Please write clearly in block capitals.

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

Surname ____________________

Forename(s) ____________________

Candidate signature ____________________
I declare this is my own work.

GCSE PHYSICS

Higher Tier Paper 1

H

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.
- 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).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- 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	

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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

0 1 **Figure 1** shows an electric car being recharged.

Figure 1

0 1 . 1 The charging station applies a direct potential difference across the battery of the car.

What does 'direct potential difference' mean?

[1 mark]

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____

Question 1 continues on the next page

Do not write outside the box

0 1 . 2 Which equation links energy transferred (*E*), power (*P*) and time (*t*)?

[1 mark]

Tick (✓) **one** box.

energy transferred = $\frac{\text{power}}{\text{time}}$ ☐

energy transferred = $\frac{\text{time}}{\text{power}}$ ☐

energy transferred = power × time ☐

energy transferred = power^2 × time ☐

0 1 . 3 The battery in the electric car can store 162 000 000 J of energy.

The charging station has a power output of 7200 W.

Calculate the time taken to fully recharge the battery from zero.

[3 marks]

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Time taken = ____________________ s

Do not write outside the box

0 1 . 4 Which equation links current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$I = V \times R$ ☐

$I = V^2 \times R$ ☐

$R = I \times V$ ☐

$V = I \times R$ ☐

0 1 . 5 The potential difference across the battery is 480 V.

There is a current of 15 A in the circuit connecting the battery to the motor of the electric car.

Calculate the resistance of the motor.

[3 marks]

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Resistance = ________________ Ω

Question 1 continues on the next page

0 1 . 6 Different charging systems use different electrical currents.

- Charging system **A** has a current of 13 A.
- Charging system **B** has a current of 26 A.
- The potential difference of both charging systems is 230 V.

How does the time taken to recharge a battery using charging system **A** compare with the time taken using charging system **B**?

[1 mark]

Tick (✓) **one** box.

Time taken using system **A** is half the time of system **B** ☐

Time taken using system **A** is the same as system **B** ☐

Time taken using system **A** is double the time of system **B** ☐

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 2 Energy from the Sun is released by nuclear fusion.

0 2 . 1 Complete the sentences.

[2 marks]

Nuclear fusion is the joining together of ____________________________.

During nuclear fusion the total mass of the particles _____________________.

0 2 . 2 Nuclear fusion of deuterium is difficult to achieve on Earth because of the high temperature needed.

Electricity is used to increase the temperature of 4.0 g of deuterium by 50 000 000 °C.

specific heat capacity of deuterium = 5200 J/kg °C

Calculate the energy needed to increase the temperature of the deuterium by 50 000 000 °C.

Use the Physics Equation Sheet.

[3 marks]

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Energy = ____________________________ J

Do not write outside the box

0 2 . 3 The idea of obtaining power from nuclear fusion was investigated using models.

The models were tested before starting to build the first commercial nuclear fusion power station.

Suggest **two** reasons why models were tested.

[2 marks]

1 ____________________

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2 ____________________

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0 2 . 4 Generating electricity using nuclear fusion will have fewer environmental effects than generating electricity using fossil fuels.

Explain **one** environmental effect of generating electricity using fossil fuels.

[2 marks]

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9

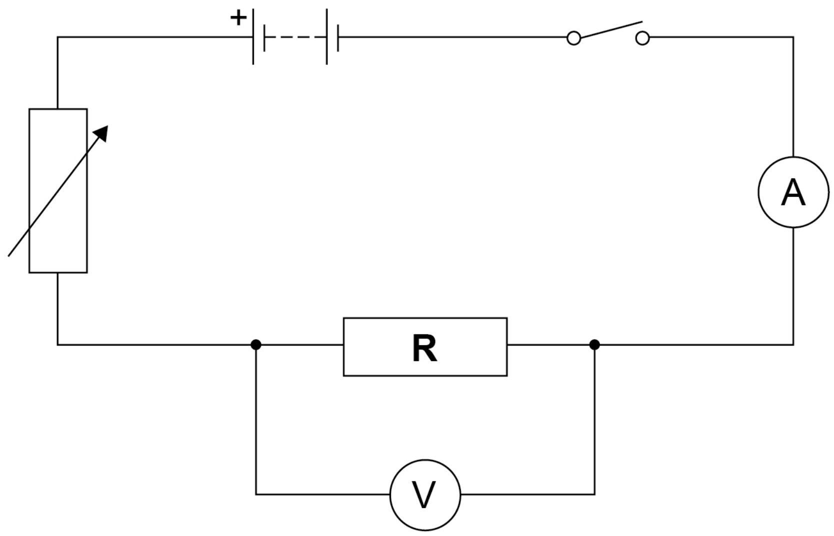
Turn over for the next question

0 3 Student **A** investigated how the current in resistor **R** at constant temperature varied with the potential difference across the resistor.

Student **A** recorded both positive and negative values of current.

Figure 2 shows the circuit Student **A** used.

Figure 2



0 3 . 1 Describe a method that Student **A** could use for this investigation.

[6 marks]

Do not write outside the box

0 3 . 2 Student **B** repeated the investigation.

During Student **B**'s investigation the temperature of resistor **R** increased.

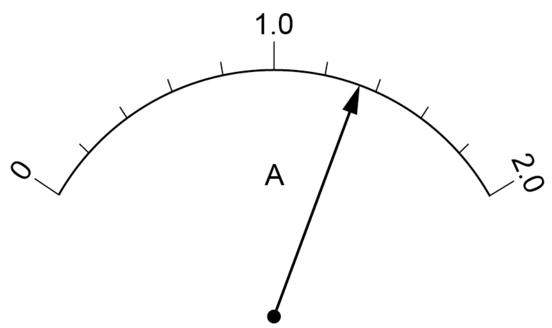
Explain how the increased temperature of resistor **R** would have affected Student **B**'s results.

[2 marks]

Question 3 continues on the next page

Figure 3 shows the scale on a moving coil ammeter at one time in the investigation.

