# Exam Questions
# Chapter 8.2 - De Broglie
# Question 1 2014:2:18

**(13 marks)**

A hydrogen atom, in an excited energy level, undergoes relaxation by emitting a photon. The energy values are given by $E_n = -\frac{13.6}{n^2}$ eV. The initial state of the electron is in energy level n = 4 and the final state after relaxation is ground state (n = 1).

(a) Does the average radius of the electron orbital remain the same, increase or decrease in value during this transition? Circle the correct answer. (1 mark)

remains the same  increases  decreases

(b) Use the formula $E_n = -\frac{13.6}{n^2}$ eV to complete the energy level diagram below. The diagram is **not** drawn to scale. (2 marks)

n=4 _____ $E_4$ = ..... eV

n=3 _____ $E_3$ = -1.51 eV

n=2 _____ $E_2$ = -3.40 eV

Ground state n=1 _____ $E_1$ = ..... eV

(c) On the diagram above, draw in all the possible transitions when an electron undergoes relaxation from n = 4 to the ground state. (3 marks)

(d) (i) Calculate the wavelength of the photon emitted from the $E_3$ to $E_2$ transition. Show **all** workings. (4 marks)

(ii) The transitions of $E_4$ to $E_2$ and $E_3$ to $E_2$ produce red and green photons. Explain which transition produces which colour. (3 marks)