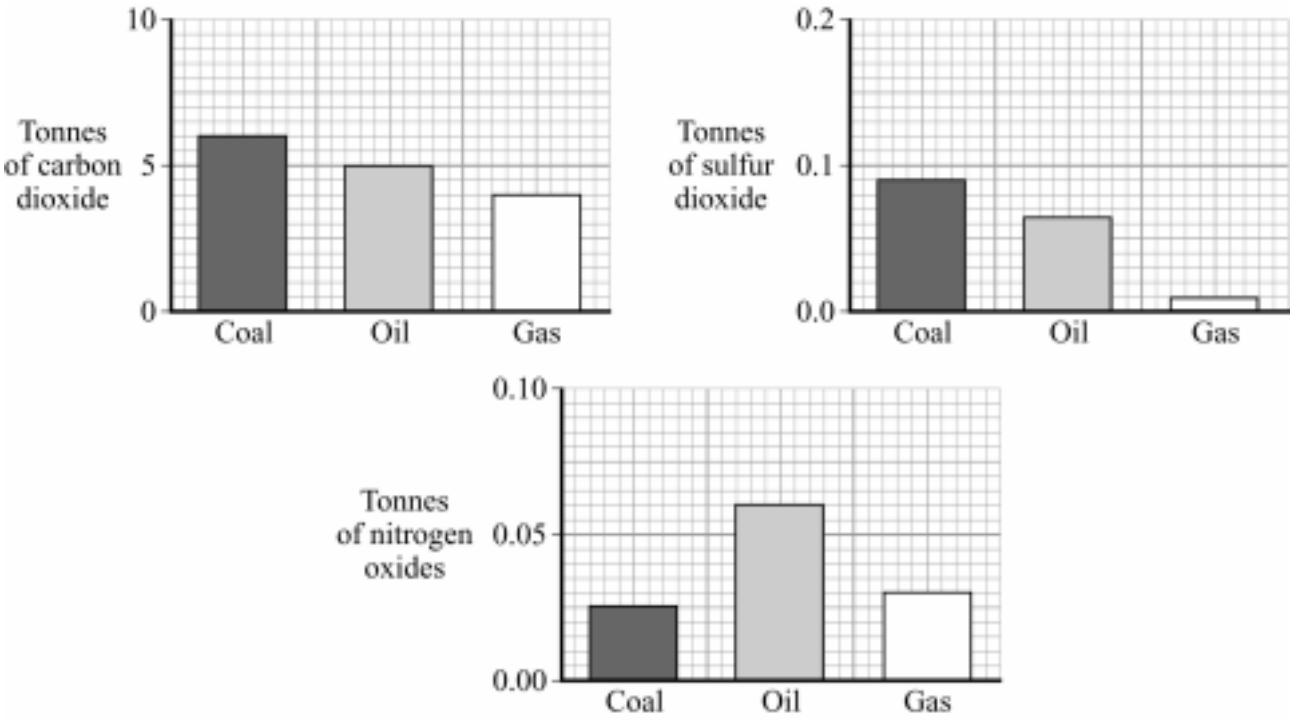
(1 mark)

Question 1 continues on the next page

(c) The diagram gives information about the waste gases produced by power stations.



The bar charts show how much waste is produced by oil, coal and gas-burning power stations for every thousand kilowatt-hour of electricity produced.



(i) Which fuel, coal, oil or gas, when burnt, produces the largest amount of waste gas?

.....

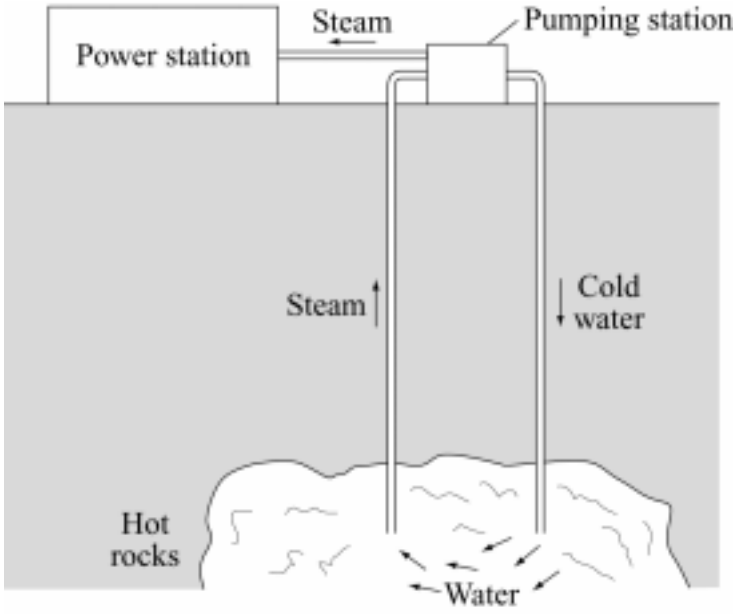
(1 mark)

(ii) Which fuel, when burnt, causes the smallest increase in the greenhouse effect?

.....

(1 mark)

(d) The diagram shows how heat trapped in the rocks of the Earth's crust can be used to generate electricity.



(i) Which **one** of the following is the name given to this source of energy?

Draw a ring around your answer.

geothermal **nuclear** **solar** **tidal**

(1 mark)

(ii) Describe **two** advantages of using this type of power station to generate electricity rather than a coal-burning power station.

1 .....

.....

2 .....

.....

(2 marks)

(e) A network of cables carries electricity from power stations to our homes.

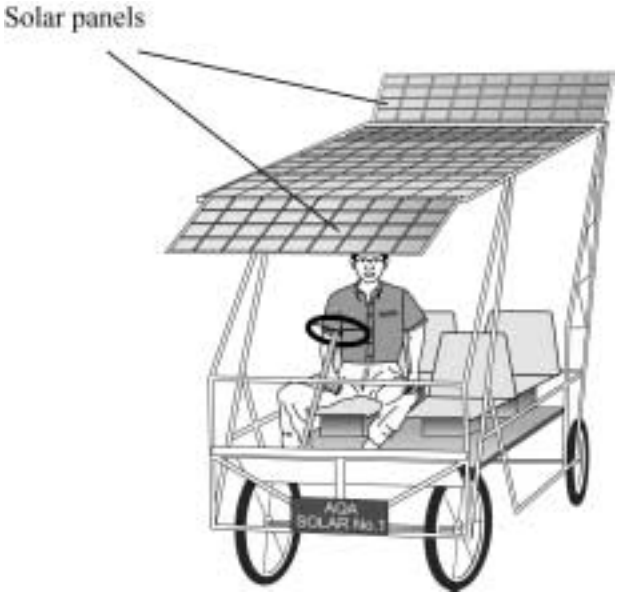
What name is given to this network of cables?

.....

(1 mark)

11

2 The picture shows an experimental electric taxi powered by six solar panels.



In full sunlight, **each** of the six solar panels transfers 85 joules of energy every second to the batteries which drive the electric motor.

(a) What is the maximum energy transferred to the batteries in 60 seconds?

.....

.....

maximum energy = ... joules

(2 marks)

(b) Complete this sentence by crossing out the **two** lines in the box that are wrong.

On a bright sunny day the energy output of the solar panels is

higher than
the same as
less than

it is on a dull cloudy day.

(1 mark)

(c) Solar cells are expensive. Give **two** reasons why they are used to generate electricity.

1 .....

.....

2 .....

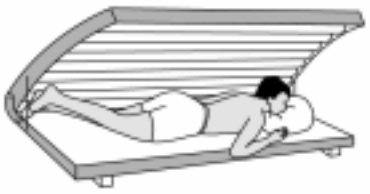
.....

(2 marks)

5

3 (a) **List A** gives the names of four different types of electromagnetic radiation.
List B gives uses of different types of electromagnetic radiation.

Draw a straight line from each type of electromagnetic radiation in **List A** to its use in **List B**.
Draw only **four** lines.

List A **Types of electromagnetic radiation**	**List B** **Uses of electromagnetic radiation**
Gamma rays	In sun beds 
Infra red rays	In radiant heaters 
Ultraviolet rays	Sending information to satellites 
X-rays	Producing shadows of bones 
	Killing cancer cells 

(4 marks)

LEAVE MARGIN BLANK

(b) Radiographers working in hospitals are exposed to different types of radiation.

Tick (√) the statement that describes what they can do to reduce their exposure to radiation.

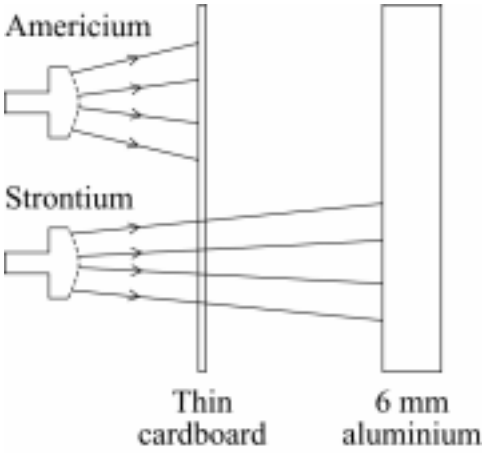
Wash their hands	☐
Wear a badge containing photographic film	☐
Wear a lead apron	☐
Wear rubber boots	☐

(1 mark)

5

4 (a) There are three types of radiation, alpha, beta and gamma.

The diagram shows what can stop the radiation from two different sources.



Which type of radiation, alpha, beta or gamma is given out by:

(i) americium

.....

(1 mark)

(ii) strontium?

.....

(1 mark)

Question 4 continues on the next page

(b) **Diagram 1** shows the position of a smoke detector inside a house.
Diagram 2 shows the warning label at the back of the smoke detector.

Diagram 1

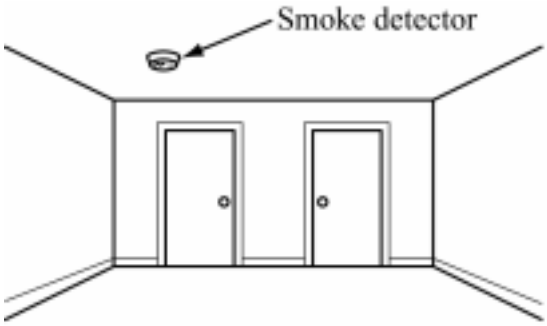
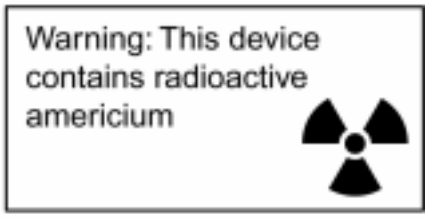


Diagram 2



Explain why the radiation given out by the americium is unlikely to do any harm to people living in the house.

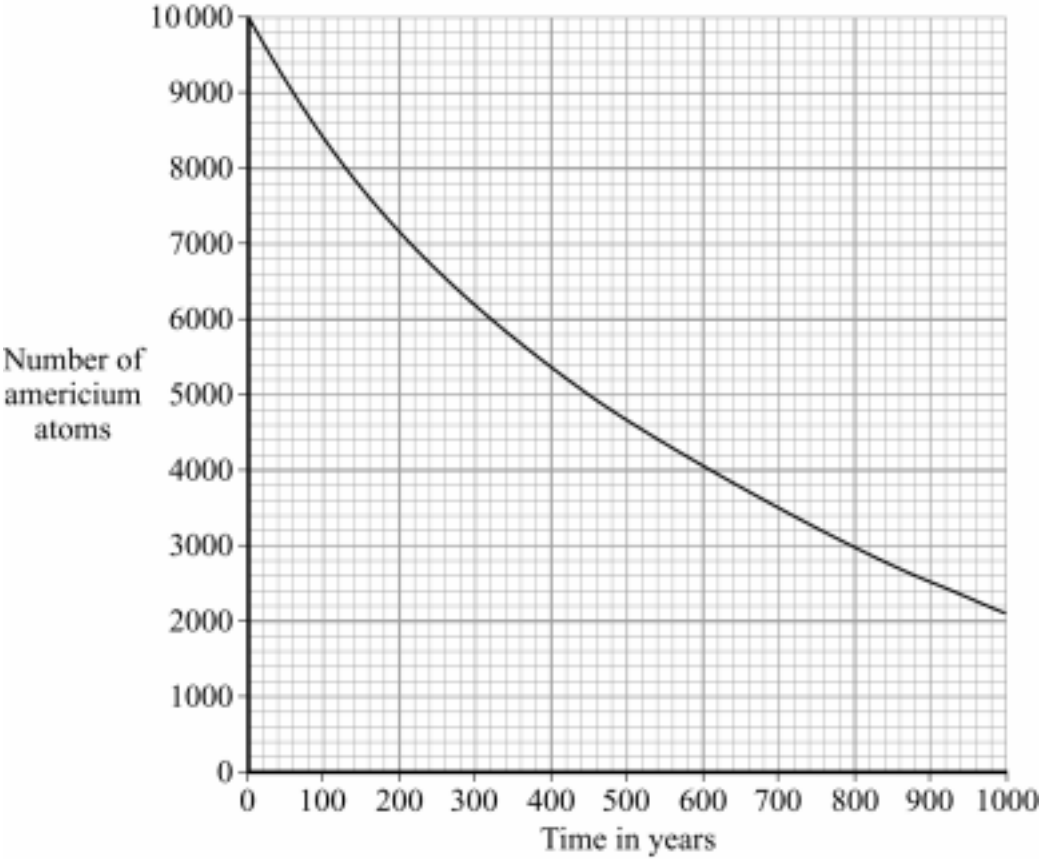
.....

.....

.....

(2 marks)

(c) The graph shows how the number of americium atoms inside a source goes down slowly.



The battery inside the smoke detector lasts one year and is then replaced.

Explain why the americium source will never need to be replaced.

.....

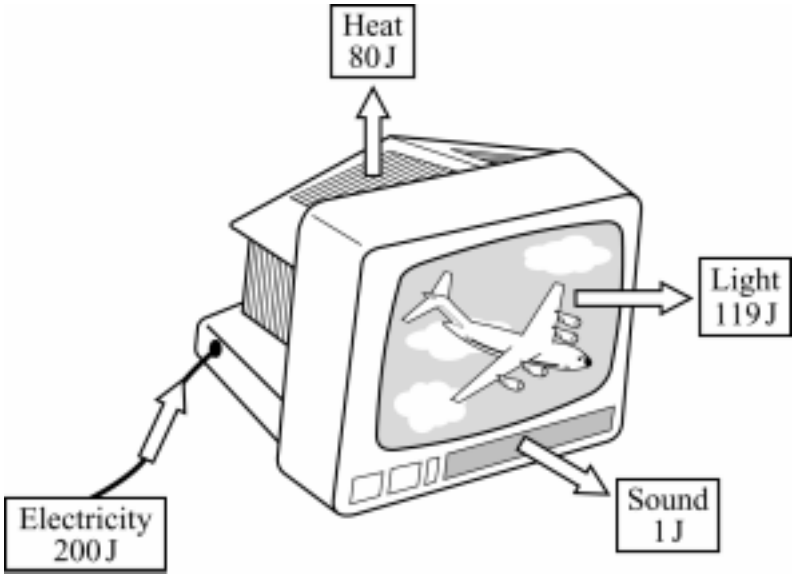
.....

(2 marks)

6

Turn over for the next question

5 The drawing shows the energy transferred each second by a television set.



(a) What form of energy is transferred as waste energy by the television set?

.....

(1 mark)

(b) What does the waste energy do to the temperature of the air around the television set?

.....

(1 mark)

(c) Use the following equation to calculate the efficiency of the television set.

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

.....

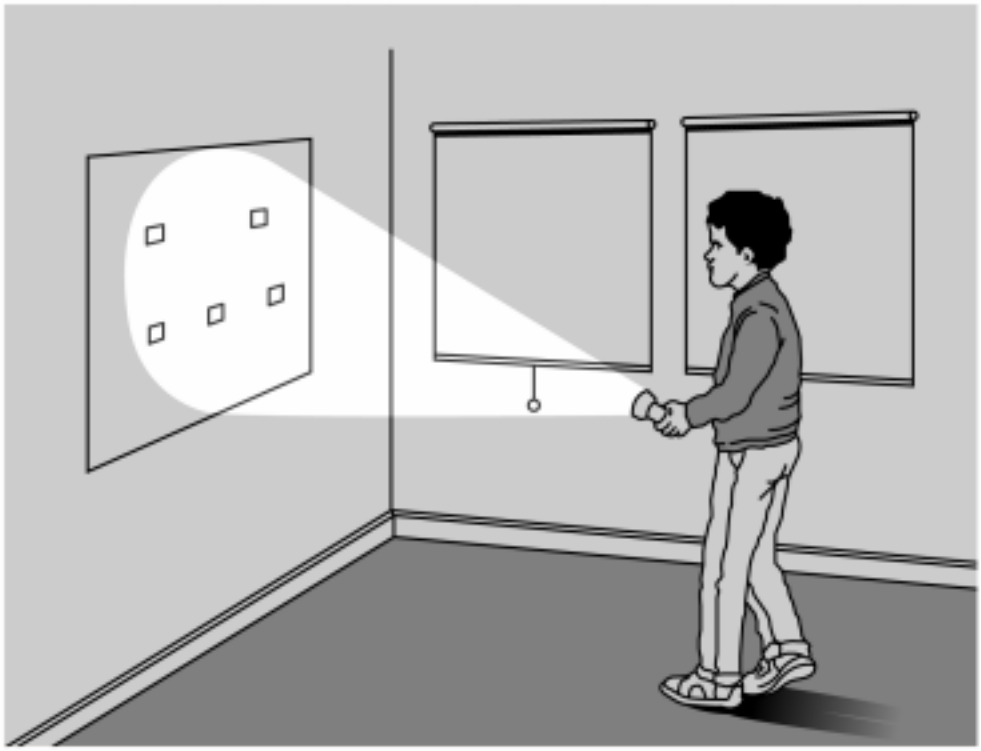
.....

efficiency = ... J

(2 marks)

4

6 (a) To be seen walking along the road on a dark night, it is important to wear clothing which will reflect light from street lights and car headlamps.
Isaac investigated which colours are best at reflecting light.



He stuck small squares of different coloured material on to a black card at one end of a darkened laboratory. He switched on his torch and moved towards the squares. When he could clearly see a coloured square, he measured the distance between his torch and the square.

(i) Why did Isaac do the investigation in a darkened laboratory?

.....

(1 mark)

(ii) Give **one** condition that Isaac should keep the same for each square.

.....

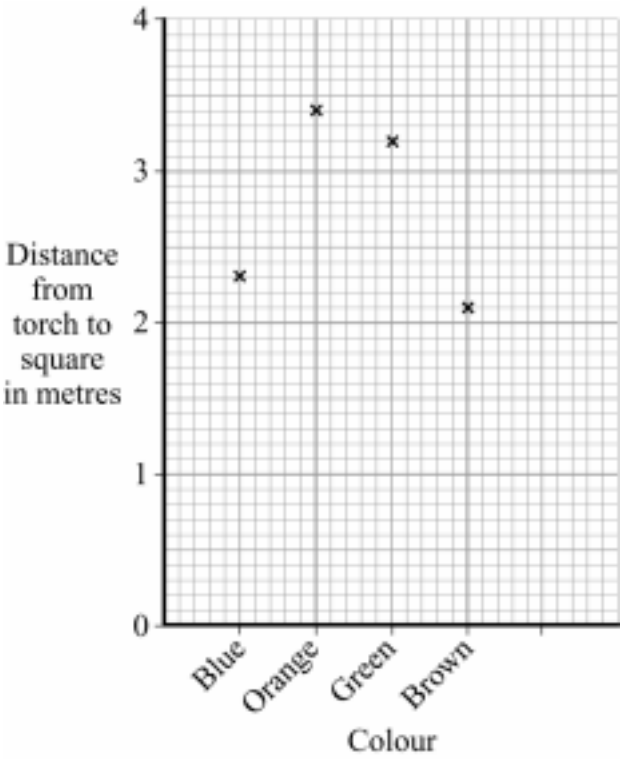
.....

(1 mark)

Question 6 continues on the next page

(b) Isaac's results are shown below in two different ways.

Colour	Distance from torch to square in metres
Blue	2.3
Orange	3.4
Green	3.2
Brown	2.1
Red	3.0



(i) Complete the graph to show all of the results.

(1 mark)

(ii) From his results, which colour clothing should Isaac recommend a walker to wear at night? Give a reason for your choice.

.....

.....

(1 mark)

(iii) Another student carrying out the same experiment, under the same conditions, does **not** get the same results.

Suggest **two** reasons why this is **not** a reliable experiment.

1 .....

.....

2 .....

.....

(2 marks)

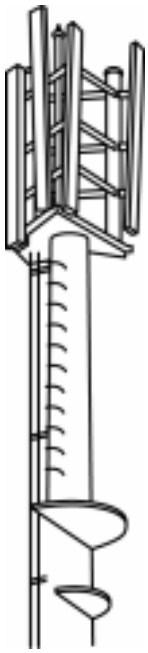
6

7 (a) Read the following information, then answer the questions.

A newspaper article had the heading:

'Are mobiles putting our children at risk?'

A recent report said that children under the age of nine should not use mobile phones because of potential health risks. Although there is no direct evidence that mobile phones are a health danger, the advice is that young children should use mobiles in emergencies only.



Currently there are over 30 000 mobile phone masts in the UK. The masts transmit microwave signals between mobile phone users.

Objects containing water absorb microwave radiation. This is why humans can absorb microwave radiation. When microwaves are absorbed they produce a heating effect; this is not thought to be a significant health risk.

Some scientists worry that long term exposure to microwave radiation may cause genetic damage and cancer. Other scientists think there is no evidence of this.

(i) Below which age is it recommended that children use a mobile phone in emergencies only?

.....

(1 mark)

Question 7 continues on the next page

(ii) Why does the human body absorb microwaves?

.....

(1 mark)

(iii) What are the possible effects on a person's body of living too close to a mobile phone mast?

.....

.....

(2 marks)

(iv) Have these effects been proven?

.....

.....

(1 mark)

(b) The microwaves used in microwave ovens have a frequency of 2400 million hertz and a wavelength of 0.125 metres.

(i) Write down the equation that links frequency, wavelength and wave speed.

.....

(1 mark)

(ii) Calculate the speed of microwaves. Show clearly how you work out your answer.

.....

