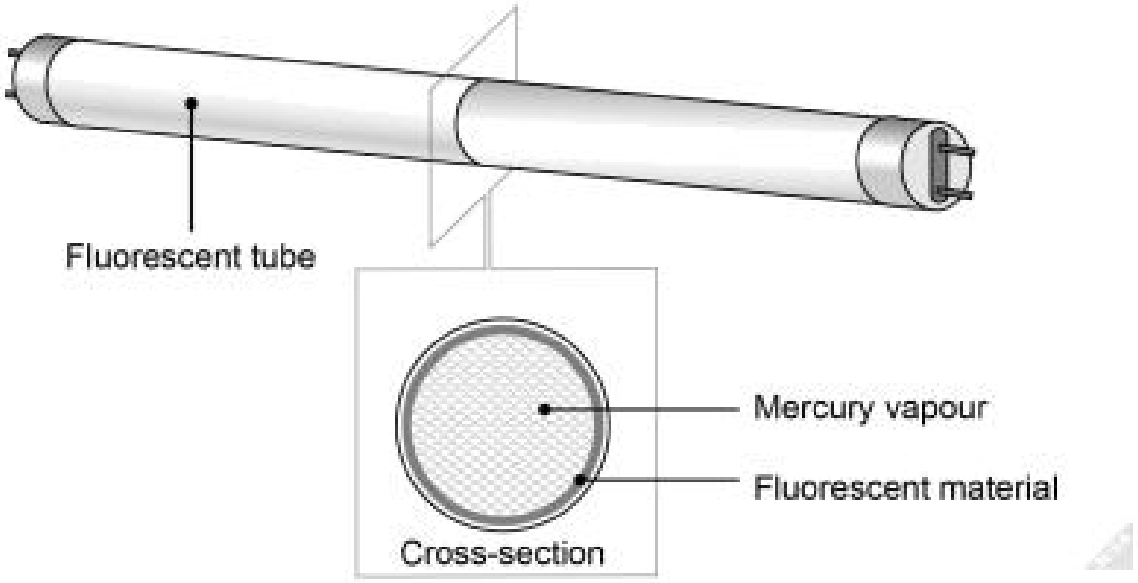
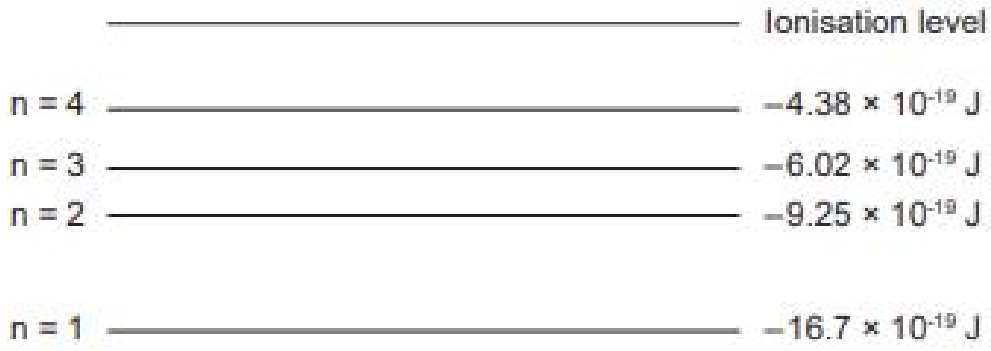
Question 14 **(13 marks)**

A fluorescent light contains mercury vapour which is excited by an electric discharge from end to end inside the tube. This excitation causes some of the mercury atoms to ionise or produce high energy photons. These high energy photons then interact with the fluorescent material coating the inside of the tube to produce visible light.



Some of the energy levels below the ionisation level for a mercury atom are shown in the energy level diagram below.



A photon with energy of 17.9×10^{-19} J collides with an electron in the ground state of a vaporised mercury atom.

(a) Calculate the velocity of any electron emitted from the ground state mercury atom.

(3 marks)

(b) Describe why some of the mercury atoms in the tube need to be ionised. (2 marks)

An electron with energy of 10.5×10^{-19} J collides with a ground state electron in a mercury atom.

(c) Calculate the possible energies the incident electron can have after this collision. (3 marks)

(d) Determine the part of the spectrum to which the lowest energy emitted photons belong when subject to an incident electron with energy 10.5×10^{-19} J. (2 marks)

The photons emitted from the electron transition of the mercury atom then interact with the fluorescent material coating the inside of the tube.

(e) Explain how the emitted photons produced by the mercury atoms produce visible light in the fluorescent material. (3 marks)