

MODERN PHYSICS DAY 9: LAB: CALIBRATED EMISSION-SPECTRUM IDENTIFICATION

CED 15.3 · Skills 3.A/1.A · FRQ: Experimental Design · bounded physical investigation: calibrate line positions before identifying an unknown

RETRIEVE

Why is a set of spectral-line wavelengths an element fingerprint?

- A. level gaps are element-specific B. brightness fixes identity C. all lines are evenly spaced
D. color names are exact wavelengths

INVESTIGATION QUESTION AND SAFETY

How can calibrated line positions identify an unknown gas?

Teacher only: operate the high-voltage supply and change tubes. **Students:** do not touch the supply; treat recently operated tubes as hot.

Fix the grating, camera/eye location, and scale. If the geometry moves after calibration, repeat the calibration.

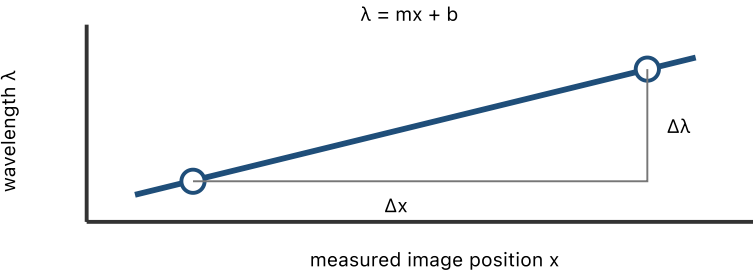
NOTES / REASONING

CALIBRATE POSITION TO WAVELENGTH

- 1. Use a known source with two separated reference lines.
- 2. Record each wavelength and its position on the same image/scale used for the unknown.
- 3. Calculate $m = \Delta\lambda/\Delta x$ and $b = \lambda - mx$.
- 4. Check the line by predicting one reference wavelength from its position.

known line	position x (cm or px)	wavelength λ (nm)
1		
2		
3		

LINEAR CALIBRATION MODEL



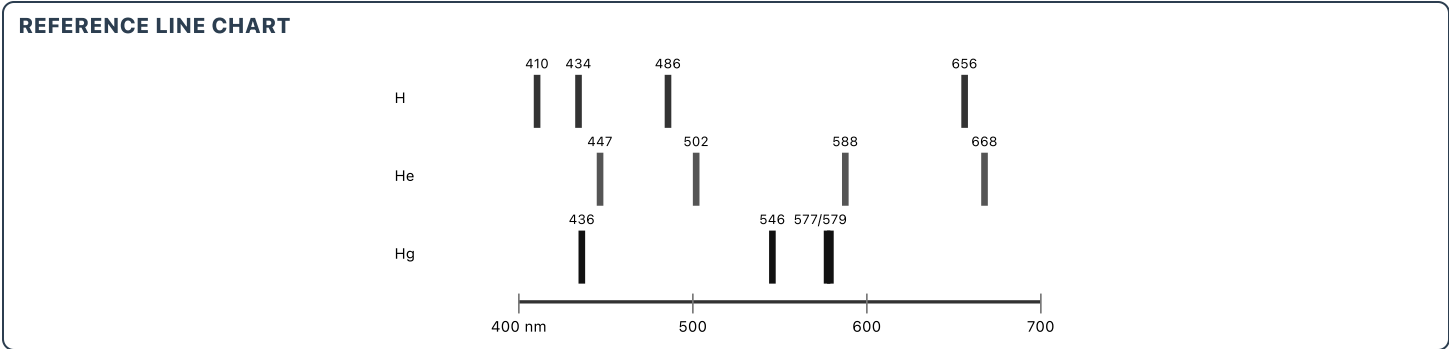
Calibration equation: $\lambda =$ _____ $x +$ _____

NOTES / REASONING

RECORD AND CONVERT THE UNKNOWN

Unknown label: _____ fixed geometry confirmed: ☐

line	measured position	calibrated wavelength (nm)	nearest reference line (nm)
1			
2			
3			
4			
5			



Identify the unknown and cite at least three calibrated line matches.

ANALYZE THE IDENTIFICATION

1. Calculate the energy in electron-volts of one calibrated line using $E = 1240 \text{ eV} \cdot \text{nm}/\lambda$.

2. Calculate the residual between each calibrated line and its matched reference. Which line has the largest residual?

3. Explain how a shift in camera position after calibration would affect the identification.

4. State one limitation if only visual color names, rather than measured positions, were recorded.