Mark Scheme (Results)

Summer 2023

Pearson Edexcel GCSE
In Physics (1PH0)
Paper 1H

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.

Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.

When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

Assessment Objective		**Command Word**	
Strand	**Element**	**Describe**	**Explain**
AO1*		An answer that combines the marking points to provide a logical description	An explanation that links identification of a point with reasoning/justification(s) as required
AO2		An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding	An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding)
AO3	1a and 1b	An answer that combines points of interpretation/evaluation to provide a logical description	
AO3	2a and 2b		An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning
AO3	3a	An answer that combines the marking points to provide a logical description of the plan/method/experiment	
AO3	3b		An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning

*there will be situations where an AO1 question will include elements of recall of knowledge directly from the specification (up to a maximum of 15%). These will be identified by an asterisk in the mark scheme.

	Answer	Additional guidance	Mark
1(a)	substitution and rearrangement (1) (f =) $\frac{330}{11(\times 10^{-3})}$ evaluation (1) 30 000 (Hz)	 award full marks for the correct answer without working 30 or 300 or 3000 scores 1 mark	**(2)** **AO2**

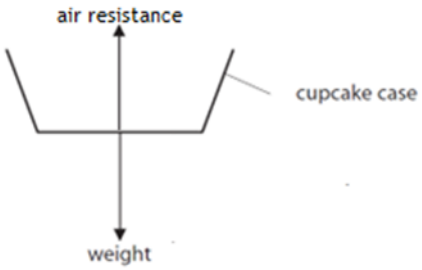
	Answer	Additional guidance	Mark
1(b)	**Two possible methods:** selection (1) distance = speed x time substitution (1) (total distance =) 330 x 18 ($x10^{-3}$) evaluation of total distance (1) 5.9(4) (m) evaluation of distance from bat to prey (1) 3.0 (m) **OR** selection (1) distance = speed x time division of time by 2 (1) 9 ($x10^{-3}$) substitution (1) (total distance =) 330 x 9 ($x10^{-3}$) evaluation of distance from bat to prey (1) 3.0 (m)	speed = distance / time 330 = d / 18($x10^{-3}$) 330x18($x10^{-3}$) scores mp1 and mp2 allow their distance divided by 2 for MP4 allow 2.97 (m) 5.94 scores 3 marks 5.94 to any other power of 10 scores 2 marks 2.97 or 3 to any other power of 10 scores 3 marks speed = distance / time 330 = d / 9($x10^{-3}$) 330x9($x10^{-3}$) scores mp1 and mp2 and mp3 allow 2.97 (m) 2.97 or 3 to any other power of 10 scores 3 marks award full marks for the correct answer without working	**(4)** **AO2**

Total for Question 1 = 6 marks.

Question Number	Answer	Additional guidance	Mark
2 (a)	**B** distance **A, C** and **D** are incorrect as these are vector quantities		**(1)** **AO1**

Question number	Answer	Additional guidance	Mark
2 (b)(i)	A description to include any 4 from: measure height (1) measure time of fall (1) use (average) speed=distance ÷ time (1) repeat with different number of cupcake cases in the stack/more cupcake cases (1) repeat **and** average time (of fall for each stack of cupcake cases) (1) plot a graph (speed of fall against number of cupcake cases dropped) (1)	 allow 'keep same height' allow in this context hold against (fixed point on) metre rule allow 'time it' accept cupcakes for cupcake cases	**(4)** **AO1**

Question Number	Answer	Additional guidance	Mark
2 (b)(ii)	substitution (1) (W=)0.005 x 10 evaluation (1) 0.05 (N)	 5×10^{-2} (N) do not allow power of ten error award full marks for the correct answer with no working give full credit for use of g=9.8 or 9.81 N/kg	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
2 (b)(iii)	 air resistance arrow (1)	Judge by eye any vertical upward arrow outside or inside the cupcake case ignore length of arrow arrow need not touch cupcake holder ignore label on arrow	**(1)** **AO2**

Question number	Answer	Additional guidance	Mark
2 (b) (iv)	zero / there is none / 0 / it has no acceleration	ignore 'constant' ignore units	**(1)** **AO2**