Figure 3



0 3 . 3 What is the resolution of the moving coil ammeter?

[1 mark]

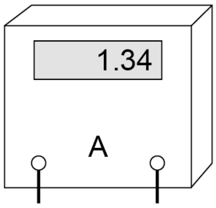
Resolution = ____________ A

Do not write outside the box

0 3 . 4 Student **B** replaced the moving coil ammeter with a digital ammeter.

Figure 4 shows the reading on the digital ammeter.

Figure 4



The digital ammeter has a higher resolution than the moving coil ammeter.

Give **one** other reason why it would have been better to use the digital ammeter throughout this investigation.

[1 mark]

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10

Turn over for the next question

Do not write outside the box

0 4 A student investigated the density of different fruits.

Table 1 shows the results.

Table 1

Fruit	**Density in g/cm^3**
Apple	0.68
Kiwi	1.03
Lemon	0.95
Lime	1.05

0 4 . 1 The student determined the volume of each fruit using a displacement can and a measuring cylinder.

What other piece of equipment would the student need to determine the density of each fruit?

[1 mark]

___

Do not write outside the box

0 4 . 2 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

___

0 4 . 3 The mass of the apple was 85 g.

The density of the apple was 0.68 g/cm^3.

Calculate the volume of the apple.

Give your answer in cm^3.

[3 marks]

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Volume = ________________ cm^3

0 4 . 4 The student only measured the volume of each fruit once.

The volume measurements **cannot** be used to show that the method to measure volume gives precise readings.

Give the reason why.

[1 mark]

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6

Do not write outside the box

0 5 . 1 During one year, 1.25×10^{18} J of energy was transferred from the National Grid.

number of seconds in 1 year = 3.16×10^{7}

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

[2 marks]

___

___

___

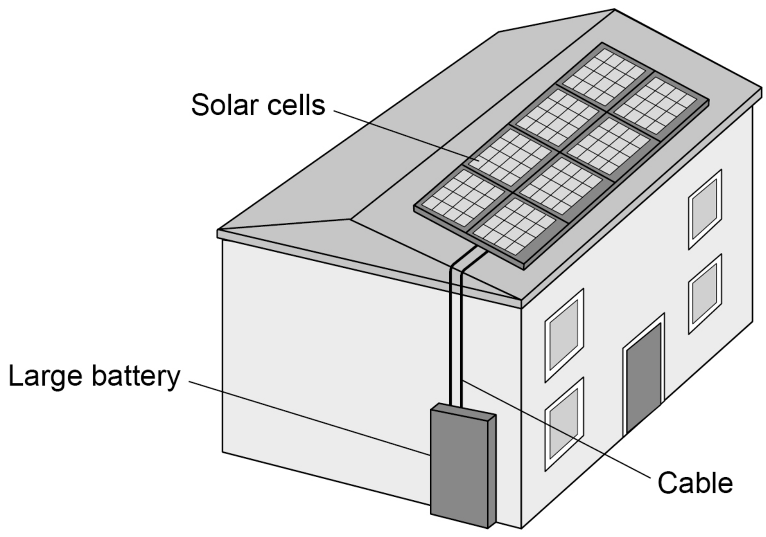
Energy each second (3 significant figures) = ____________ J

Figure 5 shows a house with a solar power system.

The solar cells generate electricity.

When the electricity generated by the solar cells is not needed, the energy is stored in a large battery.

Figure 5



Do not write outside the box

0 5 . 2 The charge flow through the cable between the solar cells and the battery in 24 hours was 27 000 coulombs.

Calculate the mean current in the cable.

[4 marks]

Mean current = ____________________ A

0 5 . 3 At one time, the total power input to the solar cells was 7.8 kW.

The efficiency of the solar cells was 0.15

Calculate the useful power output of the solar cells.

[3 marks]

Useful power output = ____________________ W

Question 5 continues on the next page

Do not write outside the box

0 5 . 4 It is unlikely that **all** of the electricity that the UK needs can be generated by solar power systems.

Explain why.

[2 marks]

11

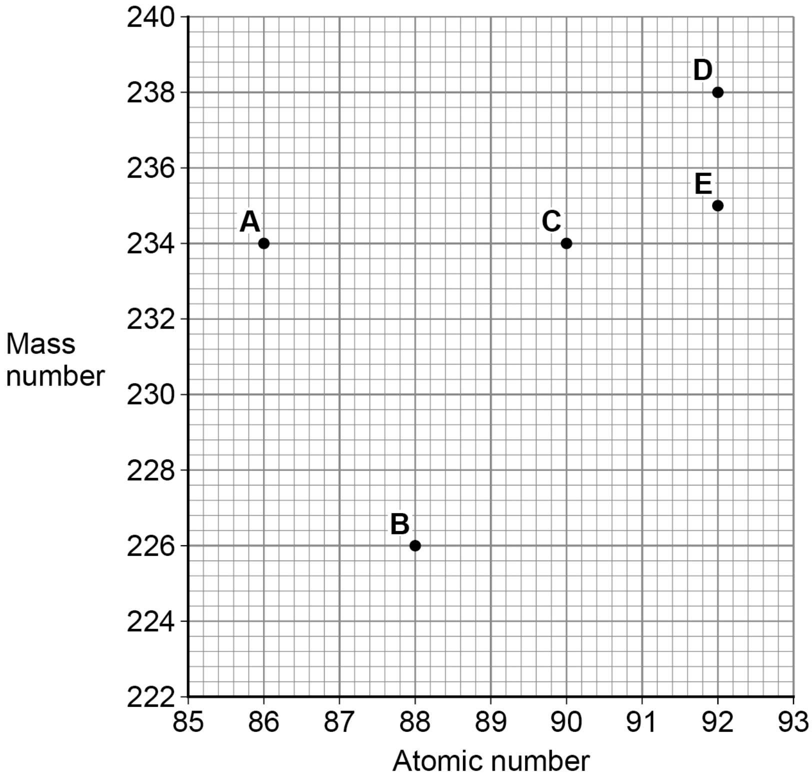
Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 6 **Figure 6** shows the mass number and the atomic number for the nuclei of five different atoms.

