Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
PHYSICS

H

Higher Tier Paper 1

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

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

Do not write outside the box

0 1 **Figure 1** shows a large wind farm off the coast of the UK.

Figure 1

The mean power output of the wind farm is 696 MW, which is enough power for 580 000 homes.

0 1 . 1 Calculate the mean power needed for 1 home.

Give your answer in watts.

[2 marks]

Mean power needed for 1 home = _____ W

Do not write outside the box

0 1 . 2 On one day the demand for electricity in the UK was 34 000 MW.

Suggest **two** reasons why wind power was not able to meet this demand.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 1 . 3 Some of the energy from the wind used to rotate a wind turbine is wasted.

An engineer oils the mechanical parts of a wind turbine.

Explain how oiling would affect the efficiency of the wind turbine.

[3 marks]

_____

_____

_____

_____

_____

0 1 . 4 In most homes in the UK there are many different electrical devices.

Explain why people should be encouraged to use energy efficient electrical devices.

[2 marks]

_____

_____

_____

_____

_____

9

Do not write outside the box

0 2 **Figure 2** shows a rock found by a student on a beach.

To help identify the type of rock, the student took measurements to determine its density.

Figure 2

0 2 . 1 Describe a method the student could use to determine the density of the rock.

[6 marks]

Do not write outside the box

The student determined the density of the rock to be 2.55 ± 0.10 g/cm^3.

0 2 . 2 What are the maximum and minimum values for the density of the rock?

[1 mark]

Maximum density = _____ g/cm^3

Minimum density = _____ g/cm^3

0 2 . 3 **Table 1** gives the density of five different types of rock.

Table 1

Type of rock	**Density in g/cm^3**
Basalt	2.90 ± 0.10
Chalk	2.35 ± 0.15
Flint	2.60 ± 0.10
Sandstone	2.20 ± 0.20
Slate	2.90 ± 0.20

Which two types of rock in **Table 1** could be the type of rock the student had?

[1 mark]

Tick (✓) **one** box.

Basalt or chalk ☐

Chalk or flint ☐

Flint or sandstone ☐

Sandstone or slate ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 The student only took one set of measurements to determine the density of the rock.

Explain why taking the measurements more than once may improve the accuracy of the density value.

[2 marks]

10

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 3 An engineering company has invented pavement tiles that generate electricity as people walk on them.

Figure 3 shows someone walking on the pavement tiles.

Figure 3

Use the Physics Equations Sheet to answer questions **03.1** and **03.2**.

0 3 . 1 What equation links current (I), potential difference (V) and power (P)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{V}{I}$ ☐

$P = V \times I$ ☐

$I = P \times V$ ☐

$V = I^2 \times P$ ☐

Do not write outside the box

0 3 . 2 When a person walks on a tile, a potential difference of 40 V is induced across the tile.

The power output of the tile is 4.4 W.

Calculate the current in the tile.

[3 marks]

Current = _____ A

Question 3 continues on the next page

Do not write outside the box

Use the Physics Equations Sheet to answer questions **03.3** and **03.4**.

0 3 . 3 What equation links efficiency, total power input and useful power output?

[1 mark]

Tick (✓) **one** box.

Efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ ☐

Efficiency = $\frac{\text{total power input}}{\text{useful power output}}$ ☐

Efficiency = useful power output × total power input ☐

0 3 . 4 The tiles are used to power LED lights in the pavement.

An LED light has a total power input of 4.0 W.

The efficiency of the LED light is 0.85

Calculate the useful power output of the LED light.

[3 marks]

Useful power output = _____ W

8

Do not write outside the box

Turn over for the next question

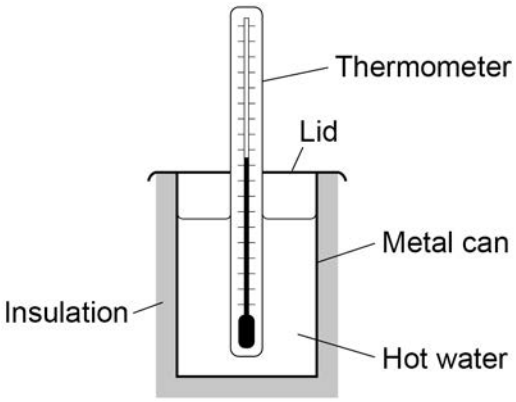
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 4 A student investigated the insulating properties of different materials.