.....

speed of microwaves = ... m/s

(2 marks)

8

END OF QUESTIONS

Physics 1F Mark Scheme

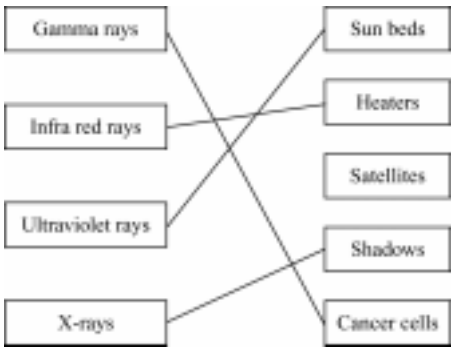
Question 1

	answers	extra information	mark
(a)	**D A C**	correct order allow **1** mark for one letter in correct place	2
(b)(i)	30 50		1 1
(ii)	less waste energy **or** some heat energy is usefully used		1
(c)(i)	coal		1
(ii)	gas		1
(d)(i)	geothermal		1
(ii)	any **two** from: • no pollutant gases produced • not using up reserves of coal • does not increase greenhouse effect **or** • does not increase global warming • does not cause acid rain	accept waste for pollutant accept for **both** marks two named pollutant gases accept is renewable	2
(e)	National Grid		1
Total			**11**

Question 2

	answers	extra information	mark
(a)	30600	accept 30.6 kilo allow **1** mark for an answer of 510 or 5100	2
(b)	higher than		1
(c)	any **two** from: • no (air) pollution • running costs are low / zero • good for remote locations • generate where electricity is needed • suitable for equipment that needs only small amounts of electricity • renewable	 accept no fuel is burnt accept no fuel (to buy) accept no new batteries (to buy) accept energy will not run out do **not** accept energy can be used again	2
Total			**5**

Question 3

	answers	extra information	mark
(a)	four lines drawn correctly  	award **1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first, mark only 4 lines.	4
(b)	wear a lead apron		1
Total			**5**

Question 4

	answers	extra information	mark
(a)(i)	alpha		1
(ii)	beta		1
(b)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation is absorbed by the air	accept detector is high up the wall accept radiation can not pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(c)	in one year / lifetime of the detector the number of americium atoms hardly changes **or** the level of radiation hardly goes down	accept for **1** mark americium has a long half-life award **2** marks for americium has a half life of 450 years	1 1
Total			**6**

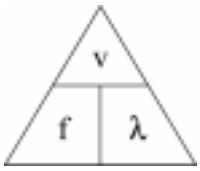
Question 5

	answers	extra information	mark
(a)	heat		1
(b)	temperature increase	accept gets warmer accept gets hotter	1
(c)	60 % / 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
Total			**4**

Question 6

	answers	extra information	mark
(a)(i)	any **one** from: • so only light from the torch is reflected • so when the torch is off the squares cannot be seen • to be able to judge better when the squares become visible		1
(ii)	area of the squares / same type of material		1
(b)(i)	last mark on x-axis labelled red **and** value plotted correctly	**both** required for mark	1
(ii)	orange **and** can be seen from furthest away	**both** required for mark	1
(iii)	any **two** from: • sensitivity of pupils eyesight difference • relies on pupil judgement • difficult to measure from the wall to the torch accurately • students results not repeated to check accuracy • it is not possible to repeat measurements in exactly the same way • repeat measurements may not be precise		2
Total			**6**

Question 7

	answers	extra information	mark
(a)(i)	9		1
(ii)	(cells) contain water		1
(iii)	genetic damage cancer	 accept any named cancer accept tumour	1 1
(iv)	no proven link		1
(b)(i)	wave speed = frequency × wavelength	 accept $v = f \times \lambda$ accept  provided subsequent method correct	1
(ii)	300 000 000	 allow **1** mark for correct substitution an answer of 300 gains **1** mark only	2
Total			**8**
		Overall marks	**45**

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Surname		Other Names	
Centre Number			Candidate Number									
Candidate signature												

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General Certificate of Secondary Education
Specimen Paper

SCIENCE B
Unit Physics 1

PHYSICS
Unit Physics 1

Higher Tier

H

AQA
ASSESSMENT and QUALIFICATIONS ALLIANCE

Date and Time

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed: 45 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations show clearly how you work out your answer.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3			
4			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

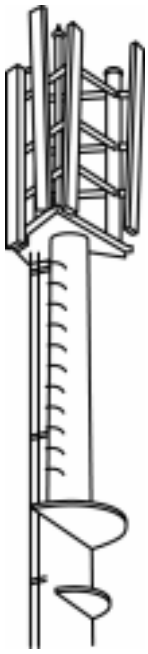
Answer **all** questions in the spaces provided.

1 (a) Read the following information, then answer the questions.

A newspaper article had the heading:

'Are mobiles putting our children at risk?'

A recent report said that children under the age of nine should not use mobile phones because of potential health risks. Although there is no direct evidence that mobile phones are a health danger, the advice is that young children should use mobiles in emergencies only.



Currently there are over 30 000 mobile phone masts in the UK. The masts transmit microwave signals between mobile phone users.

Objects containing water absorb microwave radiation. This is why humans can absorb microwave radiation. When microwaves are absorbed they produce a heating effect; this is not thought to be a significant health risk.

Some scientists worry that long term exposure to microwave radiation may cause genetic damage and cancer. Other scientists think there is no evidence of this.

(i) Below which age is it recommended that children use a mobile phone in emergencies only?

.....

(1 mark)

(ii) Why does the human body absorb microwaves?

.....

(1 mark)

(iii) What are the possible effects on a person's body of living too close to a mobile phone mast?

.....

.....

(2 marks)

(iv) Have these effects been proven?

.....

.....

(1 mark)

(b) The microwaves used in microwave ovens have a frequency of 2400 million hertz and a wavelength of 0.125 metres.

(i) Write down the equation that links frequency, wavelength and wave speed.

.....

(1 mark)

(ii) Calculate the speed of microwaves. Show clearly how you work out your answer.

.....

.....

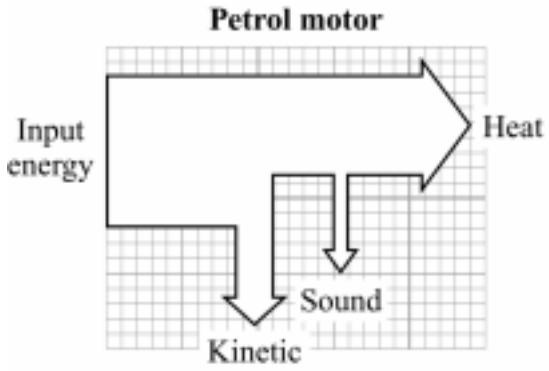
speed of microwaves = ... m/s

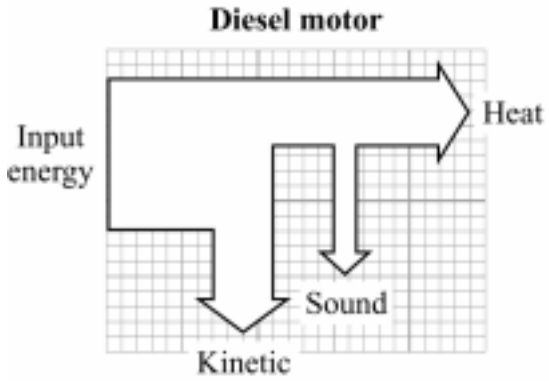
(2 marks)

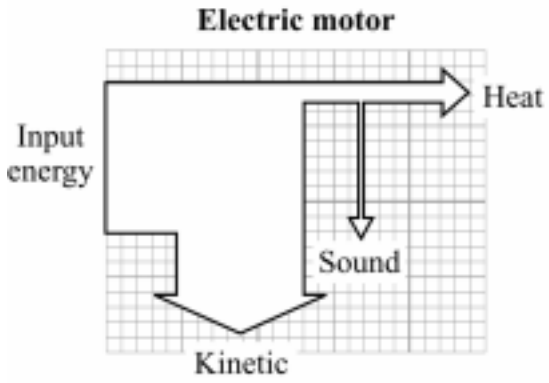
8

Turn over for the next question

2 (a) The energy transformation (Sankey) diagrams show what happens to the input energy for three different machines.







(i) Which machine is the most efficient?

.....

Give a reason for your answer.

.....

.....

(2 marks)

[100]

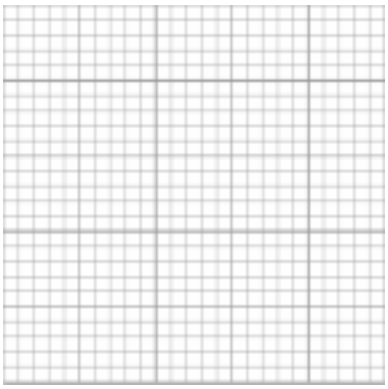
(ii) What percentage of the input energy is usefully transformed by the electric motor? Show clearly how you get your answer.

.....

.....

(2 marks)

(b) (i) Draw on the grid a labelled energy transformation (Sankey) diagram for a filament lamp.



(2 marks)

(ii) A pupil wrote the following statement.

> 'Switching lights off does not save energy. Since energy cannot be destroyed, it will always be there so none is wasted.'

Explain carefully what is wrong with the pupil's statement.

.....

.....

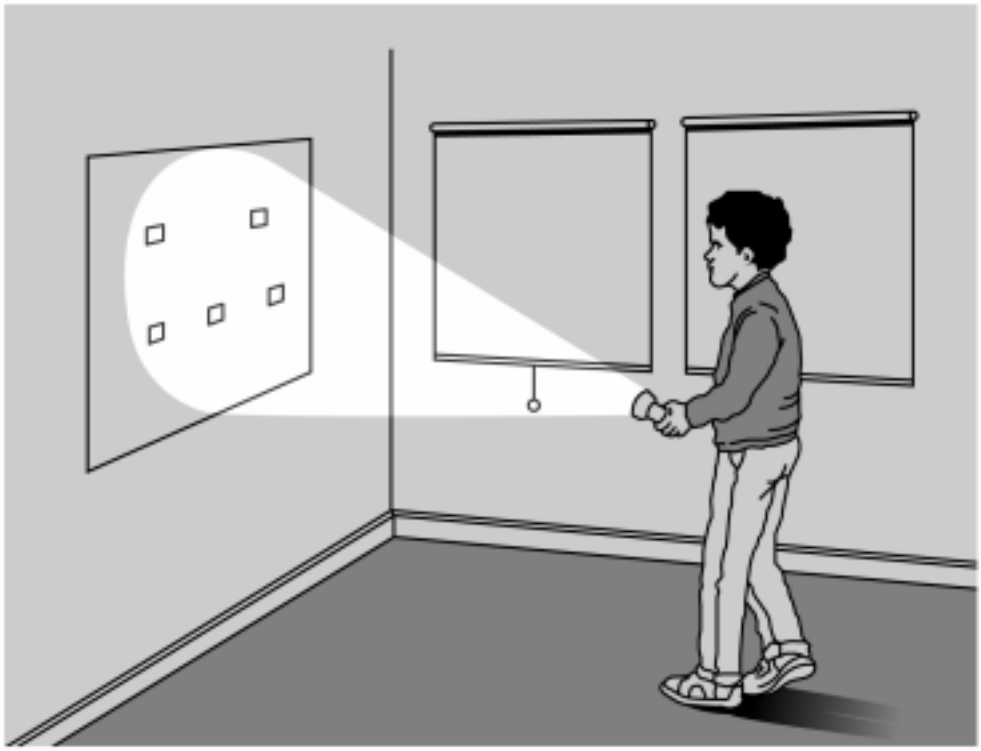
.....

(2 marks)

8

Turn over for the next question

3 (a) To be seen walking along the road on a dark night, it is important to wear clothing which will reflect light from street lights and car headlamps.
Isaac investigated which colours are best at reflecting light.



He stuck small squares of different coloured material on to a black card at one end of a darkened laboratory. He switched on his torch and moved towards the squares. When he could clearly see a coloured square, he measured the distance between his torch and the square.

(i) Why did Isaac do the investigation in a darkened laboratory?

.....

(1 mark)

(ii) Give **one** condition that Isaac should keep the same for each square.

.....

.....

(1 mark)

(b) Isaac's results are shown below in two different ways.

Colour	Distance from torch to square in metres
Blue	2.3
Orange	3.4
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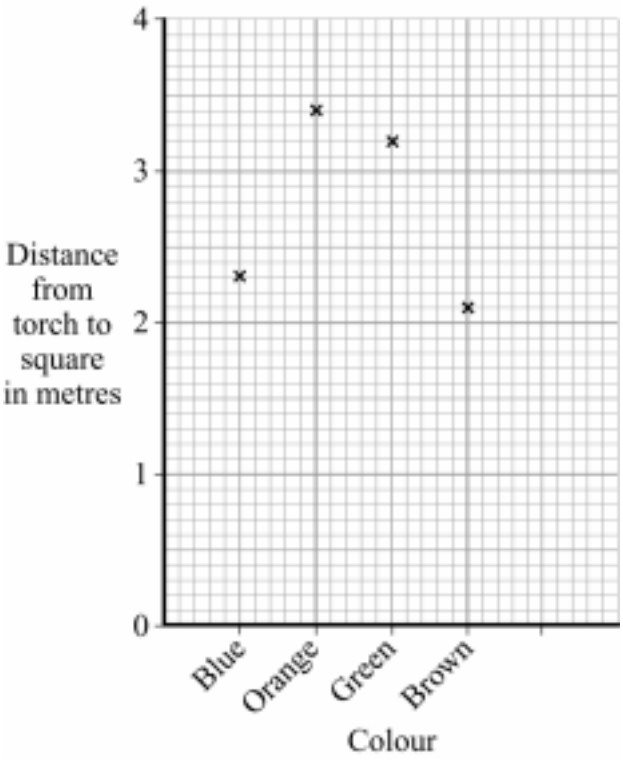


(1 mark)

(i) Complete the graph to show all of the results.

(ii) From his results, which colour clothing should Isaac recommend a walker wears at night? Give a reason for your choice.

.....

.....

(1 mark)

(iii) Another student carrying out the same experiment, under the same conditions, does **not** get the same results.

Suggest **two** reasons why this is **not** a reliable experiment.

1 .....

.....

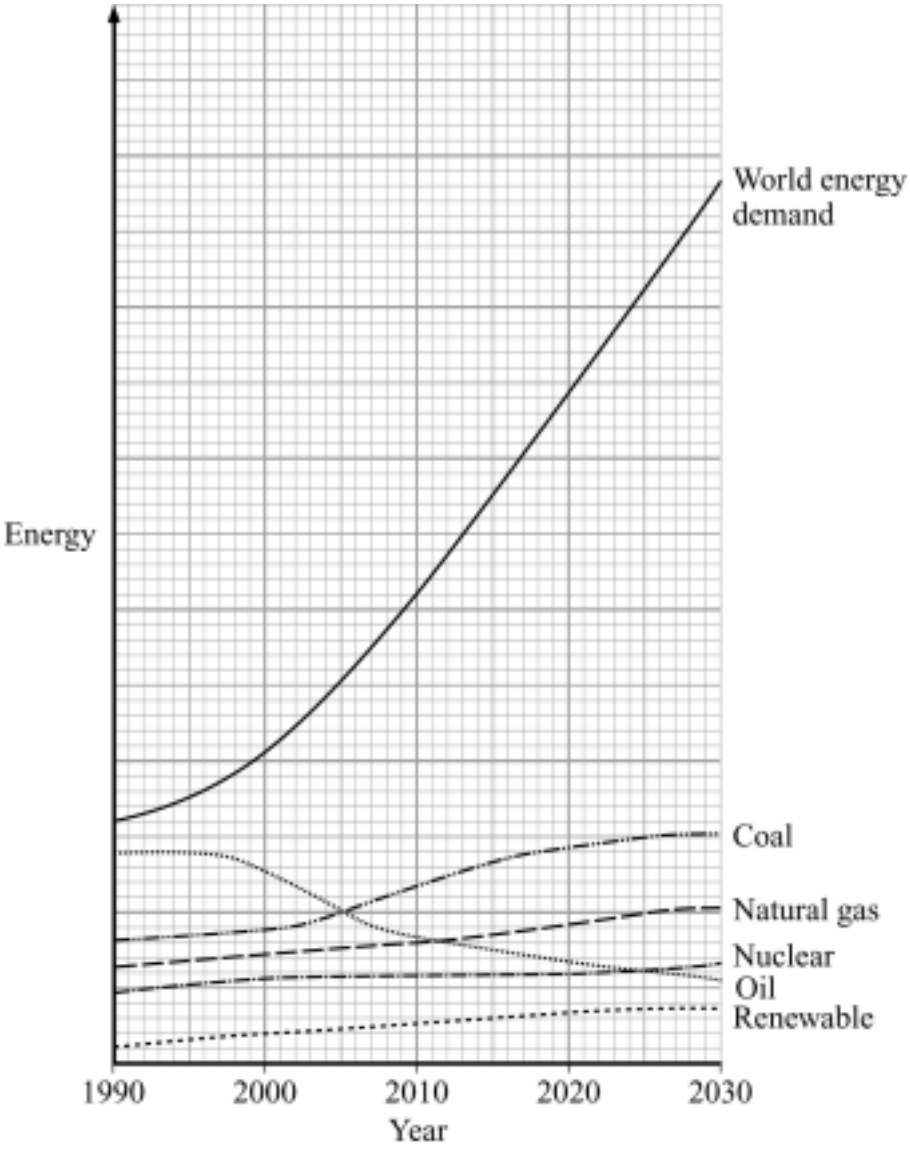
2 .....

.....

(2 marks)

6

4 The graph shows the expected change in the world demand for energy.
It also shows how the supplies of various energy resources are expected to change.



(a) Use the graph to estimate when supplies from oil and coal are equal.

.....

(1 mark)

(b) Currently we rely on coal, oil and gas to supply most of our energy needs.

Use the graph to explain why we must develop alternative energy resources.

.....

.....

.....

.....

(2 marks)

(c) On average, the energy use of each family in the UK releases over 25 tonnes of carbon dioxide and 4 kilograms of sulfur dioxide into the air every year.

(i) State **one** environmental effect that is increased by releasing carbon dioxide into the air.

.....

(1 mark)

(ii) State a different environmental effect caused by the releasing of sulfur dioxide into the air.

.....

(1 mark)

(d) Nuclear power stations use the energy released by *nuclear fission* to generate electricity.

Explain what is meant by *nuclear fission.*

.....

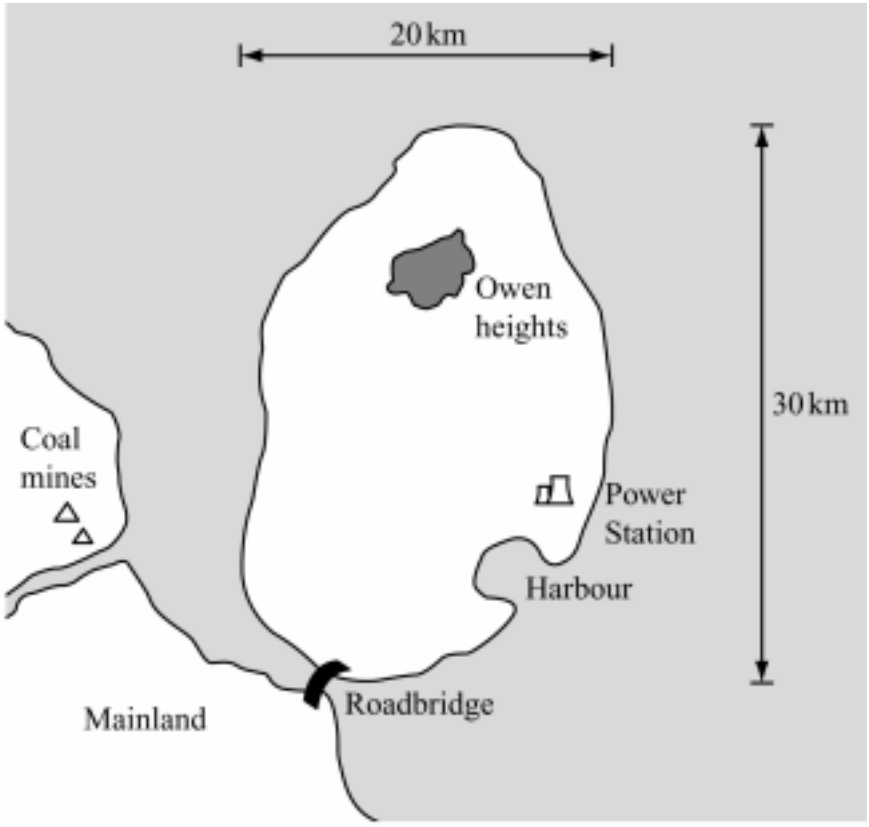
.....

.....

(2 marks)

Question 4 continues on the next page

(e) A 200 MW coal burning power station provides all the electrical power for a small island. The coal is bought to the island from the mainland.



The islanders who want to replace the power station with wind turbines have been given the following information.

Maximum output from one turbine	800 kW
Maximum number of turbines on one square kilometre of land	6
Average yearly output as a percentage of the maximum	25 %
Percentage of land suitable for a wind turbine	20 %
Reduced carbon dioxide emissions per year (in tonnes)	200 000

[106]

(i) Would you recommend that the islanders replace the coal power station with wind turbines? Explain the reasons for your recommendation.
To gain full marks you must support your explanation with relevant calculations.

.....

.....

.....

.....

.....

(3 marks)

(ii) Some islanders want to find out if it would be possible to generate the electricity they need using solar energy. How could the islanders find the data needed to make an informed decision?

.....

.....

(1 mark)

11

Turn over for the next question

5 The table gives information about some radioactive sources.

Source	Radiation emitted	Half-life
bismuth 83	beta	61 minutes
caesium 135	beta	3 million years
cobalt 60	gamma	5 years
polonium 210	alpha	138 days
radon 222	alpha	28 years
technetium 99	gamma	6 hours

(a) What is meant by half-life?

.....

