Question 14 **(15 marks)**

When a stationary neutron decays into a proton, an electron and an electron anti-neutrino are also produced. Total energy is conserved during the decay process. The reaction is described by the following equation:

$$n^0 \rightarrow p^+ + e^- + \bar{\nu}_e$$

(a) In the reaction, the quark composition of a neutron changes from udd to uud. Show how the reaction conserves both baryon number and lepton number by filling in the table below. (6 marks)

	n^0	$\rightarrow$	p^+	+	e^-	+	$\bar{\nu}_e$
Baryon number		$\rightarrow$		+		+	
Lepton number		$\rightarrow$		+		+	

(b) The mass of a stationary neutron is 1.675×10^{-27} kg. The mass of a proton is 1.673×10^{-27} kg. The mass of an electron is 9.109×10^{-31} kg. If we assume the total energy of the anti-neutrino is 0 J, calculate the total kinetic energy of the particles emitted in keV. (5 marks)

Answer: ______________________ keV

(c) If the electron accounts for 90.0% of the kinetic energy produced, calculate the velocity of the emitted proton in terms of c. If you could not determine an answer for part (b), use 581 keV (9.30×10^{-14} J). (4 marks)

Answer: ______________________ c