# MODERN PHYSICS DAY 8: EMISSION AND ABSORPTION SPECTRA

CED 15.3 · Skill 1.A · FRQ: TBR

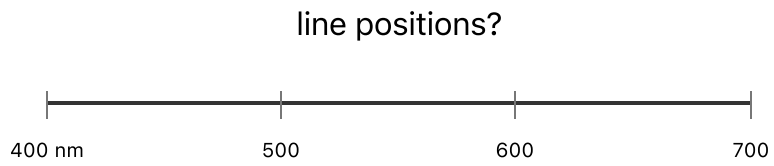
**PREDICT**

Hydrogen light is viewed through a grating. On a wavelength axis, will its visible lines be evenly spaced?

**A. evenly spaced** **B. not evenly spaced** **C. continuous** **D. one line only**

Commit before the line positions are shown.

**WAVELENGTH AXIS BEFORE THE LINES ARE REVEALED**

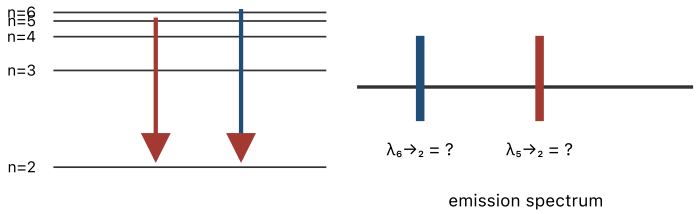



State what an evenly spaced line pattern would imply about the underlying energy gaps.

**NOTES / REASONING**

## ENERGY LEVELS PRODUCE LINE POSITIONS

### TWO LEVEL GAPS MAPPED TO TWO LINES




A downward transition emits a photon. Its wavelength is fixed by the energy gap.

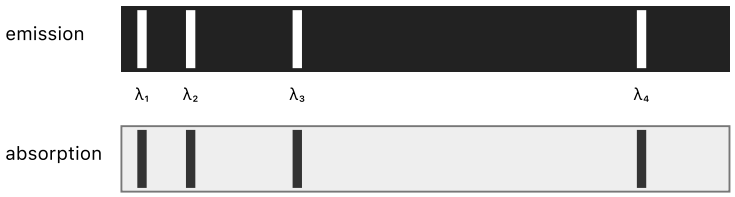
$$E_\gamma = |E_i - E_f| = \frac{hc}{\lambda}$$

Because the level energies are not equally spaced, the spectral wavelengths are not equally spaced.

**NOTES / REASONING**

## EMISSION AND ABSORPTION SHARE GAPS

### PAIRED HYDROGEN SPECTRA




same allowed gaps → same wavelength positions

### Emission

Excited atoms drop to lower states and add photons at allowed wavelengths.

### Absorption

Atoms remove photons that match allowed upward gaps, producing dark lines in a continuous background.

Explain why matching wavelength does not require matching line brightness.

## BUILD TWO HYDROGEN LINES

**1.** Calculate the photon wavelength for $n = 5 \to 2$. Use $E_5 = -0.544\,\text{eV}$ and $E_2 = -3.40\,\text{eV}$.

**2.** Calculate the wavelength for $n = 6 \to 2$ using $E_6 = -0.378\,\text{eV}$.

**3.** Add both lines to an emission row and an absorption row. Use one shared wavelength scale.

**4.** Explain why a spectral line set can identify an element.