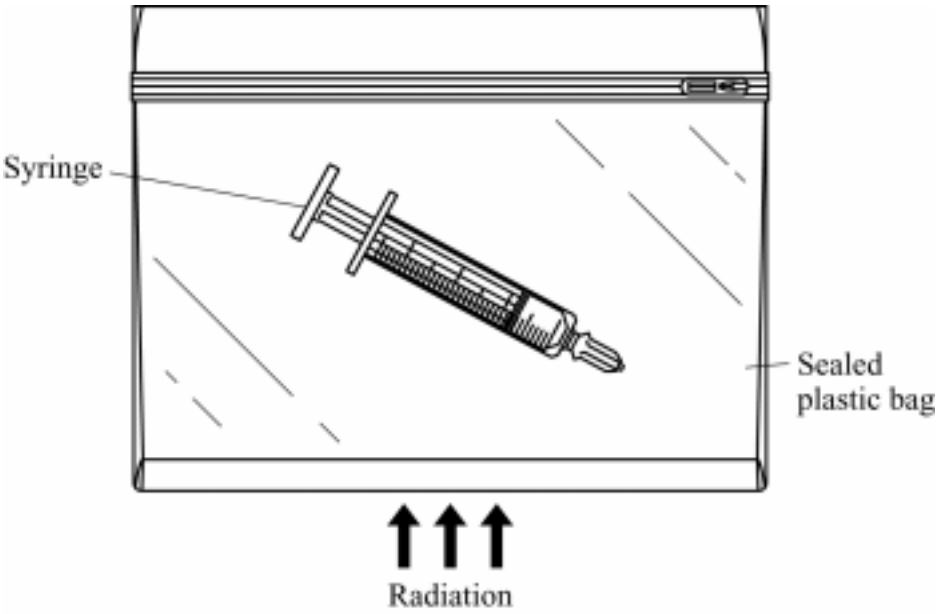
.....

(1 mark)

(b) Radiation has many uses. Which of the radioactive sources given in the table would be most suitable to use for the following?

Explain the reasons for your choice.

(i) To sterilise plastic syringes sealed in plastic bags.



Most suitable source .....

Reasons .....

.....

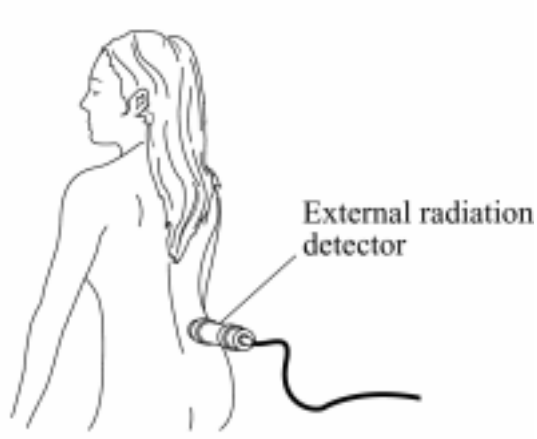
.....

.....

.....

(3 marks)

(ii) As a medical tracer injected into the body, then detected outside the body.



Most suitable source .....

Reasons .....

.....

.....

.....

.....

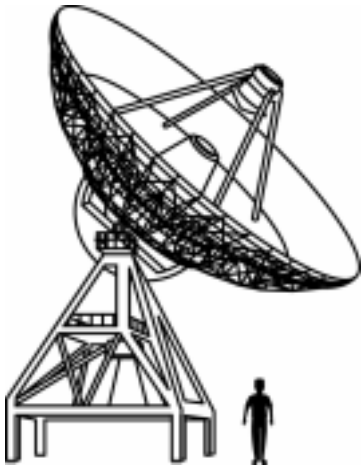
(3 marks)

7

Turn over for the next question

LEAVE MARGIN BLANK

6 (a) The diagram shows a radio telescope, used to investigate distant galaxies.



Why is a radio telescope much larger than an optical telescope?

.....

(1 mark)

(b) The light spectrum from a distant galaxy shows a *red shift.*

(i) What is meant by *red shift?*

.....

.....

(1 mark)

(ii) What does red shift tell us about distant galaxies?

.....

.....

(1 mark)

(c) The "Big Bang" theory is one theory of the origin of the Universe.
What are the main ideas of the "Big Bang" theory?

.....

.....

.....

.....

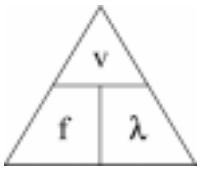
(2 marks)

END OF QUESTIONS

5

Physics 1H Mark Scheme

Question 1

	answers	extra information	mark
(a)(i)	9		1
(ii)	(cells) contain water		1
(iii)	genetic damage		1
	cancer	accept any named cancer accept tumour	1
(iv)	no proven link		1
(b)(i)	wave speed = frequency × wavelength	accept $v = f \times \lambda$ accept  provided subsequent method correct	1
(ii)	300 000 000	allow **1** mark for correct substitution an answer of 300 gains **1** mark only	2
Total			**8**

Question 2

	answers	extra information	mark
(a)(i)	electric motor any **one** from: • least energy wasted • most energy usefully transformed • largest kinetic energy output		1 1
(ii)	85 %	allow **1** mark for only using the width of input and the kinetic arrow	2
(b)(i)	two output arrows shown, one labelled heat, the other light width of the arrow significantly wider than light arrow		1 1
(ii)	any **two** from: • some energy is wasted as heat • all (output) energy is transferred to the surroundings • energy becomes spread out • difficult to use energy for further useful transformations		2
Total			**8**

Question 3

	answers	extra information	mark
(a)(i)	any **one** from: • so only light from the torch is reflected • so when the torch is off the squares cannot be seen • to be able to judge better when the squares become visible		1
(ii)	area of the squares / same type of material		1
(b)(i)	last mark on x-axis labelled red **and** value correctly plotted	**both** required for mark	1
(ii)	orange **and** can be seen from furthest away	**both** required for mark	1
(iii)	any **two** from: • sensitivity of pupils eyesight different • relies on pupil judgement • difficult to measure from the wall to torch accurately • students results not repeated to check accuracy • it is not possible to repeat measurements in exactly the same way • repeat measurements may not be precise		2
Total			**6**

Question 4

	answers	extra information	mark
(a)	2005		1
(b)	any **two** from: • reserves of coal / oil / gas are being depleted • demand (for energy) is growing at a faster rate than total (energy) supply • traditional fuels will not be able to meet future demands		2
(c)(i)	greenhouse effect / global warming		1
(ii)	acid rain		1
(d)	(large / heavy) nucleus hit by a neutron splits into (smaller) nuclei and neutron(s) (and energy)		1 1
(e)(i)	no even if all the suitable land were used the total power would be insufficient land available for turbines = 120 km^2 so maximum number of turbines 720 maximum power available 144 MW	marks are awarded for reasons allow **1** mark for total number of turbines required would create noise / visual pollution allow **1** mark for an answer yes with reasons in terms of reduced CO_2 **and** / **or** reduced transport	1 1 1
(ii)	contact manufacturers / use the internet	accept any sensible way of collecting relevant data	1
Total			**11**

Question 5

	answers	extra information	mark
(a)	the time it takes for the number of parent atoms in a sample to halve	accept the time it takes for the count rate from a sample to fall to half	1
(b)(i)	cobalt 60		1
	gamma will penetrate the plastic and kill bacteria		1
	long half-life so source does not need frequent replacement		1
(ii)	technetium 99		1
	gamma can be detected outside the body / gamma least dangerous inside the body / gamma can pass through the body		1
	short half-life so level of radiation in body falls to a safe level in short time	accept this expressed mathematically	1
Total			**7**

Question 6

	answers	extra information	mark
(a)	wavelength of radio waves (much) longer than light waves		1
(b)(i)	light moved towards red end of spectrum / longer wavelength waves		1
(ii)	any **one** from: • (galaxy) moving away from the Earth • space is expanding • the galaxy and Earth are moving apart	accept us for Earth do **not** accept galaxies are expanding	1
(c)	all matter concentrated at a single point massive explosion sends matter outwards		1 1
Total			**5**
		Overall marks	**45**

Surname		Other Names	
Centre Number			Candidate Number									
Candidate signature												

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General Certificate of Secondary Education
Specimen Paper

ADDITIONAL SCIENCE
Unit Physics 2

PHYSICS
Unit Physics 2

F

AQA
ASSESSMENT and QUALIFICATIONS ALLIANCE

Foundation Tier

Date and time

For this paper you must have:
- a ruler

You may use a calculator.

Time allowed: 45 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

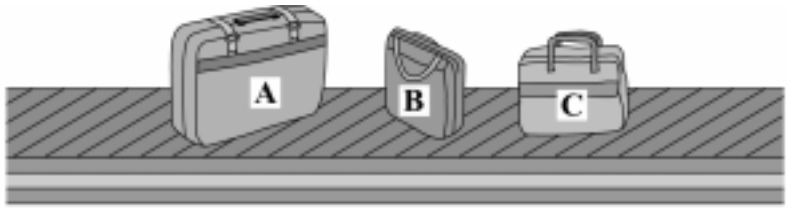
Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3		7	
4			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Answer **all** questions in the spaces provided.

1 The picture shows bags on a conveyor belt.



Each bag has a different mass.

mass of **A** = 22 kg mass of **B** = 12 kg mass of **C** = 15 kg

(i) What is the momentum of the bags before the conveyor belt starts to move?

.....

Give a reason for your answer.

.....

.....

(2 marks)

(ii) When the conveyor belt is switched on, the bags move with a constant speed.

Which bag, **A**, **B** or **C**, has the most momentum?

.....

Give a reason for your answer.

.....

.....

(2 marks)

(iii) At one point the conveyor belt turns left. The bags on the belt continue to move at a constant speed.

Why does the momentum of the bags change?

.....

(1 mark)

5

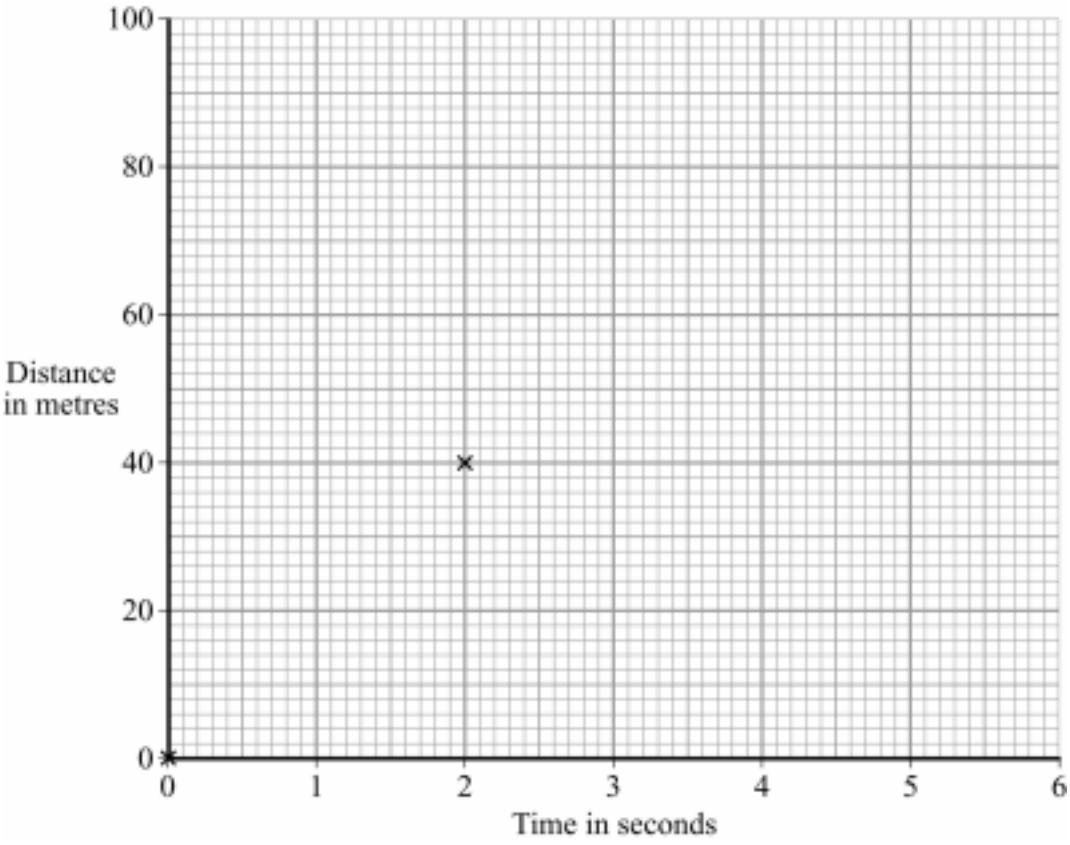
Turn over for the next question

2 The table gives values of distance and time for a car moving along a road.

Distance in metres	0	20	40	60	80	100
Time in seconds	0	1	2	3	4	5

(a) Draw a graph of distance against time.

Two of the points have been plotted for you.



(3 marks)

(b) Use your graph to find:

(i) the distance moved by the car in 2.5 seconds

distance = ...metres
(1 mark)

(ii) how many seconds it takes the car to move 30 metres.

time = ...seconds
(1 mark)

[120]

LEAVE MARGIN BLANK

(c) Complete this sentence by crossing out the **two** lines in the box that are wrong.

The car is

slowing down
moving at a steady speed
speeding up

.

(1 mark)

(d) Drinking alcohol makes a person's reactions slower.

Explain why it is a bad idea for people to drink alcohol before driving a car.

.....

.....

.....

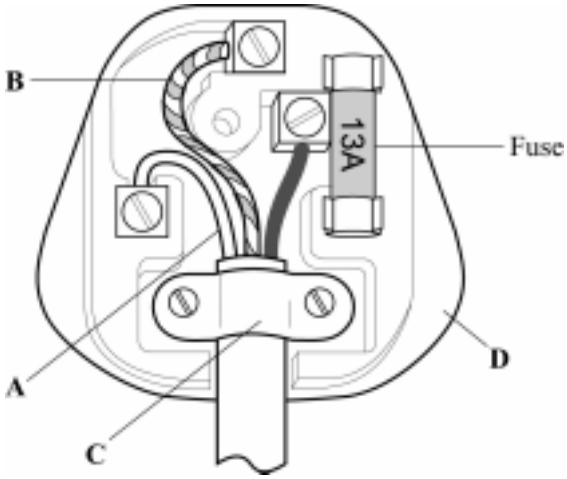
.....

(2 marks)

8

Turn over for the next question

3 (a) The diagram shows the inside of a 13 amp plug.



Each part of the plug has a job to do.

(i) Which part, **A**, **B**, **C** or **D**:

1. connects the outside metal case of an appliance to earth

.....

(1 mark)

2. holds the cable in place?

.....

(1 mark)

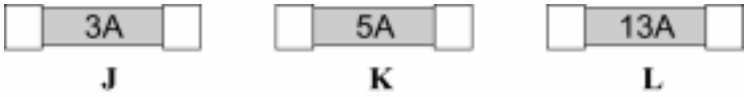
(ii) Complete the following sentence by using the correct words from the box. Each word may be used once or not at all.

breaking	**completing**	**current**	**resistance**

If the ……... becomes bigger than 13 amps, the fuse inside the plug will melt…….…… the circuit.

(2 marks)

(b) The diagrams show three different fuses.



J K L

Which fuse, **J**, **K** or **L**, would you choose for a table lamp taking a current of 0.6 amps?

…….

(1 mark)

(c) The table gives the temperature at which copper and tin melt.

	Temperature
Copper	1350 °C
Tin	500 °C

The wire inside a fuse is made of tin.

Explain why it would be **dangerous** to replace the fuse in a plug with a piece of copper wire.

.....

.....

.....

.....

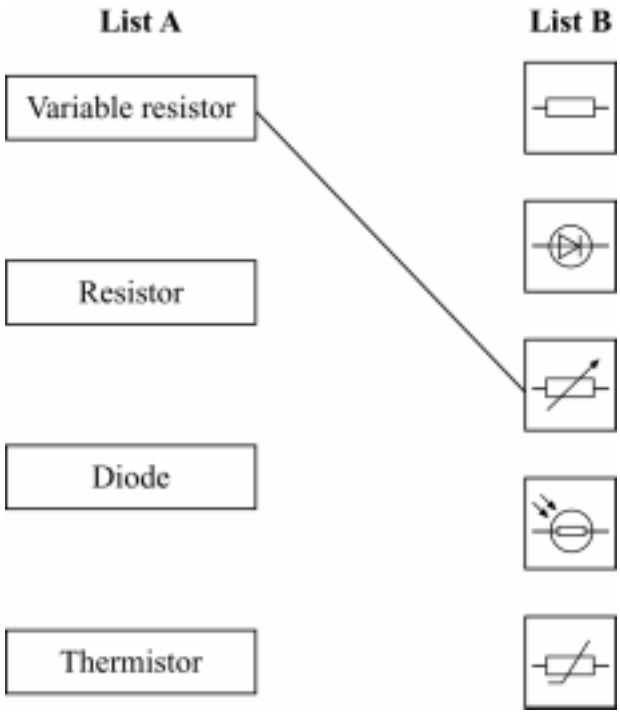
(2 marks)

7

Turn over for the next question

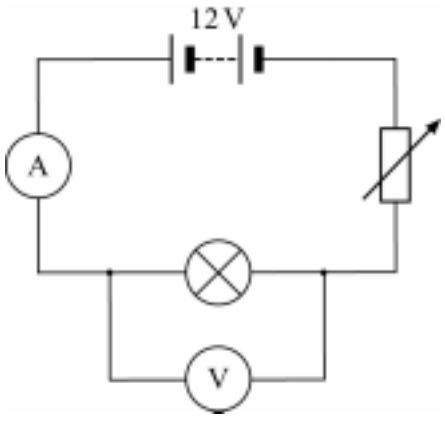
4 (a) Components in electrical circuits are represented by symbols.

Draw a straight line from each component in **List A** to its correct circuit symbol in **List B**. Draw **three** lines only. The variable resistor has been done for you.



(3 marks)

(b) Susan sets up this circuit to find out if the power of a lamp changes when the current through the lamp changes.



(i) How does Susan change the current through the lamp?

.....

(1 mark)

(ii) To calculate the power of the lamp, Susan measures the current through the lamp and the potential difference across the lamp.

What piece of apparatus does Susan use to measure the potential difference?

.....

(1 mark)

(iii) The following table is produced by Susan.

Current through the lamp in amps	0.10	0.15	0.20	0.25	0.30
Power of the lamp in watts	0.10	0.30	0.80	1.75	0.65

Susan has worked out one of the power calculations incorrectly.

Draw a ring around the value that is incorrect.

(1 mark)

(iv) Susan notices that as the current goes up the lamp gets brighter.

What apparatus could Susan use to measure the brightness of the lamp?

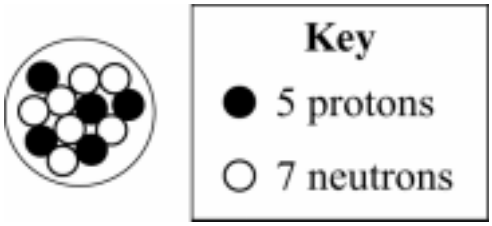
.....

(1 mark)

7

Turn over for the next question

5 (a) The diagram shows the nucleus of a boron atom.



How many electrons does a boron atom have?

.....

(1 mark)

(b) The parts of an atom are named in the box.

electron	**neutron**	**nucleus**	**proton**

(i) Choose **two** particles from the box that have the same mass.

..... and .....

(2 marks)

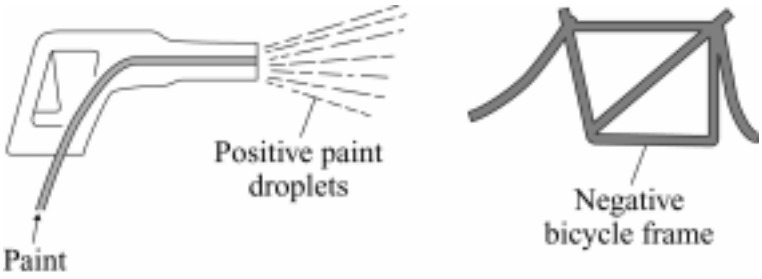
(ii) Which particle named in the box has a negative charge?

.....

(1 mark)

4

6 (a) Bicycle frames can be painted using an electrostatic paint spray.
The paint droplets leave the spray gun with a positive charge.
The bicycle frame is given a negative charge.



(i) Explain why the paint droplets are all given a positive charge.

.....

.....

.....

.....

(2 marks)

(ii) Explain why the bicycle frame is given a negative charge.

.....

.....

.....

.....

(2 marks)

Question 6 continues on the next page

(b) The picture shows a hospital operating theatre.
The drug used to make the patient unconscious is explosive.

Explain why the operating theatre has a floor designed to conduct electricity.

.....

.....

.....

.....

.....

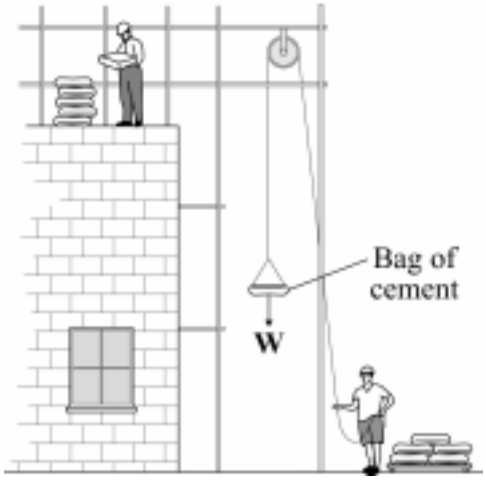
.....

(3 marks)

7

Turn over for the next question

7 A pulley system is used on a building site to lift bags of cement. A builder, pulling steadily on the rope, lifts a 25 kg bag of cement at a constant speed.



(a) (i) Write down the equation that links gravitational field strength, mass and weight.

.....

(1 mark)

(ii) Calculate the weight (**W**) of one bag of cement. Show clearly how you work out your answer.

gravitational field strength = 10 N/kg

.....

weight = ... N

(1 mark)

(iii) What size force is used to lift a bag of cement?

Assume that the weight of the rope and the force of friction at the pulley are negligible.

.....

(1 mark)

(b) Each bag of cement is lifted 5 metres.

(i) Write down the equation that links distance moved, force applied and work done.

.....

(1 mark)

LEAVE MARGIN BLANK

(ii) Calculate the work done each time the builder lifts a bag of cement. Show clearly how you work out your answer and give the unit.

.....

.....

work done = ...