Figure 6



0 6 . 1 How many neutrons are there in a nucleus of atom **A**?

[1 mark]

____

Do not write outside the box

0 6 . 2 Which **two** atoms in **Figure 6** are the same element?

[1 mark]

Tick (✓) **one** box.

A and **B** ☐

A and **C** ☐

C and **D** ☐

D and **E** ☐

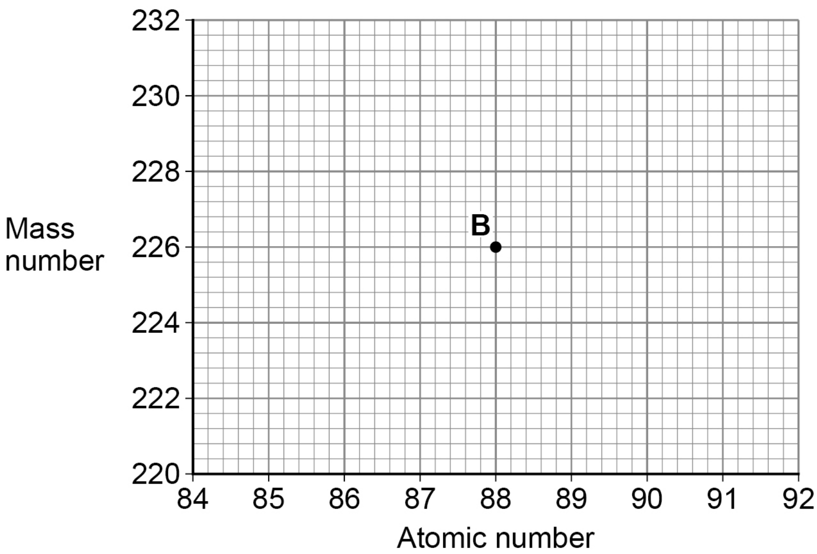
Question 6 continues on the next page

0 6 . 3 Nucleus **B** decays by emitting an alpha particle.

Draw an arrow on **Figure 7** to represent the alpha decay.

[2 marks]

Figure 7



0 6 . 4 What is meant by the 'random nature of radioactive decay'?

[1 mark]

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Do not write outside the box

0 6 . 5 A polonium (Po) nucleus decays by emitting an alpha particle and forming a lead (Pb) nucleus.

$$Po \rightarrow Pb + \alpha$$

The lead (Pb) nucleus then decays by emitting a beta particle and forms a bismuth (Bi) nucleus.

$$Pb \rightarrow Bi + \beta$$

The bismuth (Bi) nucleus then decays by emitting a beta particle and forms a polonium (Po) nucleus.

$$Bi \rightarrow Po + \beta$$

Explain how these three decays result in a nucleus of the original element, polonium.

[3 marks]

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8

Turn over for the next question

0 7 A student investigated how the current in a series circuit varied with the resistance of a variable resistor.

Figure 8 shows the circuit used.

Figure 8

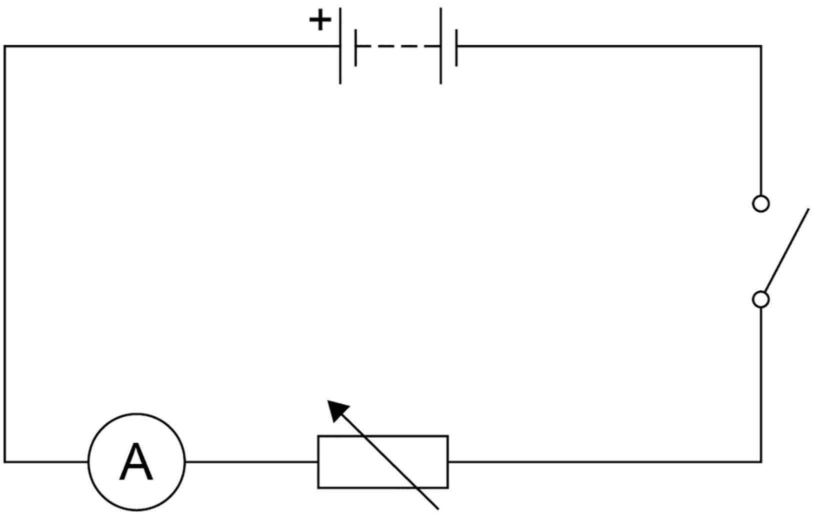
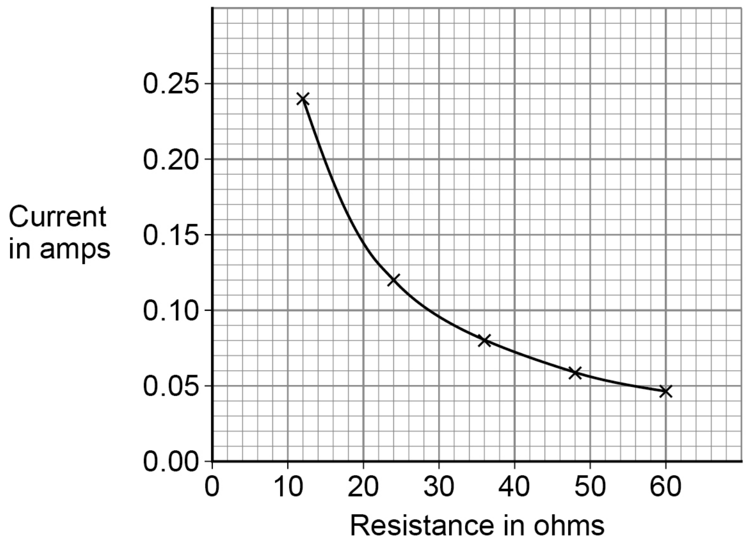


Figure 9 shows the results.

