# Commentary on candidate responses

The marking issues identified in this document are based on examples that were noted during Quality Assurance and Appeals procedures in Spring/Autumn 2021.

| Question | Candidate response | Max mark | Mark awarded | Commentary |
|---|---|---|---|---|
| 1(b)(i) | A | 3 | 0 | The candidate has not selected an appropriate relationship. Following the statement of an inappropriate relationship, an acceptable relationship cannot be implied by the subsequent 'correct' substitution of values. |
| | B | 3 | 3 | The candidate has indicated that the gradient of a line is to be calculated, and their substitution of values is consistent with the calculation of the gradient of the appropriate line on the graph. The candidate has given an acceptable final answer. The substitution and final answer clarify that the candidate is using *A* for acceleration. |
| | C | 3 | 2 | The candidate has selected an appropriate relationship and has correctly substituted values. An acceptable numerical final answer has been given, but the additional bearing is incorrect, and so the mark allocated for the final answer is not awarded. |
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| 1(b)(ii) | A | 3 | 0 | The candidate has not selected an appropriate relationship. The use of an appropriate relationship is not implied by the incorrect substitution of values. |
| | B | 3 | 3 | The candidate has not selected an appropriate relationship, but an appropriate relationship is implied by the correct substitution of values. The candidate has given an acceptable final answer. |
| | C | 3 | 0 | The candidate has not specified which 'area' is to be calculated, and the substitution of values does not imply the appropriate area. |
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| 1(c) | A | 2 | 1 | The candidate has implied the correct substitution of values to determine the appropriate angle but has rounded at an intermediate stage (0.9 rather than 0.8965517 …), resulting in an unacceptable final answer. |

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| | B | 2 | 1 | The candidate has correctly substituted values to determine the appropriate angle but has rounded incorrectly at an intermediate stage (0.896 rather than 0.897). Despite giving an acceptable answer, this is treated as an arithmetic error, and the mark for the final answer is not awarded. |
| | C | 2 | 2 | Although the candidate has not shown values being substituted into a relationship and has rounded at an intermediate stage, the rounding is not incorrect and as the candidate has given a correct final answer, both marks are awarded. |
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| 2(a)(i) | A | 1 | 0 | Although the candidate's explanation explains the purpose of using air, it does not specifically mention friction. |
| | B | 1 | 0 | The candidate's explanation does not specifically mention friction. |
| | C | 1 | 1 | The candidate's explanation appropriately mentions friction. |
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| 2(a)(ii) | A | 3 | 2 | The candidate has stated the three measurements necessary to determine the acceleration of the vehicle but has added a fourth, unnecessary measurement. The '±' rule is applied, and 2 marks are awarded. |
| | B | 3 | 2 | The candidate has clearly stated two measurements that must be made. The candidate's statement 'the size of the card' is not sufficiently specific, and this mark is not awarded. |
| | C | 3 | 0 | The candidate has clearly stated one measurement that must be made (length of the card). The candidate's statements 'timer reading' and 'stopclock reading' are not sufficiently specific, and these 2 marks are not awarded. In addition, the candidate has listed an additional, unnecessary measurement. The '±' rule is applied, and 0 marks are awarded. |
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| 2(b) | A | 2 | 0 | The candidate's statement is incorrect. Following an incorrect statement, no marks can be awarded for a 'correct' justification. |

