GCSE
PHYSICS
8463/1H

Paper 1 Higher Tier

Mark scheme

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2 3 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 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.

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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	increase decrease	must be in this order	1 1	AO1 4.2.4.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	$P = I^2R$		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$1.60 \times 10^9 = 2000^2 \times R$ $R = \frac{1.60\times10^9}{2000^2}$ $R = 400$ (Ω)		1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$ **or** efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$		1	AO1 4.1.2.2

PMT

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$0.992 = \frac{\text{useful energy output}}{34.2}$		1	AO2 4.1.2.2
	useful energy output = 0.992 × 34.2		1	
	useful energy output = 33.9 (GJ)	allow a correct answer given to more than 3 s.f.	1	

Total Question 1	**10**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	so the thermometer temperature was the same as the temperature of the iron block		1	AO3 4.1.1.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	$\Delta\theta = (54 - 28) = 26$ (°C)		1	AO2 4.1.1.3 RPA1
	$26\,000 = 2.0 \times c \times 26$	allow a correct substitution using an incorrect value of $\Delta\theta$ obtained from the graph	1	
	$c = \dfrac{26\,000}{2.0 \times 26}$	allow a correct rearrangement using an incorrect value of $\Delta\theta$ obtained from the graph	1	
	$c = 500$ (J/kg °C)	allow an answer consistent with their value of $\Delta\theta$ obtained from the graph	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	the calculated specific heat capacity will be more accurate		1	AO3 4.1.1.3 RPA1
	the iron block will transfer thermal energy to the surroundings at a lower rate		1	

Total Question 2	**7**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	polarity of the potential difference doesn't change	allow direction of the potential difference doesn't change	1	AO1 4.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	$E = QV$		1	AO1 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	$5010 = Q \times 12$		1	AO2 4.2.4.2
	$Q = \frac{5010}{12}$		1	
	$Q = 417.5$ (C)	allow 418 (C)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	$5010 = 0.015 \times L$		1	AO2 4.3.2.3
	$L = \frac{5010}{0.015}$		1	
	$L = 334\ 000$ (J/kg)		1	

Question	Answers	Mark	AO / Spec. Ref.
03.5	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1 4.3.1.1 4.3.2.1
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	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 • particles in a solid are in a regular pattern • particles in a liquid are in a random arrangement • particles in a solid are vibrating about fixed positions • particles in a liquid are moving freely • as the ice changes to water the temperature remains constant • because as the ice changes to water the potential energy of the particles increases • as the water warms the particles move faster • so the kinetic energy of the particles increases • internal energy is the total kinetic and potential energy of all the particles ignore any references to density of ice vs liquid water ignore any references to spacing of particles		

Total Question 3	**14**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	E_p = 367 500 000 (J)		1	AO2 4.1.1.2
	367 500 000 = 2 500 000 × 9.8 × h	allow a correct substitution using an incorrectly/not converted value of E_p	1	
	$h = \frac{367\ 500\ 000}{2\ 500\ 000 \times 9.8}$	allow a correct rearrangement using an incorrectly/not converted value of E_p	1	
	h = 15 (m)	allow an answer consistent with their value of E_p	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	3 kW = 3000 W		1	AO2 4.1.1.4
	$3000 = \frac{2.16 \times 10^7}{t}$	all subsequent marks can score using an incorrectly / not converted value of P	1	
	$t = \frac{2.16 \times 10^7}{3000}$		1	
	t = 7200 (s)		1	
	$t = 7.2 \times 10^3$ (s)	allow an answer given in standard form from a calculation using data given in the question	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3		allow reference to specific months eg April to September		AO3 4.1.3
	in the summer the power output from the hydroelectric generator is lower but the solar power output would be greater	allow power output of hydroelectric generator depends on rainfall **and** power output of solar power system depends on light intensity	1	
	so less variation in total power output (which improves the reliability of the supply)	allow electricity supply for total power output	1	

Total Question 4	**11**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	Similarities: • same number of protons **or** same atomic number	allow both atoms / nuclei contain 6 protons	1	AO1 4.4.1.1
	• same number of electrons		1	
	Difference: • different number of neutrons **or** different mass number	allow carbon-12 has 6 neutrons **and** carbon-14 has 8 neutrons	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the time it takes for the number of nuclei (in a radioactive sample) to halve (is 5700 years) **or** the time it takes for the activity (of a radioactive sample) to halve (is 5700 years) **or** the time it takes for the radiation emitted (by a radioactive sample) to halve (is 5700 years) **or** the time it takes for the count rate (of a radioactive sample) to halve (is 5700 years) **or** the time it takes for the mass of carbon-14 (in a sample) to halve (is 5700 years)	allow atoms for nuclei ignore radioactivity	1	AO1 4.4.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	2 half-lives		1	AO2 4.4.2.3
	128.74 (s)	allow 129 (s)	1	