Figure 9



0 7 . 1 The battery had a power output of 230 mW when the resistance of the variable resistor was 36 Ω.

Determine the potential difference across the battery.

[4 marks]

Potential difference = ____________________ V

0 7 . 2 The student concluded:

'the current in the circuit was inversely proportional to the resistance of the variable resistor.'

Explain how **Figure 9** shows that the student is correct.

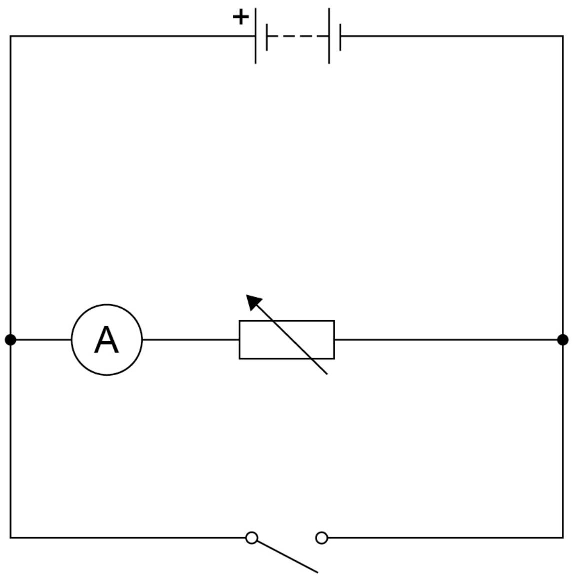
[2 marks]

Question 7 continues on the next page

Do not write outside the box

0 7 . 3 **Figure 10** shows a circuit with a switch connected incorrectly.

Figure 10



Explain how closing the switch would affect the current in the variable resistor.

[2 marks]

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8

Do not write outside the box

Turn over for the next question

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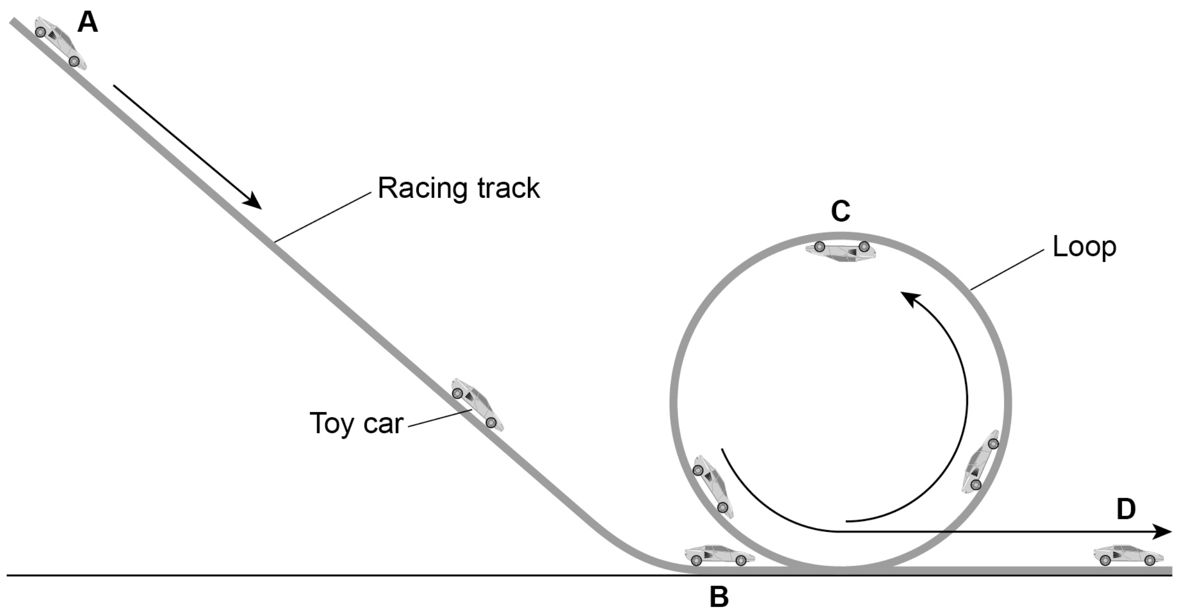
ANSWER IN THE SPACES PROVIDED

0 8 **Figure 11** shows a toy car in different positions on a racing track.

Figure 11



0 8 . 1 The toy car and racing track can be modelled as a closed system.

Why can the toy car and racing track be considered 'a closed system'?

[1 mark]

Tick (✓) **one** box.

The racing track and the car both have gravitational potential energy. ☐

The racing track and the car are always in contact with each other. ☐

The total energy of the racing track and the car is constant. ☐

Do not write outside the box

0 8 . 2 The car is released from rest at position **A** and accelerates due to gravity down the track to position **B**.

mass of toy car = 0.040 kg

vertical height between position **A** and position **B** = 90 cm

gravitational field strength = 9.8 N/kg

Calculate the maximum possible speed of the toy car when it reaches position **B**.

