Mark Scheme (Results)

November 2021

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.

Question number	Answer	Additional guidance	Mark
1(a)	uses data taken from x axis (1) 28(cm) (1)	award full marks for correct answer without working	(2) AO3

Question number	Answer	Additional guidance	Mark
1 b(i)	a description to include count the number of waves(1) (arriving/passing a point) in a specific time(1) use frequency = number of waves / time (1)	ignore in one second count the number of waves in one second scores 2 marks (MP1 and MP3) find the time between one wave and the next scores 2 marks (MP1 and MP2)	(3) AO1

Question number	Answer	Additional guidance	Mark
1 b(ii)	substitution (1) 1.5 = 0.7 x λ rearrangement and evaluation 2.1(4) m	$\dfrac{1.5}{0.7}$ allow $\dfrac{0.7}{1.5}$ for 1 mark award full marks for correct answer without working. λ = v/f scores 1 mark	(2) AO2

Question number	Answer	Additional guidance	Mark
1 b(iii)	A description to include: mention of oscillations/vibrations (1) EITHER transverse – (oscillations) perpendicular to direction of wave (travel) (1) OR longitudinal - (oscillations) in same direction as wave (travel) (1)	up and down OR side to side (movements) OR back and forth transverse movement up and down but longitudinal is side to side (1 mark only)	(2) AO1

Total marks for Question 1H =9

Question number	Answer	Mark
2(a)	B ionising and emitted by unstable nuclei A is incorrect stable nuclei do not give radioactive emissions C is incorrect not all radioactive emissions are neutral D is incorrect not all radioactive emissions are neutral	(1) AO1

Question number	Answer	Additional guidance	Mark
2(b)	same number of protons (1) different number of neutrons (1)	same atomic number different mass number	(2) AO2

Question number	Answer	Additional guidance	Mark
2(c)(i)	An explanation to include; there is no aluminium to absorb β particles (1) (therefore) more β particles reach the G-M tube (1)	aluminium absorbs/stops/blocks beta particles accept reverse arguments accept radiation for beta particles	(2) AO2

Question number	Answer	Additional guidance	Mark
2 c (ii)	(idea of) background radiation	a named source of background radiation	**(1)** **AO3**

Question number	Answer	Additional guidance	Mark
2c (iii)	becquerel	accept Bq accept close spelling	**(1)** **AO1**

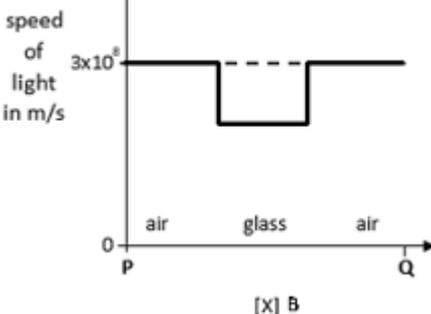| Question number	Answer	Additional guidance	Mark
2d	33 days is 3 half-lives (1) 2.1(25) × 10^{22} (1)	$\dfrac{1.7 \times 10^{23}}{2\ (\times\ 2\ \times\ 2)}$ 2.1(25) to any other power of ten scores mp1 only award full marks for correct answer without working.	**(2)** **AO2**

Total marks for Question 2H =9

Question number	Answer	Additional guidance	Mark
3 (a)(i)	curve through origin, through all points – by eye (1)	Figure 6	(1) AO1
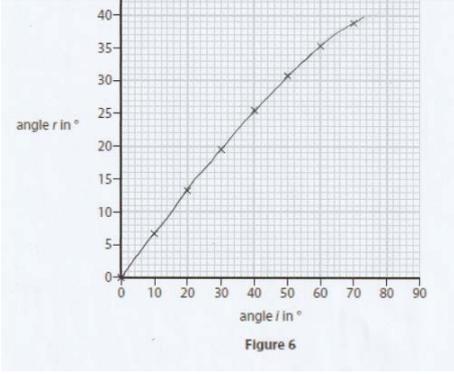
Question number	Answer	Additional guidance	Mark
3 (a)(ii)	$(r =)\ 42(°) \pm 2(°)$ (1)	ECF their graph	(1) AO3

Question number	Answer	Additional guidance	Mark
3 (a)(iii)	Description to include two from: r increases as i increases (1) (but) not in proportion (1) increase in r becomes less (for same increase in i) (1)	r increases as i increases (but) not in even steps/not straight line/non-linear/gradient changes r always less than i	(2) AO3

Question number	Answer		Mark
3 (b)			(1) AO1

	wave velocity	wavelength
[x] A	decreases	decreases

B is not correct because the wavelength does not increase
C and are not correct because the wave velocity does not increase

Question number	Answer	Additional guidance	Mark
3 (c)	Explanation linking **three** from: (some) light is <u>reflected</u> (1) (at) the top edge (1) (some) light is <u>absorbed</u> (1) by the glass (1)	 in the air in the (glass) block credit responses in terms of attenuation/ dispersion/reflection at the second face/spreading out	(3) AO2

Question number	Answer	Mark
3 (d)

B is the correct answer

A is not correct because the velocity in air is the same before and after the glass

C is not correct because the velocity is constant inside the glass

D is no correct because the velocity in glass is not greater than the velocity in air | (1) AO3 |

Total for Question 3H = 9 marks)

