GCSE
PHYSICS
8463/1H

Paper 1 Higher Tier

Mark scheme

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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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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 should be awarded for a correct numerical answer, without any working shown.
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	renewable: (an energy resource that is) replenished *(*as it is used*)*	allow replaced for replenished ignore has an infinite supply ignore not running out ignore sustainable	1	AO1 4.1.3
	non-renewable: (an energy resource that is) finite	allow limited supply ignore running out ignore won't last forever	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	density = $\frac{\text{mass}}{\text{volume}}$ **or** $\rho = \frac{m}{V}$		1	AO1 4.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$1030 = \frac{824\,000}{V}$		1	AO2 4.3.1.1
	$V = \frac{824\,000}{1030}$		1	
	$V = 800\ (m^3)$		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	any **two** from: • at very low flow speeds there is no power output • tidal power output is (always) greater than wind power output for the same flow speeds (above 0.25 m/s) • a change in flow speed makes a bigger difference to tidal power output than wind power output • there is a non-linear relationship between flow speed and power output	allow wind power needs a higher flow speed to get the same power output (as tidal power) ignore reference to exponential relationships do **not** accept flow speed of tidal is less than flow speed of wind ignore comments about reliability or efficiency	2	AO3 4.1.3

Question	Answers	Mark	AO / Spec. Ref.
01.5	**Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 4.1.3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content • wind turbine is much larger than the tidal turbine • wind turbine causes more visual pollution than the tidal turbine • tidal turbine is hidden from view (as it is under water) • tidal turbine is less likely to cause noise pollution (as it is under water) • wind turbine is likely to make more noise • wind turbine needs more raw materials (for construction) • more wind turbines needed for same power output (at the same flow speed) • wind turbine will harm birds, whereas tidal turbine will not • tidal turbine may harm fish, whereas wind turbine will not		

Total Question 1	12

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	hot water / beaker **or** heater	ignore descriptions of risk allow spilt water allow broken glass / beaker	1	AO3 4.1.1.3 4.3.2.2 RPA1

Question	Answers	Mark	AO / Spec. Ref.
02.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.1.1.3 4.3.2.2 RPA1
	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 the mass of the empty beaker on the balance • fill the beaker with water and measure the total mass of beaker and water • mass of water = total mass – mass of beaker • turn power supply on so heater increases the temperature of the water • measure temperature change / increase with thermometer • use joulemeter to measure energy transferred to water • calculate SHC using $E = mc\Delta\theta$ a level 3 answer must have a clear method of how the mass of water is determined		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	insulate the beaker of water **or** add a lid	allow named insulation allow use an insulating cup eg plastic cup	1	AO3 4.1.1.3 4.3.2.2 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	difference = 4410 – 4200 **or** difference = 210 **or** % difference = $\frac{(4410 - 4200)}{4200} \times 100$ % difference = 5 (%)	 do **not** accept 4.76 (%)	1 1	AO2 4.1.1.3 4.3.2.2 RPA1

Total Question 2	10

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **one** from: • change the resistance of the variable resistor • change the number of cells in the battery • change the potential difference of the power supply / pack • add additional resistors / components to the circuit	 allow use the variable resistor allow add another battery allow use a battery with a higher / lower potential difference	1	AO1 4.2.1.4 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	$V = I \times R$		1	AO1 4.2.1.3 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	I = 0.125 (A) 3.0 = 0.125 × R $R = \frac{3.0}{0.125}$ R = 24 (Ω)	allow a value in the range 0.12 (A) to 0.13 (A) allow a correct substitution using a value of current in the range 0.10 (A) to 0.15 (A) allow a correct rearrangement using a value of current in the range 0.10 (A) to 0.15 (A) allow a correct calculation using a value of current in the range 0.10 (A) to 0.15 (A)	1 1 1 1	AO2 4.2.1.3 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(the LED / circuit has a) large resistance in the reverse direction	 MP2 dependent on MP1 if no other marks scored allow 1 mark for: LEDs only allow current in one direction	1 1	AO1 4.2.1.3 4.2.1.4 RPA4

Total Question 3	**8**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	carbon dioxide is a greenhouse gas	allow carbon dioxide causes the greenhouse effect allow absorbs infrared (radiation)	1	AO1 4.1.3
	(which) causes global warming	allow climate change allow examples of climate change eg sea levels rising, extreme weather conditions, etc	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	8000 (kg)		1	AO3 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	17 000 (km)	allow an answer between 16 000 (km) and 18 000 (km)	1	AO3 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	the car / battery needs (re)charging		1	AO3 4.1.3
	(some of the) electricity has been generated using gas / coal / oil	allow fossil fuels	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	nuclear		1	AO1 4.1.3
	solar		1	

Total Question 4	**8**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(atoms of an element with) the same number of protons	ignore number of electrons allow same atomic number	1	AO1 4.4.1.2
	but a different number of neutrons	allow different mass number	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	light(er) nuclei fuse	allow hydrogen nuclei fuse ignore bonding / colliding	1	AO1 4.4.4.2
	to form heavier nuclei / elements	allow to form helium nuclei	1	
	some of the mass (of the nuclei) is converted into energy (of radiation)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(a large amount of energy transferred) causes a small temperature increase of the walls / material		1	AO3 4.1.1.3 4.3.2.2 4.3.2.3
	(therefore) the walls of the reactor should not reach melting point	allow (therefore) the walls of the reactor should not melt	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	any **one** from: • a nuclear explosion • a (nuclear) meltdown • a nuclear bomb	allow atomic for nuclear allow Chernobyl / Fukushima (disaster)	1	AO1 4.4.4.1