Figure 4 shows some of the equipment used by the student.

Figure 4



This is the method used:

1. Wrap insulating material around the can.
2. Put a fixed volume of boiling water in the can.
3. Place the lid on the top of the can.
4. Measure the time taken for the temperature of the water to decrease by a fixed amount.
5. Repeat steps 1–4 using the same thickness of different insulating materials.

0 4 . 1 Identify the independent variable and the dependent variable in this investigation.

[2 marks]

Independent variable _____

Dependent variable _____

Do not write outside the box

The student used two different types of thermometer to measure the temperature changes.

Figure 5 shows a reading on each thermometer.

Figure 5

0 4 . 2 What is the resolution of thermometer **B**?

[1 mark]

Resolution = _____ °C

0 4 . 3 Thermometer **A** is more likely to be misread.

Give **one** reason why.

[1 mark]

_____

_____

_____

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 For one type of insulating material, the temperature of the water decreased from 85.0 °C to 65.0 °C.

The energy transferred from the water was 10.5 kJ.

specific heat capacity of water = 4200 J/kg °C

Calculate the mass of water in the can.

Use the Physics Equations Sheet.

[3 marks]

Mass = _____ kg

Do not write outside the box

0 4 . 5 **Table 2** shows the results for two insulating materials.

Table 2

Material	Time for temperature to decrease by 20 °C in seconds
X	450
Y	745

Explain how the results in **Table 2** can be used to compare the thermal conductivity of the two materials.

[2 marks]

9

Turn over for the next question

Do not write outside the box

0 5 A student rubbed a plastic rod with a cloth.

The rod became negatively charged and the cloth became positively charged.

0 5 . 1 Explain why the cloth became positively charged.

[3 marks]

Figure 6 shows the negatively charged rod on a balance.

Figure 6

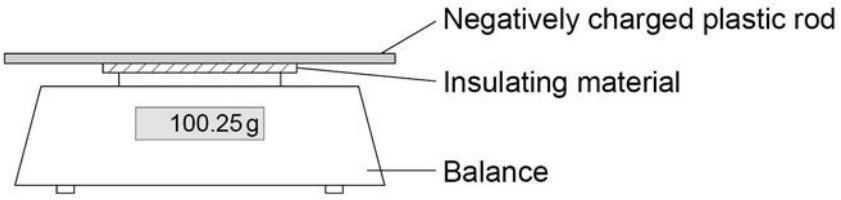
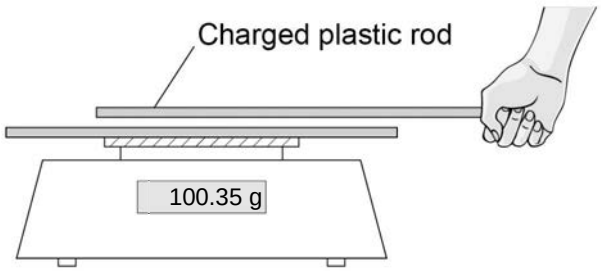


Figure 7 shows another charged rod being held stationary above the rod on the balance.

The rods do not touch each other.

Figure 7



Do not write outside the box

0 5 . 2 Explain why the reading on the balance increases.

[3 marks]

0 5 . 3 The balance had a zero error.

The zero error is not important in this experiment.

Give the reason why.

[1 mark]

0 5 . 4 A negatively charged rod is held near an earthed conductor.

Explain why a spark jumps between the negatively charged rod and the earthed conductor.

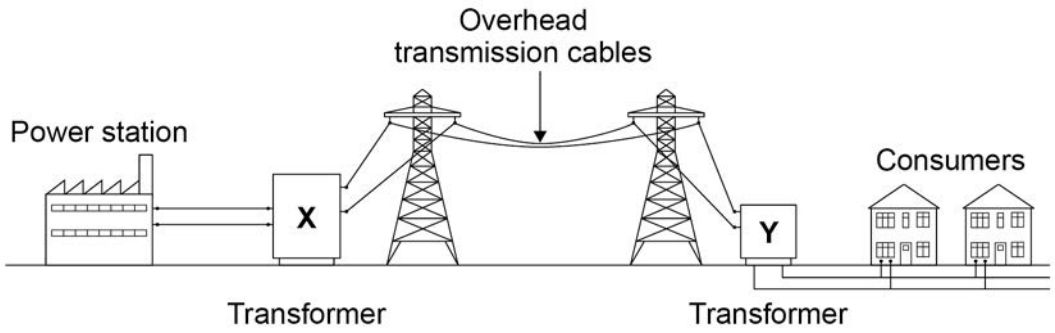
[3 marks]

10

Do not write outside the box

0 6 **Figure 8** shows how electricity is supplied to consumers by the National Grid.