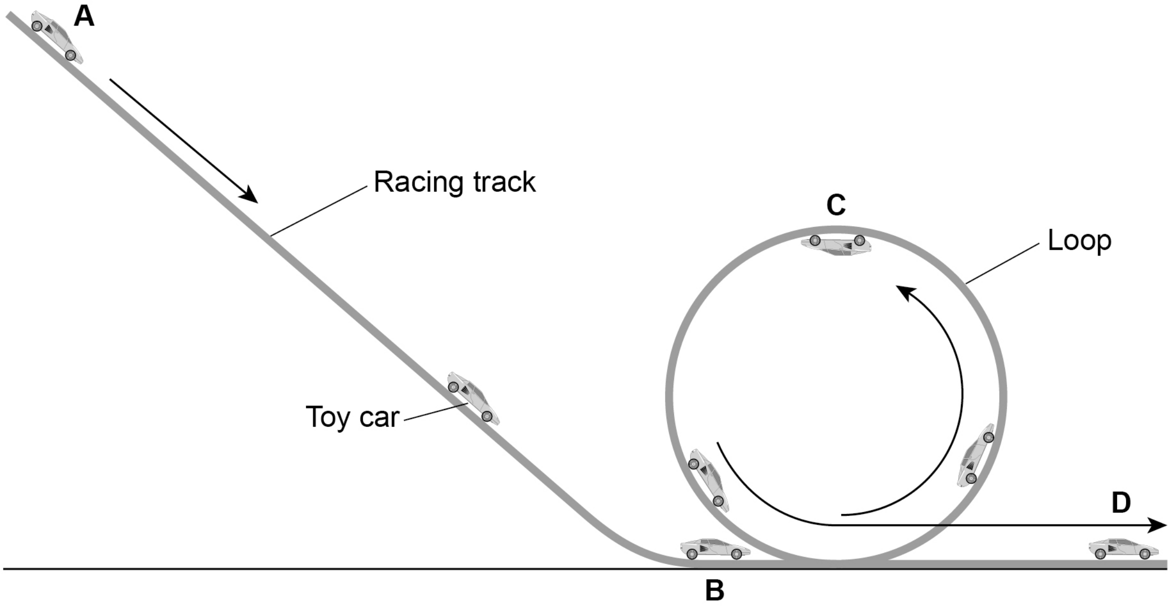
[5 marks]

Speed = ____________________ m/s

Question 8 continues on the next page

Figure 11 is repeated below.

Figure 11



0 8 . 3 At position **C** the car's gravitational potential energy is 0.20 J greater than at position **B**.

How much kinetic energy does the car need at position **B** to complete the loop of the track?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Less than 0.20 J ☐

Exactly 0.20 J ☐

More than 0.20 J ☐

Reason ____

____

____

8

Do not write outside the box

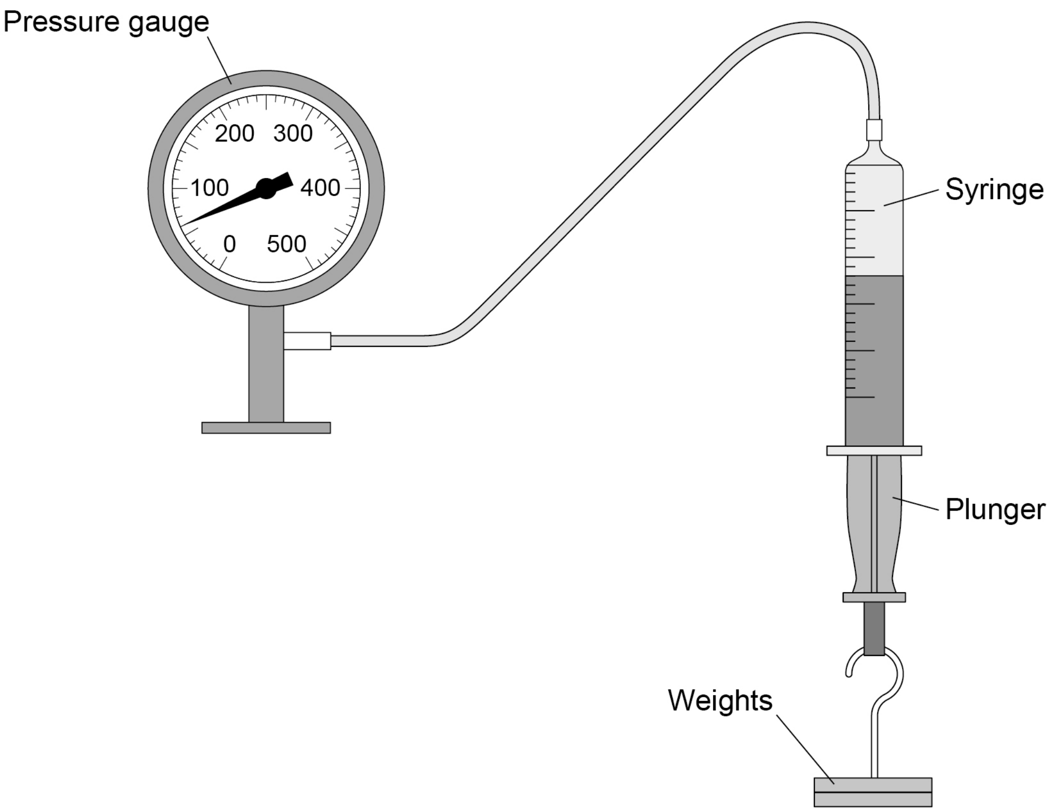
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 9 A teacher demonstrated the relationship between the pressure in a gas and the volume of the gas.

Figure 12 shows the equipment used.

Figure 12



This is the method used.

1. Record the initial volume of gas in the syringe and the pressure reading before any weights are attached.
2. Attach a 2.0 N weight to the syringe.
3. Record the volume of the gas and the reading on the pressure gauge.
4. Repeat steps 2 and 3 until a weight of 12.0 N is attached to the syringe.

0 9 . 1 What was the range of force used?

[1 mark]

From __________ N to __________ N

0 9 . 2 Give **one** control variable in the investigation.

[1 mark]

____

Do not write outside the box

0 9 . 3 When the volume of gas in the syringe was 45 cm^3, the pressure gauge showed a value of 60 kPa.

Calculate the pressure in the gas when the volume of gas in the syringe was 40 cm^3.

[4 marks]

Pressure = ____________ kPa

0 9 . 4 When the volume of gas in the syringe increased, the pressure on the inside walls of the syringe decreased.

Explain why.