Total for question 2 = 9 marks

Question number	Answer	Additional guidance	Mark
3 (a) (i)	substitution (1) 11 = 0.42 x 10 x Δh rearrangement (1) (Δh =) $\frac{11}{0.42 \times 10}$ evaluation (1) 2.6 (m)	 accept substitution and rearrangement in either order (Δh =) $\frac{\Delta GPE}{m \times g}$ accept any value which rounds to 2.6 (m) award 2 marks for 2.6 to any other power of 10 allow 1 mark for 0.38 allow 1 mark for 46(.2) award full marks for the correct answer with no working give full credit for use of g=9.8 or 9.81 N/kg (gives 2.7 (m))	**(3)** **AO2**

Question number	Answer	Additional guidance	Mark
3 (a) (ii)	substitution(1) (KE=)$\frac{1}{2}$ x 0.42 x 12^2 evaluation (1) 30 (J)	 allow 30.2(4) (J) award 1 mark for 30 240 (J) award 1 mark for 2.52 (J) award 1 mark for 60.5 (J) award full marks for the correct answer with no working	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
3(a)(iii)	A description including: KE/kinetic (energy store) (1) (transfers to) and **one** of: elastic (potential energy store) (1) OR thermal (energy of ball/wall/surroundings) (1) OR <u>dissipates</u> (to surroundings) (1)	 allow mechanically / mechanical transfer ignore reference to gravitational potential energy allow heat for thermal allow sound in this context ignore reference to the ground	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
3 (b)	selection **and** substitution (1) $17^{(2)} = 2 \times 10 \times$ distance evaluation (1) 14(.45) (m)	use of either $v^2 - u^2 = 2ax$ or $v^2 = 2gh$ $17^{(2)} = 2 \times a \times$ distance allow 289 for 17^2 award full marks for the correct answer without working give full credit for use of g=9.8 or 9.81 m/s^2 gives 14.7 (m)	**(2)** **AO2**

Total for question 3 =9 marks

	Answer	Additional guidance	Mark
4 (a) (i)	(1.98-1.86) = (+/-) 0.12		**(1)** **AO2**

	Answer	Additional guidance	Mark
4(a)(ii)	(velocity =) $\frac{330 \times 0.12}{1.86}$ (1) (+/-) 21.3 (m/s) (1)	ecf from 4ai accept numbers that round to 21 (m/s) award 1,2 marks for (i) and (ii) for the correct answer for (ii) even without working	**(2)** **AO2**

	Answer	Additional guidance	Mark
4 (b)	(there is) an increase in wavelength (of light) (1) shows galaxies are moving away (from Earth) (1)	allow wavelength stretches allow red shift ignore shift to red end of spectrum ignore objects / stars / planets	**(2)** **AO1**

	Answer	Additional guidance	Mark
4 (c)	1(.0) (1) mm (1)	Allow values between 1.0 and 1.9 allow $1x10^{-3}$ m or 0.001 m for 2 marks if nothing in answer line, credit answer indicated in table	**(2)** **AO3**

	Answer	Additional guidance	Mark
4 (d)(i)	gravitational attraction / gravitational force (causing collapse) (1)	allow gravity ignore weight ignore gpe ignore gravitational energy	**(1)** **AO1**

	Answer	Additional guidance	Mark
4 (d)(ii)	An explanation linking: (gravity causing) increase in temperature (1) (until hot enough for) fusion (1) (until) balance (between gravity and fusion/thermal) (1)	 allow increase in pressure/density hydrogen to form helium allow nuclear reactions ignore fission allow equilibrium / counteracts	**(3)** **AO1**

Total for Question 4 = 11 marks.

