

	Mark	Commentary
Q6(b)(ii)	2	
Response 1	2	The candidate has shown evidence of establishing three half-value thicknesses and obtained a correct final answer.
Response 2	2	The candidate has shown evidence of establishing three half-value thicknesses and obtained a correct final answer.
Response 3	2	The candidate has shown evidence of establishing three half-value thicknesses and obtained a correct final answer.
Response 4	2	The candidate has shown no working but has stated an acceptable final answer.
Response 5	1	The candidate has shown evidence of establishing three halving's but has not stated a final answer with units.
Response 6	2	The candidate has shown evidence of establishing three half-value thicknesses and obtained a correct final answer that is consistent with their answer to 6(b)(i).
Response 7	2	The candidate has shown evidence of establishing three half-value thicknesses and obtained a correct final answer.
Q6(b)(iii)	1	
Response 1	1	The candidate has made an acceptable prediction about the value obtained for the half-value thickness of aluminium compared to lead.
Response 2	1	The candidate has made an acceptable prediction about the value obtained for the half-value thickness of aluminium compared to lead.
Response 3	1	The candidate has implied that the value would increase. The size of the increase is not taken into account.
Response 4	0	The candidate has not made any prediction about the value obtained for the half-value thickness of aluminium compared to lead.
Q6(c)	3	
Response 1	3	The candidate has implied the selection of an appropriate relationship by a correct substitution. The final answer, expressed in scientific notation, is correct.
Response 2	2	The candidate has selected an appropriate relationship and substituted correctly. For this question, the final answer does not require the unit 'hours' to be stated, however if candidates give a unit in their final answer it must be correct. This candidate has given an incorrect unit in their final answer. The mark for the final answer is not awarded.
Response 3	2	The candidate has implied the selection of an appropriate relationship by a correct substitution. The final answers is incorrect.
Response 4	0	The value for the equivalent dose rate has not been substituted correctly. The marks for an implied relationship and final answer are not accessible.
Response 5	3	The candidate has stated an ambiguous relationship between the quantities in this question, however the substitution clarifies that correct physics has been used which has led to a correct final answer.
Response 6	0	The relationship stated is incorrect. The marks for a substitution and a final answer are not accessible.
Response 7	2	The candidate has implied the selection of an appropriate relationship by a correct substitution. The candidate has performed additional calculations beyond the required answer. The mark for the final answer is not awarded.

Response 8	3	The candidate has scored-out their answer and has made no further attempt to answer the question. Scored-out working which has not been replaced should be marked where still legible. The correct substitution and final answer can clearly be seen under the wavy lines.
Response 9	2	The candidates working makes it clear that they have made an error in converting mSv into Sv. The candidate has implied the selection of an appropriate relationship by a correct substitution of their values. The mark for the final answer is not awarded due to the incorrect unit for the values substituted.
Q7(a)	1	
Response 1	0	The candidates answer is incomplete as it does not include the number 80 000.
Response 2	0	The first part of the candidates answer is incomplete as it does not include the number 80 000 and the second part is incorrect.
Response 3	1	The candidate's answer is correct.
Q7(b)(i)	2	
Response 1	2	The candidate has made a statement about neutrons creating a chain reaction.
Response 2	0	The candidate statement suggests that the nucleus will continue to divide which is an incorrect answer.
Response 3	1	The candidate is awarded a mark for making a statement about a chain reaction.
Q7(b)(ii)	4	
Response 1	1	The candidate has selected an appropriate relationship but substituted incorrectly.
Response 2	4	The candidate has selected an appropriate relationship. The calculation of energy released per minute is not shown but is implied by correct substitution. The final answer is correct.
Response 3	1	A mark is awarded in the marking instructions for multiplying the number of reactions per minute by the energy released by one reaction.
Response 4	1	The candidate has calculated the power of one decay over a minute. The marking instructions identify this calculation as wrong physics and only one mark is available for the selected relationship.
Q7(c)	1	
Response 1	1	The candidate has stated an acceptable use of nuclear radiation.
Response 2	0	The candidate's answer is not sufficiently detailed.
Response 3	0	The candidate's answer is not sufficiently detailed.
Response 4	1	The candidate has stated an acceptable use of nuclear radiation.
Response 5	0	The candidate has not stated an acceptable use of nuclear radiation.
Response 6	0	The candidate has given two uses. When a candidate provides more than the required number of responses then each incorrect response negates a correct response. In this case X-rays is incorrect and negates any other answer.
Response 7	1	The candidate has stated an acceptable use of nuclear radiation.
Q8(a)	1	
Response 1	1	The candidate has stated the correct displacement. The additional information about the direction is ignored.
Response 2	1	In this question, the unit is not required in the final answer.
Response 3	1	The candidate has given an acceptable answer.