[3 marks]

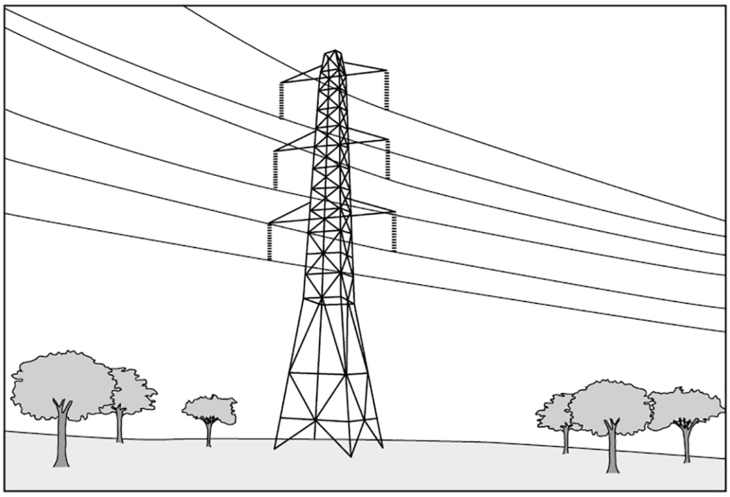
9

Turn over for the next question

Do not write outside the box

1 0 **Figure 13** shows some overhead power cables in the National Grid.

Figure 13



1 0 . 1 Explain the advantage of transmitting electricity at a very high potential difference.

[3 marks]

1 0 . 2 It is dangerous for a person to fly a kite near an overhead power cable.

Figure 14 shows a person flying a kite.

Figure 14

The person could receive a fatal electric shock if the kite was very close to, but not touching the power cable.

Explain why.

[3 marks]

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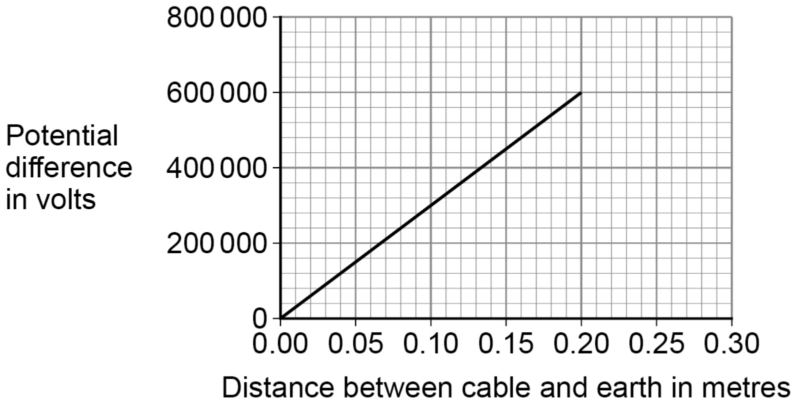
Question 10 continues on the next page

Do not write outside the box

A scientist investigated how the potential difference needed for air to conduct charge varies with the distance between a cable and earth.

Figure 15 shows the results.

Figure 15



1 0 . 3 The data in **Figure 15** gives the relationship between potential difference and distance when the air is dry.

When the humidity of air increases the air becomes a better conductor of electricity.

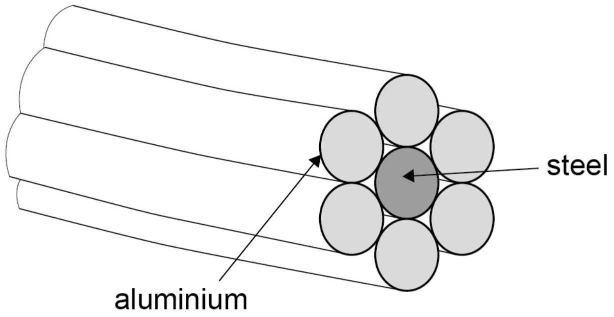
Draw a line on **Figure 15** to show how the potential difference changes with distance if the humidity of the air increases.

[2 marks]

Do not write outside the box

1 0 . 4 **Figure 16** shows a cross-section through a power cable.

Figure 16



A 1 metre length of a single aluminium wire is a better conductor than a 1 metre length of the steel wire.

The individual wires behave as if they are resistors connected in parallel.

Explain why the current in the steel wire is different to the current in a single aluminium wire.

[2 marks]

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10

Turn over for the next question

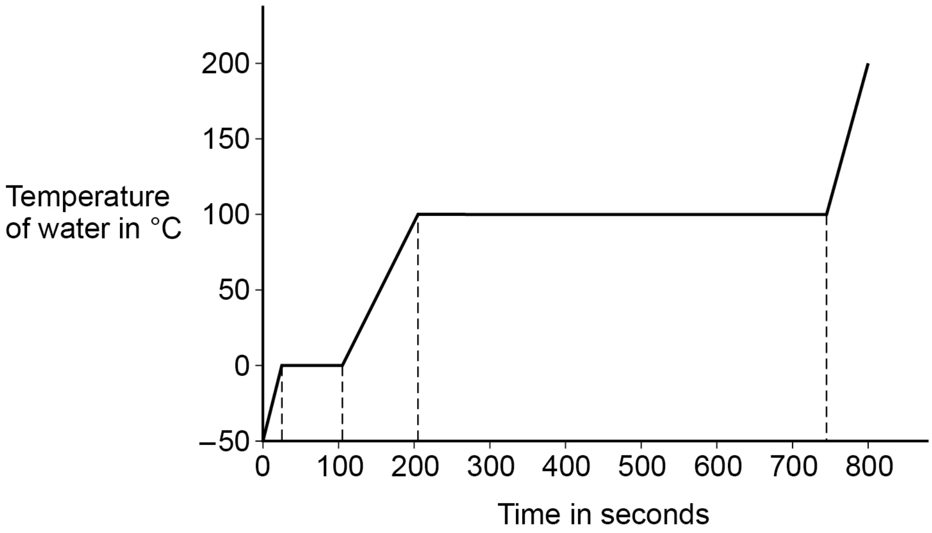
1 1 A student investigated how the temperature of a lump of ice varied as the ice was heated.

The student recorded the temperature until the ice melted and then the water produced boiled.

Figure 17 shows the student's results.

The power output of the heater was constant.

Figure 17



1 1 . 1 The specific heat capacity of ice is less than the specific heat capacity of water.

Explain how **Figure 17** shows this.

