Energy level diagrams

The opposite page shows the hydrogen energy levels neglecting fine structure (this means we are ignoring the fact that electrons have spin). One interesting fact: the energies do not depend on the quantum number l (the azimuthal quantum number). States with the same n but different l have the same energy: the higher l states have higher potential energy but lower kinetic energy, in a way that the total energy remains the same. This is a unique property of the Coulomb potential.

(a) Determine the energy E_n for each Hydrogen energy level from $n = 1$ to $n = 5$ in both eV and cm^{-1}.

(b) Draw all allowed transitions between these levels. Remember: only $\Delta l = \pm 1$ transitions are allowed by selection rules.

(c) Determine the wavelength (in nm) of the three transitions from n =3, 4, and 5 to $n = 2$ (the Balmer series).

(a)

$n=1$	-13.61 eV	0 cm^{-1}
$n=2$	-3.402 eV	82300 cm^{-1}
$n=3$	-1.512 eV	97550 cm^{-1}
$n=4$	-0.850 eV	102890 cm^{-1}
$n=5$	-0.544 eV	105360 cm^{-1}

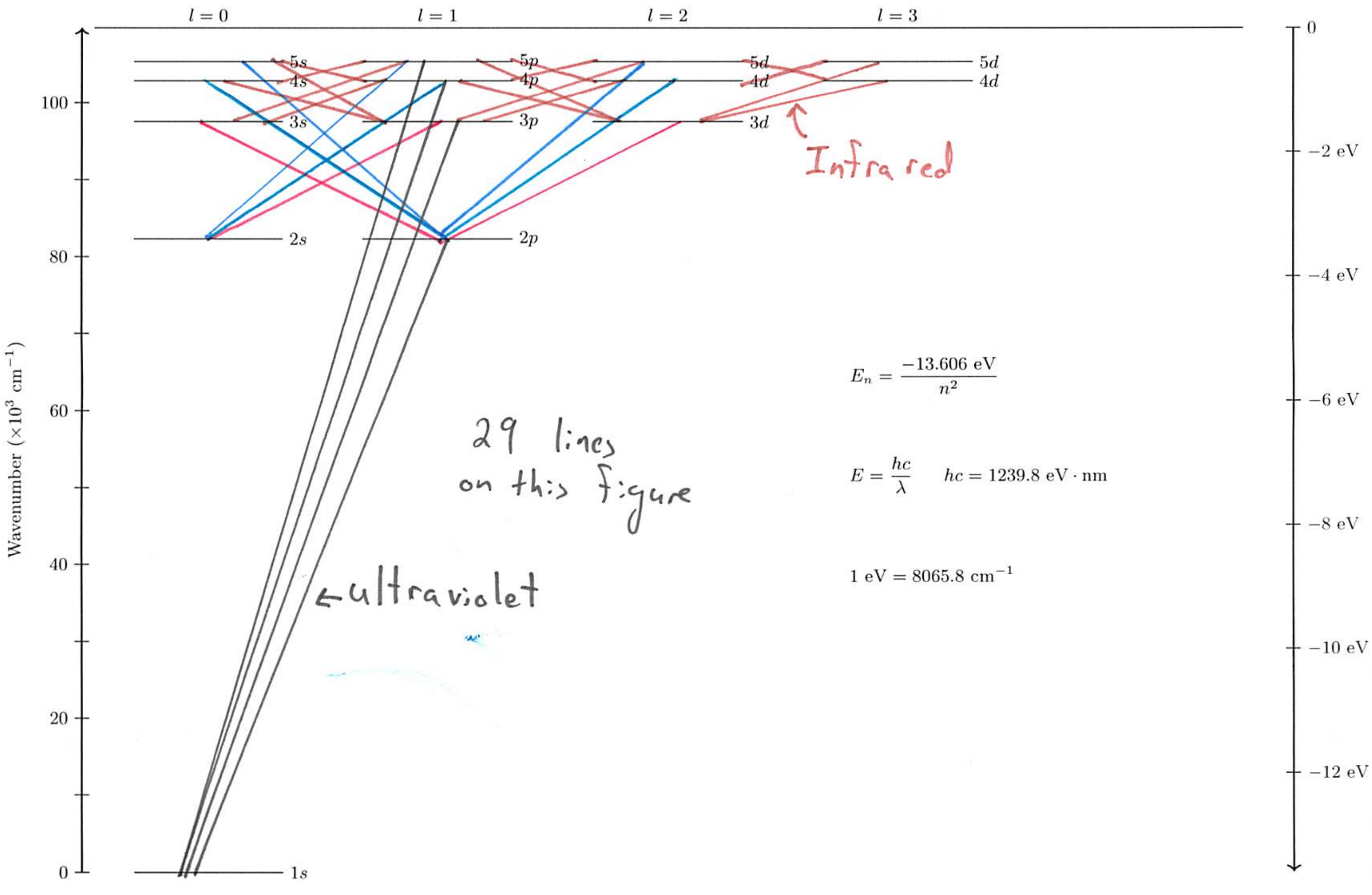
(c)

$n=5 \rightarrow n=2$ $\quad (105360 \text{ cm}^{-1} - 82300 \text{ cm}^{-1})^{-1}$
$= 4.337 \times 10^{-5} \text{ cm} = 433.7 \text{ nm}$

$n=4 \rightarrow n=2$ $\quad (102890 \text{ cm}^{-1} - 82300 \text{ cm}^{-1})^{-1}$
$= 4.857 \times 10^{-5} \text{ cm} = 485.7 \text{ nm}$

$n=3 \rightarrow n=2$ $\quad (97550 \text{ cm}^{-1} - 82300 \text{ cm}^{-1})^{-1}$
$= 6.557 \times 10^{-5} \text{ cm} = 655.7 \text{ nm}$

Hydrogen Energy Level Diagram (ignoring fine structure)



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