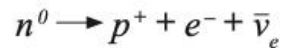


### Question 14

(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:



- (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  $1.675 \times 10^{-27}$  kg. The mass of a proton is  $1.673 \times 10^{-27}$  kg. The mass of an electron is  $9.109 \times 10^{-31}$  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 ( $9.30 \times 10^{-14}$  J). (4 marks)

Answer: \_\_\_\_\_  $c$