Total Question 5	**8**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$8000 = 0.20 \times 1600 \times \Delta\theta$ $\Delta\theta = \frac{8000}{(0.20 \times 1600)}$ $\Delta\theta = 25$ (°C)		1 1 1	AO2 4.3.2.2 4.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$E = 180\,000$ (J)	all subsequent marks can score using an incorrectly / not converted value of E	1	AO2 4.2.4.2
	$180\,000 = Q \times 5.0$		1	
	$Q = \frac{180\,000}{5.0}$		1	
	$Q = 36\,000$ (C)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(when both switches are closed) the resistance of the circuit decreases		1	AO1 4.2.2
	(so) current increases	MP2 dependent on MP1	1	
	(so) power output is greater as potential difference across the battery remains the same and $P = IV$	ignore reference to $P = I^2R$ unless a quantitative comparison is included	1	

Total Question 6	**10**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	new evidence is discovered that existing models cannot explain		1	AO1 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	irradiation is the exposure to radiation		1	AO1 4.4.2.4
	(radioactive) contamination is the (unwanted) presence of radioactive material on / inside a person	allow an object for a person	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(Po) 84		1	AO1 4.4.2.2
	(Pb) 206		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	number of half-lives = 4		1	AO2 4.4.2.3
	time = 4 × 138		1	
	time = 552 (days)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	polonium-209 has a lower <u>activity</u> than polonium-210	ignore description of rate of decay	1	AO3 4.4.2.1
	(because polonium-209) has a longer half-life	MP2 dependent on MP1	1	

Total Question 7	**10**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	m = 0.050 (kg)	all subsequent marks can score using an incorrectly / not converted value of m	1	AO2 4.3.2.3
	9950 = 0.050 × L		1	
	$L = \frac{9950}{0.050}$		1	
	L = 199 000 (J/kg)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	the potential energy of the particles increases		1	AO1 4.3.2.1
	(but) the kinetic energy of the particles does not change (as temperature does not change)		1	
	(so the) internal energy increases	MP3 dependent on MP1 **and** MP2	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	the *(*mean*)* kinetic energy of the gas particles increased	allow the *(*mean*)* speed of the gas particles increased	1	AO1 4.3.3.1
	(so) particles exert a greater force on the walls of the container during each collision		1	
	(and) the frequency of collisions of the particles and the walls of the container increases	allow 'rate of' for 'frequency'	1	
	(so) pressure increases	this mark is dependent on scoring at least 1 other mark	1	

Total Question 8	**11**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	h = 0.70 (m)	all subsequent marks can score using an incorrectly / not converted value of h	1	AO2 4.1.1.2
	0.343 = m × 9.8 × 0.70		1	
	$m = \frac{0.343}{9.8 \times 0.70}$		1	
	m = 0.050 (kg)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	4.86 = I^2 × 6.0		1	AO2 4.2.1.3
	$I^2 = \frac{4.86}{6.0}$		1	4.2.4.1
	I = 0.90 (A)		1	
	t = 1800 (s)	all subsequent marks can score using an incorrectly / not converted value of t	1	
	Q = 0.90 × 1800	allow a correct substitution using their value of current	1	
	Q = 1620 (C)	allow a correct calculation using their value of current allow an answer of 1600 (C)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	greater mass / volume of water each second	allow water flow will increase ignore increased water speed	1	AO3
	(because) smaller proportion / percentage of energy is wasted	allow greater (useful) power output allow less energy / power wasted	1	AO1 4.1.2.2

Total Question 9	**12**

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	$E_e = 0.5 \times 64 \times 0.075^2$		1	AO2 4.1.1.1
	$E_e = 0.18$ (J)	the equation $E_e = 0.5ke^2$ must have been used to score subsequent calculation marks	1	4.1.1.2
	$0.18 = 0.5 \times 0.052 \times v^2$	allow a correct substitution using their value of E_e	1	
	$v^2 = \frac{0.18}{0.5 \times 0.052}$	allow a correct rearrangement using their value of E_e	1	
	$v = 2.631\ldots$ (m/s)	allow a correct calculation using their value of E_e	1	
	$v = 2.6$ (m/s)	allow an answer given to 2 sf using **all** the data in the question	1	
		alternative approach: ($F = ke$) ($F = 64 \times 0.075$) (maximum) $F = 4.8$ (N) (1) ($F = ma$) ($4.8 = 0.052 \times a$) (maximum) $a = 92.3$ (m/s^2) (1) (mean) $a = 46.2$ (m/s^2) (1) ($v^2 - u^2 = 2as$) $v^2 = 2 \times 46.2 \times 0.075$ (1) **or** $v^2 = 6.923$ $v = 2.631\ldots$ (1) $v = 2.6$ (m/s) (1)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2		ignore comments about energy dissipation allow E_k for kinetic energy allow E_p for gravitational potential energy		AO1 4.1.1.1
	kinetic energy decreases moving from **A** to **B**	allow kinetic energy is transferred to gravitational potential energy while moving from **A** to **B** for MP1 and MP2	1	
	(and) gravitational potential energy increases moving from **A** to **B**		1	
	(then) gravitational potential energy decreases from **B** to **C** and kinetic energy increases	allow gravitational potential energy is transferred to kinetic energy while moving from **B** to **C**	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	length of the toy car		1	AO2 4.1.1.2
	time for toy car to pass the light gate		1	

Total Question 10	**11**