Figure 8



0 6 . 1 Explain why transformer **X** is used in the National Grid.

[4 marks]

0 6 . 2 Explain why transformer **Y** is used in the National Grid.

[2 marks]

Do not write outside the box

0 6 . 3 The town of Hornsdale in Australia has electricity supplied by a huge battery.

On one day the battery transferred 3.24×10^{11} J of energy to the town.

The potential difference of the town's electricity supply is 230 V.

Calculate the charge flow to the town on this day.

Use the Physics Equations Sheet.

Give your answer to **3** significant figures.

[4 marks]

Charge flow (3 significant figures) = _____ C

10

Turn over for the next question

Do not write outside the box

0 7 Alpha particles, beta particles and gamma rays are types of nuclear radiation.

0 7 . 1 What does an alpha particle consist of?

[1 mark]

0 7 . 2 A krypton (Kr) nucleus decays into a rubidium (Rb) nucleus by emitting a beta particle.

Complete the nuclear equation for this decay by writing the missing number in each box.

[2 marks]

$$\square_{36}\mathrm{Kr} \longrightarrow \square^{85}\mathrm{Rb} + {}^{0}_{-1}\mathrm{e}$$

0 7 . 3 Internal contamination of the human body means radioactive material is inside the human body.

Explain how the risk from internal contamination is different to the risk from external irradiation by a source of alpha radiation.

[5 marks]

8

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Turn over for the next question

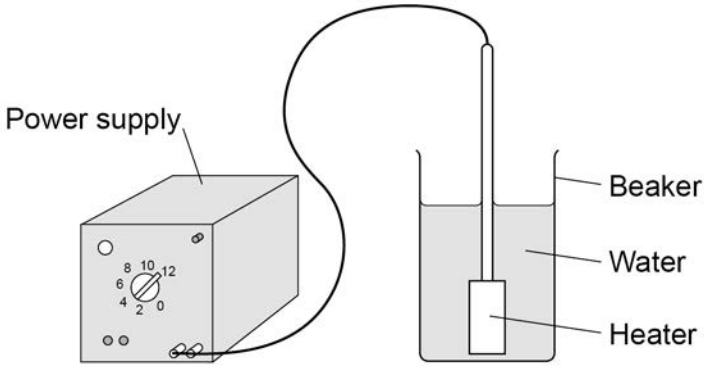
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 8 A student determined the specific latent heat of vaporisation of water.

Figure 9 shows some of the equipment used.

Figure 9



This is the method used:

1. Put 50 cm^3 of water in a beaker.
2. Measure the mass of the beaker and water.
3. Use a heater to boil the water and keep it boiling for 600 seconds.
4. Measure the mass of the beaker and water after 600 seconds.

0 8 . 1 What measuring instrument should be used to measure the volume of water?

[1 mark]

0 8 . 2 What is a hazard in the student's investigation?

[1 mark]

Tick (✓) **one** box.

burns ☐

boiling water ☐

heatproof gloves ☐

safety goggles ☐

Do not write outside the box

0 8 . 3 The initial mass of the beaker and water was 0.080 kg.

The final mass of the beaker and water was 0.071 kg.

The energy transferred by the immersion heater as the water boiled was 25 200 J.

Calculate the specific latent heat of vaporisation of water given by the student's data.

Give the unit.

Use the Physics Equations Sheet.

