2.41 Calculate the energy of the electron in the hydrogen atom (in units of eV) for the first four allowed energy levels.

- Also, find the wavelength and frequency of the photon emitted if an electron drops from a) second to first energy level, b) third to second energy level, and c) fourth to third energy level.

Used MathCad, to deal w/ very small numbers.

Define some constants

$h := 6.62607015 \cdot 10^{-34}$ J-s $hmod := \frac{h}{2 \cdot \pi}$ $hmod = 1.05457 \times 10^{-34}$ J-s

$m0 := 9.1093837 \cdot 10^{-31}$ kg $\varepsilon 0 := 8.8541878 \cdot 10^{-12}$ F/m

$qe := 1.6021766 \cdot 10^{-19}$ C $eV := 1.602176634 \cdot 10^{-19}$ J $c := 299792458$ m/s

Find electron energies using (2.73)

$n = 1$ $E1 := \frac{-m0 \cdot qe^4}{(4 \cdot \pi \cdot \varepsilon 0)^2 \cdot 2 \cdot hmod^2 \cdot 1^2}$ $E1 = -2.18 \times 10^{-18}$ J $E1eV := \frac{E1}{eV}$

$E1eV = -13.606$ eV

$n = 2$ $E2 := \frac{E1}{2^2}$ $E2eV := \frac{E2}{eV}$ $E2 = -5.45 \times 10^{-19}$ J $E2eV = -3.401$ eV

$n = 3$ $E3 := \frac{E1}{3^2}$ $E3eV := \frac{E3}{eV}$ $E3 = -2.422 \times 10^{-19}$ J $E3eV = -1.512$ eV

$n = 4$ $E4 := \frac{E1}{4^2}$ $E4eV := \frac{E4}{eV}$ $E4 = -1.362 \times 10^{-19}$ J $E4eV = -0.85$ eV

Using (2.1) & $c = f\lambda$, find λ (m) and υ or f (Hz) of the photon emitted if electron drops from:

a) E_2 to E_1 $f21 := \frac{E2 - E1}{h}$ $f21 = 2.467 \times 10^{15}$ Hz

$\lambda 21 := \frac{c}{f21}$ $\lambda 21 \cdot 10^{10} = 1215$ Angstroms (ultraviolet)

a) E_3 to E_2 $f32 := \frac{E3 - E2}{h}$ $f32 = 4.569 \times 10^{14}$ Hz

$\lambda 32 := \frac{c}{f32}$ $\lambda 32 \cdot 10^{10} = 6561.1$ Angstroms (red)

c) E_4 to E_3 $f43 := \frac{E4 - E3}{h}$ $f43 = 1.599 \times 10^{14}$ Hz

$\lambda 43 := \frac{c}{f43}$ $\lambda 43 \cdot 10^{10} = 18746.1$ Angstroms (infrared)