



GCSE PHYSICS 8463/1H

Paper 1 Higher Tier

Mark scheme

June 2019

Version: 1.0 Final



1 9 6 G 8 4 6 3 / 1 H / M S

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 Assessment Writer.

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.

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Level of response marking instructions

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 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. 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 and not look to pick holes in 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 and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 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.

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

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.

Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|---|--|-------------|----------------------------------|
| 1.1 | The energy transferred each second to the bulb. | | 1 | 4.1.1.4 AO1 |
| 1.2 | power = potential difference × current or $P = VI$ | | 1 | 4.2.4.1 AO1 |
| 1.3 | $40 = I \times 230$ $I = \frac{40}{230}$ $I = 0.17 \text{ (A)}$ | an answer of 0.17 (A) scores 3 marks a correct answer that rounds to 0.17 (A) scores 3 marks | 1 1 1 | 4.2.4.1 AO2 |
| 1.4 | efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ | | 1 | 4.1.2.2 AO1 |
| 1.5 | $0.30 = \frac{\text{useful power output}}{9.0}$ useful power output = 0.30×9.0 useful power output = 2.7 (W) | an answer of 2.7 (W) scores 3 marks | 1 1 1 | 4.1.2.2 AO2 |
| 1.6 | bulbs also transfer thermal energy the efficiency of the light bulb also needs to be considered | allow light bulbs emit infrared radiation as well as visible light ignore so people know how bright the bulb is allow the cost to power the light bulb depends on the efficiency allow to see how much energy is wasted | 1 1 | 4.1.2.2 4.1.1.4 AO1 AO3 |
| Total | | | 11 | |

Question 2

| Question | Answers | Mark | AO/ Spec. Ref. | |
|--------------|--|--|--------------------------------|--------------------------------|
| 2.1 | Level 3: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced. | 5–6 | RP2 WS2.2 4.1.2.1 AO1 | |
| | Level 2: The design/plan 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 design/plan 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 <ul style="list-style-type: none"> • Wrap N layers of newspaper around the metal can • Heated water in a kettle or Using a Bunsen burner • Put hot water in the metal can • Use a measuring cylinder to measure the volume of water • Measure initial and final temperature with the digital thermometer • Use a stopclock / stopwatch to measure a time of 5 minutes • Calculate temperature decrease • Repeat with different number of layers of newspaper • Repeat with no layers of newspaper • Use same initial temperature of hot water • Use same volume of water each time <p>Level 3: Workable method which includes changing the number of layers and includes at least one control variable (same volume of water or same starting temperature)</p> | | | |
| 2.2 | the digital thermometer and the datalogger have the same resolution | allow both measure to 1 d.p. | 1 | RP2 WS2.3 4.1.2.1 AO3 |
| | only need to measure the start and end temperature or only need 2 readings or only need to calculate the temperature change | ignore accuracy ignore precision they give the same result is insufficient | | |
| Total | | | 8 | |

Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|----------|--|--|------|-----------------|
| 3.1 | $41 = \frac{9.8 \times h}{0.12}$ $h = \frac{41 \times 0.12}{9.8}$ $h = 0.50 \text{ (m)}$ | an answer of 0.50 scores 3 marks allow a correct answer that rounds to 0.50 for 3 marks | 1 | 4.1.1.2 AO2 |
| | | | 1 | |
| | | | 1 | |
| 3.2 | kinetic energy = 0.5 × mass × (speed) ² or $E_k = \frac{1}{2} mv^2$ | | 1 | 4.1.1.2 AO1 |
| 3.3 | $270 = \frac{1}{2} \times m \times 3^2$ $m = \frac{270}{(\frac{1}{2} \times 3^2)}$ or $m = \frac{270}{4.5}$ $m = 60 \text{ (kg)}$ | an answer of 60 (kg) scores 3 marks | 1 | 4.1.1.2 AO2 |
| | | | 1 | |
| | | | 1 | |