PMT

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	nitrogen-18		1	AO3 4.4.2.1 4.4.3.3
	greatest activity	MP2 and MP3 dependent on scoring MP1 allow emits most radiation per second allow emits most radiation in a given time period ignore shortest half-life	1	
	(so) greatest dose of radiation absorbed (per second)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	irradiation is the exposure of an object / person to radiation	allow 'absorption of radiation' for 'exposure' allow specific examples of ionising radiation	1	AO1 4.4.2.4
	(while) contamination is the (unwanted) presence of radioactive material / atoms on an object / person	allow 'inside a person' for 'on an object / person'	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any **one** from: • cancer / tumours • DNA / genetic mutation • damages / kills cells • radiation poisoning / sickness / burns	ignore mutates cells ignore death	1	AO3 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	some radioactive materials emit alpha radiation		1	AO3 4.4.2.1
	which has a (very) short range (in air)	MP2 dependent on scoring MP1 allow weakly penetrating for short range (in air)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	pilot's dose in 24 hours = 0.072 (mSv)		1	AO2 4.4.3.1
	number of days = $\frac{0.072}{0.00050}$		1	
	number of days = 144		1	
	OR			
	nuclear power worker hourly dose = 0.0000208… (mSv) (1)			
	number of days = $\frac{0.0030}{0.0000208}$ (1)			
	number of days = 144 (1)			
	OR			
	$\frac{\text{hourly dose}}{\text{daily dose}} = \frac{0.0030}{0.00050} = 6$ (1)			
	number of days = 6 × 24 (1)			
	number of days = 144 (1)			

Total Question 5	17

Question 6

Question	Answers	Mark	AO / Spec. Ref.
06.1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.2.1.4 RPA4
	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 • ammeter in series with filament lamp • current measured with an ammeter • voltmeter in parallel with filament lamp • p.d. measured with a voltmeter • variable resistor (or variable power pack or variable number of cells) used to vary current in and p.d. across filament lamp • range of p.d. of 0 to 6 V • interval of p.d. of 1 V • reverse connections to power supply to obtain negative values • take repeat readings and calculate a mean • discard anomalies Indicative content may be seen in a circuit diagram. Level 3 answer: needs to include a circuit which would work (if included) and a method to obtain negative values.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	3.0 = 0.16 × *R*	allow a correct substitution of an incorrect value of *I* in the range 0.15 (A) to 0.17 (A)	1	AO2 4.2.1.3
	$R = \frac{3.0}{0.16}$	allow a correct rearrangement of an incorrect value of *I* in the range 0.15 (A) to 0.17 (A)	1	
	R = 18.75 (Ω)	allow 19 (Ω) allow 18.8	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	*t* = 1800 (s)		1	AO2 4.2.4.2 4.1.1.4 4.2.1.2 4.2.4.1
	Q = 0.21 × 1800	all subsequent marks can score if an incorrectly / not converted value of *t* is used	1	
	Q = 378 (C)		1	
	E = 378 × 6.0		1	
	E = 2268 (J)	allow an answer to 2 or 3 s.f.	1	
	OR			
	P = 0.21 × 6.0 (1)			
	P = 1.26 (W) (1)			
	t = 1800 (s) (1)	all subsequent marks can score if an incorrectly / not converted value of *t* is used		
	E = 1.26 × 1800 (1)			
	E = 2268 (J) (1)	allow an answer to 2 or 3 s.f.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(for the power to quadruple) the current and the p.d. would both need to double		1	AO3 4.2.1.4 4.2.4.1
	(but the current doesn't double) because the resistance of the filament lamp increases **or** (but the current doesn't double because the graph shows that) current is not proportional to p.d.	allow the graph does not show direct proportionality ignore the graph is not a straight line ignore the graph is not linear	1	