[5 marks]

Specific latent heat of vaporisation = _____ Unit _____

Question 8 continues on the next page

Do not write outside the box

0 8 . 4 Some thermal energy was transferred to the surroundings while the water was being heated.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

[2 marks]

0 8 . 5 Some of the water evaporated before its temperature reached 100 °C.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

[2 marks]

11

Do not write outside the box

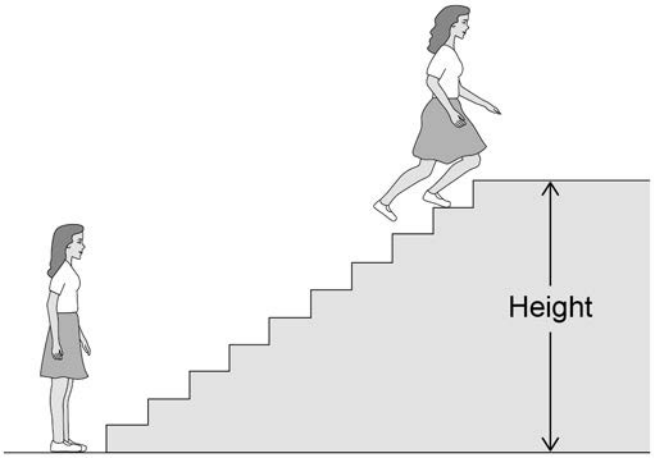
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 9 **Figure 10** shows a girl doing an experiment to determine her power output by running to the top of some stairs.

Figure 10



0 9 . 1 The mass of the girl was 60.0 kg.

The height of the stairs was 175 cm.

The girl ran to the top of the stairs in 1.40 s.

gravitational field strength = 9.8 N/kg

Calculate the power output of the girl.

Use the Physics Equations Sheet.

[5 marks]

Power = _____ W

Do not write outside the box

0 9 . 2 The **total** power output of the girl was greater than the answer to question **09.1**.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 3 A boy took more than 1.40 s to run up the same stairs.

The power output of the boy was the same as the power output of the girl.

What conclusion can be made about the boy's mass?

[1 mark]

Tick (✓) **one** box.

The boy's mass was greater than the girl's mass. ☐

The boy's mass was lower than the girl's mass. ☐

The boy's mass was the same as the girl's mass. ☐

8

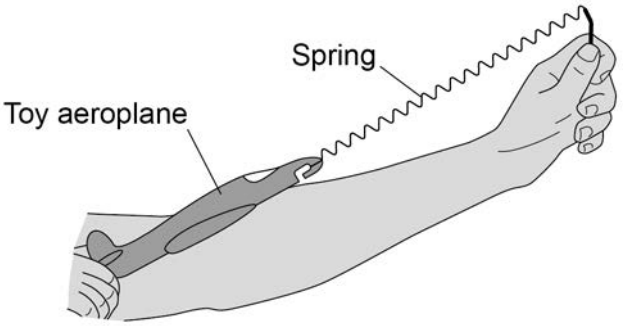
Turn over for the next question

Do not write outside the box

1 0 **Figure 11** shows a student launching a toy aeroplane.

To launch the aeroplane, the student pulls on it to stretch the spring and then releases it.

Figure 11



1 0 . 1 Just before the toy aeroplane is released, the spring has an extension of 0.12 m.

mass of aeroplane = 0.020 kg

spring constant of the spring = 50 N/m

Calculate the maximum speed of the toy aeroplane just after it is launched.

Use the Physics Equations Sheet.

Give the unit.

[6 marks]

Speed = _____ Unit _____

Do not write outside the box

1 0 . 2 Complete the sentence.

[1 mark]

As the aeroplane moves upwards through the air there is a decrease

in the _____ energy of the aeroplane.

1 0 . 3 Give **one** factor which would increase the distance the toy aeroplane travels horizontally before hitting the ground.

[1 mark]

_____

_____

8

Turn over for the next question

Do not write outside the box

1 1 **Figure 12** shows some hair straighteners.

Hair straighteners contain heating elements.

Figure 12

1 1 . 1 When the hair straighteners reach normal operating temperature, an LED turns on.

Draw the circuit symbol for an LED in the box.

[1 mark]

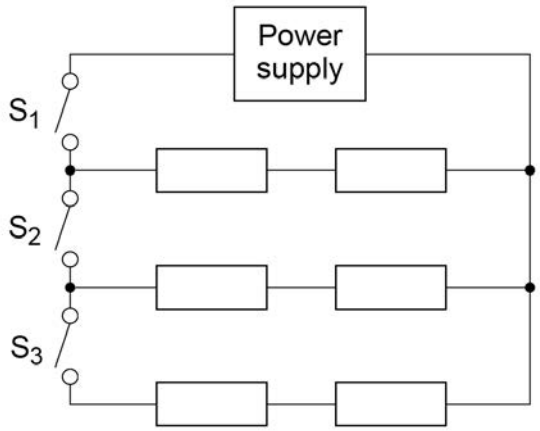
Do not write outside the box

Figure 13 shows the circuit diagram for the hair straighteners.

