PHYS Remote Lab on Spectra            Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Watch the following video and answer the questions below:

<https://www.youtube.com/watch?v=jjy-eqWM38g>

1. What is light?
2. How is the energy (E) of a photon of light related to its wavelength (λ)?
3. What are spectra (plural for spectrum)?
4. Expain the origin of light (or how light is produced)?
5. Wavelength of light emitted by a body depends on the body’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
6. Name three subatomic particles the atoms are made of?
7. What is the analogy used for quantization of electron energy in the video?
8. What is the key to the universe, according to the video?

1. Name the device that measures the wavelength of light?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. What is Doppler effect?
3. How do we know that the universe is expanding?

2. Energy levels of the electron of the hydrogen atom are shown below. Calculate and list the energy values, $E\_{n}=-\frac{13.6}{n^{2}}$ eV, with the orbitals.

a. Watch this video for an understanding of electron transitions.
<https://www.youtube.com/watch?v=wiINTUZoAiw>
Identify one error made in the video\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Show the transitions of electron for the Lyman (Higher level🡪1), Balmer (Higher level🡪2), and Paschen (Higher level🡪3) series in the above diagram.

c. A photon of light is emitted when the electron transitions to a lower energy. The wavelength (λ) of emitted light is given by:
 $∆E=\frac{hc}{λ}$; h = 6.626x10-34J.s and c = 2.998x108m/s. 1eV=1.602x10-19J

1. Calculate the value of *hc*, in the unit eV.nm.

2. Calculate the 4 of the highest wavelengths (λ) of the Balmer series.

3. Visit this simulation: <https://javalab.org/en/spectrum_of_hydrogen_en/>

a. The simulation shows the light emission for the hydrogen atom. Make a note of the wavelength (λ), energy difference (ΔE), and energy levels involved for the light emitted.

λ = \_\_\_\_\_\_\_\_\_\_\_\_ΔE = \_\_\_\_\_\_\_\_\_\_\_\_Energy levels (E1, E2, etc) involved =\_\_\_\_\_\_\_\_\_

b. To find out the transitions to which electron orbit will result in the visible spectra:

|  |  |  |  |
| --- | --- | --- | --- |
| Move Electron to get transition: | Wavelength (nm) | ΔE (eV) | Visible (Yes or No) |
| E2 🡪 E1 |  |  |  |
| E3 🡪 E1 |  |  |  |
| E4 🡪 E1 |  |  |  |
| E5 🡪 E1 |  |  |  |
| E6 🡪 E1 |  |  |  |
| E7 🡪 E1 |  |  |  |
| E8 🡪 E1 |  |  |  |
| Move Electron to get transition: | Wavelength (nm) | ΔE (eV) | Visible (Yes or No) |
| E3 🡪 E2 |  |  |  |
| E4 🡪 E2 |  |  |  |
| E5 🡪 E2 |  |  |  |
| E6 🡪 E2 |  |  |  |
| E7 🡪 E2 |  |  |  |
| E8 🡪 E2 |  |  |  |
| E9 🡪 E2 |  |  |  |
| Move Electron to get transition: | Wavelength (nm) | ΔE (eV) | Visible (Yes or No) |
| E4 🡪 E3 |  |  |  |
| E5 🡪 E3 |  |  |  |
| E6 🡪 E3 |  |  |  |
| E7 🡪 E3 |  |  |  |
| E8 🡪 E3 |  |  |  |
| E9 🡪 E3 |  |  |  |

c. Go to Excel, and enter the wavelength, λ and absolute values of ΔE, $\left|∆E\right|$ values, for the visible spectrum. Also insert a column after the first column, and calculate 1/λ.

d. Plot $\left|∆E\right|$ versus 1/λ, determine the slope with unit. Slope = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

e. What is the theoretical value for the slope in the same unit?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

f. Calculate the % difference for the above two values\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

g. Write a conclusion for this last section, 3.