Total Question 6	16

Question 7

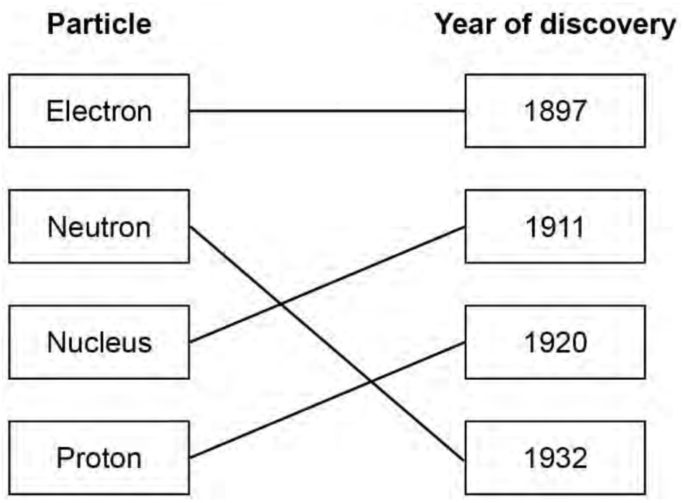
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	spring may become permanently extended **or** extension of the spring may be too great (so the baby's feet are always on the floor)	ignore reference to limit of proportionality allow the harness / spring / chain may break ignore baby may be injured / harmed / may hit doorframe	1	AO3 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(in position **A**) the baby has gravitational potential energy (as the baby moves down this) is transferred to kinetic energy (of the baby) and / then elastic potential energy (of the spring) (in position **B**) all the energy is elastic potential energy	allow E_p for gravitational potential energy allow E_k for kinetic energy allow E_e for elastic potential energy ignore energy dissipated to the surroundings	1 1 1	AO1 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	$e = 0.080$ (m)		1	AO2 4.1.1.2
	$4.0 = \frac{1}{2} \times k \times 0.080^2$	allow a correct substitution using an incorrectly / not converted value of *e*	1	
	$k = \dfrac{4.0}{(0.5 \times 0.080^2)}$	allow a correct rearrangement using an incorrectly / not converted value of *e*	1	
	$k = 1250$ (N/m)	allow an answer consistent with their value of *e*	1	

Total Question 7	**8**

Question 8

Question	Answers	Mark	AO / Spec. Ref.
08.1	 4 correct for 2 marks 2 or 3 correct for 1 mark additional line from a box on the left negates the mark for that box	2	AO1 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2		'it' is alpha particle **A**		AO1
	both the alpha particles and the (gold) nucleus have positive / same charge	allow alpha particles and protons have positive / same charge	1	
				AO3
	so the alpha particle and the gold nucleus repel each other	allow like charges repel ignore deflection (this refers to the path taken not the force)	1	4.4.1.1 4.2.5.1 4.2.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	particle **B** passes closer to the nucleus so experiences a stronger (repulsive) force **or** so experiences a stronger electric field	'it' is particle **B** any mention of particle **B** colliding with the nucleus scores zero	1 1	AO3 4.4.1.1 4.2.5.1 4.2.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	the atom is mostly empty space		1	AO3 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	in the Bohr model the electrons orbit (the nucleus) at specific distances (whereas in the nuclear model the electrons can orbit at a continuous range of distances)	allow energy levels or shells for specific distances	1	AO1 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	to move to a higher energy level an electron absorbs energy from electromagnetic radiation	allow absorbs energy by collision with another electron allow EM radiation for electromagnetic radiation	1	AO1 4.4.1.1
	to move to a lower energy level an electron emits energy in the form of electromagnetic radiation		1	
		if no other mark scored allow 1 mark for an electron changes energy level by emitting or absorbing electromagnetic radiation		

Total Question 8	**10**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	random	allow all / any ignore many different	1	AO1 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	more (air) particles (in the tyre)		1	AO1 4.3.3.1 4.3.3.2
	greater number of collisions with tyre (walls) per second	allow collisions with tyre (walls) are more frequent allow greater rate of collisions with tyre (walls) do **not** credit MP2 if linked to an increased air temperature or increased speed / E_k of particles ignore greater force per m^2	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	(as temperature increases the) air particles have greater (mean) kinetic energy	allow particles move with greater speeds (on average)	1	AO1 4.3.3.1
	(so) more collisions with tyre (walls) per second	allow collisions with tyre (walls) are more frequent allow greater rate of collisions with tyre (walls)	1	
	(and) greater force in each collision	allow greater rate of change of momentum in each collision	1	
	greater (mean) force per square metre causes greater pressure (on wall of tyre)	allow 'on a given area' for 'per square metre'	1	

Total Question 9	**7**