Question Number	Answer		Mark
21(a)	$u\bar{d}$ **Or** $d\bar{u}$ **Or** $u\bar{u}$ **Or** $d\bar{d}$	**(1)**	**1**
21(b)	MAX 2 conservation laws (Conservation of) charge $-1 \rightarrow -1 + 0$ Dependent on MP1 (Conservation of) lepton number $0 \rightarrow 1 + -1$ Dependent on MP3 (Conservation of) baryon number $0 \rightarrow 0 + 0$ Dependent on MP5	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**4**
21(c)	Conversion of eV to J Use of $\Delta E = c^2 \Delta m$ $m = 1.9 \times 10^{-28}$ (kg) <u>Example of calculation</u> $m = 106 \text{ MeV} \times 10^6 \times 1.6 \times 10^{-19} \text{J eV}^{-1} = 1.70 \times 10^{-11} \text{ J}$ $m = \frac{1.70 \times 10^{-11} \text{ J}}{(3.0 \times 10^8)^2} = 1.88 \times 10^{-28} \text{ kg}$	**(1)** **(1)** **(1)**	**3**
21(d)	(When $v = 0.99c$) relativistic effects will be significant **Or** (When $v = 0.99c$) time dilation occurs The lifetime (of high energy pions) would be longer (than for pions at rest) MP2 dependent on MP1	**(1)** **(1)**	**2**
	Total for question 21		**10**