(3 marks)

7

END OF QUESTIONS

Physics 2F Mark Scheme

Question 1

	answers	extra information	mark
(i)	zero	accept nothing	1
	zero velocity	accept speed for velocity	1
		accept not moving	
(ii)	**A**		1
	has the largest mass	do **not** accept it is the biggest	1
		do **not** accept it is the largest	
(iii)	changes direction	accept turns left	1
Total			**5**

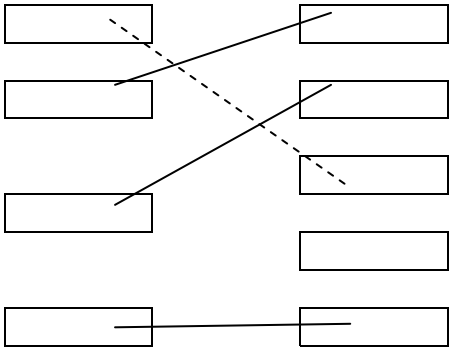
Question 2

	answers	extra information	mark
(a)	all points plotted correctly	allow **1** mark for 3 correct points	2
	straight line of best fit		1
(b)(i)	50 (metres)		1
(ii)	1.5 (seconds)		1
(c)	moving at a steady speed		1
(d)	react more slowly to a situation	accept any reasonable specific situation eg child running into the road	1
	car travels greater distance before brakes are applied		1
Total			**8**

Question 3

	answers	extra information	mark
(a)(i)	1. **B**		1
	2. **C**		1
(ii)	current		1
	breaking		1
(b)	**J**	accept 3 (amp)	1
(c)	would not melt		1
	unless the current was very high / with a normal current		1
Total			**7**

Question 4

	answers	extra information	mark
(a)	3 lines correct 	award **1** mark for each correct line if more than 3 lines are drawn, mark the incorrect ones first, mark only 3 lines	3
(b)(i)	adjust the (variable) resistor	do **not** accept adjust the power supply	1
(ii)	voltmeter		1
(iii)	0.65		1
(iv)	any **one** from: • LDR and ohm meter / ammeter and voltmeter • light sensor (and data logger)		1
Total			**7**

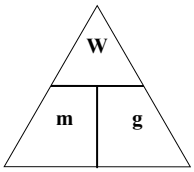
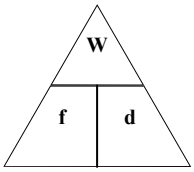
Question 5

	answers	extra information	mark
(a)	5		1
(b)(i)	neutron	answer can be in either order	1
	proton		1
(ii)	electron		1
Total			**4**

Question 6

	answers	extra information	mark
(a)(i)	droplets will repel (each other)		1
	giving an even spray / layer of paint		1
(ii)	attracts (all) the paint droplets		1
	paint covers entire frame / little paint wasted	accept paint front and back at same time	1
		accept spreads to hard to reach places	
(b)	any (electrostatic) charge		1
	will flow to earth (through the floor)		1
	reducing the risk of a spark	allow reducing the risk of an electric shock	1
Total			**7**

Question 7

	answers	extra information	mark
(a)(i)	weight = mass × gravitational field strength	accept weight = mass × gravity accept W = m × g accept  provided subsequent method is correct	1
(ii)	250 (N)		1
(iii)	250 (N)		1
(b)(i)	work (done) = force (applied) × distance (moved)	accept W = f× s accept W = f× d accept  provide subsequent method is correct	1
(ii)	1250 joules	allow **1** mark for correct substitution accept J do **not** accept j	2 1
Total			**7**
		Overall marks	**45**

Surname		Other Names	
Centre Number			Candidate Number				
Candidate signature									

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General Certificate of Education
Specimen Paper

ADDITIONAL SCIENCE
Unit Physics 2

PHYSICS
Unit Physics 2

Higher Tier

H

AQA
ASSESSMENT and QUALIFICATIONS ALLIANCE

Date and Time

For this paper you must have:
- A ruler
- You may use a calculator

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3		7	
4			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Time allowed: 45 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

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- The marks for questions are shown in brackets.
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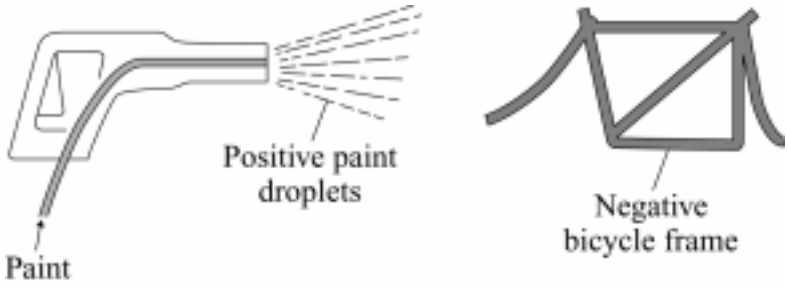
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

1 (a) Bicycle frames can be painted using an electrostatic paint spray.
The paint droplets leave the spray gun with a positive charge.
The bicycle frame is given a negative charge.



(i) Explain why the paint droplets are all given a positive charge.

.....

.....

.....

.....

(2 marks)

(ii) Explain why the bicycle frame is given a negative charge.

.....

.....

.....

.....

(2 marks)

(b) The picture shows a hospital operating theatre.

The drug used to make the patient unconscious is explosive.

Explain why the operating theatre has a floor designed to conduct electricity.

.....

.....

.....

.....

.....

.....

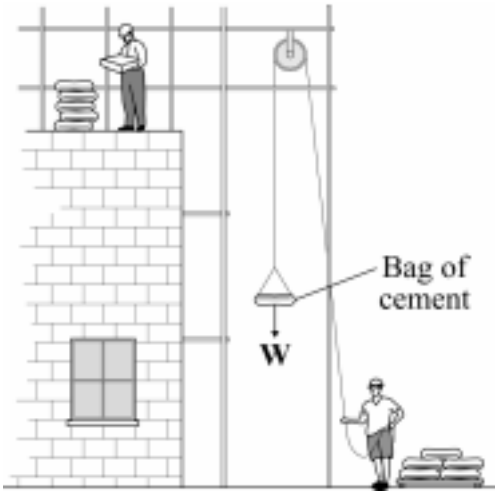
.....

(3 marks)

7

Turn over for the next question

2 A pulley system is used on a building site to lift bags of cement. A builder, pulling steadily on the rope, lifts a 25 kg bag of cement at a constant speed.



(a) (i) Write down the equation that links gravitational field strength, mass and weight.

.....

(1 mark)

(ii) Calculate the weight (**W**) of one bag of cement. Show clearly how you work out your answer.

gravitational field strength = 10 N/kg

.....

weight = ... N

(1 mark)

(iii) What size force is used to lift a bag of cement?

Assume that the weight of the rope and the force of friction at the pulley are negligible.

.....

(1 mark)

(b) Each bag of cement is lifted 5 metres.

(i) Write down the equation that links distance moved, force applied and work done.

.....

(1 mark)

(ii) Calculate the work done each time the builder lifts a bag of cement. Show clearly how you work out your answer and give the unit.

.....

.....

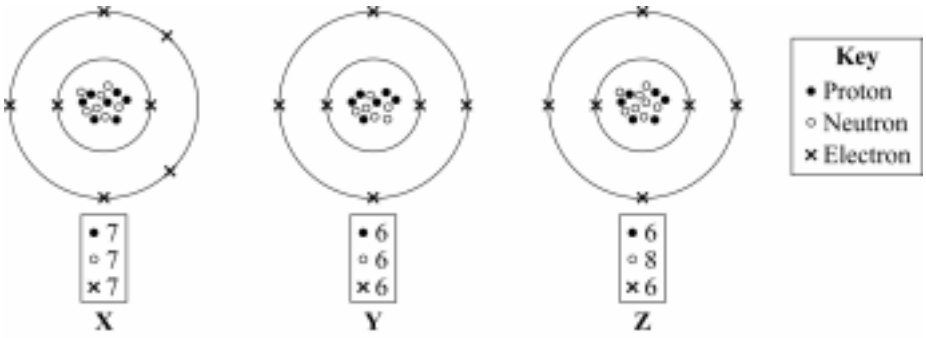
work done = ...

(3 marks)

7

Turn over for the next question

3 (a) The diagram represents three atoms **X**, **Y**, and **Z**.



(i) Which **two** of the atoms are from the same element?

.....

(ii) Give a reason for your answer.

.....

.....

(2 marks)

(b) What is the mass number of an atom?

.....

(1 mark)

(c) What happens to an atom to change it into an ion?

.....

(1 mark)

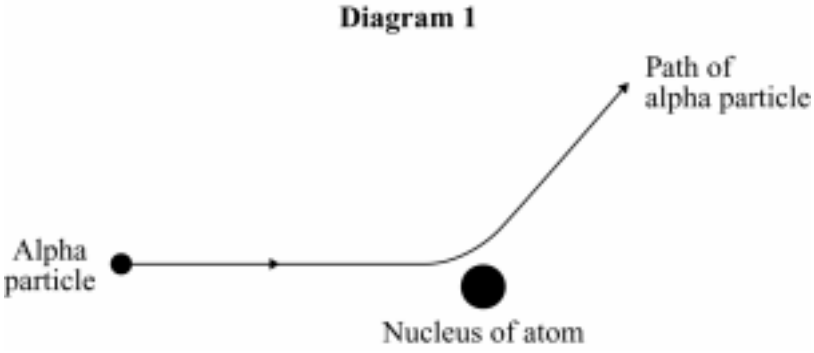
4

4 (a) In the early part of the 20th century, some scientists investigated the paths taken by positively charge alpha particles that were fired at a very thin piece of gold foil.

The results of the investigation led to a new model of the atom. In this new model each atom has a nucleus.

Diagram 1 shows the path of an alpha particle as it passes the nucleus of an atom.

Diagram 1



(i) Explain why the alpha particle changes direction.

.....

.....

.....

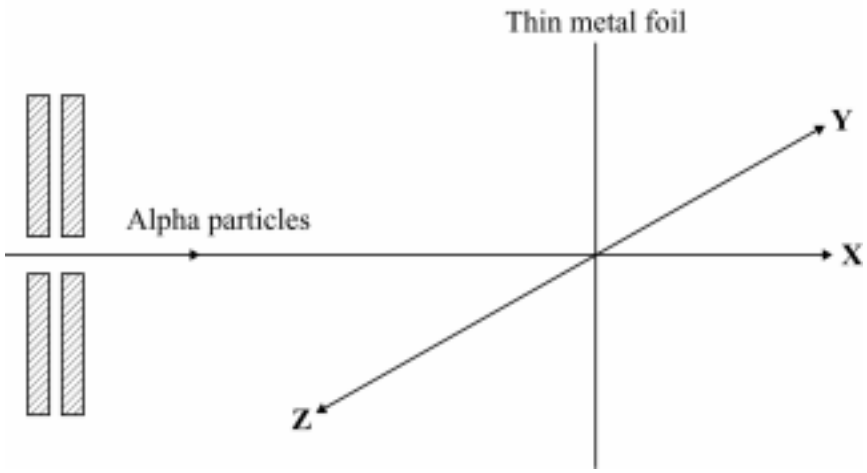
.....

(2 marks)

Question 4 continues on the next page

(ii) **Diagram 2** shows different paths taken by alpha particles when they were fired at the gold foil.

Diagram 2



The boxes on the left show some observations from the investigation.
The boxes on the right give their explanations.

Draw a straight line from each observation to its explanation. Draw **three** lines only.
One has been done for you.

Observation	Explanation
Some alpha particles travel along path **Y**	Because the nucleus has a very large positive charge and a large mass
Most of the alpha particles follow path **X**	Because the nucleus is very small
Some alpha particles scatter backwards along path **Z**	Because most of each atom is empty space
Some alpha particles follow path **Z**	Because the nucleus is positively charged

(2 marks)

LEAVE MARGIN BLANK

(b) The word equation shows what may happen to the nucleus of a uranium-235 atom if it absorbs a neutron.

Uranium-235 + Neutron → Nuclei **A** + Nuclei **B** + 2 neutrons

Draw a labelled diagram to show how this process will lead to a chain reaction.

(2 marks)

6

Turn over for the next question

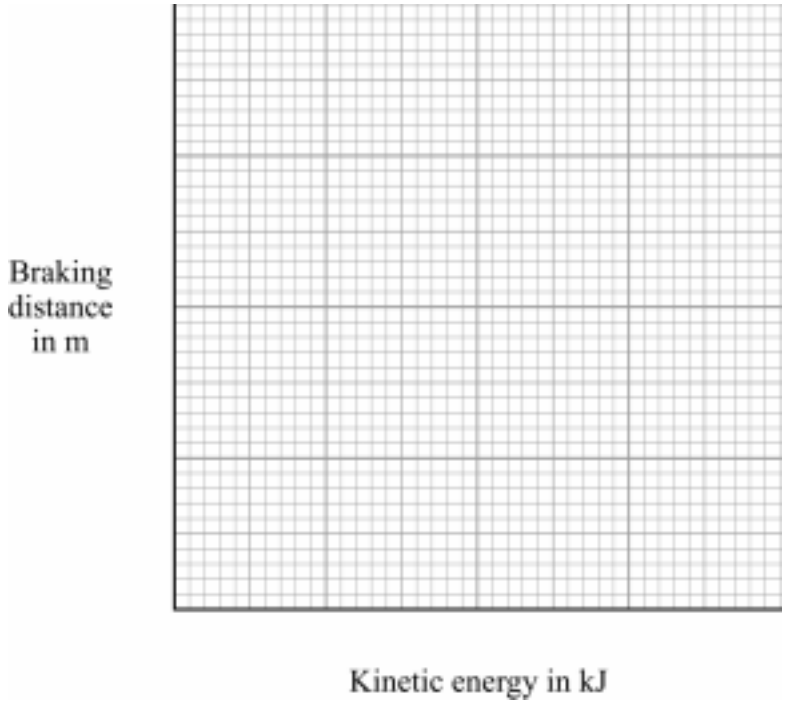
There are no questions printed on this page

5 The table shows the braking distances for a car at different speeds and kinetic energy. The braking distance is how far the car travels once the brakes have been applied.

Braking distance in m	Speed of car in m/s	Kinetic energy of car in kJ
7	10	40
16	15	90
30	20	160
46	25	250
65	30	360

(a) A student suggests, "the braking distance is directly proportional to the kinetic energy".

(i) Draw a graph to test this suggestion.



(3 marks)

(ii) Does the graph show that the student's suggestion was correct or incorrect? Give a reason for your answer.

.....

.....

(1 mark)

Question 5 continues on the next page

(iii) State **one** factor, apart from speed, which would increase the car's braking distance.

.....

(1 mark)

(b) In an experiment at an accident research laboratory, a car moving at 14 m/s is made to collide with a brick wall. On impact the dummy inside the car moves forward. Its head hits the dashboard and stops.

(i) Write down the equation that links mass, momentum and velocity.

.....

(1 mark)

(ii) Calculate the momentum of the dummy's head just before impact. Take the mass of the head to be 8 kg. Show clearly how you get your answer.

.....

.....

momentum of dummy's head = ... kg m/s

(1 mark)

(iii) Write down the equation that links change in momentum, force and time.

.....

(1 mark)

(iv) The impact between the head and dashboard lasts 0.008 s.

Calculate the impact force between the head and dashboard. Show clearly how you get your answer.

.....

.....

impact force = ... N

(1 mark)

(c) Most new cars are fitted with a driver's airbag. These are like large cushions, designed to inflate when the car is in a severe collision. In a test, an airbag deflates slowly when hit by the dummy's head.

Use the idea of momentum to explain why an airbag should reduce the risk of a serious head injury.

.....

.....

.....

.....

.....

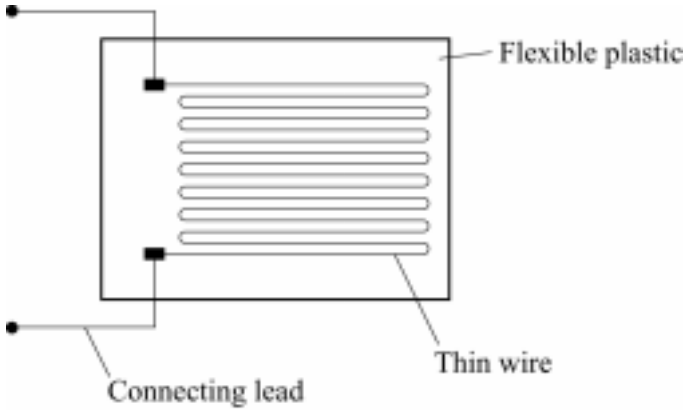
.....

(3 marks)

12

6 A strain gauge is a device used to detect a force. It is made from a thin piece of wire set into a flexible piece of plastic. When the plastic bends, the wire stretches. This causes the electrical resistance of the gauge to change.

(a) Using the correct symbols, complete the diagram to show how a battery, an ammeter and a voltmeter can be used to measure the resistance of the gauge.



(1 mark)

(b) Before being stretched, a gauge correctly connected to a 3 V battery has a current of 0.025 A flowing through it.

(i) Write down the equation that links current, potential difference and resistance.

.....

(1 mark)

(ii) Calculate the resistance of the unstretched gauge. Show clearly how you get your answer.

.....

.....

.....

resistance = ... Ω

(2 marks)

(iii) When a gauge is stretched, the current flowing through it changes to 0.022 A.

State how the resistance of the gauge has changed. (You do not need to do any further calculation.)

.....

(1 mark)

LEAVE MARGIN BLANK

(c) John has been asked to measure the strain that heavy lorries cause when they go over a road bridge. John decides to do this by linking a strain gauge to a data logger and computer.

Give **one** practical reason why John decided to link the strain gauge to the data logger and computer.

.....

.....

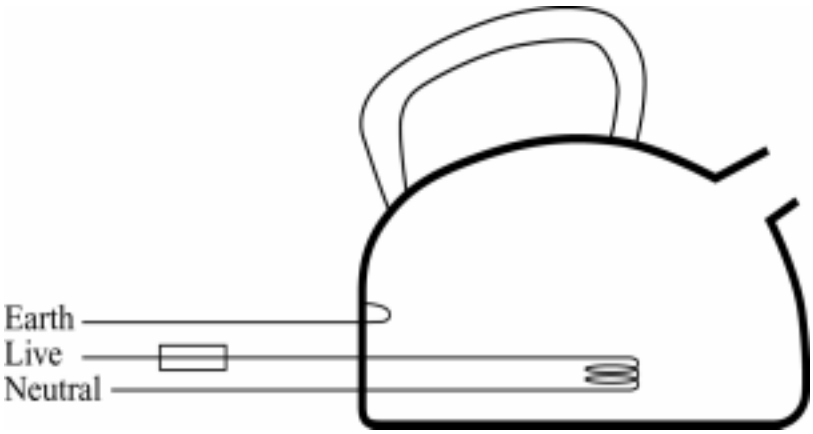
(1 mark)

6

Turn over for the next question

LEAVE MARGIN BLANK

7 The diagram shows the wiring to an electrical appliance. The outside of the appliance is metal.



Explain how the earth wire and fuse protect both the appliance and the user. The answer has been started for you.

If a fault occurs which causes .....

.....

.....

.....

.....

.....

(3 marks)

3

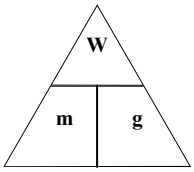
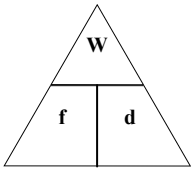
END OF QUESTIONS

Physics 2H Mark Scheme

Question 1

	answers	extra information	mark
(a)(i)	droplets will repel (each other)		1
	giving an even spray / layer of paint		1
(ii)	attracts (all) the paint droplets	accept paint front and back at the same time	1
	paint covers the entire flame / little paint wasted	accept spreads to hard to reach places	1
(b)	any (electrostatic) charge		1
	will flow to earth (through the floor)		1
	reducing the risk of a spark	allow reducing the risk of an electric shock	1
Total			**7**

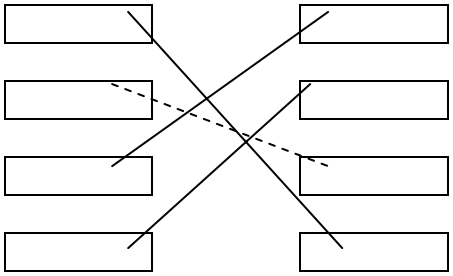
Question 2

	answers	extra information	mark
(a)(i)	weight = mass × gravitational field strength	accept weight = mass × gravity accept W = m × g accept  provided subsequent method is correct	1
(ii)	250 (N)		1
(iii)	250 (N)		1
(b)(i)	work (done) = force (applied) × distance (moved)	accept W = f× s accept W = f× d accept  provide subsequent method is correct	1
(ii)	1250 joules	allow **1** mark for correct substitution accept J do **not** accept j	2 1
Total			**7**

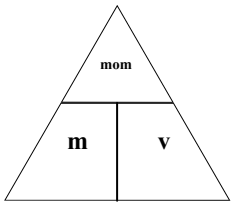
Question 3

	answers	extra information	mark
(a)(i)	**Y** and **Z**	both required	1
(ii)	have the same number of protons		1
(b)	total number of protons and neutrons in the atom / nucleus		1
(c)	gains / loses one (or more) electrons		1
Total			**4**

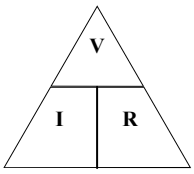
Question 4

	answers	extra information	mark
(a)(i)	nucleus is positively charged repulsion between like charges		1 1
(ii)	3 lines correct 	allow **1** mark for 1 correct line If more than 3 lines drawn maximum of **1** mark can be scored	2
(b)	labelled diagram to show given equation neutrons shown splitting further atoms with more neutrons produced		1 1
Total			**6**

Question 5

	answers	extra information	mark
(a)(i)	sensible scales chosen all points plotted correctly straight line of best fit drawn		1 1 1
(ii)	correct, the graph gives a straight line through the origin		1
(iii)	any **one** from: • road conditions • weather conditions • condition of the car		1
(b)(i)	momentum = mass × velocity	accept mom = mv or p = mv accept  provided subsequent method is correct	1
(ii)	112 (kg m/s)		1
(iii)	force = $\frac{\text{change in momentum}}{\text{time}}$		1
(iv)	14 000 (N)	accept their (b)(ii) ÷ 0.008 correctly evaluate	1
(c)	increase collision time for the same change in momentum reducing the force required		1 1 1
Total			**12**

Question 6

	answers	extra information	mark
(a)	battery, ammeter and voltmeter correctly joined all circuit symbols correct		1
(b)(i)	potential difference = current × resistance	accept pd or voltage for potential difference accept V = I × R accept  provided subsequent method is correct	1
(ii)	120 (Ω)	allow **1** mark for correct substitution and transformation	2
(iii)	resistance has increased		1
(c)	any feasible practical reason, for example: allows continuous monitoring all data is (automatically) recorded data can be taken over a long period of time John could make mistakes when taking readings	allow , without data logger and computer John may miss some lorries allow John would only be able to take readings for a few hours	1
Total			**6**

Question 7

	answers	extra information	mark
	the live wire to touch the metal case		1
	a large current is drawn from the live which flows through earth wire / to earth	accept if there were no earth and someone touched the appliance current would flow through them to earth	1
	the current melts the fuse, switching off the appliance	an answer given in terms of there being no earth gains a maximum of **2** marks	1
Total			**3**
		Overall marks	**45**

Surname		Other Names	
Centre Number			Candidate Number									
Candidate signature												

Leave blank

General Certificate of Secondary Education
Specimen Paper

PHYSICS
Unit Physics 3

F

Foundation Tier

Date and Time

For this paper you must have:
- a ruler

You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3		7	
4		8	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Time allowed: 45 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

LEAVE MARGIN BLANK

Answer **all** questions in the spaces provided.

