Deducing Energy Levels

Usually in textbook or exam questions, you will be shown an energy level diagram with the energy levels values added, usually in eV. A standard question then is to calculate the wavelength of light emitted when an electron de-excites from a higher state to a lower one.

However, this is a bit back-to-front compared to what actually happens: in reality, scientists observed the spectra of emitted light, measured the wavelengths of light being emitted and then had to deduce what the energy levels were that produced such lines. That's what you're going to do here.

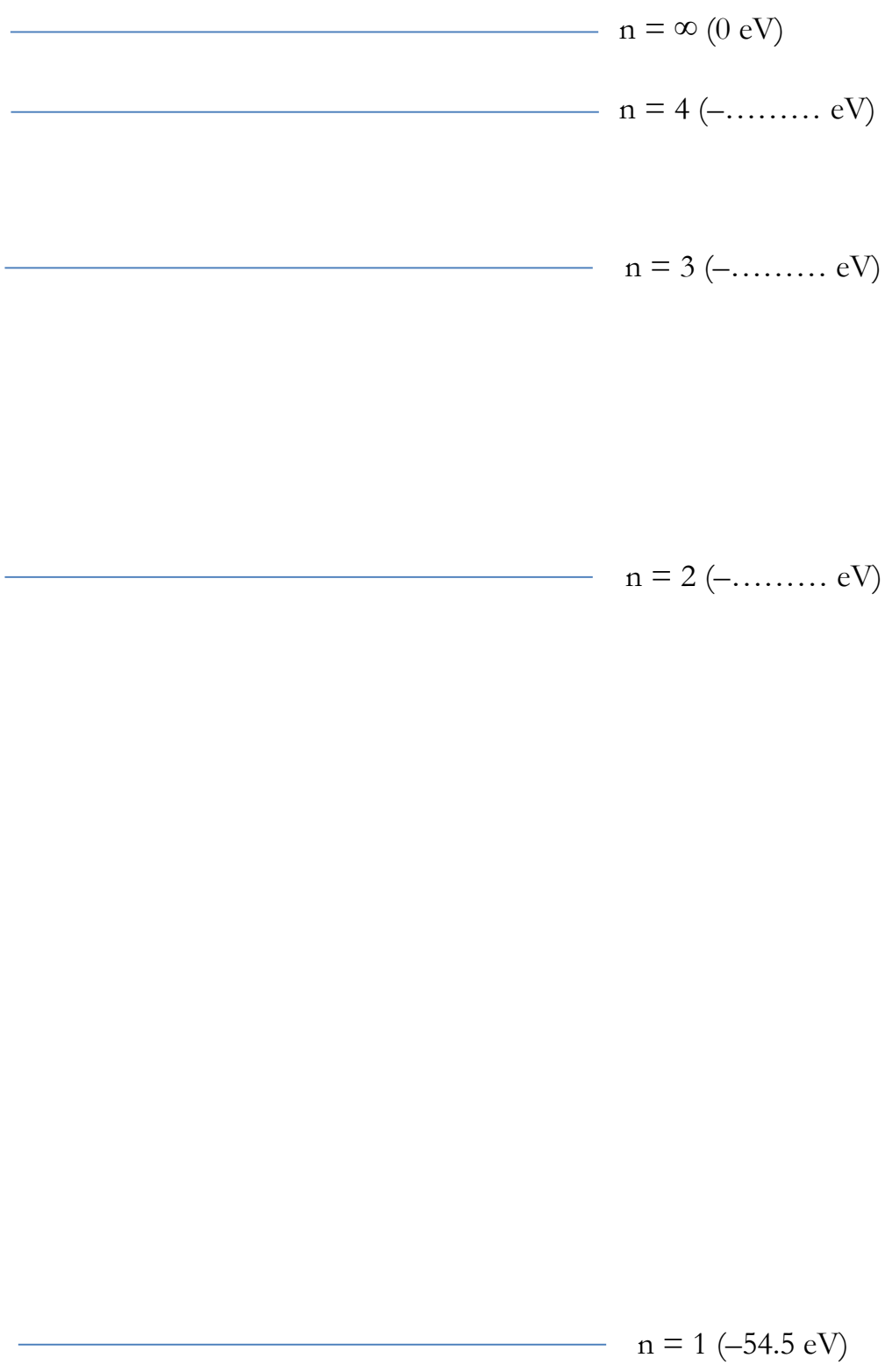
Listed below are the nine shortest wavelengths of light from the spectrum produced by a gas of singly ionized Helium ions:

λ (nm)	E_{photon} (eV)
22.8	
24.4	
25.7	
30.5	
91.4	
122	
164	
206	
365	
471	

To work out what the energy levels were that produced photons of these wavelengths, you need to:

1) **Calculate what the energy of each photon is and add it to the blank column in the table above.**
2) **Try to work out which wavelength was caused by which transition, and hence the exact energy levels of singly ionised Helium. Draw downwards arrows on the diagram overleaf to show the transitions.**

Since the wavelengths listed are the shortest ones the gas emits, you can assume that they are emitted by electrons transitioning between the lowest four energy levels, or from ∞ to one of the lowest four levels.


n = ∞ (0 eV)
n = 4 (–…… eV)
n = 3 (–…… eV)
n = 2 (–…… eV)
n = 1 (–54.5 eV)