Each resistor represents a heating element.

The power output of the hair straighteners can be changed by closing different switches.

Figure 13



1 1 . 2 Why do the hair straighteners **not** turn on when only switch S_2 is closed?

[1 mark]

Question 11 continues on the next page

Do not write outside the box

1 1 . 3 The hair straighteners have a maximum power output of 120 W.

The energy transferred to the hair straighteners to reach normal operating temperature is 3.6 kJ.

Calculate the time taken for the hair straighteners to reach normal operating temperature when operating at maximum power.

Use the Physics Equations Sheet.

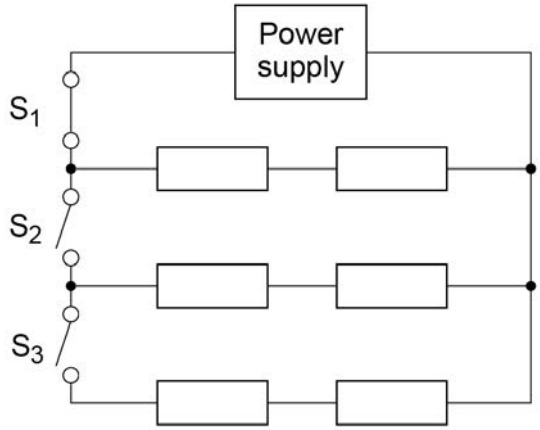
[4 marks]

Time = _____ seconds

Do not write outside the box

1 1 . 4 **Figure 14** shows the hair straighteners circuit with switch S_1 closed.

Figure 14



Switch S_2 and switch S_3 are then closed at the same time.

Explain what happens to the power output of the power supply.

[3 marks]

9

END OF QUESTIONS

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There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**
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GCSE
PHYSICS
8463/1H

Paper 1 Higher Tier

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

226G8463/1H/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the examiner make their judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Alternative words in the mark scheme are shown by a solidus eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name **two** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level.

The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	*P* = 696 000 000 (W) *P* = 1200 (W)	 allow an answer consistent with their incorrectly / not converted value of *P*	1 1	AO2 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **2** from: • wind is unreliable • wind turbines don't turn when the wind is too strong/weak • there are not enough wind turbines (in the UK)	 allow it was not windy (on that day) allow some wind turbines may be offline for maintenance allow energy from wind may not be enough (to generate 34 000 MW) ignore weather conditions unqualified	2	AO2 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	the efficiency would increase because the percentage / proportion / amount of energy usefully transferred would increase **or** because the percentage / proportion / amount of energy wasted would decrease (because) less (work is done against) friction	 ignore more electricity generated allow less energy wasted	1 1 1	AO3 AO1 AO1 4.1.2.1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	more efficient devices waste less energy **or** more efficient devices need a lower energy input (for the same energy output)	ignore use less electricity	1	AO3 4.1.2.2 4.1.3
	which would minimise the electricity / energy demand **or** which would minimise the environmental impact from (fossil fuel) electricity generation	allow less electricity needs to be generated allow lower energy / electricity bill allow examples of environmental impact e.g. lower CO_2 emissions ignore 'better for the environment' unless qualified ignore answers that discuss 'saving energy' unless qualified ignore answers that discuss alternative methods of generating electricity	1	

Total Question 1		**9**

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	**Level 3**: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.3.1.1 RPA5
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content: • measure mass using a balance / scales • part fill a measuring cylinder with water and measure initial volume • place rock in water and measure final volume • volume of rock = final volume − initial volume • fill a displacement / eureka can with water level with spout • place rock in water and collect displaced water • measuring cylinder used to determine volume of displaced water • volume of rock = volume of displaced water • use mass and volume to calculate density • use of: density = $\frac{\text{mass}}{\text{volume}}$		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	maximum density = 2.65 (g/cm^3) minimum density = 2.45 (g/cm^3)	both required	1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	chalk or flint		1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	a mean can be calculated which reduces the effect of random errors	 allow anomalies can be identified / removed	1 1	AO3 4.3.1.1 RPA5