1 (a) Complete the sentences by choosing the correct word or phrase from the box.

Each word or phrase may be used once or not at all.

andromeda	**milky way**	**solar system**	**Universe**

(i) The Sun is part of the ……... galaxy.

(1 mark)

(ii) The …… contains at least a billion galaxies.

(1 mark)

(b) The following sentences describe the stages that a star such as the Sun goes through during its life.

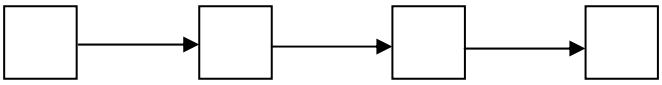
A The star is stable.

B The star contracts to a white dwarf.

C The star expands to a red giant.

D The star is formed when the force of gravity pulls dust and gases together.

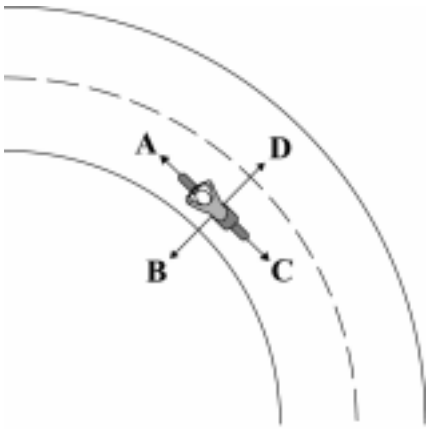
Arrange the sentences, **A**, **B**, **C** and **D**, in the order in which the stages happen.



(3 marks)

5

2 A motorbike is being driven round a circular bend in a road.



(a) (i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act?

.....

(1 mark)

(ii) Which one of the following forces provides the centripetal force on the motorbike?

Draw a ring around your answer.

air resistance **friction** **gravity** **tension**

(1 mark)

(b) Complete the following sentences by crossing out the **two** lines in each box that are wrong.

(i) If the motorbike is driven round the bend at a higher speed, the centripetal force would

be smaller
stay the same
be bigger

.

(1 mark)

(ii) If the motorbike is driven at the same speed round a bend with a smaller radius, the centripetal force would

be smaller
stay the same
be bigger

.

(1 mark)

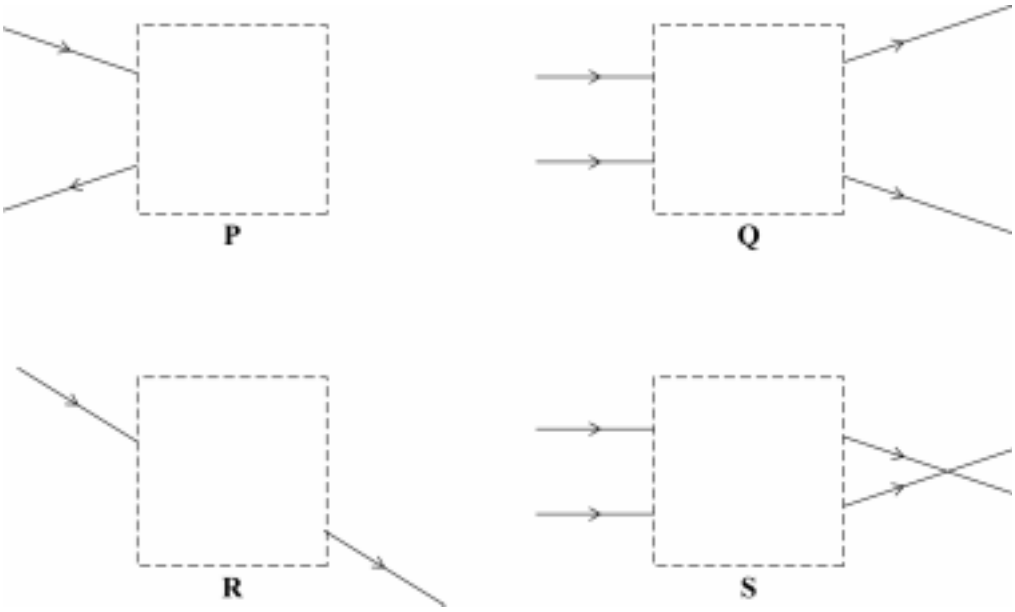
4

3 (a) Four pieces of apparatus are shown below.

converging lens diverging lens glass block plane mirror

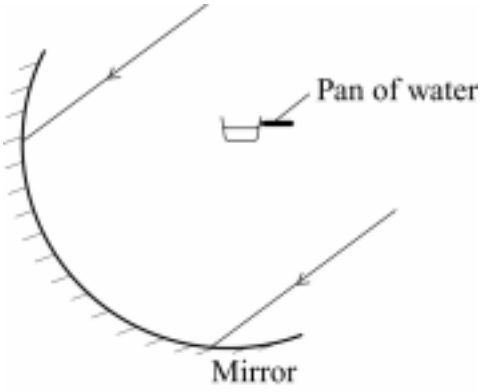
Each box below contains a piece of apparatus. The lines show light rays going into and out of the boxes.

In each box, draw **one** piece of apparatus (from the four above) that affects the light rays in the way shown. Use each piece of apparatus once only.



(3 marks)

(b) The diagram shows a solar cooker being used to heat water. The pan of water is at the focus of the mirror.



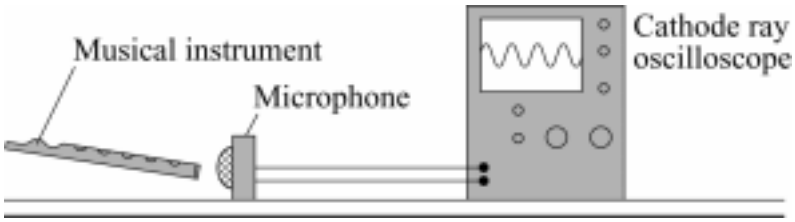
Complete the diagram to show the path of the **two** light rays after they hit the mirror.

(2 marks)

5

Turn over for the next question

4 (a) A microphone and oscilloscope are used to show the sound wave pattern of a musical instrument.

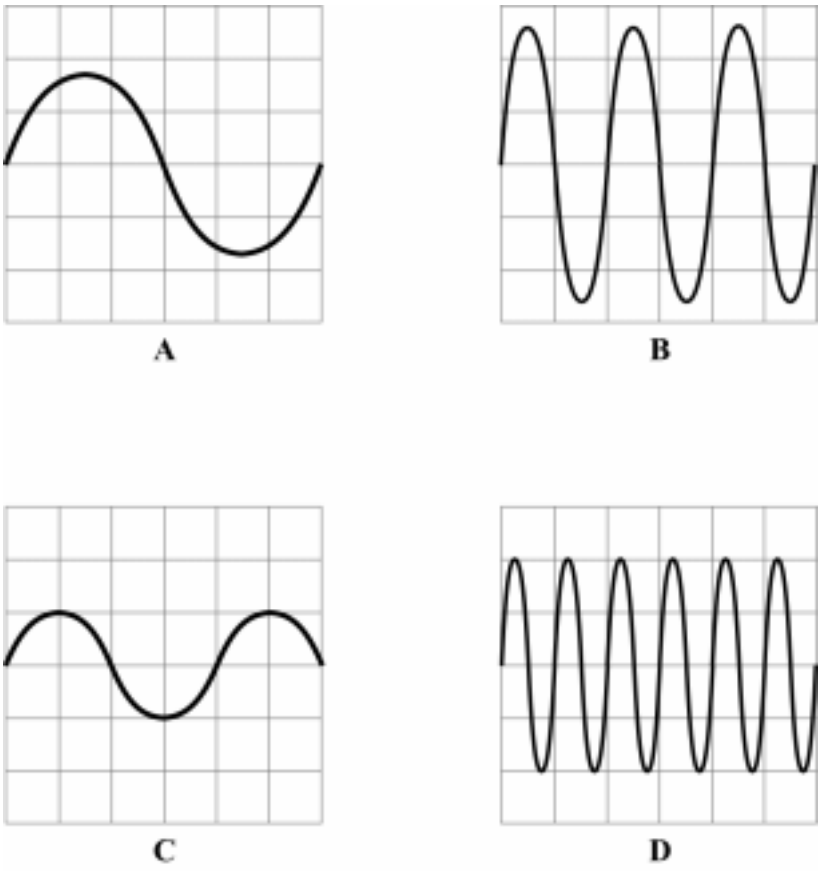


(i) What does the musical instrument make the surrounding air do?

.....

(1 mark)

(ii) Four different sound wave patterns are shown. They are all drawn to the same scale.



Which one of the sound wave patterns, **A**, **B**, **C** or **D** has:

1. the largest amplitude .....

2. the lowest frequency? .....

(2 marks)

(b) Complete the sentences by choosing the correct word from the box.

Each word may be used once or not at all.

higher	louder	lower	quieter

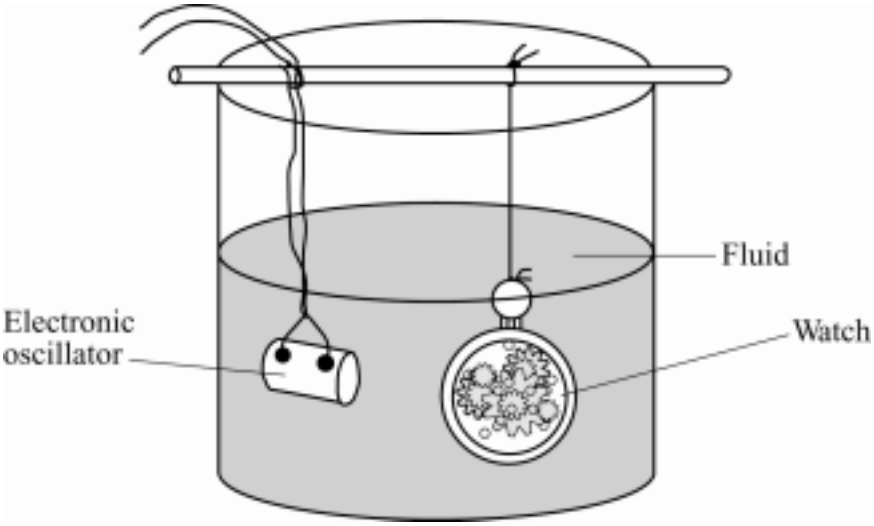
(i) A musical note with a low frequency has a ..... pitch than one with a high frequency.

(1 mark)

(ii) A musical note with a large amplitude sounds ..... than one with a small amplitude.

(1 mark)

(c) The diagram shows how ultrasound waves can be used to clean a watch.



Suggest how this method cleans the watch.

.....

.....

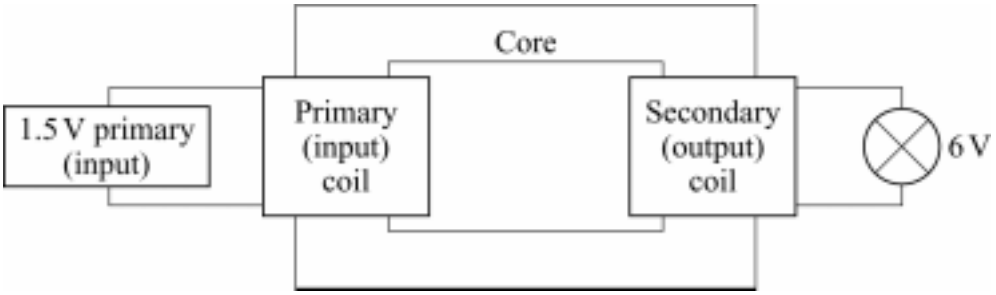
.....

.....

(2 marks)

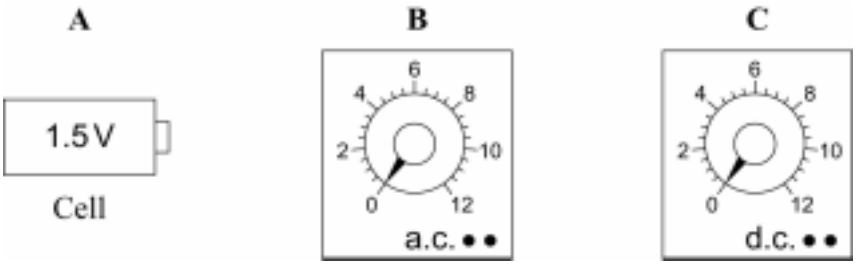
7

5 (a) The diagram shows a simple step-up transformer. It is designed to light a 6 V lamp using a 1.5 V power supply.



(i) Which one of the following power supplies should be used?

Draw a ring around your answer.



(1 mark)

(ii) Which one of the following metals is used to make the core of the transformer?

Draw a ring around your answer.

aluminium **copper** **iron** **steel**

(1 mark)

(iii) Complete this sentence by crossing out the **two** lines in the box that are wrong.

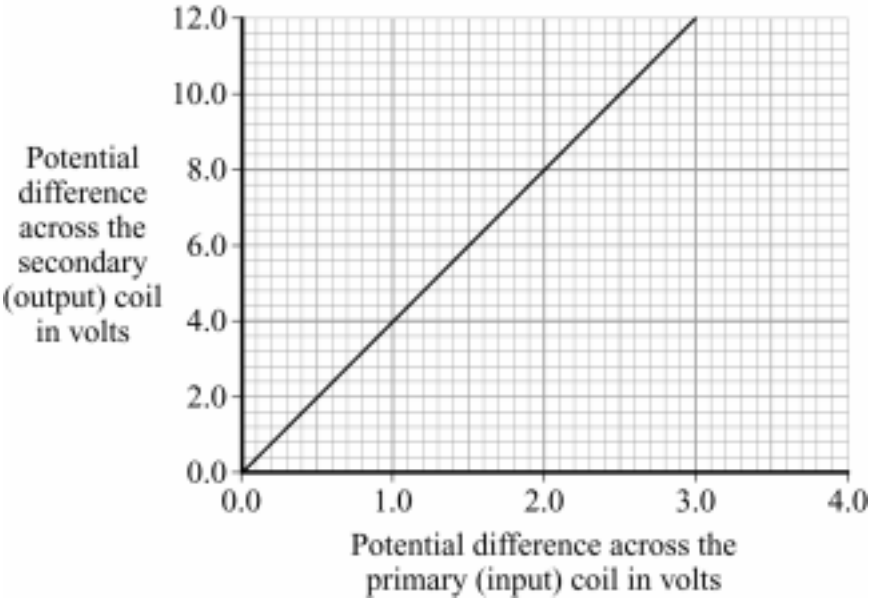
If there are 20 turns of wire on the primary (input) coil, there will be

less than 20
exactly 20
more than 20

turns of wire on the secondary (output) coil.

(1 mark)

(b) The graph shows how the potential difference across the secondary (output) coil of a transformer changes as the potential difference across the primary (input) coil is changed.



How does the graph show that the transformer is a step-up transformer?

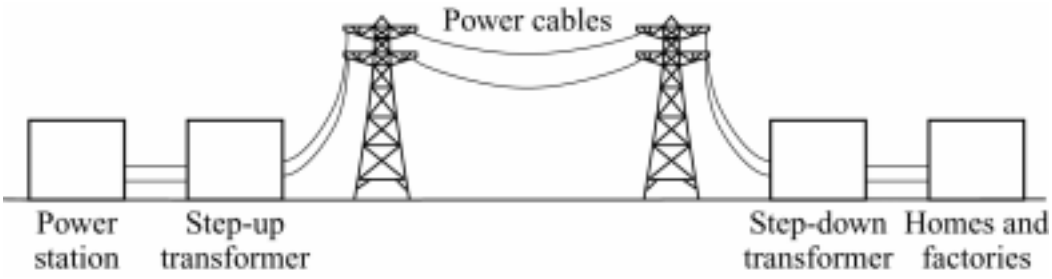
.....

.....

(1 mark)

Question 5 continues on the next page

(c) The diagram shows how the National Grid transmits electrical energy over long distances.



Complete the sentences by choosing the correct word or phrase from the box.

Each word or phrase may be used once or not at all.

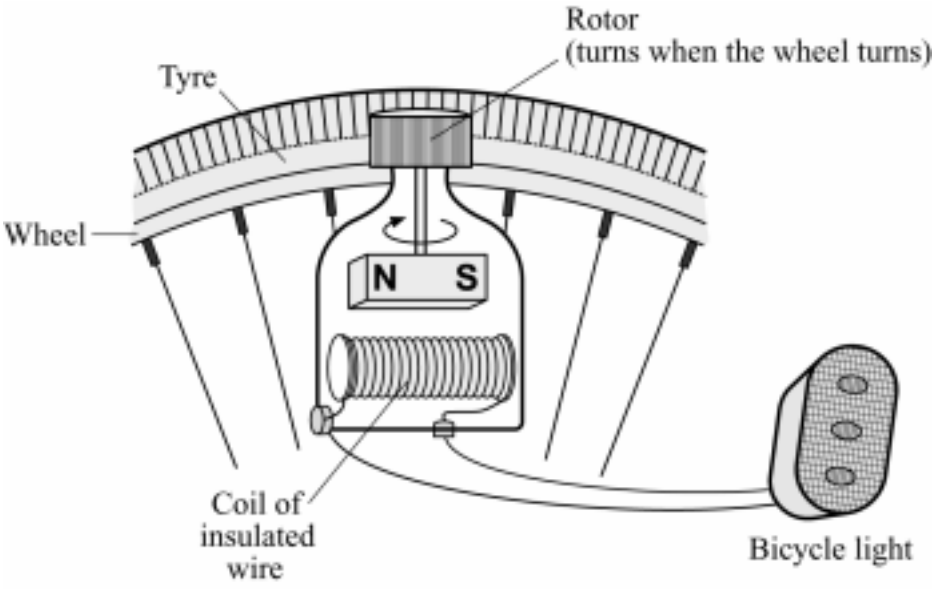
current	**less**	**more**	**potential difference**	**resistance**

The step-up transformer increases the ..... at which the electrical energy is transmitted through the cables. The transformer also reduces the ..... in the cables. This makes the whole system ……. efficient.

(3 marks)

7

6 The diagram shows the inside of a bicycle dynamo.



Read the following passage carefully. It explains how the dynamo works.

- Turning the bicycle wheel causes the rotor and magnet to turn.
- This induces a voltage across the ends of the coil of wire.
- Because the bicycle light is connected to the coil a current flows.
- The light comes on.

Using the information in the passage, explain why the light does **not come** on when the bicycle wheel is **not** turning.

.....

.....

.....

.....

.....

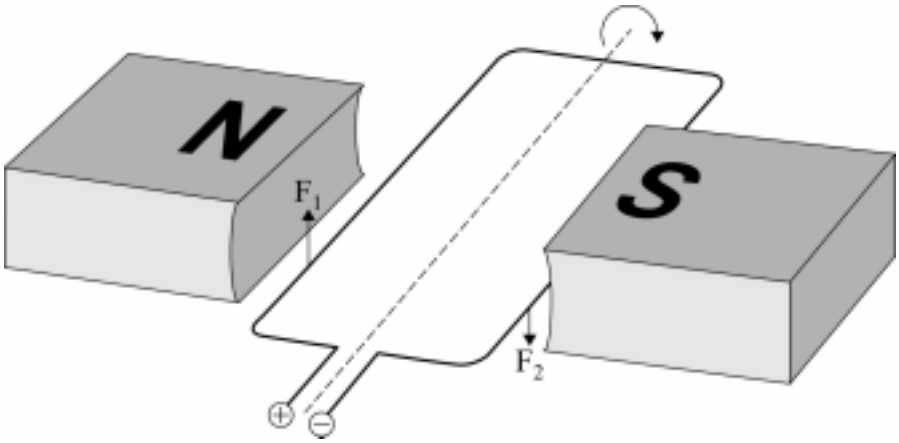
.....

(3 marks)

3

LEAVE MARGIN BLANK

7 The diagram shows a simple electric motor.



The coil rotates as shown in the diagram.

(a) State **two** ways of reversing the direction of forces F_1 and F_2.

1 .....

.....

2 .....

.....

(2 marks)

(b) Give **two** ways in which the size of the forces can be increased.

1 .....

.....

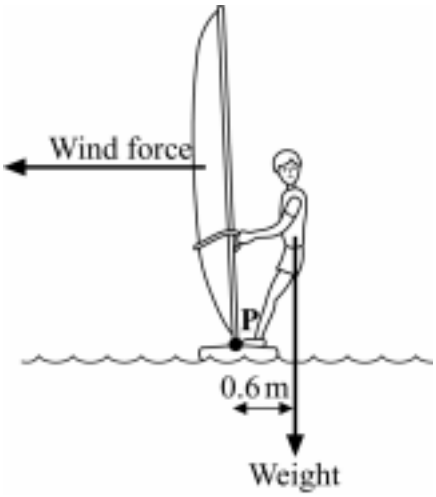
2 .....

.....

(2 marks)

4

8 (a) The diagram shows a windsurfer and sailboard.



To keep the sail upright, the windsurfer leans out from the sailboard.

(i) Use the three words in the box to complete the equation used to calculate the moment (turning effect) of a force.

distance	**force**	**moment**

…… = …… × perpendicular …… from the line of action of the force to the axis of rotation.

(1 mark)

(ii) The windsurfer weighs 700 newtons.

Calculate the moment, about the point **P**, of the windsurfer. Show clearly how you work out your answer and give the unit.

.....

.....

Moment = ...

(3 marks)

Question 8 continues on the next page

LEAVE MARGIN BLANK

(b) As the wind speed increases, the windsurfer leans further out from the sailboard.

How does leaning further out change the moment produced by the windsurfer?

.....

Give a reason for your answer.

.....

.....

(2 marks)

6

LEAVE MARGIN BLANK

9 The table gives information about three different weather satellites.

Satellite	Time to orbit the Earth	Average height above the Earth in km	Type of orbit polar or geostationary
A	94 minutes	440	
B	101 minutes	760	
C	24 hours	36 000	

(a) Complete the column in the table to show which type of orbit each satellite is in.

(1 mark)

(b) Each satellite sends back information about the Earth's weather.

Describe how the information from a satellite in a polar orbit will be different to the information from a satellite in a geostationary orbit.

.....

.....

.....

.....

(2 marks)

(c) Why are communication satellites normally placed in a geostationary orbit?

.....

.....