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| | B | 2 | 1 | The candidate has made a correct statement. The justification, however, is not sufficiently clear for the second mark to be awarded. |
| | C | 2 | 0 | The candidate has not answered the question and has given a value for the hanging mass rather than the acceleration, which is specifically asked for in the question. |
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| 3(a) | A | 2 | 0 | The candidate has not selected an appropriate relationship. In a 'show' question, an appropriate relationship cannot be implied by the subsequent correct substitution of values. |
| | B | 2 | 1 | The candidate has selected an appropriate relationship and correctly substituted values. In a 'show' question candidates must state the given final answer. In this response the unit in the final answer is omitted, so the mark for substitution and statement of final answer is not awarded. |
| | C | 2 | 0 | The candidate has not selected an appropriate relationship. |
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| 3(c) | A | 3 | 0 | The candidate has not selected an appropriate relationship. Following the statement of an inappropriate relationship, an appropriate relationship cannot be implied by the 'correct' substitution of values. |
| | B | 3 | 2 | In this question the use of '$W$' to represent energy is not ambiguous. The candidate has selected an appropriate relationship and correctly substituted values. The final answer, however, has an incorrect unit (kg m $s^{-1}$ rather than kg m $s^{-2}$) and so the mark allocated for the final answer is not awarded. |
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| 4(a) | A | 1 | 0 | The candidate's statement is not sufficiently precise, omitting 'of a planet'. |
| | B | 1 | 0 | The candidate's statement is not sufficiently precise, as 'celestial object' includes stars, etc. |
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| 4(b) | A | 2 | 1 | The candidate has made a correct statement. The justification, however, |

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| | | | | is incorrect. Since this is a 'justify' rather than a 'must justify' question, 1 mark is awarded for a correct statement. |
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| 4(d)(i) | A | 3 | 1 | The candidate has selected an appropriate relationship but has incorrectly substituted values ($2.3 \times 10^4$ rather than $(2.3 \times 10^4)^2$). Following incorrect substitution of values, correct substitution cannot be implied by a correct final answer. |
| | B | 3 | 2 | The candidate has stated an acceptable relationship and correctly substituted values (assuming $v$ is in km $s^{-1}$). The unit in the final answer, however, is not consistent with this assumption (J rather than MJ), and so the mark allocated for the final answer is not awarded. |
| | C | 3 | 1 | The candidate has stated an acceptable relationship but has incorrectly substituted values (230 rather than $23.0 \times 10^3$). |
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| 4(d)(ii) | A | 2 | 1 | The candidate's explanation states, 'no forces acting', which implies no forces acting against New Horizons. However, 'no acceleration' is just paraphrasing 'maintained this speed', which is given in the question. |
| | B | 2 | 2 | The candidate has stated that no forces act against New Horizons and states that rocket motors are not needed. |
| | C | 2 | 1 | The candidate has stated that no forces act against New Horizons but does not link this either to engine force or zero unbalanced force. |
| | D | 2 | 1 | The candidate's reference to the forces acting on New Horizons being balanced implies that there are a number of non-zero forces acting, which is incorrect. The statement that the rocket engines are not needed is correct. |
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| 4(e) | A | 3 | 2 | The candidate has selected an appropriate relationship, correctly substituted values, with the conversion from hours to seconds in the third line. However, there is an arithmetic error in |

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| | | | | the third line and so the mark for the final answer cannot be awarded. |
| | B | 3 | 2 | The candidate has selected an appropriate relationship and correctly substituted values.<br>The final answer should be given to 2 significant figures (sig figs), but the candidate has given the final answer to 5 significant figures and so the mark for a correct or acceptable final answer is not awarded. |
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| 5 | A | 3 | 1 | The response to an open-ended question is marked holistically and judged on whether the candidate has demonstrated a good, reasonable, limited, or no understanding response. Markers do not award a mark for every good point made or deduct a mark for every example of wrong physics. In this case the candidate has demonstrated a limited level of understanding. |
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| 6(a)(i) | A | 1 | 0 | Reduction in the brightness of the LEDs is an effect of the resistor connected in series, but it is not its purpose, and so the candidate's statement does not address the question. |
| | B | 1 | 0 | The candidate has made a correct statement regarding the prevention of damage to the LEDs, but the remainder of the statement contains wrong physics. |
| | C | 1 | 0 | Again, reduction in the brightness of the LEDs is an effect of the resistor connected in series, but it is not its purpose, and so the candidate's statement does not address the question. |
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| 6(b) | A | 2 | 1 | The candidate has made a correct statement, but the justification is not sufficiently clear. There is doubt as to whether the candidate means 'same as before' or 'same as the other LEDs'. The justification is treated as incomplete. |
| | B | 2 | 0 | The candidate has made a correct statement, but the justification contains wrong physics ('voltage in' rather than |

