<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>*13a</td><td>
This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.

Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.

The following table shows how the marks should be awarded.

<table>
<tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking points</th><th>Max structure mark available</th><th>Max final mark</th></tr>
<tr><td>6</td><td>4</td><td>2</td><td>6</td></tr>
<tr><td>5</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>4</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>3</td><td>2</td><td>1</td><td>3</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
The following table shows how the marks should be awarded for structure and lines of reasoning.
<table>
<tr><th></th><th>Number of marks awarded for structure of answer and sustained line of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkages between points and is unstructured</td><td>0</td></tr>
</table>
Guidance on how the mark scheme should be applied: The mark for indicative content should be added to the mark for lines of reasoning. For example, an answer with five indicative marking points which is partially structured with some linkages and lines of reasoning scores 4 marks (3 marks for indicative content and 1 mark for partial structure and some linkages and lines of reasoning). If there are is no structure and no linkages between points, the same five indicative marking points would yield an overall score of 3 marks (3 marks for indicative content and no marks for structure, linkages and lines of reasoning).
</td><td>6</td></tr>
</table>

	Indicative content: IC1 Electrons accelerate in the gaps IC2 Frequency of a.c. supply is constant IC3 Time taken for an electron to travel between (consecutive) tubes is constant (and they are accelerating) IC4 Reference to $s = vt$, e.g. electrons travel further in a fixed time with a higher speed IC5 (In the last section of the linac) the electron approaches the speed of light IC6 Speed becomes (almost) constant so distance travelled in a fixed amount of time becomes (almost) constant	
13b	**Max 2 from:** Reference to $E=mc^2$ (1) There will be more kinetic energy available (for same accelerating p.d.) with colliding beams (1) (Total) momentum of two beams is zero before collision **Or** single beam and stationary target has (net) momentum before collision (1) **AND** All of the kinetic energy of the two beams available (to be converted to mass) so colliding beams more likely to produce particle with larger mass **Or** So with single beam particle(s) must have momentum after collision so less energy available (to be converted to mass) so lower mass particles produced (1) **Or** So with single beam particle(s) must have kinetic energy after collision so less energy available (to be converted to mass) so lower mass particles produced	**3max**
	Total for question 13	**9**