(1 mark)

4

END OF QUESTIONS

Physics 3F Mark Scheme

Question 1

	answers	extra information	mark
(a)(i)	milky way		1
(ii)	universe		1
(b)	**D** **A** **C** **B**	all in correct order 2 correct gains **2** marks 1 correct gains **1** mark	3
Total			**5**

Question 2

	answers	extra information	mark
(a)(i)	**B**		1
(ii)	friction		1
(b)(i)	be bigger		1
(ii)	be bigger		1
Total			**4**

Question 3

	answers	extra information	mark
(a)	**P** – plane mirror **Q** – diverging lens **R** – glass block **S** – converging lens	all **4** correct 2 correct gains **2** marks 1 correct gains **1** mark	3
(b)	each ray reflects through the pan reflected rays cross somewhere in the water		1 1
Total			**5**

Question 4

	answers	extra information	mark
(a)(i)	vibrate	do **not** accept move	1
(ii)	1. **B** 2. **A**		1 1
(b)(i)	lower		1
(ii)	louder		1
(c)	ultrasound generator makes the particles of the fluid vibrate fluid particles knock small dirt particles off the watch	accept fluid vibrated by ultrasound accept vibration knocks dirt particles off	1 1
Total			**7**

Question 5

	answers	extra information	mark
(a)(i)	**B**		1
(ii)	iron		1
(iii)	more than 20		1
(b)	pd across secondary is (always) bigger than pd across primary coil	accept voltage for pd	1
(c)	potential difference current more		1 1 1
Total			**7**

Question 6

	answers	extra information	mark
	rotor / magnet does not turn		1
	there is no voltage (induced)		1
	no current flows		1
Total			**3**

Question 7

	answers	extra information	mark
(a)	reverse the current		1
	reverse the magnetic field	accept swap the magnets over	1
(b)	increase the strength of the magnetic field	accept use stronger magnets do **not** accept use bigger magnets	1
	increase the size of the current		1
Total			**4**

Question 8

	answers	extra information	mark
(a)(i)	moment force distance	correct order only	1
(ii)	420	allow **1** mark for correct substitution	2
	newton metres / Nm	do **not** accept nm or NM	1
(b)	increases (it)		1
	weight / force acts further from the pivot	accept distance has increased	1
Total			**6**

Question 9

	answers	extra information	mark
(a)	polar polar geostationary	correct order only	1
(b)	polar satellite scans the whole surface **or** polar satellite passes over different parts of the Earth geostationary monitors one part of the Earth so can watch changing patterns over a period of time		1 1
(c)	always over same point on the Earth's surface **or** do not need continuous tracking		1
Total			**4**
		Overall marks	**45**

Surname		Other Names	
Centre Number			Candidate Number									
Candidate signature												

Leave blank

General Certificate of Secondary Education
Specimen Paper

PHYSICS
Unit Physics 3

H

Higher Tier

Date and Time

For this paper you must have:
- a ruler

You may use a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1		5	
2		6	
3		7	
4		8	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Time allowed: 45 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

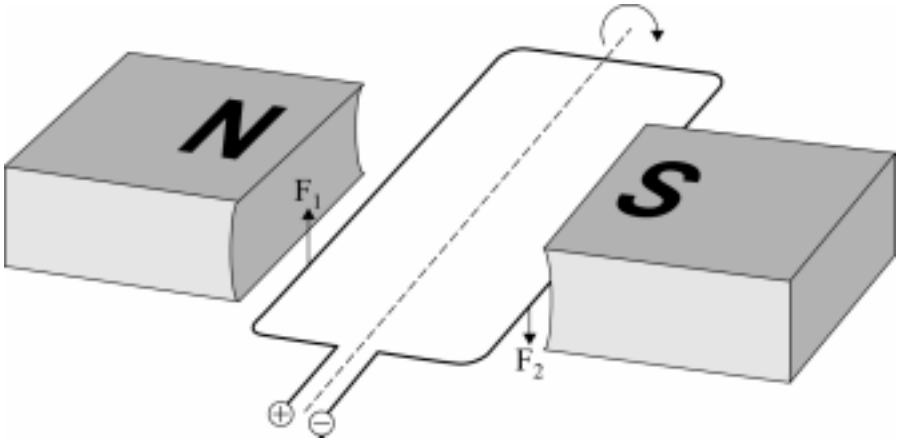
Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

LEAVE MARGIN BLANK

Answer **all** questions in the spaces provided.

1 The diagram shows a simple electric motor.



The coil rotates as shown in the diagram.

(a) State **two** ways of reversing the direction of forces F_1 and F_2.

1 .....

.....

2 .....

.....

(2 marks)

(b) Give **two** ways in which the size of the forces can be increased.

1 .....

.....

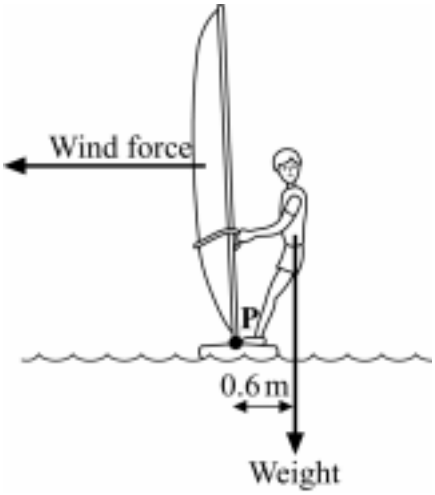
2 .....

.....

(2 marks)

4

2 (a) The diagram shows a windsurfer and sailboard.



To keep the sail upright, the windsurfer leans out from the sailboard.

(i) Use the three words in the box to complete the equation used to calculate the moment (turning effect) of a force.

distance	**force**	**moment**

…… = …… × perpendicular …… from the line of action of the force to the axis of rotation.

(1 mark)

(ii) The windsurfer weighs 700 newtons.

Calculate the moment, about the point **P**, of the windsurfer. Show clearly how you work out your answer and give the unit.

.....

.....

Moment = ...

(3 marks)

Question 2 continues on the next page

(b) As the wind speed increases, the windsurfer leans further out from the sailboard.

How does leaning further out change the moment produced by the windsurfer?

.....

Give a reason for your answer.

.....

.....

(2 marks)

6

3 The table gives information about three different weather satellites.

Satellite	Time to orbit the Earth	Average height above the Earth in km	Type of orbit polar or geostationary
A	94 minutes	440	
B	101 minutes	760	
C	24 hours	36 000	

(a) Complete the column in the table to show which type of orbit each satellite is in.

(1 mark)

(b) Each satellite sends back information about the Earth's weather.

Describe how the information from a satellite in a polar orbit will be different to the information from a satellite in a geostationary orbit.

.....

.....

.....

.....

(2 marks)

(c) Why are communication satellites normally placed in a geostationary orbit?

.....

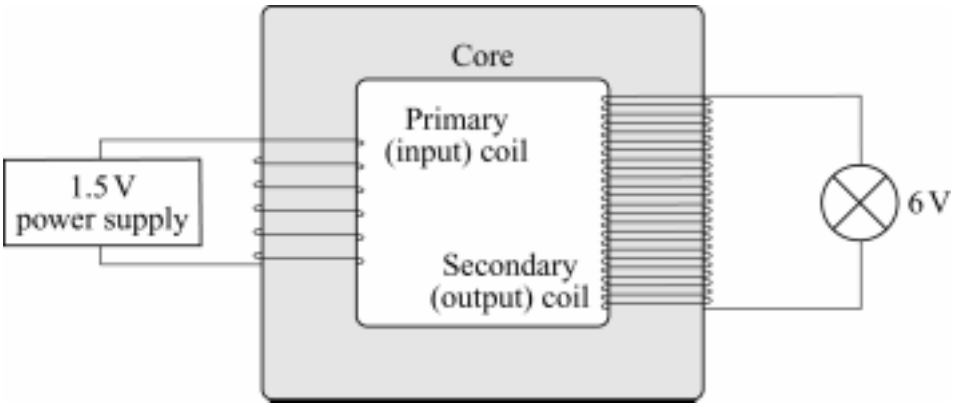
.....

(1 mark)

4

Turn over for the next question

4 (a) The diagram shows a simple *step-up* transformer. It is designed to light a 6 V lamp using a 1.5 V power supply.



(i) How can you tell from the diagram that this is a *step-up* transformer?

.....

(1 mark)

(ii) Which material is used to make the core of a transformer?

.....

(1 mark)

(iii) State **two** ways in which the design of the transformer could be changed to **reduce** the brightness of the lamp.

1 .....

.....

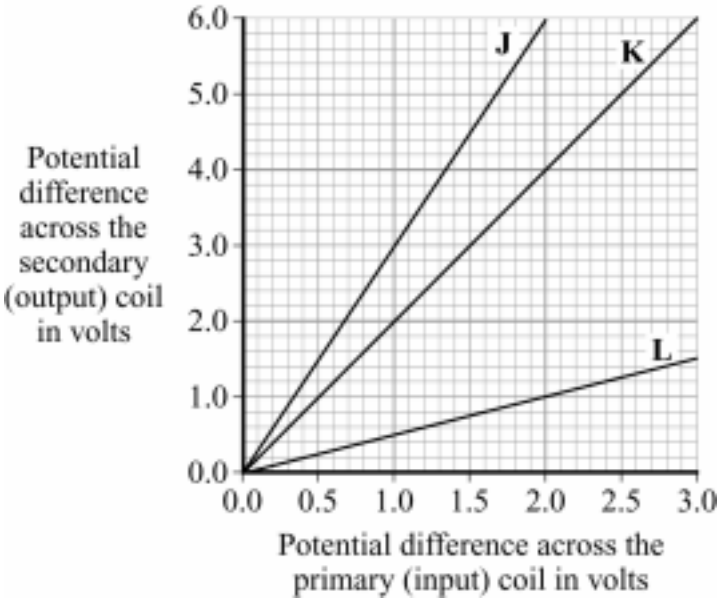
2 .....

.....

(2 marks)

(b) Chris investigates three different transformers. For each transformer Chris changes the potential difference across the primary (input) coil and measures the potential difference across the secondary (output) coil.

The results for each transformer are given in the graph.



Which of the transformers, **J**, **K** or **L**, is working as a step-down transformer?

.....

Give a reason for your answer.

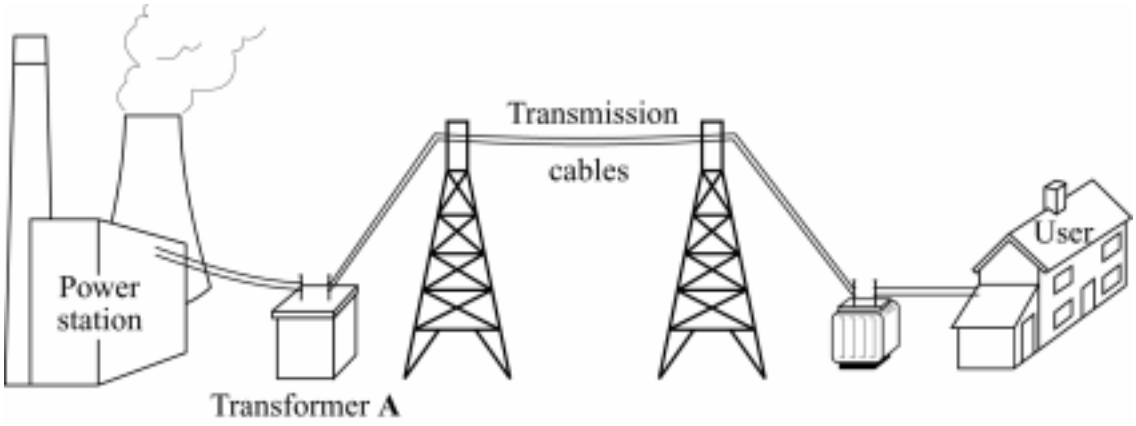
.....

.....

(2 marks)

Question 4 continues on the next page

(c) The diagram shows how the National Grid transmits electrical energy over long distances.



(i) Why do the power stations generate a.c. and not d.c.?

.....

.....

(1 mark)

(ii) State the purpose of transformer **A** and explain why it is an essential part of the National Grid system.

.....

.....

.....

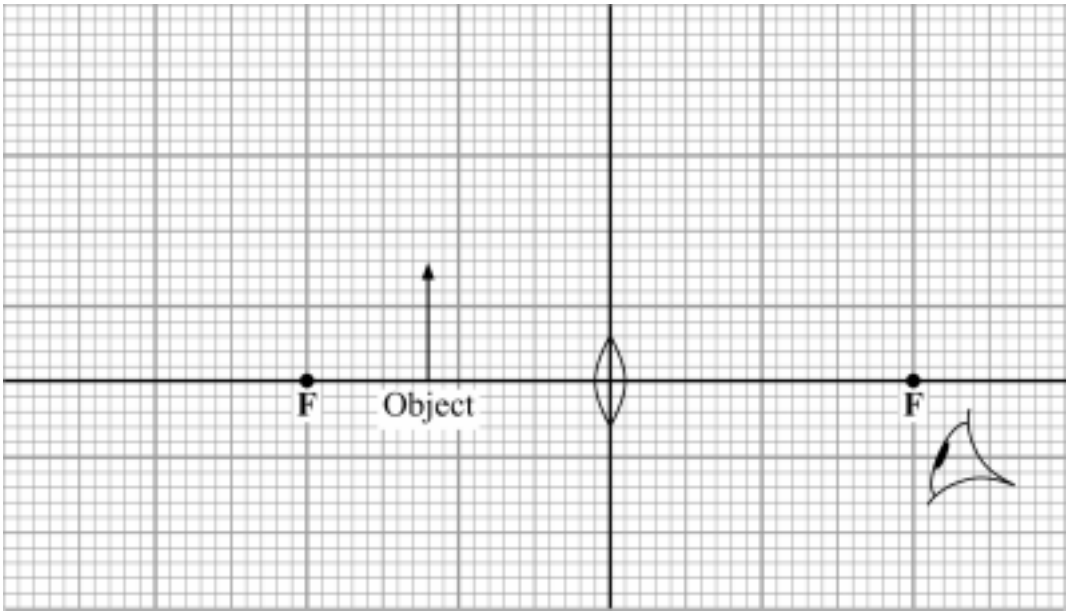
.....

.....

(3 marks)

10

5 The diagram shows a converging lens of focal length 4 cm being used as a magnifying glass. An object 1.6 cm tall is placed 2.4 cm from the lens.



(a) On the diagram, use a ruler to construct accurately the position and size of the image. You should show how you construct your ray diagram and how light appears to come from the image to the eye.

(4 marks)

(b) The image is *virtual*. What is a *virtual* image?

.....

.....

(1 mark)

(c) Calculate the magnification produced by the lens. Show clearly how you work out your answer.

.....

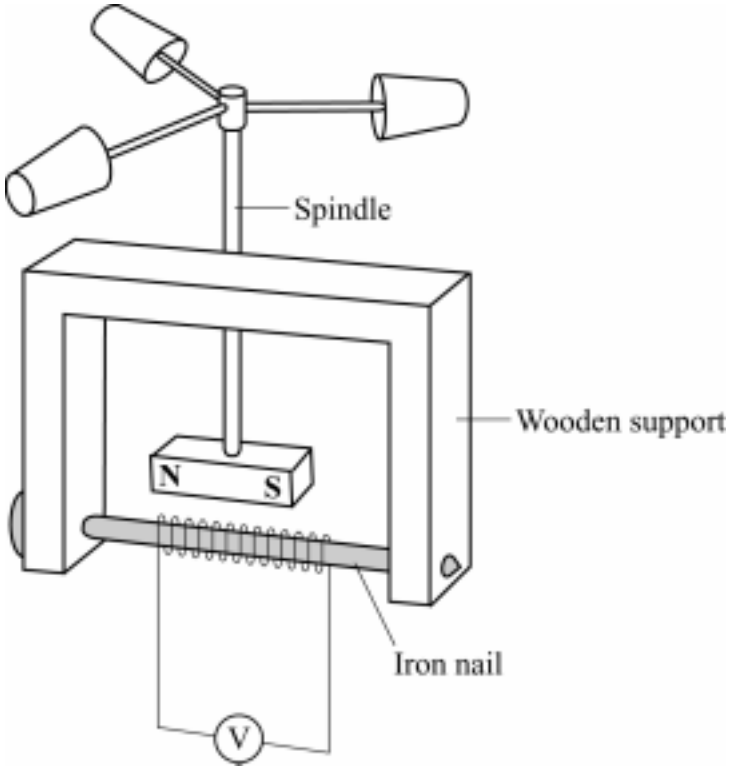
.....

magnification = ...

(2 marks)

7

6 The diagram shows Sue's design for a simple wind speed gauge.



(a) Explain why the wind causes the a.c. voltmeter to give a reading. The explanation has been started for you.

The wind causes the plastic cups to turn. This causes the spindle and .....

.....

.....

.....

.....

.....

.....

(3 marks)

(b) Why does the voltmeter reading increase as the wind speed increases?

.....

.....

(1 mark)

(c) The gauge is not sensitive enough to measure light winds.

Give **one** way that Sue can modify the design to make the gauge more sensitive.

.....

.....

(1 mark)

(d) How could Sue make the gauge monitor and record wind speed automatically?

.....

.....

(1 mark)

6

Turn over for the next question

7 The picture shows a pre-natal scan obtained using a narrow beam of *ultrasound* waves.

(a) What is *ultrasound*?

.....

.....

(1 mark)

(b) Why is it possible to produce a very narrow beam with ultrasound but not with normal sound waves?

.....

.....

(1 mark)

(c) Explain how ultrasonic waves produce the image of an unborn baby.

.....

.....

.....

.....

(2 marks)

(d) Give **one** important piece of information about an unborn baby that can be gained from the image produced by an ultrasound scan.

.....

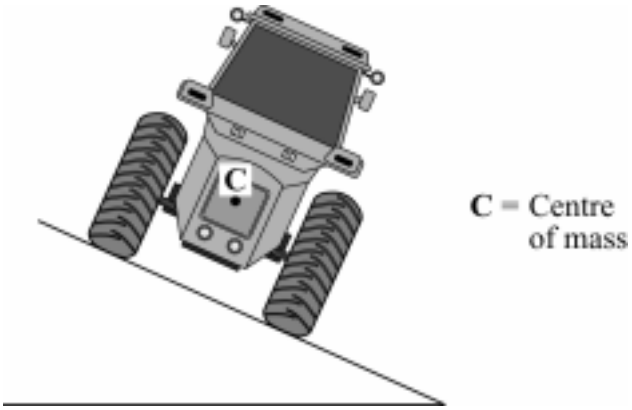
.....

(1 mark)

5

LEAVE MARGIN BLANK

8 The diagram shows a tractor being used on a hillside.



Describe and explain what would happen if the tractor were used on a hillside steeper than the one in the diagram.

.....

.....

.....

.....

.....

(3 marks)

3

END OF QUESTIONS

Physics 3H Mark Scheme

Question 1

	answers	extra information	mark
(a)	reverse the current		1
	reverse the magnetic field	accept swap the magnets over	1
(b)	increase the strength of the magnetic field	accept use stronger magnets do **not** accept us bigger magnets	1
	increase the size of the current		1
Total			**4**

Question 2

	answers	extra information	mark
(a)(i)	moment force distance	correct order only	1
(ii)	420	allow **1** mark for correct substitution	2
	newton metres / Nm	do **not** accept nm or NM	1
(b)	increase (it)		1
	weight / force acts further from the pivot	accept distance has increased	1
Total			**6**

Question 3

	answers	extra information	mark
(a)	polar polar geostationary	correct order only	1
(b)	polar satellite scans the whole surface **or** polar satellite passes over different parts of the Earth		1
	geostationary monitors one part of the Earth so can watch changing patterns over a period of time		1
(c)	always over the same point on the Earth's surface **or** do not need continuous tracking		1
Total			**4**

Question 4

	answers	extra information	mark
(a)(i)	more turns / coils on the secondary than primary	accept output for secondary accept input for primary accept converse	1
(ii)	iron		1
(iii)	decrease number turns on secondary increase number turns on primary	 do **not** accept reduce voltage of power supply	1 1
(b)	**L** pd across secondary is smaller than pd across primary	accept voltage for pd	1 1
(c)(i)	transformers only work with a.c.	accept converse accept transmission system would be very inefficient if d.c. used	1
(ii)	to increase the pd at which the energy is transmitted any **two** from: energy / power losses (from cables) are much lower reduces current in cables cables heat up less efficiency of system increases		1 2
Total			**10**

Question 5

	answers	extra information	mark
(a)	two correct construction lines drawn passing through the lens to the eye lines traced back to cross in front of lens image drawn in correct plane and upright		2 1 1
(b)	cannot be projected onto a screen		1
(c)	2.5 ± 0.2	allow **1** mark for correct substitution of 4.0 ± 0.2 and 1.6 allow **2** marks for correct use and evaluation of values correctly taken from the diagram	2
Total			**7**

Question 6

	answers	extra information	mark
(a)	magnet to turn		1
	magnetic field cut by the coil **or** rotating magnetic field links with the coil	accept magnetic field links with coil	1
	potential difference induced across coil	accept voltage for pd	1
(b)	any **one** from: • speed of rotation of magnet increases • magnetic field lines cut at a faster rate • rate of change of flux linkage increases		1
(c)	any **one** from: • increase number of turns on coil • use stronger magnet • use larger cups • use more cups • use a millivoltmeter		1
(d)	any **one** from: • replace the voltmeter with a datalogger • connect voltmeter to a computer • record output with a computer		1
Total			**6**

Question 7

	answers	extra information	mark
(a)	sound with a frequency above the audible range **or** sound with a frequency above 20 000 Hz		1
(b)	very short wavelength (compared with normal sound)		1
(c)	(partly) reflected when they hit a (boundary between two) different media / substance / tissue time taken for reflected wave (to return) is used to produce image		1 1
(d)	any **one** from: • stage of development • potential problems art birth • developmental problems	accept any reasonable specific information	1
Total			**5**

Question 8

	answers	extra information	mark
	topple (over)		1
	line of action of the weight lies outside the base	accept weight acts outside the base accept wheels for base	1
	producing a resultant turning moment		1
Total			**3**
		Overall marks	**45**

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Teachers' Notes
ISA – Physics 1 – Thermal Insulation
Specimen Material

This ISA relates to: Physics 1

How is heat (thermal energy) transferred and what factors affect the rate at which heat is transferred?

Candidates should be given the opportunity to carry out an investigation concerning the rate of loss of heat from a container.

The simplest method would be to fill a container with hot water and record the temperature at the start and at suitable intervals for, say, 10 minutes.

Any variable may be investigated, eg shape or colour of container, surface area, lagging, initial temperature, volume.