Total Question 2		**10**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$P = V \times I$		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	$4.4 = 40 \times I$ $I = \frac{4.4}{40}$ $I = 0.11$ (A)		1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$		1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	$0.85 = \frac{P}{4.0}$ $P = 0.85 \times 4.0$ $P = 3.4$ (W)		1 1 1	AO2 4.1.2.2

Total Question 3		**8**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	independent variable: (type of) insulation / material dependent variable: time	do not accept thickness of material	1 1	AO1 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	0.1 (ºC)		1	AO3 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	viewing angle affects measurement **or** parallax error	allow judgement needed in reading the position (of the liquid in the thermometer) allow the level of the liquid may be between lines allow number of lines may be miscounted ignore harder to read ignore lines are close together ignore human error	1	AO3 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	E = 10 500(J)		1	AO2 4.1.1.3
	$m = \frac{10\ 500}{4200 \times (85\text{-}65)}$	allow a correct substitution **and** rearrangement using an incorrectly / not converted value of E	1	RPA2
	m = 0.125 (kg)	allow a correct calculation using an incorrectly / not converted value of E	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(same) temperature decrease in a shorter time means a higher thermal conductivity	allow converse answer	1	AO1 4.1.2.1 RPA2
	(because) the rate of energy transfer is higher		1	

Total Question 4		**9**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1		any mention of transfer of positive charge scores 0 any mention of positive electrons scores 0		AO1 4.2.5.1
	electrons transferred from the cloth (to the rod)		1	
	electrons are negatively charged	this mark only scores if linked to the first marking point	1	
	(so) there are more positive charges than negative charges on the cloth	ignore more protons than electrons unqualified	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	there is an additional (downwards) force on the balance (increasing the mass reading)		1	AO3 AO3
	(because) the (held) rod is negatively charged	allow both rods have the same (negative) charge	1	AO1
	(and rods with) like charges repel **or** (and rods with) negative charges repel each other		1	4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	only the change in reading / mass is being observed	allow difference / increase for 'change in'	1	AO3 4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the (large) potential difference between the two objects	allow (strong) electric field causes breakdown of air do not accept earthed conductor is positively charged	1	AO1 4.2.5.2
	(causes negative) electrons / charges to move (through the air)	allow there is a current in the air (between the two objects)	1	
	(from the rod) to the conductor		1	

Total Question 5		**10**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	transformer **X** increases potential difference		1	AO1 4.2.4.3
	and decreases current	do not accept if student states that potential difference decreases	1	
	reducing (thermal) energy transfer to surroundings **or** reducing (thermal) energy transfer from transmission cables	do not accept no energy transfer to surroundings	1	
	increasing the efficiency (of power transmission)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	transformer **Y** decreases the potential difference		1	AO1 4.2.4.3
	to a safe / safer value	dependent on scoring 1st marking point	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$3.24 \times 10^{11} = Q \times 230$		1	AO2 4.2.4.2
	$Q = \frac{3.24 \times 10^{11}}{230}$		1	
	Q = 1 408 695 652 (C)		1	
	$Q = 1.41 \times 10^{9}$ (C) **or** *Q* = 1 410 000 000 (C)	allow correct rounding of an incorrect answer using data from the question	1	

Total Question 6		**10**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	two protons and two neutrons	allow helium nucleus ignore symbols	1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	85 37	this order only	1 1	AO1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	alpha radiation has a low penetrating ability		1	AO1 4.4.2.4
	(so externally) alpha radiation is stopped by skin (so is low risk)	allow absorbed for stopped ignore reference to range of alpha particles through other materials	1	
	internally, alpha radiation is absorbed by living tissue / organs	allow (internal) contamination will increase the radiation dose	1	
	(as) alpha radiation is highly ionising		1	
	(internal) contamination will cause greater (risk of) harm to cells / tissues / organs / DNA / genes	allow contamination causes greater chance of developing cancer allow greater chance of mutations	1	

