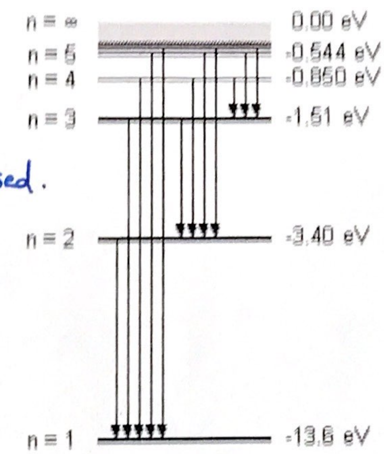
The energy level diagram for a hydrogen atom is shown. The following questions are about the energy levels of the hydrogen atom. An electron jumps from the n = 5 level to the n = 1 level.



1. Will this result in an emission line, or an absorption line in the spectrum of this atom? Emission Line – energy has been released.

2. Which excited state did the electron start at? $n = 5$

3. What is the principal quantum number of the electron after it has jumped?

   $n = 1$

4. Which series does this jump belong to Lyman

5. What is the energy, in Joules, of the energy packet or particle associated with this jump?

$\Delta E = E_f - E_i$
$= (-13.6\text{ eV}) - (-0.544\text{ eV})$
$= -13.056\text{ eV}$

$13.056\text{ eV}\left(\frac{1.602\times10^{-19}\text{ J}}{1\text{ eV}}\right) = 20.8896\times10^{-19}\text{ J}$
$= 2.08896\times10^{-18}\text{ J}$
$= 2.09\times10^{-18}\text{ J}$

6. What is the frequency of this energy packet?

Joules $\rightarrow E = hf$
$2.09\times10^{-18} = 6.63\times10^{-34}\cdot f$
$3.15\times10^{+15}\text{ Hz} = f$ (UV spectrum)

7. What is the wavelength, in nanometers (nm) of the photon associated with this jump?

$v = f\cdot\lambda$
$c = f\cdot\lambda$
$\frac{c}{f} = \lambda$
$\frac{3\times10^{8}}{3.15\times10^{15}} = \lambda$
$\lambda = 9.523\times10^{-8}\text{ m}$ OR
$\lambda = 95.23\text{ nm}$ (nanometers)

8. A photon having an energy of 10.2 eV now strikes this hydrogen atom. Can the photon be absorbed by the atom? If so, describe the electron jump that will occur. If not, explain why not.

The photon CAN be absorbed. The jump would be from $n = 1$ to $n = 2$.
$\Delta E = E_f - E_i$
$\Delta E = -3.40 - (-13.6)$
$\Delta E = +10.2\text{ eV}$ ← increase in energy

9. What is the frequency of this photon?

$10.2\text{ eV}\left(\frac{1.602\times10^{-19}\text{ J}}{1\text{ eV}}\right) = 16.32\times10^{-19}\text{ J}$

$E = hf$
$16.32\times10^{-19} = 6.63\times10^{-34}\cdot f$
$2.4615\times10^{15}\text{ Hz} = f$

10. What is the wavelength in nanometers (nm) of this photon?

$v = f\cdot\lambda$
$\lambda = \frac{c}{f}$

$\lambda = \frac{3\times10^{8}}{2.4615\times10^{15}}$
$= 1.2188\times10^{-7}\text{ m}$
$= 121.88\text{ nm}$ (nanometers)