Candidates should use a liquid-in-glass thermometer, with a smallest scale division of 1 °C.

Instructions of a general nature may be given, but these must not be too prescriptive as the candidate should make any decisions for him or herself.

Note that if this practical is being used to assess the skills associated with the carrying out of practical work then the method should be sufficiently sophisticated to allow access to the marks expected for those candidates. Note that any help given could reduce the marks available.

Candidates can work individually or in groups and can pool results if it is thought to be appropriate.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way, eg bar chart or line graph. This part of the activity must be carried out individually and under direct supervision (ie controlled conditions). The table of data and graphs should then be kept by the teacher and provided to the candidate for the subsequent ISA.

Candidates should have a copy of **their** results, any pooled results and a suitable graphical representation of those results at the assessment.

GCSE Science – Investigative Skills Assignment
Physics 1 – Thermal Insulation
Specimen Material

Centre number						Candidate number					Today's date	. . . /. . . / . . .
Candidate name (please print)								Are your own results submitted with this ISA?				YES/NO (delete one)

Instructions

- Maximum time allowed: 45 minutes.
- Use blue or black ink or ball-point pen.
- Fill in the boxes above.
- Answer **all** questions.
- Answer the questions in the spaces provided.

Code	Title of own investigation	Mark (to be filled in by teacher)	
		Section 1	
		Section 2	
		Total (max 34)	

Signature of candidate ..... Date .....

Signature of teacher marking this ISA ..... Date .....

LEAVE MARGIN BLANK

Section 1

These questions refer to **your own investigation** concerning heat loss. You should use your own results, your graph/s and what you remember about doing your investigation to answer these questions. All answers should be in the spaces provided.

1 What were you trying to find out in your investigation?
Complete the blank spaces in the sentence below.

I was trying to find out if the.....

.....depends on the

.....

(1 mark)

2 In your investigation, which was:

(a) the independent variable .....

(1 mark)

(b) the dependent variable. .....

(1 mark)

3 What instrument did you use to measure the temperature?

.....

(1 mark)

4 Complete the sentence below by writing a suitable word in the blank space.

This instrument works because the …… of the liquid inside increases with temperature.

(1 mark)

5 The instrument that you used to measure temperature had a smallest scale division of 1 °C. You could have used an instrument in which the smallest scale division was 0.1 °C.

What effect would this have had?

Tick the box beside the correct answer.

The measurement would have been more accurate ☐

The measurement would have been more precise ☐

The measurement would have been more reliable ☐

The measurement would have been more reproducible ☐

(1 mark)

6 In order to make it a fair test, you needed to control some **key variables**.

(a) Name **one** of the key variables that you needed to control.

.....

(1 mark)

(b) Explain why you needed to control this variable.

.....

.....

(1 mark)

7 It is better to take a series of temperature readings rather than just one at the start and one at the end. What is the reason for this?

.....

(1 mark)

8 Look back to Question 1 where you wrote down what you were trying to find out.

Now write down what you **did** find out from this investigation.

.....

.....

(1 mark)

9 Carry out a final check of your results and graph/s. You will be awarded up to 6 marks for these.

(6 marks)

16

Turn over for the next question

LEAVE MARGIN BLANK

Section 2

These questions are about an investigation that is similar to yours. You should use the results below, as well as your own understanding of how these investigations are carried out, to answer the questions.

Kwikdrinks Ltd. makes machines that sell hot drinks in disposable cups.
They want to find out two things:

(a) which is the best material for making the cup?

(b) is it worth supplying a lid to keep the drink hot for longer?

They filled different cups with the same volume of hot coffee and recorded the temperature every minute for 10 minutes.

The results are shown below.

Polystyrene cup – no lid	
Time/min	Temperature/°C
0	100
1	85
2	84
3	80
4	78
5	76
6	73
7	70
8	69
9	67
10	65

Paper cup – no lid	
Time/min	Temperature/°C
0	100
1	82
2	80
3	77
4	75
5	72
6	68
7	64
8	60
9	57
10	55

Polystyrene cup – with lid	
Time/min	Temperature/°C
0	100
1	88
2	86
3	84
4	82
5	80
6	78
7	77
8	75
9	74
10	73

Paper cup – with lid	
Time/min	Temperature/°C
0	100
1	84
2	81
3	79
4	77
5	75
6	71
7	68
8	65
9	63
10	60

10 Which of these **independent variables** were used in this investigation?

Tick **two** from the list below.

- The material the cup is made from ☐
- Whether or not the cup had a lid ☐
- The starting temperature of the water ☐
- The time for which the investigation was carried out ☐
- The volume of drink inside the cup ☐

(1 mark)

11 Write down one **control variable** which was kept constant during the investigations.

.....

(1 mark)

12 Which is the best way:

(a) to show how the temperature of **one** of the cups changed with time

Tick the box beside the correct answer.

- Bar chart ☐
- Line graph ☐
- Pie chart ☐
- Scatter graph ☐

(1 mark)

(b) to compare the temperature drop between all four cups?

Tick the box beside the correct answer.

- Bar chart ☐
- Line graph ☐
- Pie chart ☐
- Scatter graph ☐

(1 mark)

13 There is one anomalous result shown in one of the tables.

Draw a ring around this result.

(1 mark)

LEAVE MARGIN BLANK

14 Why did the tester make sure that all the tests started at 100 °C?

.....

(1 mark)

15 The thermometer used in one of the investigations was found to be reading 5 °C higher than the others.

(a) What kind of an error would this cause?

.....

(1 mark)

(b) Would this make any difference to the conclusion drawn? Explain your answer.

.....

.....

(1 mark)

16 Each container was tested only once.

If each container had been tested several times, what would this have improved?

Tick the box beside the correct answer.

The precision ☐

The reliability ☐

The reproducibility ☐

The validity ☐

(1 mark)

17 If the tests had been repeated, how should the results for each container be treated?
Tick the box beside the correct answer.

The best set of results should be kept and the other discarded ☐

The results of all the tests should be averaged to find the mean ☐

The first set of results should be used unless the others are very different ☐

The results of all the tests should be added together ☐

(1 mark)

18 Which container showed the biggest range of temperatures?

.....

(1 mark)

19 By how many degrees Celsius did the temperature drop in the first five minutes in the polystyrene cup with a lid?

..... °C

(1 mark)

20 From looking at these results, which do you think is more important for keeping the drinks hot; the type of material the cup is made from, **or** whether or not the cup has a lid.

I think that ..... is more important.

I think this because .....

.....

(1 mark)

21 One customer of Kwikdrinks Ltd. said 'I think the lid helps to keep the coffee hot because it stops the steam from escaping'.

Is there any evidence **in the tables of results** that this could be a correct scientific explanation, or is it just one person's opinion? Give a reason for your answer.

.....

.....

(1 mark)

22 Kwikdrinks decide that, based only on the ability to keep drinks hot, one of the cups is better than the others. However, before deciding which one to use, they need to consider other factors. These factors may be economic, environmental or technological.

Give **one** example of **each** kind of factor that they may need to consider.

Quality of written communication is important in this answer.

.....

.....

.....

.....

.....

(4 marks)

14

END OF QUESTIONS

ISA – Physics 1 – Thermal Insulation

Marking Guidelines

Specimen Material

Please mark in red ink, and use one tick for one mark.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

One of the marks on this test is to be awarded for the Quality of Written Communication (QWC)

Section 1

1	Dependent and independent variables correctly named, and in correct order		1 mark
2	(a)	correct independent variable, eg size, volume, colour	1mark
	(b)	correct dependent variable, eg temperature	1 mark
3	Thermometer		1 mark
4	Volume/length		1 mark
5	Precise		1 mark
6	(a)	Any correct key variable named (eg volume of water used)	1 mark
	(b)	Reason given correct but must be linked to key factor stated (eg larger volume of water would contain more heat energy)	1 mark
7	Easier to spot a trend or pattern/easier to see if an erroneous result occurs.		1 mark
8	Conclusion which matches the candidate's own results		1 mark
9	Suitable table of results with all relevant data included		1 mark
	Columns and rows correctly labelled		1 mark
	Units present and correct		1 mark
	Correct choice of bar chart or graph		1 mark
	Suitable scales chosen and labelled		1 mark
	Correct plotting		1 mark

Max 16 marks

Section 2

10 The material the cup is made from/whether or not the cup had a lid (both correct for one mark) 1 mark

11 Volume of liquid/initial temperature 1 mark

12 (a) Line graph 1 mark

(b) Bar chart 1 mark

13 Four minutes for paper cup with lid ringed 1 mark

14 Idea of fair test/easier to compare 1 mark

15 (a) Systematic error/zero error 1 mark

(b) Either no, because it is the temperature drop which is important, or yes, because it meant they would not all have started from the same temperature 1 mark

16 The reliability 1 mark

17 The results of all the tests should be averaged to find mean 1 mark

18 Paper cup with lid 1 mark

19 20 1 mark

20 B – because those showed the largest temperature drop 1 mark

21 No – evidence plus reason, eg steam not measured in investigation 1 mark

22 (economic) cost of cups/availability of material 1 mark

(environmental) whether they are biodegradable/whether they are produced from replenishable sources 1 mark

(technological) strength of material/how easy it is to work/thermal conductivity 1 mark

Quality of written communication - correct use of any **three** technical terms, 1 mark

eg biodegradable; recyclable/reusable; renewable/replenishable; terms connected with thermal properties, eg conductivity/insulation/melting point; terms connected with mechanical properties, eg strength/rigidity/density/ hardness.

Underline each term correctly used. Once three have been underlined, tick the icon.

Max 18 marks

Teachers' Notes
ISA – Physics 1 – Immersion Heaters
Specimen Material

This ISA relates to: Physics 1

Preparation sheet for an investigation into the efficiency of the transfer of energy from an immersion heater to a beaker of water.

This investigation is based on the section relating to efficiency of energy transfer in Physics 1.

The practical work can be carried out in several ways, but is designed to produce data on the energy input into a type of immersion heater and the measured output of the heat in an amount of water. It is not intended that the investigation assesses the knowledge or the use of formulae to calculate these changes in energy, or indeed the calculation of the efficiency. This can be carried out by candidates, as part of their further learning or by programmed spreadsheets or any way that does not interfere with the candidates' understanding of 'how science works'.

If this investigation is to be related to the assessment of skills then students should be given some responsibility for the organisation of the equipment. If not then support can be given to the construction of the circuit and the immersion heater. The heater can be of any type that gives reasonable results in a satisfactory length of time. Candidates should be instructed to set the correct voltage and check on the voltage and current during the investigation, to keep them constant. They should record temperatures regularly during the heating and continue until such time as it seems likely that they have a curve appearing to illustrate a slowing down in the rate of heating. A simple explanation of why this happens can be given. Candidates should be familiar with how their temperature measuring device works. Each candidate should have their own set of results even if they work collaboratively.

Note that if this practical is being used to assess the skills associated with the carrying out of practical work then the method should be sufficiently sophisticated to allow access to the marks expected for those candidates. Note that any help given could reduce the marks available.

Candidates can work individually or in groups and can pool results if it is thought to be appropriate.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way, eg bar chart or line graph. This part of the activity must be carried out individually and under direct supervision (ie controlled conditions). The table of data and graphs should then be kept by the teacher and provided to the candidate for the subsequent ISA.

Candidates should have a copy of **their** results, any pooled results and a suitable graphical representation of those results at the assessment.

GCSE Science – Investigative Skills Assignment
Physics 1 – Immersion Heaters
Specimen Material

Centre number						Candidate number					Today's date	. . . /. . . / . . .
Candidate name (please print)								Are your own results submitted with this ISA?				YES/NO (delete one)

Instructions

- Maximum time allowed: 45 minutes.
- Use blue or black ink or ball-point pen.
- Fill in the boxes above.
- Answer **all** questions.
- Answer the questions in the spaces provided.

Code	Title of own investigation	Mark (to be filled in by teacher)	
		Section 1	
		Section 2	
		Total (max 34)	

Signature of candidate ..... Date .....

Signature of teacher marking this ISA ..... Date .....

Section 1

These questions refer to **your own investigation** into the efficiency of heating water using an immersion heater. You should use your own results, your graph/s and what you remember about doing your investigation to answer these questions.
All answers should be in the spaces provided.

1 What was the purpose of your investigation?

.....

.....

(1 mark)

2 In your investigation, which was:

(a) the **independent** variable

.....

(1 mark)

(b) the **dependent** variable?

.....

.....

(1 mark)

3 Why did you need to keep checking the readings on the voltmeter and the ammeter?

.....

.....

(1 mark)

4 (a) What was the efficiency of your immersion heater?

..... %

Write down how your results compared with others in your group.

.....

(1 mark)

(b) Different groups will have obtained different results.
Suggest **one** possible cause for these differences.

.....

.....

(2 marks)

LEAVE MARGIN BLANK

5 Your teacher suggests that your result is not very reliable.
Explain what you could do to make your result more reliable.

.....

.....

(2 marks)

6 Write down the range of temperatures that you recorded.

.....

(1 mark)

7 Did your thermometer measure the thermal energy being given out by the immersion heater directly or indirectly?

Cross out one of the words in the box below, and then explain your answer.

Indirectly Directly

because.....

.....

(*1 mark)*

8 During your investigation, did you notice anything that could account for any loss of thermal energy from the water?

.....

(1 mark)

9 Look carefully at the pattern in your graph.
Use evidence from your graph to explain whether you believe that, as a measure of the efficiency of the immersion heater, this data is reliable.

.....

.....

(2 marks)

10 Carry out a final check of your results and graph/s. You will be awarded up to 6 marks for these.

(6 marks)

20

Turn over for the next question

Section 2

These questions refer to the data provided by a manufacturer of immersion heaters and to some records taken by Hamish who used the heater. You should use the results below as well as your own understanding of how these investigations are carried out to answer the questions.

The heater runs on mains electricity at 230 volts and is designed to heat enough water for a bath – about 500 litres. The manufacturer claims that this would use 5.5 kWh (or units) of electricity. Hamish checked this. He measured the temperature of the water by using a thermometer with a scale measuring every 2 °C. He repeated his investigation five times.

The manufacturer claimed an efficiency of 95 %.

Hamish's results are shown in the table below.

Electrical energy used (kWh)	Amount of water heated (litres)	Temperature before (^{o}C)	Temperature after (^{o}C)	Temperature change (^{o}C)	Calculated efficiency (%)
30.3	500	15	55	40	77
24.5	500	23	57	34	81
28.1	500	20	58	38	79
26.5	500	25	60	35	77
32.2	500	16	59	43	78

11 Hamish drew a bar chart of his data.
What should his bar chart show?
Tick the box beside the correct answer.

Just Hamish's five results ☐

Just Hamish's average of his results ☐

Just the manufacturer's claimed efficiency ☐

Hamish's average efficiency and manufacturer's claimed efficiency ☐

(1 mark)

12 What was the average amount of electrical energy used by Hamish?

.....kWh

(1 mark)

13 Which **one** of the following variables did Hamish control during this investigation?
Tick the box beside the correct answer.

The amount of water heated ☐

The energy used to heat the water ☐

The temperature before heating ☐

The temperature change ☐

(1 mark)

14 Look carefully at how Hamish had measured the temperature of the water in his bath.
Identify an error in the way Hamish collected these results. Suggest **two** ways he could have used better equipment and a better method to get greater precision.

Quality of written communication is important in this answer.

First way:.....

.....

.....

Second way: .....

.....

.....

(4 marks)

15 Because of the way that Hamish designed his investigation, it is difficult to judge which of Hamish's results are correct. Why is it difficult to judge which results are correct?

.....

.....

(1 mark)

16 Hamish concluded that the manufacturing company was not telling the truth about the efficiency of the heater.
Do you agree with Hamish's conclusion?
Answer yes or no and explain your answer.

.....

.....

(1 mark)

17 Hamish believed that the efficiency of an immersion heater depended on the starting temperature of the water being heated.
Think about how you could adapt your own investigation and use your immersion heater to test this idea.

(a) Which range and frequency temperatures would you choose for this investigation?
Tick the box beside the correct answer.

0 °C to 30 °C at 5 °C intervals ☐

0 °C to 100 °C at 10 °C intervals ☐

10 °C to 30 °C at 5 °C intervals ☐

10 °C to 100 °C at 10 °C intervals ☐

(1 mark)

(b) How would you change your method to get the correct starting temperatures?

.....

.....

(1 mark)

(c) Your immersion heater was run off a low voltage power supply that was connected to the mains.

The mains electricity meter measures energy. Would it be suitable for recording how much energy you used during your investigation?
Explain your answer.

.....

.....

(1 mark)

18 It is important that we are aware of the efficiency of domestic immersion heaters**.**
Explain why it is important.

.....

.....

(1 mark)

LEAVE MARGIN BLANK

19 Why was Hamish sensible to question the manufacturer's stated efficiency of the immersion heater?
Tick the box beside the correct answer.

The manufacturer could be biased ☐

The results might be out of date ☐

Efficiency can never be as high as 95% ☐

Efficiency is not measured in percentages ☐

(1 mark)

14

END OF QUESTIONS

ISA – Physics 1 – Immersion Heaters

Marking Guidelines

Specimen Material

Please mark in red ink, and use one tick for one mark.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

One of the marks on this test is to be awarded for the Quality of Written Communication (QWC)

Section 1

1		Any accurate statement that describes or states the efficiency of the immersion heater or the efficiency of the heating of the water using the immersion heater	1 mark
2	(a)	Independent variable correctly identified	1 mark
	(b)	Dependent variable correctly identified	1 mark
3		Idea that readings may fluctuate during investigation	
		Any change would have altered the amount of energy put into the heater or would have affected the calculation of the efficiency	1 mark
4	(a)	Identifies that there are some differences	1 mark
	(b)	Suggests a possible cause for the variation eg different amounts of water, different heaters, different lengths of time for heating, different voltages or currents	1 mark
		Suggestions linked correctly to a systematic or random error	1 mark
5		Idea of more repeats	1 mark
		Improved technique using a different set up, eg use digital meters, use some insulation, or repeat with a different person taking the readings	1 mark
6		Correctly stated range – upper and lower temperatures with units.	1 mark
7		Indirectly, because thermometer measures temperature, then thermal energy (heat) is calculated from this	1 mark
8		Correct statement such as: beaker or container getting hot, steam being given off	1 mark
9		Correct statement referring to graph about any variation or lack of it in those results	1 mark
		Includes evidence correctly used to show this variation/or lack of it	1 mark

10	Simple table of results (eg time and temperature only)	1 mark
	Complex table (eg including amps, volts, time and temperature)	1 mark
	All headings and units correctly entered	1 mark
	Choice of appropriate graphical format, eg bar chart or line graph	1 mark
	Sensible choice of scale, with axes labelled	1 mark
	Points correctly plotted and sensible line drawn	1 mark

Max 20 marks

Section 2

11	Hamish's average efficiency and manufacturer's claimed efficiency	1 mark
12	28.3	1 mark
13	The amount of water heated	1 mark
14	Identification of cause of unreliable results e.g. should have measured a consistent starting temperature **or** finishing temperature	1 mark
	Change of instrument, eg use a thermometer with a smaller scale	1 mark
	Change of method, eg take temperature of the water as it leaves the taps	1 mark
	Quality of Written Communication – Correct logical linkage between cause of unreliable results and any one change. Underline each term correctly used, tick the icon.	1 mark
15	Hamish did not make a fair test/did not control all the variables	1 mark
16	No – because Hamish's results are not reliable or they not valid The mark is for the reason – **not** just for saying no	1 mark
17	(a) 10 °C to 30 °C at 5 °C intervals	1 mark
	(b) eg leave beaker in a water bath until correct temperature is achieved – check using the thermometer	1 mark
	(c) Idea of sensitivity, eg No, because it would not measure such small amounts of energy	1 mark
18	eg so that we can save money/so we can reduce our energy consumption/reduce greenhouse gas emissions	1 mark
19	The manufacturer could be biased	1 mark

Max 14 marks

Teachers' Notes
ISA – Physics 2 – Resistance
Specimen Material

This ISA relates to: Physics 2

What does the current through an electrical circuit depend on?

Candidates should be given the opportunity to carry out an investigation concerning the resistance of any conductor, ohmic or non-ohmic.

Any suitable method will be acceptable.

Instructions of a general nature may be given, but these must not be so prescriptive as to not allow the candidate to make any decisions for him or herself.

Note that if this practical is being used to assess the skills associated with the carrying out of practical work then the method should be sufficiently sophisticated to allow access to the marks expected for those candidates. Note that any help given could reduce the marks available.

Candidates can work individually or in groups and can pool results if it is thought to be appropriate.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way, eg bar chart or line graph. This part of the activity must be carried out individually and under direct supervision (ie controlled conditions). The table of data and graphs should then be kept by the teacher and provided to the candidate for the subsequent ISA.

Candidates should have a copy of **their** results, any pooled results and a suitable graphical representation of those results at the assessment.

GCSE Science – Investigative Skills Assignment
Physics 2 – Resistance
Specimen Material

Centre number						Candidate number					Today's date	. . . /. . . / . . .
Candidate name (please print)								Are your own results submitted with this ISA?			YES/NO (delete one)

Instructions

- Maximum time allowed: 45 minutes.
- Use blue or black ink or ball-point pen.
- Fill in the boxes above.
- Answer **all** questions.
- Answer the questions in the spaces provided.

Code	Title of own investigation	Mark (to be filled in by teacher)	
		Section 1	
		Section 2	
		Total (max 34)	

Signature of candidate ..... Date .....

Signature of teacher marking this ISA ..... Date .....

Section 1

These questions refer to **your own investigation** into currents and electrical circuits. You should use your own results, your graph/s and what you remember about doing your investigation to answer these questions.

All answers should be written in the spaces provided.

1 What were you trying to find out in your investigation? Complete the blank spaces in the sentence below.

I was trying to find out if the.....

.....depends on the

.....

(1 mark)

2 In your investigation, which was:

(a) the independent variable .....

(1 mark)

(b) the dependent variable. .....

(1 mark)

3 Name one of the instruments that you used in your investigation.

I used a .....

.....

(1 mark)

4 Look at your results table.
What was the smallest scale division on the instrument that you wrote down in Question 3?

The smallest scale division was .....

(1 mark)

LEAVE MARGIN BLANK

5 If you had used an instrument with a smaller scale division, what effect would this have had? Tick the box beside the correct answer.

The measurement would have been more accurate ☐

The measurement would have been more precise ☐

The measurement would have been more reliable ☐

The measurement would have been more reproducible ☐

(1 mark)

6 In order to make it a fair test, you needed to control some **key variables**.

(a) Name one key variable that you needed to control.