| | | | | |
|--------------|--|---|-----------|-------------------------|
| 3.4 | Level 2: Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear. | | 3–4 | WS3.5 4.1.1.2 AO3 |
| | Level 1: Relevant features are identified and differences noted. | | 1–2 | |
| | No relevant content | | 0 | |
| | Indicative content <ul style="list-style-type: none"> • males have a greater muscle power than females for most of their lives • males have a greater muscle power than females above 9/10 years old • males have a lower muscle power than females below 9/10 years old • there is a similar pattern for males and females as age increases • males have a peak muscle power at 25 years old whereas females have a peak muscle power at 20/21 years old • at 9/10 years old males have the same muscle power as females • peak muscle power for males (47 W/kg) is greater than peak muscle power for females (37 W/kg) • the rate of increase of muscle power is greater for males than females (between 5 and 25 years old) • the rate of decrease of muscle power is greater for males than females. Ignore comments relating to strength | | | |
| 3.5 | any 1 from: | | 1 | WS3.7 4.1.1.4 AO3 |
| | <ul style="list-style-type: none"> • maximum height reached is a better indicator of maximum muscle power • maximum / peak muscle power was being investigated, not mean / average muscle power • volunteer may not use maximum effort on the first try • performance may improve with practise • performance may get worse with tiredness | allow maximum time in the air for maximum height reached / jumped | | |
| Total | | | 12 | |

Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|----------|--|--|------|-------------------------------|
| 4.1 | electric car journey will take a (much) longer time | allow diesel car journey will take a shorter time | 1 | 4.1.3 AO3 |
| | (because) battery will need recharging or (because) the car will need to stop for 40 minutes | allow diesel car will not need to be refuelled | 1 | |
| 4.2 | energy stored in diesel = $45 \times 51 = 2295$ (MJ) | | 1 | 4.1.3 1AO1 1AO2 1AO3 |
| | energy stored in batteries = $0.95 \times 280 = 266$ (MJ) | | 1 | |
| | (so) the diesel stores more energy than the battery (and the diesel car has a higher range) | this mark is dependent on correct calculations of energy stored | 1 | |
| 4.3 | any 2 from: <ul style="list-style-type: none"> recharging is a continuous process fewer cells needed in the car more cars can be charged at the same time | allow cars do not need to stop to recharge allow shorter journey times allow don't have to wait for battery to recharge allow longer time between recharges allow the range of the electric car is increased allow smaller battery needed in the car allow do not need to find a charging point allow fewer charging stations needed ignore it is quicker ignore cost of charging ignore methods of electricity generation | 2 | 4.1.3 AO1 |

| | | | | |
|--------------|--|---|----------|--------------|
| 4.4 | when cars are plugged in | | 1 | 4.1.3 AO1 |
| | the energy from car batteries could be transferred back to the National Grid | allow mains supply for National Grid allow energy from car batteries could be used to power household appliances | 1 | |
| Total | | | 9 | |



Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|---|---|-----------------|-----------------|
| 5.1 | ${}_{82}^{206}\text{Pb}$ | | 1 1 | 4.4.2.2 AO1 |
| 5.2 | alpha radiation is highly ionising causing an increased risk of cancer or organ failure or radiation sickness / poisoning or mutation of genes / DNA or damage to cells / tissues / organs until the radioactive material is removed / excreted or activity of radioactive material reaches / approaches background radiation levels | allow kill cells allow all the alpha radiation is absorbed by the body ignore references to half-life | 1 1 1 | 4.4.2.4 AO1 |
| 5.3 | $\frac{414}{138} = 3$ (half-lives) $1.45 \times 10^{-4} \times 2 \times 2 \times 2$ $= 1.16 \times 10^{-3}$ (g) or $= 0.00116$ (g) | an answer of 1.16×10^{-3} (g) scores 3 marks | 1 1 1 | 4.4.2.3 AO2 |
| Total | | | 8 | |

Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|--|--|-----------|-----------------|
| 6.1 | 50 | | 1 | 4.2.3.1 AO1 |
| | Hz / hertz | allow Hertz | 1 | |
| 6.2 | (both) switches need to be closed / on | | 1 | 4.2.2 AO1 |
| | to complete the <u>series</u> circuit or to allow charge to flow or so there is a current in the circuit | | 1 | |
| 6.3 | $1800 = I^2 \times 32$ $I^2 = \frac{1800}{32}$ or $I^2 = 56.25$ $I = 7.5 \text{ (A)}$ | an answer of 7.5 (A) scores 3 marks an answer of 0.237(A) scores 2 marks | | 4.2.4.1 AO2 |
| | | this mark may be awarded if P is incorrectly or not converted | 1 | |
| | | this mark may be awarded if P is incorrectly or not converted | 1 | |
| | | this answer only | 1 | |
| 6.4 | $1500 = \frac{450\,000}{t}$ $t = \frac{450\,000}{1500}$ $t = 300 \text{ (s)}$ | an answer of 300 (s) scores 3 marks an answer of 300 000 (s) scores 2 marks | | 4.1.1.4 AO2 |
| | | this mark may be awarded if P is incorrectly or not converted | 1 | |
| | | this mark may be awarded if P is incorrectly or not converted | 1 | |
| | | this answer only | 1 | |
| Total | | | 10 | |

Question 7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|--|---|----------|---------------------------|
| 7.1 | $1470 = 60 \times 9.8 \times h$ | an answer of 2.5 (m) scores 3 marks | | 4.1.1.2 AO2 |
| | $h = \frac{1470}{60 \times 9.8}$ or $h = \frac{1470}{588}$ | this mark may be awarded if E_p is incorrectly/not converted | 1 | |
| | $h = 2.5$ (m) | this mark may be awarded if E_p is incorrectly/not converted | 1 | |
| 7.2 | (work done against) air resistance or (work done against) friction (between zip line and pulley) | | 1 | 4.1.1.1 AO1 |
| | causes thermal energy to be transferred to surroundings | ignore sound energy | 1 | |
| 7.3 | different people have different surface areas | allow streamlining allow body position body size is insufficient | 1 | 4.1.1.1 4.1.1.2 AO1 |
| | so would be affected by air resistance differently OR initial speed may not be zero (1) which would add to the total energy (of the system) (1) | allow people have different masses / weights (1) so people have different terminal velocities (1) reference to mass changing the kinetic energy or gravitational potential energy negates both these marks | 1 | |
| Total | | | 7 | |

Question 8

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|----------|---|---|------------|-------------------------|
| 8.1 | Initial temperature was a control variable | | 1 | WS3.7 4.3.2.2 AO3 |
| 8.2 | copper greater change in mass (than the other metals) | this mark is dependent on scoring the first mark allow more ice melted (than the other metals) allow the ice melted faster (than the other metals) | 1 1 | 4.1.2.1 AO3 |
| 8.3 | variation in initial mass of ice cube or surface area of the ice cube touching the metal | allow variation in initial volume of ice cube allow melting of ice while handling allow variation in room temperature allow initial temperature of metal block | 1 | WS3.7 4.1.2.1 AO3 |

| | | | |
|--|--|--|---|
| <p>8.4</p> <p>$E = m \times 2100 \times 15$</p> <p>$E = m \times 334\,000$</p> <p>$5848 = 31\,500\,m + 334\,000\,m$</p> <p>or</p> <p>$5848 = 365\,500\,m$</p> <p>$m = \frac{5848}{(31\,500 + 334\,000)}$</p> <p>or</p> <p>$m = \frac{5848}{(365\,500)}$</p> <p>$m = 0.016\text{ (kg)}$</p> | <p>an answer of 0.016 (kg) scores 5 marks</p> | <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>allow 2 marks for an answer that rounds to 0.186 or 0.0175</p> <p>if no other mark scored allow 1 mark for either</p> <p>$5848 = m \times 2100 \times 15$</p> <p>or</p> <p>$5848 = m \times 334\,000$</p> | <p>4.3.2.2 4.3.2.3 AO2</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> |
| <p>Total</p> | | | <p>9</p> |