	Answer Additional guidance	Mark
5(a)	**B** 3.0 s **A, C** and **D** are incorrect as they are the wrong time.	**(1)** **AO3**

	Answer	Additional guidance	Mark
5(b)	4.6 (m/s)	allow any value between 4.5 and 4.7 (m/s) inclusive	**(1)** **AO3**

	Answer	Additional guidance	Mark
5(c)	correct data point(s) seen (1) (accel =) $\frac{\Delta v}{t}$ (1) evaluation (1) 2.9 (m/s^2)	allow MP1 and MP2 in either order any data point(s) on the line e.g. (1.4,4) allow 'gradient' allow e.g. $\frac{4}{1.4}$ for 2 marks allow values that round to 2.9 (m/s^2) (e.g. 2.857...) award full marks for the correct answer without working	**(3)** **AO3**

	Answer	Additional guidance	Mark
5(d)	(distance =) area (under graph) (1) substitution (1) ½(1.4 x 4) + (3.6 x 4) + ½(1x 4) evaluation (1) 19 (m)	may be seen on graph 2.8 + 14.4+ 2.0 ½ x [3.6+6] x 4 allow values that round to 19 (m) (e.g. 19.2..) award full marks for the correct answer without working if no other marks scored allow (4 x 6 =)24 (m) for 1 mark	**(3)** **AO3**

	Answer	Additional guidance	Mark
5(e)	graph continued below time axis, starting at 18 s	do not accept vertical line do not accept line extending to left of 18 s	**(1)** **AO3**

Total for Question 5 = 9 marks.

	Answer	Additional guidance	Mark
6(a)(i)	calculation of time of travel (1) (120/330 =) 0.36(36) (s) substitution (1) $\frac{0.23 \times 100}{0.36(36)}$ evaluation (1) 63 (%)	 ecf from MP1 for MP2&3 accept values that round to 64 or 63 accept values that round to 0.64 or 0.63 for 2 marks award full marks for the correct answer without working	**(3)** **AO2**

	Answer	Mark
6(a)(ii)	**C** Increase the distance between L and M. **A, B** and **D** are incorrect as these would not improve the technicians' measurement	**(1)** **AO3**

	Answer	Additional guidance	Mark
6(b)	an explanation linking: (refraction caused by) change in speed (1) sound speeds up (when entering water) (1) light slows down (when entering water) (1)	allow 3 marks for sound speeds up and light slows down (when entering water) allow 2 marks for sound speeds up (when entering water) OR light slows down (when entering water) if no other marks scored allow 1 mark for description of any speed change (when entering water) if no other marks scored allow 1 mark for wavelength changes ignore references to transverse, longitudinal.	**(3)** **AO1**

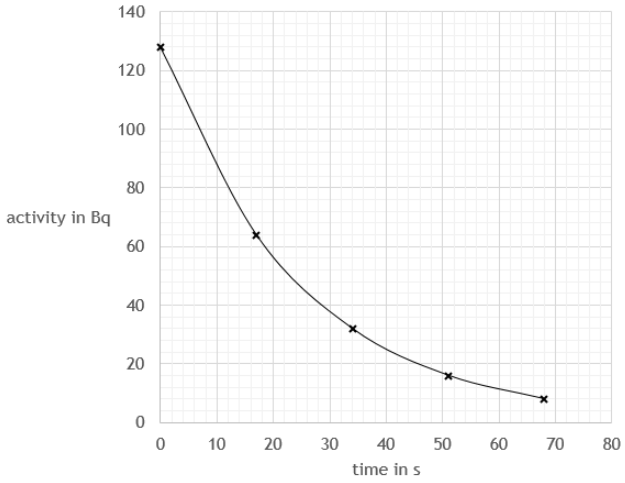
	Answer	Additional guidance	Mark
6(c)	example 1 e-m wave (1) corresponding result of energy transfer (1) example 2 e-m wave (1) corresponding result of energy transfer (1)	e.g. radio waves: communication, oscillations (of electrons) in wires microwaves: cooking, communications and satellite transmissions, internal heating of body cells, increase KE/vibration of water molecules infrared: cooking, thermal imaging, optical fibres, television remote controls, skin burns ultraviolet: security marking, fluorescent lamps, detecting forged bank notes and disinfecting water, damage to surface cells and eyes, skin cancer x-rays: observing the internal structure of objects, airport security scanners and medical x-rays, mutation or damage to cells in the body, cancer gamma rays: including sterilising food and medical equipment, and the detection of cancer and its treatment, mutation or damage to cells in the body, cancer additional effect for visible light scores 1 mark e.g. : including vision, photography and illumination	**(4)** **AO1**

Total for Question 6 = 11 marks.