[2 marks]

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Do not write outside the box

1 1 . 2 The specific latent heat of fusion of ice is less than the specific latent heat of vaporisation of water.

Explain how **Figure 17** shows this.

[2 marks]

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____

1 1 . 3 A second student did the same investigation and recorded the temperature until the water produced boiled.

In the second student's investigation more thermal energy was transferred to the surroundings.

Describe **two** ways the results of the experiment in **Figure 17** would have been different.

[2 marks]

1 ____

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2 ____

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Question 11 continues on the next page

Do not write outside the box

1 1 . 4 When the water was boiling, 0.030 kg of water turned into steam.

The energy transferred to the water was 69 kJ.

Calculate the specific latent heat of vaporisation of water.

Give the unit.

[5 marks]

Specific latent heat of vaporisation = ____________________

Unit ____________

11

END OF QUESTIONS

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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

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

AQA

GCSE
PHYSICS
8463/1H

Paper 1 Higher Tier

Mark scheme

June 2021

Version: 1.1 Final Mark Scheme

216g8463/1H/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 his or her judgement
- the Assessment Objectives, level of demand 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.

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**. Different terms in the mark scheme are shown by a /; 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 error/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 planets in the solar system.

[2 marks]

Student	**Response**	**Marks awarded**
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols/formulae

If a student writes a chemical symbol/formula instead of a required chemical name, 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. Full marks can, however, be given for a correct numerical answer, without any working shown.

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

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **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 not 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.

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 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.

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	the polarity (of the supply) does not change	allow potential difference in one direction (only)	1	AO1 4.2.3.1
01.2	energy transferred = power × time		1	AO1 4.1.1.4 4.2.4.2
01.3	162 000 000 = 7200 × t $t = \frac{162\ 000\ 000}{7200}$ t = 22 500 (s)		1 1 1	AO2 4.1.1.4 4.2.4.2
01.4	$V = I \times R$		1	AO1 4.2.1.3
01.5	480 = 15 × R $R = \frac{480}{15}$ R = 32 (Ω)		1 1 1	AO2 4.2.1.3
01.6	time taken using system **A** is double the time of system **B**		1	AO3 4.2.4.1
Total			**10**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	nuclei decreases	do not accept atoms	1 1	AO1 4.4.4.2
02.2	m = 0.004 (kg) E = 0.004 × 5200 × 50 000 000 $E = 1.04 \times 10^9$ (J) **or** E = 1 040 000 000 (J)	 allow a correct substitution of an incorrectly/not converted value of m allow a correct calculation using an incorrectly/not converted value of m	1 1 1	AO2 4.3.2.2 4.1.1.3
02.3	any **two** from: • to make sure the fusion process is possible • to develop an understanding of the process • to make adaptations to the process • to assess the efficiency of the process • to make predictions • assess safety risks • to assess environmental impact • set-up cost is lower (for small scale experiments)		2	AO3 4.1.3

02.4	releases carbon dioxide which causes global warming **OR** releases particulates which causes global dimming **or** which causes breathing problems **OR** releases sulfur dioxide which causes acid rain **OR** releases nitrogen oxides which causes breathing problems **or** which causes acid rain	allow releases greenhouse gases allow which causes climate change	1 1	AO1 4.1.3
Total			**9**	

Question 3

Question	Answers	Mark	AO/ Spec. Ref
03.1	**Level 3**: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.2.1.4 RPA4
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan 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 the current in **R** using the ammeter • measure the p.d. across **R** using the voltmeter • vary the resistance of the variable resistor (or vary the number of cells or use a variable power supply) • record a range of values of current and p.d. • ensure current is low to avoid temperature increase • switch circuit off between readings • reverse connection of **R** to power supply • repeat measurements of I and V in negative direction • plot a graph of current against p.d.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	current and p.d. would not be directly proportional **or** I-V graph would not be straight **or** I-V graph would be curved		1	AO3 4.2.1.4 RPA4
	(because) resistance of **R** would increase		1	
03.3	0.2 (A)		1	AO3 4.2.2 RPA4
03.4	any **one** from: • less chance of misreading • no parallax error • it can give a reading closer to the true value	allow position of eye(s) does not affect reading allow 'it is more accurate' ignore 'no human error' ignore 'easier to read'	1	AO3 4.2.2 RPA4
Total			**10**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	balance / scales		1	AO1 4.3.1.1 RPA5
04.2	density = $\frac{\text{mass}}{\text{volume}}$ **or** $\rho = \frac{m}{V}$		1	AO1 4.3.1.1 RPA5
04.3	$0.68 = \frac{85}{V}$ $V = \frac{85}{0.68}$ V = 125 (cm^3)		1 1 1	AO2 4.3.1.1 RPA5
04.4	repeat readings (of volume) need taking (of each fruit) to show that the readings are close together	allow 'the same' for 'close together'	1	AO3 4.3.1.1 RPA5
Total			**6**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$E = \frac{1.25\times10^{18}}{3.16\times10^{7}}$		1	AO2 4.1.1.4
	$E = 3.96 \times 10^{10}$ (J)	an answer that rounds to 3.96×10^{10} (J) scores **1** mark	1	
05.2	t = 86 400 (s)		1	AO2 4.2.1.2
	27 000 = I × 86 400	allow a correct substitution of an incorrectly/not converted value of t	1	
	$I = \frac{27\ 000}{86\ 400}$	allow a correct rearrangement using an incorrectly/not converted value of t	1	
	I = 0.3125 (A)	allow a correct calculation using an incorrectly/not converted value of t allow a correctly calculated answer rounded to 2 or 3 sf	1	
05.3	$0.15 = \frac{\text{useful power output}}{7800}$	allow a correct substitution of an incorrectly/not converted value of total power input	1	AO2 4.1.2.2
	useful power output = 0.15 × 7800	allow a correct rearrangement using an incorrectly/not converted value of total power input	1	
	useful power output = 1170 (W)	this answer only but allow 1200 (W) if correct working shown	1	
05.4	a really large area of land would need to be covered with solar cells		1	AO2 4.1.3
	due to the low useful power output of the solar cells	allow due to the low efficiency of the solar cells	1	

