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Question 4

Given:
- $m1$ = 102 ± 1.0 grams
- $m2$ = 86 ± 0.90 grams

Find:
- Equation for the uncertainty in the expected acceleration (δa)
- Calculate $a \pm \delta a$ using the given values

Theory:
- Formula for acceleration is:
  - $a = \frac{g*(m1-m2)}{(m1+m2)}$
- Formula for propagation of uncertainties:
  - $\frac{\delta a}{a} = \sqrt{(\left(\frac{\delta m1}{m1}\right)^2 + \left(\frac{\delta m2}{m2}\right)^2)}$

Where:
- δa is uncertainty in the acceleration.
- $\delta m1$ is uncertainty in mass $m1$.
- $\delta m2$ is uncertainty in mass $m2$.

Assumptions: Masses m1 and m2 are independent measurements, there is no correlation between them.

Solution:

Solve for acceleration:

$a = \frac{g*(m1-m2)}{(m1+m2)} \rightarrow a = \frac{9.81*(0.102-0.086)}{(0.102+0.086)}$ = 0.835 m/s²

Rearrange the propagation of uncertainties:

$$\delta a = \frac{g*(m1-m2)}{(m1+m2)} \times \sqrt{(\left(\frac{\delta m1}{m1}\right)^2 + \left(\frac{\delta m2}{m2}\right)^2)}$$

$$\delta a = 0.835 \times \sqrt{(\left(\frac{1.0}{102}\right)^2 + \left(\frac{0.90}{86}\right)^2)} = 0.014339 \times 0.83489 = 0.012$$

$a \pm \delta a$ is approximately 0.835 ± 0.012 m/s².