

Question Number	Answer	Mark
<b>18a</b>	<p>(to conserve charge, as) no other charged particle is produced (1)</p> <p><b>Or</b> no other track is produced (1)</p> <p>It has the same direction of curvature (as the pion track)</p>	<b>2</b>
<b>18b</b>	<p>The radius of the (spiral) path decreases (following it clockwise) (1)</p> <p>The momentum/velocity/speed of the particle is decreasing (1)</p> <p>as energy is transferred from the anti-muon (by ionisation and electromagnetic radiation) (1)</p>	<b>3</b>
<b>18c</b>	out of page (1)	<b>1</b>
<b>18d</b>	<p>Use of <math>r = p/BQ</math> (1)</p> <p>Substitute <math>Q = 1.6 \times 10^{-19} \text{ C}</math> (1)</p> <p>radius = 0.21 m (1)</p> <p><u>Example of calculation</u></p> $r = \frac{1.2 \times 10^{-19} \text{ N s}}{3.5 \text{ T} \times 1.6 \times 10^{-19} \text{ C}}$ <p><math>r = 0.21 \text{ m}</math></p>	<b>3</b>
<b>18ei</b>	<p><math>\pi^+ \rightarrow (\mu^+) + \nu_{(\mu)}</math> (1)</p> <p><b>Or</b></p> <p><math>\pi^+ \rightarrow \bar{\mu} + \nu_{(\mu)}</math></p> <p>(accept anything reasonable for “muon”)</p>	<b>1</b>
<b>18eii</b>	<p>draws a straight line labelled for any of pion, muon or neutrino (accept momentum values) (1)</p> <p>uses a recognisable scale e.g. 7.5 cm for muon or 12 cm for pion or 5.4 cm for neutrino (1)</p> <p>vectors drawn correctly end to end (1)</p> <p>correct arrows on at least two vectors (dependent on MP3) (1)</p> <p>statement such as the three lines form a closed triangle so follows conservation of momentum (requires 3 arrows in correct direction)</p> <p><b>Or</b> conclusion that a quantity resulting from scale drawing has the correct value (e.g. sss <math>\rightarrow</math> correct angle or sas <math>\rightarrow</math> correct length) (1)</p> <p>(accept calculations showing conservation of momentum)</p>	<b>5</b>