	Answer	Mark
7(a)(i)	C $^{245}_{95}Am$ **A, B** and **D** are incorrect as these are not isotopes of americium.	**(1)** **AO1**

	Answer	Mark
7(a)(ii)	[x] B 5 cm **A, C** and **D** are incorrect as these are not the correct range of an alpha particle in air.	**(1)** **AO1**

	Answer	Additional guidance	Mark
7(a)(iii)	$^{4}_{2}\alpha$ (1) $^{237}_{93}Np$ (1) (1)	both correct for the mark ecf from mp1 ecf from mp1	**(3)** **AO2**

	Answer	Additional guidance	Mark
7(b)	plots at three of: 17,64 (1) 34,32 (1) 51,16 (1) 68,8 (1) tolerance ±1 s ±4 Bq	 allow line passing through correct point(s) ignore incorrect curve if no other marks scored allow 1 mark for evidence of halving activity e.g. 128 to 64	**(3)** **AO3**

	Answer	Additional guidance	Mark
7(c)	description to include: proton (1) becomes a neutron (1)	award 2 marks for p → n award 2 marks for answers in terms of quarks: u→d or up → down or uud→udd if no other mark scored, allow 1 mark for any **one** of neutron becomes proton n → p d→u decrease in atomic number <u>by one</u> mass number stays the same gains a neutron reduce charge (of nucleus) <u>by one</u> responses referring to emission of gamma or neutrino	**(2)** **AO1**

Total for Question 7 = 10 marks.

	Answer	Mark
8(a)(i)	**A** The ray enters along a normal to the edge of the block. **B, C** and **D** are incorrect as these do not explain why the light ray does not change direction.	**(1)** **AO2**

	Answer	Additional guidance	Mark
8(a)(ii)	explanation linking: extrapolate / extend the graph/curve (1) (until it reaches) $r = 90°$ (1) read corresponding value of *i* (1)	Allow annotation on graph: extension of line on graph to at least $r = 90°$ line down from line to x axis and labelled as critical angle	**(3)** **AO2**

	Answer	Additional guidance	Mark
8(b)(i)	explanation linking any 2 of: black / P is good absorber / poor reflector (1) white / Q is good reflector poor absorber (1) different colour of surfaces absorb differently (1)	allow any one statement for 2 marks: • black / P **better** absorber • black / P **worse** reflector • white / Q **worse** absorber • white / Q **better** reflector • black / P absorbs (radiation) **and** white / Q reflects (radiation)	**(2)** **AO1**

	Answer	Additional guidance	Mark
8(b)(ii)	explanation linking **four** from: P is absorbing radiation/(thermal) energy (1) P is (also) emitting radiation/(thermal) energy (1) (rate of) emission increases with temperature (1) (temperature constant) when (rate of) emission = (rate of) absorption (1) mention of rate in either mp3 or mp4 (1)	 allow heat in this context temperature of P constant when rate of emission of radiation = (rate of) absorption of radiation scores 4 marks (rate of) absorption of radiation is greater than (rate of) emission of radiation (so temperature increases) scores MP1 and 2	**(4)** **AO1**

Total for Question 8 = 10 marks.

	Answer	Additional guidance	Mark
9(a)	selection (1) $p = m \times v$ substitution (1) $6.6 (\times 10^{-26}) \times 480$ evaluation (1) 3.2×10^{-23} (kg m/s)	allow mom(entum) = mass x velocity allow numbers that round to 3.2×10^{-23} e.g. 3.168×10^{-23} award full marks for the correct answer without working $6.6 (\times 10^{-26}) \times 480$ seen scores MP1 and MP2, 2 marks 3.2 to any other power of ten scores MP1 and MP2, 2 marks	**(3)** **AO2**

	Answer	Additional guidance	Mark
9(b)	attempt to find momentum change (Δp) (1) (Δp) =± 1.4 substitution in to F = $\frac{\Delta p}{t}$ (1) $\frac{\pm 1.4}{70 \times 10^{-3}}$ evaluation (1) (±) 20 (N)	± 0.8 ± 0.6 allow (Δp) =± 0.2 allow $\frac{\pm 0.2}{70 \times 10^{-3}}$ answers which round to (±) 20 to any other power of 10 score 2 marks answers which round to (±) 2.9 scores 2 marks answers which round to (±) 2.9 to any other power of 10 score 1 mark award full marks for the correct answer without working	**(3)** **AO2**