		or number of hours of daylight is too low (in UK) **or** low solar intensity (in UK) **or** solar radiation (in UK) is too low **or** material for construction of solar cells and/or lithium batteries is in limited supply		
Total			**11**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	148		1	AO1 4.4.1.2
06.2	D and E		1	AO1 4.4.1.2
06.3	line between B and 86 protons same line between B and 222 mass number		1 1	AO2 4.4.2.2
06.4	can't predict which nucleus will decay next **or** can't predict when a (particular) nucleus will decay		1	AO1 4.4.2.3
06.5	one alpha decay would decrease proton number by 2 two beta decays would increase proton number by 2 so the proton / atomic number of the final nucleus is the same as the proton / atomic number of the original nucleus	 this mark is dependent on scoring the first two marks	1 1 1	AO1 4.4.2.2
Total			**8**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	I = 0.08 (A)	an incorrect value of I from the graph can score all subsequent marks	1	AO2 4.2.4.1
	0.230 = 0.08 × V	allow a correct substitution of an incorrectly/not converted value of P	1	
	$V = \frac{0.230}{0.08}$	allow a correct rearrangement using an incorrectly/not converted value of P	1	
	V = 2.875 (V) **OR** I = 0.08 (A) (1) V = 0.08 × 36 (2) V = 2.88 (V) (1) **OR** $0.230 = I^2 \times 36$ (1) I = 0.08 (A) (1) V = 0.08 × 36 (1) V = 2.88 (V) (1)	allow a correct calculation using an incorrectly/not converted value of P	1	
07.2	the product of current and resistance = a constant		1	AO2
	calculation of constant (2.88) using three or more pairs of values	if no other marks scored allow for one mark a statement that doubling one quantity (R or I) halves the other quantity	1	AO3 4.2.1.3

07.3	current would be (almost) zero (in the variable resistor)		1	AO1
	(because) the switch has (effectively) zero resistance **or** the potential difference across the variable resistor is (effectively) zero	the switch's resistance is much lower than the variable resistor allow the switch creates a short circuit	1	AO2 4.2.2 4.2.1.3

Total			**8**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	the total energy of the racing track and the car is constant.		1	AO1 4.1.2.1
08.2	$E_p = 0.040 \times 9.8 \times 0.90$	allow a correct substitution of an incorrectly/not converted value of h	1	AO2 4.1.1.1 4.1.1.2
	$E_p = 0.3528$ (J)	this answer only	1	
	$0.3528 = 0.5 \times 0.040 \times v^2$	allow a correct substitution of a calculated E_p	1	
	$v^2 = \frac{0.3528}{0.5 \times 0.040}$	allow a correct rearrangement using a calculated E_p	1	
	v = 4.2 (m/s)	allow an answer consistent with their calculated E_p	1	
08.3	more than 0.20 J		1	AO3 4.1.1.1
	(because) the car needs to be moving at the top of the loop **or** (because) the car needs to be moving to complete the loop **or** not all E_k at **B** will be transferred to E_p at **C**	this mark is dependent on scoring the first mark allow energy dissipated to the surroundings	1	
Total			**8**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	0(.0) to 12(.0)	allow 2(.0) to 12(.0) (N)	1	AO1 4.3.3.2
09.2	mass of gas (in the syringe) **or** temperature (of the gas)		1	AO3 4.3.3.2
09.3	constant = 60 × 45 **or** constant = 2700		1	AO2 4.3.3.2
	2700 = p × 40		1	
	$p = \frac{2700}{40}$		1	
	p = 67.5 (kPa)	allow 68 (kPa)	1	

09.4	there is more time between collisions of particles and the walls of the syringe **or** there are less frequent collisions between the particles and the walls of the syringe		1	AO1 4.3.3.2
	(causing) a lower (average) force on the walls of the syringe		1	
	(and) pressure is the total force per unit area		1	

Total			**9**

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(very high p.d. means) very low currents which means less (thermal) energy is transferred to surroundings which increases the efficiency of power transmission	 allow less power loss in cables	1 1 1	AO1 4.2.4.3
10.2	electric field strength is very high causing the air to become ionised (the kite / string) conducts charge to the person / earth	 allow the air breaks down allow the air becomes a conductor allow the air conducts charge ignore answers referring to the kite touching the power cables	1 1 1	AO1 4.2.5.2
10.3	straight line passing through the origin line drawn below existing line for all values		1 1	AO3 4.2.5.2
10.4	the potential difference across the wires/cable is the same (but) the resistance of the steel wire is greater (and so less current in the steel)		1 1	AO1 4.2.2 4.2.1.4
Total			**10**	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	the gradient for ice is steeper than the gradient for water (liquid)	allow the temperature of the ice increased faster than the temperature of the water	1	AO3 4.3.2.2
	which means that less energy is needed to increase the temperature by a fixed amount		1	
11.2	water took more time to vaporise than the ice took to melt		1	AO3 4.3.2.3
	which means that less energy is needed to change the state from solid to liquid (than from liquid to vapour)		1	
11.3	any **two** from: • ice/water would take more time to increase in temperature • ice/water would take more time to change state • the change in temperature with time would not be linear	allow gradients would be less steep allow horizontal lines would be longer	2	AO3 4.3.2.2 4.3.2.3 RPA1

11.4	E = 69 000 (J)		1	AO2 4.3.2.3
	69 000 = 0.030 × L	allow a correct substitution of an incorrectly/not converted value of E	1	
	$L = \frac{69\ 000}{0.030}$	allow a correct rearrangement using an incorrectly/not converted value of E	1	
	L = 2 300 000 **or** $L = 2.3 \times 10^6$	allow a correct calculation using an incorrectly/not converted value of E	1	
	J/kg	allow a unit consistent with their numerical answer eg 2300 kJ/kg	1	

Total			**11**