Question number	Answer	Mark
4 (a)	 A is not correct because it shows a constant velocity of 0.4 m/s B and D are not correct because they show constant acceleration.	**(1)** **AO3**

Question number	Answer	Additional guidance	Mark
4 (b)(i)	attempt to use correct data from graph or equation (1) substitution (1) $(a =)\ \dfrac{26 - 14}{34}$ evaluation to 2 sf (1) 0.35 (m/s²)	quoting $a = \dfrac{(\Delta)\,v}{t}$ or a = gradient (of line) 0.3529… scores mp1 and mp2 $\dfrac{26}{34}$ scores mp1 independent mark award full marks for correct answer without working.	**(3)** **AO2**

Question number	Answer	Additional guidance	Mark
4 (b)(ii)	attempt to calculate area under the line (1) calculates EITHER area of triangle OR area of rectangle (1) 204 (m) or 476 (m) evaluation (1) 680 (m)	accept count squares use of $v^2 - u^2 = 2ax$ $x = \dfrac{v^2 - u^2}{2a}$ allow ecf from b(i) award full marks for correct answer without working award 1 mark for final answer 408 (m)	**(3)** **AO2**

Question number	Answer	Additional guidance	Mark
4 (c)	An explanation linking three of: acceleration increases (1) as F = ma (1) (and) mass decreases (1) due to burning/using fuel (1)	 independent mark	**(3)** **AO1**

Total marks for Question 4H = 10

Question number	Answer	Additional guidance	Mark
5(a)	substitution (1) $(t^2=)$ $\dfrac{2 \times 1.4}{10}$ evaluation (1) $(t =)$ 0.53 (s)	0.28 allow numbers that round to 0.53 e.g. 0.52915 award full marks for correct answer without working.	(2) AO2

Question number	Answer	Additional guidance	Mark
5(b)(i)	(students') reaction time (is significant compared with recorded time) (1)	g is really 9.8	(1) AO2

Question number	Answer	Additional guidance	Mark
5(b)(ii)	**One** from use light gates (1) use automatic timer (1) Use time lapse/ stroboscopic photography (1) drop from greater height (1)	 ignore repeats or more people	(1) AO3

Question number	Answer	Additional guidance	Mark
5(c)(i)	substitution (1) (force =) $\dfrac{8.7}{0.35}$ evaluation (1) 25 (N)	use of force = $\dfrac{\text{change in momentum}}{\text{time}}$ allow numbers that round to 25 e.g 24 .8571 award full marks for correct answer without working.	(2) AO2

Question number	Answer	Additional guidance	Mark
5(c)(ii)	(magnitude) 25 (N) (1) (direction) down(wards)/ towards floor (1)	ecf from 7bi allow arrow drawn pointing down "south"	(2) AO3

Question number	Answer	Additional guidance	Mark
5(d)	Two stage calculation substitution$_1$ (1) $(v^2 - 0 =) 2 \times 10 \times 3.8$ evaluation of v (1) $(v =) 8.7$ (m/s) substitution$_2$ (1) $0.40 = m \times 8.7$ rearrangement and evaluation (1) $(m =) 0.046$ (kg)	 use of $v^2 - u^2 = 2ax$ OR $\frac{1}{2} mv^2 = mgh$ 76 allow numbers that round to 8.7 e.g. 8.718 use of $p = mv$ allow numbers that round to 0.046 e.g. 0.04598 award full marks for correct answer without working.	**(4)** **AO2**

Total for Question 5H = 12 marks)

	Answer	Additional guidance	Mark
6(a)	A description to include **two** from: (radioactive material/substances) inside the food/body (1) emit radiation from inside the body (1) damage body cells (1)	trapped in the body exposed to radioactivity cause cancer	**(2)** **AO1**

	Answer	Additional guidance	Mark
6(b)	An explanation linking **two** from: to preserve food (1) by 'killing' bacteria (1) (gamma) is (very) penetrating (and so reaches all the food). (1) sterilising (1)	stop food going off	**(2)** **AO2**

	Answer	Additional guidance	Mark
6(c)	**One** from: rearrangement (of particles) (1) loses/emits energy (1) becomes (more) stable (1)		**(1)** **AO1**

Question number	Indicative content	Mark
6 *(d)	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 1 **(6 marks)** **alpha** • a particle (not a wave) • made up of 4 particles • helium nucleus • has a positive charge • when emitted by a nucleus, atomic number goes down by 2 • mass number goes down by 4 **beta** • a particle (not a wave) • made up of 1 particle • electron (or positron) • has a negative charge • when emitted, atomic number goes up by 1 • mass number does not change Ignore references to range, penetration, ionisation.	(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 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 facts	Possible candidate responses A beta particle is an electron. An alpha particle is a helium nucleus
Level 2	3–4	Additional guidance effect of alpha and beta decay or nature and effect of alpha or beta	Possible candidate responses A beta particle is an electron. When emitted the mass number doesn't change but atomic number goes up by one
Level 3	5–6	Additional guidance detailed comparison that includes nature of alpha and nature of beta and effect of either alpha or beta OR effect of alpha and beta and nature of either alpha or beta	Possible candidate responses Alpha particle is a helium nucleus AND A beta particle is an electron. When emitted the mass number doesn't change but atomic number goes up by one

Total for Question 6H = 12 marks

TOTAL FOR PAPER = 60 MARKS