Total Question 7		**8**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	measuring cylinder	allow burette allow beaker with scale / graduations	1	AO3 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	boiling water		1	AO3 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	change in mass = 0.009 (kg)		1	AO2
	25 200 = 0.009 *L*	allow a correct substitution using an incorrectly calculated value of *m*	1	AO2
	$L = \frac{25\,200}{0.009}$	allow a correct rearrangement using an incorrectly calculated value of *m*	1	AO2 AO2
	$L = 2.8 \times 10^6$ or $L = 2\,800\,000$	allow a correctly calculated answer using an incorrectly calculated value of *m*	1	AO1 4.3.2.3
	J/kg	if a unit other than J/kg is given it must match the numerical answer	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	less energy (than 25 200 J) was transferred to the water		1	AO3 4.3.2.3
	(so) student's value of *L* was too high	2nd mark conditional on scoring 1st mark	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	the measured change in mass is too high (for the energy supplied)	allow a smaller mass of water actually changed state at boiling point	1	AO3 4.3.2.3
	(so) student's value of L is too low	2nd mark conditional on scoring 1st mark	1	

Total Question 8		**11**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	h = 1.75 (m)		1	AO2 4.1.1.4
	E_p = 60 × 9.8 × 1.75	allow a correct substitution using an incorrectly / not converted value of h	1	4.1.1.2
	E_p = 1029 (J)	allow a correct calculation using an incorrectly / not converted value of h	1	
	$P = \frac{1029}{1.40}$	allow a correct substitution using their calculated value of E_p	1	
	P = 735 (W)	allow an answer consistent with their value for E_p	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	girl increases her kinetic energy (as well as increasing her gravitational potential energy)		1	AO2 4.1.1.1 4.1.2.1
	some energy is wasted in her muscles **or** some energy transferred as thermal energy (to surroundings)	allow some energy transferred due to air resistance ignore unqualified references to friction ignore references to sound	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	the boy's mass was greater than the girl's mass		1	AO3 4.1.1.1

Total Question 9		**8**

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	$E_e = 0.5 \times 50 \times 0.12^2$		1	AO2 4.1.1.2
	$E_e = 0.36$ (J)		1	
	$0.36 = 0.5 \times 0.020 \times v^2$	allow a correct substitution of their calculated value of E_e	1	
	$v^2 = \frac{0.36}{0.5 \times 0.020}$ **or** $v^2 = 36$	allow a correct rearrangement of their calculated value of E_e	1	
	speed = 6.0	allow an answer consistent with their calculated value of E_e	1	
	m/s **or** metres/second		1	
		Alternative approach: ($F = ke$) ($F = 50 \times 0.12$) (maximum) $F = 6.0$ (N) (1) ($F = ma$) ($6.0 = 0.020 \times a$) (maximum) $a = 300$ (m/s^2) (1) mean $a = 150$ (m/s^2) (1) ($v^2 - u^2 = 2as$) $v^2 = 2 \times 150 \times 0.12$ (1) **or** $v^2 = 36$ $v = 6.0$ (1) m/s (1) **or** metres/second		

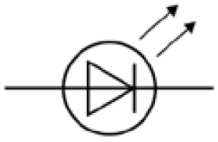
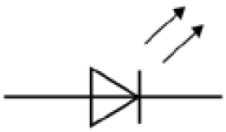
Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	kinetic		1	AO1 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	increasing the extension of the spring **or** more elastic potential energy **or** increase the angle of release (to the horizontal by a small amount)	allow other factors that would increase the horizontal distance travelled eg a tail-wind ignore factors without a change specified e.g. extension unqualified would not score ignore changing the spring or changes to the toy aeroplane	1	AO2 4.1.1.1

Total Question 10		**8**

Question 11

Due to incorrect Advance Information guidance being issued for this question, and to avoid any students being disadvantaged, Question 11 was discounted and all students were awarded full marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1		allow: 	1	AO1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.2	there is a gap in the circuit **or** S_1 needs to be closed to complete the circuit **or** S_1 needs to be closed to turn the hair straighteners on		1	AO1 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.3	E = 3600 (J) 3600 = 120 × t $t = \frac{3600}{120}$ t = 30 (s)	 this mark may score if E is incorrectly / not converted this mark may score if E is incorrectly / not converted allow an answer consistent with their value of E	1 1 1 1	AO2 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.4	the total resistance of the circuit decreases so the current increases which increases the power output		1 1 1	AO1 4.2.4.1 4.2.2

Total Question 11		**9**