| Question Number | Answer | | Mark |
|---|---|---|---|
| **17a** | The beam/electron/positron is gaining speed | (1) | **4** |
| | The length of tubes increases **or** the length of gaps between tubes increases | (1) | |
| | So time between beam exiting (successive) tubes is constant<br>**Or** time spent in each tube is constant<br>**Or** time spent between (each successive pair of) tubes is constant | (1) | |
| | The p.d. has to reverse in this time period and hence frequency is constant | (1) | |
| **17bi** | Use of $m_\Omega = 3272 \times m_e$ | (1) | **4** |
| | Use of $\Delta E = c^2 \Delta m$ | (1) | |
| | Use of conversion factor for eV | (1) | |
| | mass of omega baryon = 1680 MeV/$c^2$ | (1) | |
| | <u>Example of calculation</u><br>$\text{mass} = 3272 \times 9.11 \times 10^{-31}\text{kg}$<br>$\text{Energy} = 2.981 \times 10^{-27}\text{kg} \times (3 \times 10^8\ \text{ms}^{-1})^2$<br>$\text{Energy} = \frac{2.68 \times 10^{-10}\text{J}}{1.6 \times 10^{-19}\text{JeV}^{-1}}$<br>$\text{mass} = 1677\ \text{MeV/c}^2$ | | |
| **17bii** | Total energy of electron and positron = 29 GeV<br>**Or** total energy available for each omega baryon = 14.5 GeV<br>**Or** $\Delta E = c^2 \Delta m$ for omega rest mass energy<br>**Or** Use of conversion factor for GeV to J for electron and positron energy (ignore rest mass of electron and positron) | (1) | **3** |
| | Uses Kinetic Energy = Total Energy – Rest mass energy of baryon | (1) | |
| | Kinetic energy of either omega = 12.8 GeV<br>**Or** Kinetic energy of either omega = $2.05 \times 10^{-9}$ J | (1) | |
| | <u>Example of calculation</u><br>Kinetic energy of both omegas = 29 GeV – 2 ×1.7 GeV = 25.6 GeV<br>So kinetic energy of either omega baryon = 12.8 GeV | | |
| **17c** | If both omega, it would break the conservation of baryon number | (1) | **3** |
| | Must be omega and anti-omega | (1) | |
| | Further detail of baryon number:<br>If both omega, before collision baryon number = 0<br>and after collision baryon number = 2 (which breaks conservation law)<br>**Or**<br>If omega and anti-omega before collision baryon number = 0<br>and after 1 – 1 = 0 (which obeys conservation law) | (1) | |
| | **Total for question 17** | | **14** |