.....

(1 mark)

(b) Explain why you needed to control this variable.

.....

(1 mark)

7 Did you decide to repeat any of your readings?
Answer yes or no, and give a reason for your decision.

.....

.....

(1 mark)

8 Look back to Question 1 where you wrote down what you were trying to find out.
Now write down what you **did** find out from this investigation.

.....

.....

(1 mark)

9 Carry out a final check of your results and graph/s. You will be awarded up to 6 marks for these.

(6 marks)

16

Section 2

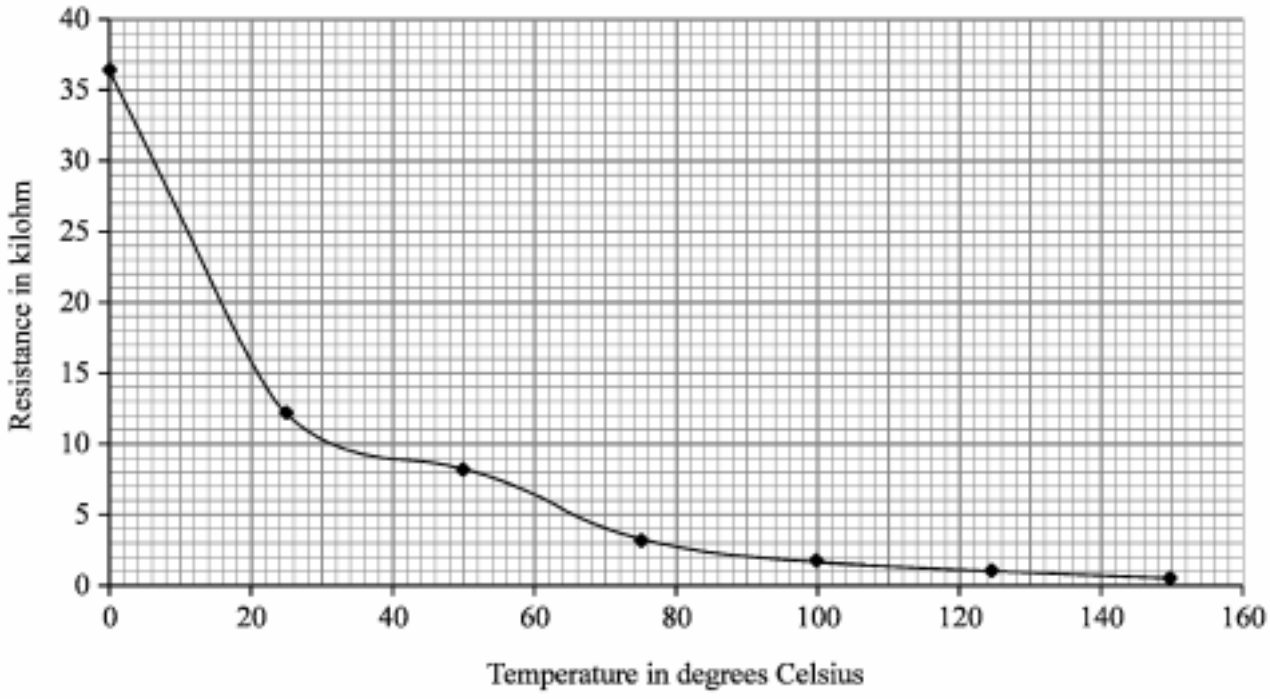
These questions are also concerned with electrical resistance. You should use the results below, as well as your own understanding of how these investigations are carried out, to answer the questions.

The 'Home Resistance Company plc' manufactures thermistors. These are resistors whose resistance changes with temperature. They can be used to switch electric circuits on or off at different temperatures. For example, they could switch a heater on if a room is too cold.

They recently supplied a batch of these thermistors to 'Glowarm Ltd.'. This company uses them to make room thermostats that control the room temperature in houses.

'Glowarm' complained that they had received a batch of thermistors that did not work properly, and asked 'Home Resistance Company' to check them. Here is part of their report.

We have checked one of the thermistors from the batch of 1000 that we recently supplied to you, and have found that it should be acceptable for your needs. We tested the thermistor at temperatures ranging from 0 °C to 150 °C, at 25 °C intervals. We did not test at higher temperatures than this because above 100 °C this device is not suitable for measuring small temperature changes. Here is a graph of our results.



You will notice that there is one anomalous result, but as this is outside the normal temperature range for house rooms (15 °C to 30 °C), this should not be a problem for you.

10 Describe the relationship between temperature and resistance that is shown in the graph.

.....

.....

(1 mark)

11 (a) Over what range of temperatures had the company tested the thermistors?

.....

.....

(1 mark)

(b) Was this the most appropriate range to choose?
Explain your answer.

.....

.....

(1 mark)

12 Why is this device 'not suitable for measuring small temperature changes above 100 °C'?

.....

.....

(1 mark)

13 (a) Draw a circle on the graph around the point that the Home Resistance Company considered to be anomalous.

(1 mark)

(b) Do you agree that this point is anomalous?
Explain your answer.

.....

.....

(1 mark)

14 The Home Resistance Company tested only one thermistor from the batch that they had supplied.

(a) Why was this **not** a good thing to do?

.....

.....

(1 mark)

(b) Suggest a suitable number that they should have sampled.

.....

(1 mark)

15 If they had tested more than one, what effect would this have had on the findings?
Tick the box beside the correct answer.

The results would be more accurate ☐

The results would be more precise ☐

The results would be more reliable ☐

The results would be more reproducible ☐

(1 mark)

16 How could the company have improved the **validity** of their tests?
Tick the box beside the correct answer.

Extended the range above 150 °C ☐

Extended the range below 0 °C ☐

Have larger intervals of temperature between the readings ☐

Have smaller intervals of temperature between the readings ☐

(1 mark)

17 Glowarm were not satisfied with the report, and claimed that the manufacturers were biased.
Explain what Glowarm meant by claiming that the report was biased.
Your answer should include **one** reason why it would be an **advantage** to Glowarm to produce a biased report and **one** reason why it would be a **disadvantage** to Glowarm to produce a biased report.

Quality of written communication is important in this answer.

.....

.....

.....

.....

.....

.....

(4 marks)

18 Glowarm asked another company to check the thermistors for them.
Explain why this was a good idea.

.....

.....

(1 mark)

19 Part of the report from the second company to test the thermistors is shown below.

We have tested a batch of the thermostats that you have manufactured with the thermistors supplied to you. We have **calibrated** these and found them to be within acceptable **tolerance** limits, which the table below shows.

Temperature °C	Maximum degrees error allowed	% error allowed
10	0.50	
15	0.75	
20	1.00	
25	1.25	
30	1.50	

(a) What is meant by the word '**calibrated**'?
Tick the box beside the correct answer.

They have had a scale marked on them ☐

They have been checked for accuracy ☐

They have been tested against a control ☐

They have been measured very accurately ☐

(1 mark)

(b) What is meant by '**tolerance**'?
Tick the box beside the correct answer.

A range either side of the intended value that is considered acceptable ☐

The highest temperature that the thermistor can withstand without damage ☐

The range of currents that the thermistor is designed to handle without damage ☐

The smallest temperature change that will produce a change in the resistance ☐

(1 mark)

(c) Work out the percentage error allowed at 10 °C

..... %

(1 mark)

18

END OF QUESTIONS

ISA – Physics 2 – Resistance

Marking Guidelines

Specimen Material

Please mark in red ink, and use one tick for one mark.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

One of the marks on this test is to be awarded for the Quality of Written Communication (QWC)

Section 1

1	Dependent and independent variables correctly named, and in the correct order		1 mark
2	(a)	Correct independent variable, eg length, cross-sectional area	1 mark
	(b)	Correct dependent variable, eg resistance	1 mark
3	Appropriate instrument AND measurement given, eg ammeter to measure current, voltmeter to measure voltage (p.d.), ruler to measure length, ohmmeter to measure resistance		1 mark
4	Correct smallest scale division given (see students table of results)		1 mark
5	The measurement would have been more precise		1 mark
6	(a)	any correct key variable named (eg diameter of wire)	1 mark
	(b)	reason given correct, but must be linked to key factor stated, eg thicker wires will/might have less/different resistance	1 mark
7	Either: Yes, because some variation detected to improve reliability **or**: No, because no deviation from pattern observed		1 mark
8	Conclusion consistent with the candidate's own results		1 mark
9	Suitable table of results with all relevant data included		1 mark
	Columns and rows correctly labelled		1 mark
	Units present and correct		1 mark
	Correct choice of bar chart or graph		1 mark
	Suitable scales chosen and labelled		1 mark
	Correct plotting		1 mark

Max 16 marks

Section 2

10	As temperature increases, resistance falls		1 mark
11	(a)	0 °C to 150 °C	1 mark
	(b)	No, don't need to go up as high	1 mark
12	Idea that at those temperatures there is very little change in resistance		1 mark
13	(a)	the point at 50 °C circled	1 mark
	(b)	No, more likely to be the point at 25 °C	1 mark
14	(a)	the one tested might not be typical	1 mark
	(b)	100 (= 10 % out of 1000) allow 50 to 200	1 mark
15	The results would be more reliable		1 mark
16	Have smaller intervals of temperature between the readings		1 mark
17	Idea that they were influencing the outcome of the tests		1 mark
	Avoid bad publicity/save money		1 mark
	Would reflect badly on company if made public		1 mark
	Quality of written communication - correct use of any **three** technical terms, eg bias; opinion; generalise; evidence; conclusion; valid/validity.		1 mark
	Underline each term correctly used.		
	Once three have been underlined, tick the icon.		
18	Idea of improved reliability		1 mark
19	(a)	They have had a scale marked on them	1 mark
	(b)	A range either side of the intended value that is considered acceptable	1 mark
	(c)	5 %	1 mark

Max 18 marks

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Teachers' Notes
ISA – Physics 3 – Transformers
Specimen Material

This ISA relates to: Physics 3

How do transformers work?

Candidates should be given the opportunity to carry out an investigation concerning transformers. They may use pre-wound, commercially available coils, or may wind their own coils.

They may investigate any aspect of transformers, eg the link between the ratio of turns and the ratio of the voltages, or the efficiency.

Any suitable method will be acceptable.

Instructions of a general nature may be given, but these must not be too prescriptive as the candidate should make any decisions for him or herself.

Note that if this practical is being used to assess the skills associated with the carrying out of practical work then the method should be sufficiently sophisticated to allow access to the marks expected for those candidates. Note that any help given could reduce the marks available.

Candidates can work individually or in groups and can pool results if it is thought to be appropriate.

Each candidate should draw up his or her own table of results and should process the data in an appropriate way, eg bar chart or line graph. This part of the activity must be carried out individually and under direct supervision (ie controlled conditions). The table of data and graphs should then be kept by the teacher and provided to the candidate for the subsequent ISA.

Candidates should have a copy of **their** results, any pooled results and a suitable graphical representation of those results at the assessment.

GCSE Science – Investigative Skills Assignment
Physics 3 – Transformers
Specimen Material

Centre number						Candidate number					Today's date	. . . /. . . / . . .
Candidate name (please print)								Are your own results submitted with this ISA?				YES/NO (delete one)

Instructions

- Maximum time allowed: 45 minutes.
- Use blue or black ink or ball-point pen.
- Fill in the boxes above.
- Answer **all** questions.
- Answer the questions in the spaces provided.

Code	Title of own investigation	Mark (to be filled in by teacher)	
		Section 1	
		Section 2	
		Total (max 34)	

Signature of candidate ..... Date .....

Signature of teacher marking this ISA ..... Date .....

Section 1

These questions refer to **your own investigation** into transformers. You should use your own results, your graph/s and what you remember about doing your investigation to answer these questions. All answers should be written in the spaces provided.

1 What were you trying to find out in your investigation? Complete the blank spaces in the sentence below.

I was trying to find out if the.....

.....depends on the

.....

(1 mark)

2 In your investigation:

(a) Which was the independent variable that you deliberately changed?

.....

(1 mark)

(b) What kind of a variable was this?
Draw a ring around the word that best describes your independent variable.

categoric **continuous** **discrete** **ordered** *(1 mark)*

3 What was the range of values that you chose for the independent variable?

The range was from.....to .....

(1 mark)

4 Was this a sensible range to choose?
Answer yes or no and give a reason for your answer.

.....

.....

(1 mark)

5 Look at your results.
If you had more time, is there any section within your chosen range where you would like to get more results?
Answer yes or no and give a reason for your answer.

.....

.....

.....

(1 mark)

6 In your investigation you would have used at least one kind of meter (ammeter, voltmeter or ohmmeter).

(a) Was the range over which the instrument was capable of measuring suitable for your investigation?
Explain your answer.

.....

.....

(1 mark)

(b) Was the sensitivity of this instrument suitable?
Explain your answer.

.....

.....

(1 mark)

7 Before you carried out your investigation, either you or your teacher would have carried out a preliminary test.
What was the reason for doing this?

.....

.....

(1 mark)

8 Look back to Question 1 where you wrote down what you were trying to find out
Now write down what you **did** find out from this investigation.

.....

.....

(1 mark)

9 Carry out a final check of your results and graph/s. You will be awarded up to 6 marks for these.

(6 marks)

16

Turn over for the next question

Section 2

These questions are also about transformers. You should use the results below, as well as your own understanding of how these investigations are carried out, to answer the questions.

Kate works in the research department of a company that manufactures transformers. The manufacturer is developing a new transformer for an audio speaker system.

Kate has been given the job of finding out how the efficiency of the transformer varies when the *load* applied to the secondary coil is changed.

The *load* is the device connected to the secondary coil, eg a speaker. The value of the load is measured in ohms.

Kate decided to find out how the efficiency of the transformer varied with the load.
Here is a table of her results.

Load at secondary coil (Ω)	**Efficiency (%)**
2	12.15
5	28.4
10	43.5
20	54.0
40	65.6
75	59.9
100	55.3
125	50.3
146	45.6
200	36.9
500	17.0

Answer the questions that follow.

10 Write down **one** variable that Kate should have controlled or monitored during the investigation.

.....

(1 mark)

11 Look at the first column in the table headed "Load at secondary coil (Ω)"

(a) What is the range of this variable?

.....

(1 mark)

(b) Describe the way in which the interval of the readings changes over this range.

.....

.....

(1 mark)

(c) Kate claimed that her measurement of the load at the secondary coil was to within ± 10%.

(i) What does this tell you about her measurements?
Draw a ring around the correct answer

the accuracy **the precision** **the reliability** **the validity**

(1 mark)

(ii) Complete the blank spaces in the following sentence.

When Kate claimed that the load was 100 ohms, it might actually have been

anything between …….ohms and ……..ohms.

(1 mark)

(d) Use the table to explain why Kate should have taken more readings between 20 Ω and 75 Ω.

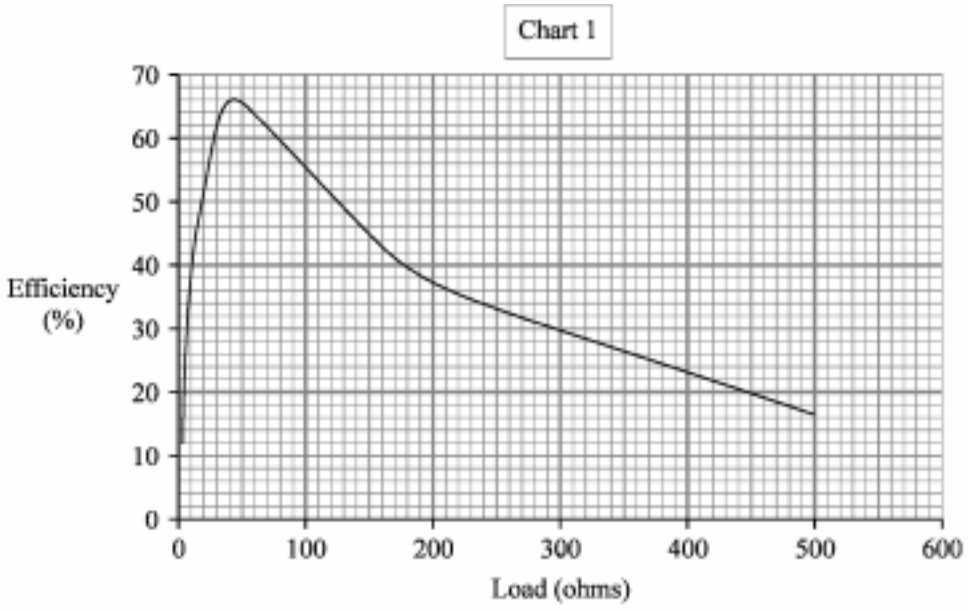
.....

.....

(1 mark)

Turn over for the next question

Kate produced two different charts of these results:



12 Look at Chart 1

Describe in detail what it tells you about the relationship between the load at the secondary and the efficiency.

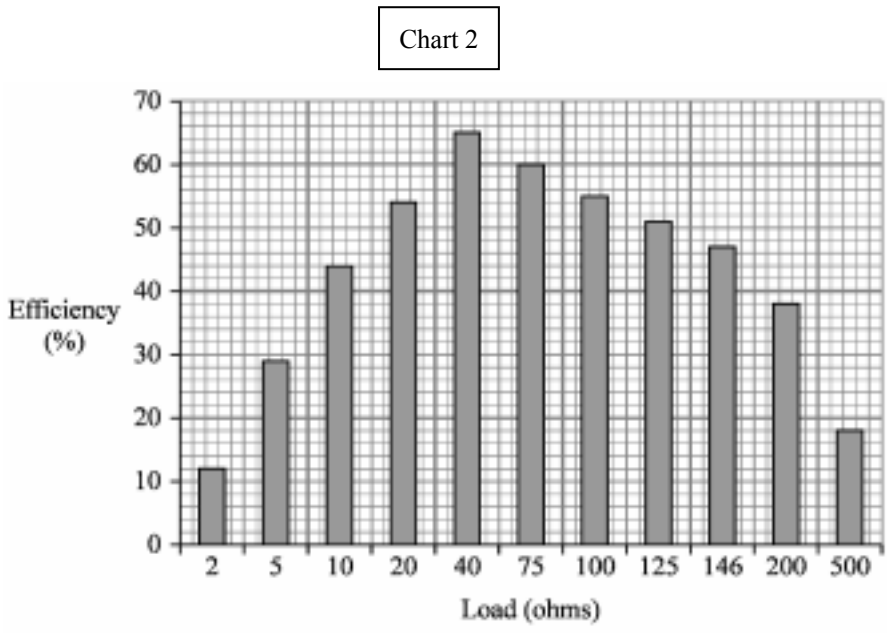
.....

.....

.....

.....

(2 marks)



13 Explain **two** reasons why Chart 2 is a **bad** way to present the results.

Quality of written communication is important in this answer.

.....

.....

.....

.....

(4 marks)

14 Kate's supervisor looked at the table of results and stated that it was a poor way of reporting. He said that Kate had not quoted any *measurements* of the outcome, but had only quoted a *calculated* result of the efficiency.
This also meant that he did not know if Kate had repeated any of the tests.

(a) Why would it have been important for Kate to repeat the tests?

.....

.....

(1 mark)

(b) In fact Kate had done each test 3 times.
What should she have done with these results?

Tick the box beside the correct answer.

Chosen the best set and discarded the others ☐

Taken an average of all three sets ☐

Discarded any anomalous results and averaged the rest ☐

Taken the middle value out of each set ☐

(1 mark)

(c) Explain why it is important to show actual results as well as calculated values.

.....

.....

(1 mark)

(d) Use the table to explain why Kate should have taken more readings between 20 Ω and 75 Ω.

.....

.....

(1 mark)

15 Why is it important that transformers should be as efficient as possible?

.....

.....

(1 mark)

16 The supervisor said, "If we publish Chart 2, our customers may think we have produced an excellent transformer. But if we hide the real data, the company will be accused of being *biased*"

(a) What did he mean by using the word *biased*?

.....

.....

(1 mark)

(b) Why might a manufacturer sometimes want to present a biased report?

.....

.....

(1 mark)

18

END OF QUESTIONS

ISA – Physics 3 – Transformers

Marking Guidelines

Specimen Material

Please mark in red ink, and use one tick for one mark.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

One of the marks on this test is to be awarded for the Quality of Written Communication (QWC)

Section 1

1	Dependent and independent variables correctly named, and in the correct order		1 mark
2	(a)	Correct independent variable, eg length, cross-sectional area	1 mark
	(b)	Correct variable chosen, eg continuous if length or cross-section, categoric if type of metal	1 mark
3	Range correctly stated and consistent with candidate's results		1 mark
4	Either yes, because eg it gave a good variation in the output variable **or**, no, because e.g. there was little variation in output variable		1 mark
5	Either no, because eg there were sufficient results to come to a conclusion **or** yes, because, eg there was a gap in the results where the pattern was uncertain		1 mark
6	(a)	Either yes because eg all readings fitted onto scale **or** no because eg needed readings higher than scale	1 mark
	(b)	Either yes because eg significant difference between all readings **or** no because eg hardly any change in readings	1 mark
7	To determine suitable range or choice of measuring instrument		1 mark
8	Conclusion consistent with the candidate's own results		1 mark
9	Suitable table of results with all relevant data included		1 mark
	Columns and rows correctly labelled		1 mark
	Units present and correct		1 mark
	Correct choice of bar chart or graph		1 mark
	Suitable scales chosen and labelled		1 mark
	Correct plotting		1 mark

Max 16 marks

Section 2

10 Any valid, eg primary voltage, primary current, number of turns 1 mark

11 (a) 2 to 500 ohms 1 mark

(b) Close together at the start, getting further apart 1 mark

(c) (i) The precision 1 mark

(ii) 90 and 110 (both figures correct) 1 mark

(d) Because this is where the peak of the graph lies. 1 mark

12 Efficiency increases rapidly to start with 1 mark
then falls off slowly 1 mark

13 Any three from:

Chart 2 is a bar chart; 3 marks

Continuous variable better on a line graph;

Scale on x axis is non linear;

Distorts where the peak occurs

Quality of written communication - correct use of any **three** technical terms, 1 mark
eg linear/non-linear; dependent variable/independent variable;
continuous variable/categoric variable; axis.

Underline each term correctly used. Once three have been underlined, tick the icon.

14 (a) Results would be more reliable 1 mark

(b) Left out any anomalous results and averaged the rest 1 mark

(c) To enable the supervisor to judge the work better / easier to spot any anomalous results 1 mark

15 Conserve energy/prevent overheating 1 mark

16 (a) Idea of being influenced by non-scientific factors, eg commercialism 1 mark

(b) For financial/commercial gain 1 mark

Max 18 marks