

Solute Extraction Calculation: Two Extractions

<https://gemini.google.com/app/02d20013e01802af>

Response: Here is the step-by-step solution to find the amount of solute **A** remaining in the aqueous phase after two extractions.

Given Data

- Initial volume of aqueous solution = V
- Volume of organic solvent per extraction = $2V$
- Partition coefficient, $K_D = \frac{[A]_{\text{org}}}{[A]_{\text{aq}}} = 4.0$
- Initial moles of **A** in the aqueous phase = a mol

Formula

For solvent extraction, the fraction of solute remaining in the aqueous layer after n extractions with fresh portions of solvent is given by:

$$n_{\text{remaining}} = a \left(\frac{V_{\text{aq}}}{V_{\text{aq}} + K_D \cdot V_{\text{org}}} \right)^n$$

Where:

- $V_{\text{aq}} = V$
- $V_{\text{org}} = 2V$
- $K_D = 4.0$
- $n = 2$ (since it is extracted twice)

Step-by-Step Calculation

1. Calculate the fraction remaining after a single extraction ($n = 1$):

$$\frac{V_{\text{aq}}}{V_{\text{aq}} + K_D \cdot V_{\text{org}}} = \frac{V}{V + 4.0(2V)} = \frac{V}{V + 8V} = \frac{V}{9V} = \frac{1}{9}$$

2. Calculate the amount remaining after two extractions ($n = 2$):

$$n_{\text{remaining}} = a \left(\frac{1}{9} \right)^2 = a \left(\frac{1}{81} \right) = \frac{a}{81}$$

Correct Option

The correct choice is **(5)** $\frac{a}{81}$.
