5. (a) According to Niel Bohr's theory, the energy of a hydrogen atom when it is in the stationary state with principal quantum number n is given by $E_n = -\frac{me^4}{8\varepsilon_0^2 h^2}\frac{1}{n^2}$, where $m \,\&\, e$ are the mass and charge of an electron, ε_0 is the permittivity of free space and h is the Planck's constant.

A hydrogen atom is initially at rest. An electron in the hydrogen atom makes a transition from the state with $n = 3$ to the state with $n = 1$. Calculate the recoil speed and recoil energy of the hydrogen during the process.

[Mass of hydrogen atom is 1.66×10^{-27} kg]

[6 marks]