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| | | | | 'voltage across'). Since this is a 'must justify' question, the mark for a correct statement is dependent on a correct, or a correct but incomplete justification. |
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| 7(b)(i) | A | 1 | 1 | The candidate's explanation implies that the floodlight requires a higher current than can be supplied in the transistor circuit. |
| | B | 1 | 0 | The candidate's explanation is not sufficiently clear. |
| | C | 1 | 1 | The candidate's explanation implies that the floodlight requires a higher current than can be supplied in the transistor circuit. |
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| 8(a) | A | 3 | 1 | The candidate has selected an appropriate relationship but has not correctly substituted values (238 rather than 228). Since the values required for the $\Delta T$ calculation are not explicitly stated, it cannot be assumed that the candidate has made an arithmetic error. |
| | B | 3 | 2 | The candidate has selected an appropriate relationship and correctly substituted values but has given a final answer to an inappropriate number of significant figures. A final answer rounded to two sig figs is correct, rounded to 1, 3 or 4 sig figs is acceptable. (4.61700 has 6 sig figs). |
| | C | 3 | 3 | The candidate has selected an appropriate relationship, correctly substituted values, and has given a final answer to an acceptable number of significant figures (461700 has 4 sig figs). |
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| 8(b)(i) | A | 3 | 0 | The candidate has not selected an appropriate relationship ($R = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ rather than $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$). Following the statement of an inappropriate relationship, an appropriate relationship cannot be implied by 'correct' substitution of values or an acceptable final answer. |

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| | B | 3 | 3 | The candidate has selected an appropriate relationship, correctly substituted values and given an acceptable final answer. The omission of $\frac{1}{R}$ on the left-hand side of the equation in the second line, and of the $R$ on the third line is accepted as bad form rather than wrong physics. |
| | C | 3 | 3 | The candidate has not stated an appropriate relationship, but this can be implied by the correct substitution of values in both uses of the relationship. The candidate has given an acceptable final answer. |
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| 8(b)(ii) | A | 3 | 1 | The candidate has selected an appropriate relationship but has not correctly substituted values (230 rather than $230^2$). Following the statement of incorrect substitution of values, correct substitutions cannot be implied by a 'correct' final answer. |
| | B | 3 | 3 | The candidate has selected appropriate relationships, correctly substituted values into each relationship, and given an acceptable final answer.<br>The candidate has rounded a calculated value at an intermediate stage of the working, which is not good practice, but the rounding is correct, and the final answer is acceptable. |
| | C | 3 | 3 | The candidate has selected one of the required appropriate relationships. The relationship $I = \frac{V}{R}$ can be implied by correctly substituted values in the first line. The final answer given is rounded to an acceptable number of significant figures.<br>The candidate has rounded a calculated value at an intermediate stage of the working, which is not good practice, but the rounding is correct, and the final answer is acceptable. |
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| 8(c) | A | 2 | 0 | The candidate has made an incorrect statement. Following an incorrect statement, the mark for a 'correct' justification cannot be awarded. |

