

Question			Expected response	Max mark	Additional guidance
6.	(a)		Meson(s)	1	
	(b)	(i)	Anti-up strange	1	Both required Do not accept: anti anti-strange
		(ii)	Weak (nuclear force)	1	
	(c)	(i)	$d = vt$ (1) $30.0 = (0.95 \times 3.00 \times 10^8) \times t$ (1) $t = 1.05 \times 10^{-7} \text{ s}$ (1)	3	Accept: 1.1, 1.053, 1.0526
		(ii)	$l' = l \sqrt{1 - \left(\frac{v}{c}\right)^2}$ (1) $l' = 30.0 \sqrt{1 - \left(\frac{0.95c}{c}\right)^2}$ (1) $l' = 9.37 \text{ m}$ (1)	3	Accept: 9.4, 9.367, 9.3675 Accept: $l' = 30.0 \sqrt{1 - (0.95)^2}$
	(d)		For a stationary observer's frame of reference, the mean lifetime of the pion is greater (than 26 ns) OR In a pion's frame of reference, the distance is shorter (than 30.0 m).	1	The response must involve a statement referring to, or implying, a frame of reference.

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6.	(e)		Award 3 marks where the candidate has demonstrated a good understanding of the physics involved. They show a good comprehension of the physics of the situation and provide a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. The answer does not need to be 'excellent' or 'complete' for the candidate to gain full marks. Award 2 marks where the candidate has demonstrated a reasonable understanding of the physics involved. They make some statement(s) that are relevant to the situation, showing that they have understood the problem. Award 1 mark where the candidate has demonstrated a limited understanding of the physics involved. They make some statement(s) that are relevant to the situation, showing that they have understood at least a little of the physics within the problem. Award 0 marks where the candidate has not demonstrated an understanding of the physics involved. There is no evidence that they have recognised the area of physics involved, or they have not given any statement of a relevant physics principle. Award this mark also if the candidate merely restates the physics given in the question.	3	Candidates may use a variety of physics arguments to answer this question. Award marks based on candidates demonstrating overall good, reasonable, limited, or no understanding.