Question number	Indicative content	Mark
9c	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 isolated statements • weights on hanger • weights added to trolley • light gate(s) / ticker(tape) timer / ultrasonic transducer • datalogger • (interrupter) card on trolley • sloping runway • weigh trolley • use newtonmeter • use a = (v-u)/t • measure distance and time • use stopclock and ruler • use (average) speed = distance / time • use $a = (v^2-u^2)/ 2s$ • plot graph of F against a detail of procedure • suspend weights from weight hanger to produce force • changing weights on hanger • keeping mass constant by moving weights between hanger and trolley • light gates/ticker(tape) timer/ultrasonic transducer used to measure acceleration/velocity/time • runway on slope so no (effect of) friction /so trolley rolls at constant speed (with no weights/force) • increase angle of slope to increase force • interrupter card for time through gate • final speed = 2 x average speed	**(6)** AO1

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3–4	Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5–6	Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance isolated facts mention at least 2 isolated statements evidence may be seen in the diagram	Possible candidate responses add weights and use light gates
Level 2	3–4	Additional guidance limited procedure 1 detail of procedure **and** mention 1 other isolated statement evidence may be seen in the diagram	Possible candidate responses use light gates to measure acceleration/velocity/time and add weights
Level 3	5–6	Additional guidance detailed procedure 2 details of procedure **and** mention 1 other isolated statement evidence may be seen in the diagram	Possible candidate responses use light gates to measure acceleration/velocity/time and suspend weights from weight hanger to produce force and sloping runway

Total for Question 9 = 12 marks

	Answer	Additional guidance	Mark
10(a)(i)	substitution **and** rearrangement (1) $\text{useful energy transferred} = \frac{7(\%) \times 1300}{100}$ evaluation (1) 90 (J)	$\text{useful energy transferred} = 0.07 \times 1300$ allow 91 (J) 0.91 or 0.9 scores 1 mark award full marks for the correct answer without working	**(2)** **AO2**

	Answer	Additional guidance	Mark
10(a)(ii)	statement plus reason for example: long half-life (1) with one from: the rover takes a long time (to get to Mars) (1) rover needs to operate for a long time (on Mars) (1) (once on Mars) cannot be replaced (1)	Allow other relevant properties for MP1 with reason for MP2, for example: high melting point … to maintain RTG integrity not chemically reactive … to prevent corrosion	**(2)** **AO3**

	Answer	Additional guidance	Mark
10(b)	substitution (1) 1.49×10^{-10} = change in mass x $(3 \times 10^{8})^{2}$ rearrangement (1) (change in mass =) $\frac{1.49 \times 10^{-10}}{9 \times 10^{16}}$ evaluation (1) 1.66×10^{-27} (kg)	$\frac{1.49 \times 10^{-10}}{(3 \times 10^{8})^{2}}$ allow $m=E/c^{2}$ Accept values that round to 1.7×10^{-27} if no other marks scored 1.66 or 1.7 to any other power of ten scores 1 mark award full marks for the correct answer without working	**(3)** **AO2**

Question number	Indicative content	Mark
10c	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 chain reaction • neutrons emitted in one fission go on to hit other U-235 nuclei • neutrons emitted in one fission go on to cause a chain reaction control rods • rods absorb/capture/stop neutrons • limit/control number of fissions • varies rate of (thermal) energy released moderator • slows down neutrons • makes them more likely to cause fission	**(6)** AO1

Level	Mark	Descriptor
	0	• No rewardable material. relevant
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance isolated statements	Possible candidate responses Mention of 2 of: chain reaction **OR** control/boron rods **OR** moderator
Level 2	3–4	Additional guidance limited explanation detail of 1 of chain reaction/ control rods/ moderator **and** mention at least 1 other	Possible candidate responses neutrons emitted in one fission go on to hit other U-235 nuclei **and** mention control rods
Level 3	5–6	Additional guidance detailed explanation detail of 2 of chain reaction/ control rods/ moderator and mention the other one	Possible candidate responses neutrons emitted in one fission go on to hit other U-235 nuclei AND control rods absorb neutrons to reduce number of fissions AND mention of moderator