| Question | Candidate response | Max mark | Mark awarded | Commentary |
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| | B | 2 | 1 | The candidate has made a correct statement, but the justification is wrong. In a 'justify' question, the mark allocated for a correct statement is not dependent on a correct justification. |
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| 9(a) | A | 2 | 1 | The candidate has selected an appropriate relationship and correctly substituted values but has not stated the given final answer (2 rather than 2.0). The mark for substitution and statement of given answer is not awarded. |
| | B | 2 | 1 | The candidate has selected an appropriate relationship but has not correctly substituted values ($2.5 \times 10^6$ rather than $2.5 \times 10^5$). |
| | C | 2 | 0 | The candidate has not selected an appropriate relationship (the use of superscripts rather than subscripts is ambiguous). Following the statement of an inappropriate relationship, an acceptable relationship cannot be implied by the subsequent 'correct' substitution of values. |
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| 9(b)(i) | A | 3 | 1 | The candidate has selected an appropriate relationship but has incorrectly substituted values (284 rather than 294). Since the candidate has not shown working for the conversion from °C to K, an arithmetic mistake cannot be assumed.<br>It should also be noted that the unit in the final answer (°K) is not acceptable. |
| | B | 3 | 2 | The candidate has selected an appropriate relationship and correctly substituted values. The final answer, however, is not acceptable, possibly due to intermediate rounding in the penultimate line, and so the mark allocated for the final answer is not awarded. |
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| 9(b)(ii) | A | 3 | 2 | The candidate's explanation is brief but covers the slowing of particles and the reduced force of collision with the walls. |
| | B | 3 | 1 | The candidate's explanation implies only a reduced force of collision with the walls. |

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| | C | 3 | 0 | The symbols '↑' and '↓' are not acceptable alternatives for 'increases' and 'decreases'. |
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| 11(a)(i),(ii) | A | 1,1 | 1,1 | The amplitude is indicated correctly, the use of 'amp' to represent amplitude is not ambiguous.<br>The wavelength is indicated and labelled correctly. |
| | B | 1,1 | 0,0 | Neither the amplitude or the wavelength are indicated with sufficient accuracy. |
| | C | 1,1 | 1,0 | Although the amplitude is indicated to the right of the diagram, it is indicated accurately.<br>The wavelength is not indicated with sufficient accuracy as the line indicating wavelength should be horizontal. |
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| 11(c)(i),(ii) | A | 3, 1 | 2,0 | The candidate's graph has suitable scales, labels and units.<br>The first, fourth and fifth points are not plotted with sufficient accuracy.<br>The best fit curve drawn by the candidate is acceptable.<br>The predicted frequency of 740 Hz is not consistent with the candidate's graph. |
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| 11(c)(iii) | A | 1 | 0 | The results of the experiment shown in the table would suggest that the frequency is already measured to the nearest 1 Hz, and so the candidate's suggestion would not be an improvement.<br>The word 'precise', however, is used correctly. |
| | B | 1 | 0 | The results of the experiment shown in the table would suggest that the frequency is already measured to the nearest 1 Hz, and so the candidate's suggestion would not be an improvement.<br>The word 'accurate' is not used correctly. |
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| 12(b)(i) | A | 1 | 0 | The candidate has stated one correct and one incorrect source of background radiation. The '±' rule is applied, and the mark is not awarded. |

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| 13(a)(i) | A | 1 | 1 | The candidate's handwriting is poor, but legible as 'fission'. |
| | B | 1 | 0 | The term 'fussion' is incorrect. |
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| 13(a)(ii) | A | 2 | 1 | The candidate's explanation covers chain reactions but suggests that the same two or three nuclei released by the first fission repeatedly hit further nuclei, which is wrong physics. |
| | B | 2 | 0 | The candidate has indicated that the same nucleus keeps splitting. Even though they have mentioned a chain reaction occurring. 0 marks are awarded. |
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| 13(c)(i) | A | 4 | 3 | The candidate has selected an appropriate relationship and correctly substituted values to the relationship for both radiations, assuming that the intended unit of absorbed dose is pGy (picoGrays).<br>The unit in the final answer, however, is not consistent with this assumption (Sv rather than pSv), and so the mark allocated for the final answer is not awarded. |
| | B | 4 | 3 | The candidate has selected an appropriate relationship and correctly substituted values to the relationship for both radiations.<br>Gray(Gy) is not an acceptable unit for equivalent dose, so the mark for the final answer is not awarded. |