Question 9

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|---|--|----------|--------------------------------|
| 9.1 | metre rule has a <u>lower</u> resolution | allow metre rule has a resolution of 1mm / 1cm fewer decimal places is insufficient | 1 | WS2.3 RP5 4.3.1.1 AO1 |
| | so is less accurate (than the micrometer screw gauge) | | 1 | |
| 9.2 | record the value of the zero error when there is no object on the balance | | 1 | RP5 4.3.1.1 AO3 |
| | subtract / add the value of the zero error | | 1 | |
| 9.3 | $V = (18.45 \times 10^{-3})^3$ or $V = 0.01845^3$ | an answer of 0.0502 (kg) scores 5 marks this mark may be awarded if width is incorrectly / not converted | 1 | RP5 4.3.1.1 AO2 |
| | $V = 6.28 \times 10^{-6} \text{ (m}^3\text{)}$ | this answer only | 1 | |
| | $8.0 \times 10^3 = \frac{m}{6.28 \times 10^{-6}}$ | allow $8.0 \times 10^3 = \frac{m}{\text{their calculated V}}$ | 1 | |
| | $m = 8.0 \times 10^3 \times 6.28 \times 10^{-6}$ | allow $m = 8.0 \times 10^3 \times \text{their calculated V}$ | 1 | |
| | $m = 0.0502 \text{ (kg)}$ | allow an answer consistent with their calculated V | 1 | |
| Total | | | 9 | |

Question 10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|--|--|-----------|---------------------------|
| 10.1 | non-contact (force) | allow electrostatic (force) | 1 | 4.2.5.2 AO1 |
| | attraction (between hair and balloon) | allow repulsion between the hairs on the head | 1 | |
| 10.2 | $0.0050 = Q \times 2500$ $Q = \frac{0.0050}{2500}$ $Q = 2.0 \times 10^{-6} \text{ (C)}$ or $Q = 0.0000020 \text{ (C)}$ | an answer of $2.0 \times 10^{-6} \text{ (C)}$ scores 3 marks an answer of $2 \times 10^{-3} \text{ (C)}$ scores 2 marks | | 4.2.4.2 AO2 |
| | | this mark may be awarded if pd is incorrectly or not converted | 1 | |
| | | this mark may be awarded if pd is incorrectly or not converted | 1 | |
| | | these answers only | 1 | |
| 10.3 | $0.16 = I \times 4.0 \times 10^{-3}$ or $I = \frac{0.16}{4.0 \times 10^{-3}}$ $I = 40 \text{ (A)}$ $4800 = 40 \times R$ $R = \frac{4800}{40}$ $R = 120 \text{ (}\Omega\text{)}$ | an answer of $120 \text{ (}\Omega\text{)}$ scores 5 marks | | 4.2.1.2 4.2.1.3 AO2 |
| | | this mark may be awarded if time is incorrectly / not converted | 1 | |
| | | this value only | 1 | |
| | | allow $4800 = \text{their calculated } I \times R$ | 1 | |
| | | allow $R = 4800 / \text{their calculated } I$ | 1 | |
| | | allow an answer consistent with their calculated I | 1 | |
| Total | | | 10 | |

Question 11

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|--|--|----------|-----------------|
| 11.1 | the (mean) kinetic energy of the particles increases | allow the (mean) speed of the particles increases 'kinetic energy increases' is insufficient by itself do not accept particles vibrating | 1 | 4.3.2.1 AO1 |
| | which increases the (internal) energy of the water | ignore description of evaporation | 1 | |
| 11.2 | Particles in a gas have more potential energy than particles in a liquid. | | 1 | 4.3.1.1 AO1 |
| 11.3 | Energy given to water $E = mL$ with quantities defined | | 1 | 4.3.3.1 AO1 |
| | power output (of Bunsen burner) energy transferred (to water) $= \frac{\text{energy transferred (to water)}}{\text{time}}$ | allow $P = \frac{E}{t}$ with quantities defined | 1 | |
| | power output change in mass \times specific latent heat $= \frac{\text{change in mass} \times \text{specific latent heat}}{\text{time}}$ | allow $E = Pt$ equated with $E = mL$ or stated in words or $P = \frac{mL}{t}$ with quantities defined | 1 | |
| | time should be converted to seconds or use a time of 300 seconds | | 1 | |
| Total | | | 7 | |