Q8b(i)	3	
Response 1	1	The candidate has stated the correct relationship but has made an incorrect substitution.
Response 2	2	The candidate has implied the correct relationship by correct substitution. The final answer does not have a unit. The mark for the final answer is not awarded.
Response 3	0	The use of $d=vt$ is wrong physics.
Q9(a)	1	
Response 1	0	The candidate has given an incomplete answer. The directions of the forces are not compared.
Response 2	1	The candidate has given an acceptable answer.
Response 3	1	The candidate has given an acceptable answer in terms of size and direction.
Q9(b)	3	
Response 1	0	The use of $F=ma$ is wrong physics.
Response 2	2	The candidate has selected an appropriate relationship and substituted correctly. The unit in the final answer is incorrect. The mark for the final answer is not awarded.
Response 3	0	The candidate has scored-out their answer. Scored-out working which has not been replaced should be marked where still legible. It is clear that the candidate has selected two relationships but has not identified which relationship can be used to answer the question.
Response 4	3	The candidate has used non-standard symbols. The substitution and the final answer are correct.
Q9(c)	4	
Response 1	0	The candidate has not selected an appropriate relationship.
Response 2	4	The candidate has selected an appropriate relationship. The calculation of the unbalanced force is not shown but is implied by correct substitution. The final answer is correct.
Response 3	1	The candidate has selected an appropriate relationship, but has made an incorrect substitution. The unbalanced force is not 1344 N.
Response 4	1	The candidate has selected an appropriate relationship. The subscript 'un' can be ignored. There is, however, an incorrect substitution (1334 rather than 1344).
Response 5	2	The candidate has correctly selected an appropriate relationship and calculated the unbalanced force. The substitution is incomplete.
Q11(b)	2	
Response 1	1	The candidate has stated the time is equal but does not provide an acceptable justification.
Response 2	1	The candidate has stated the time is equal but does not provide an acceptable justification.
Response 3	1	The candidate has stated the time is equal but has given an incorrect justification.
Response 4	2	The candidate has stated the time is equal and justified in terms of the vertical acceleration.
Response 5	1	The candidate has stated the time is equal but given an incorrect justification

Q12(a)(ii)	3	
Response 1	1	The candidate has selected an appropriate relationship but substituted incorrectly. This is not a 'standard 3 marker' question (general marking principles 9 relating to unit conversions does not apply).
Response 2	1	The candidate has selected an appropriate relationship but substituted incorrectly.
Response 3	3	The candidate has implied the correct relationship by correct substitution and given an acceptable final answer.
Response 4	3	The candidate has selected the correct relationship and substituted correctly giving a correct final answer.
Response 5	1	The candidate has implied the correct relationship by substitution. The substitution, however, is incomplete and so the marks for substitution and final answer are not awarded.
Response 6	3	The candidate has selected an appropriate relationship. The working has given a correct final answer and shows no wrong physics.
Response 7	2	The correct relationship is implied by correct substitution. The final answer, however, has not been rounded to an acceptable number of significant figures and so the mark for the final answer is not awarded.
Response 8	2	The candidate has selected an appropriate relationship which should have appeared in the first line of the calculation but this is being ignored in this answer as all the substitutions have been made. Substitutions are correct however the final answer is incorrect due to intermediate rounding.
Q12(b)(i)	1	
Response 1	0	The candidate has given two detectors. When a candidate provides more than the required number of responses then each incorrect response negates a correct response. Photographic film is correct. The human eye is not an acceptable answer.
Response 2	1	LDR is an acceptable answer.
Response 3	1	Photographic film is an acceptable answer.