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# Distribution Ratio and Length of Column Formulas

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# List of 15 Distribution Ratio and Length of Column Formulas

## Distribution Ratio and Length of Column

### 1) Change in Retention Time given Half of Average Width of Peaks

$$\text{fx } \Delta t_{r_H} = \frac{R \cdot w_{1/2av}}{0.589}$$

Open Calculator 

$$\text{ex } 112.0543s = \frac{11 \cdot 6s}{0.589}$$

### 2) Change in Retention Time given Resolution and Average Width of Peak

$$\text{fx } \Delta t_{r\_RandW} = (R \cdot w_{av})$$

Open Calculator 

$$\text{ex } 44s = (11 \cdot 4s)$$

### 3) Change in Retention Volume given Resolution and Average Width of Peak

$$\text{fx } \Delta V_{r\_RandW} = (R \cdot w_{av})$$

Open Calculator 

$$\text{ex } 733333.3mL = (11 \cdot 4s)$$



#### 4) Column Length given Number of Theoretical Plates

$$fx \quad L_c = (N \cdot H)$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$ex \quad 120m = (10 \cdot 12m)$$

#### 5) Column Length given Number of Theoretical Plates and Standard Deviation

$$fx \quad L_c = \sigma \cdot (\sqrt{N})$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 129.1158m = 40.83 \cdot (\sqrt{10})$$

#### 6) Column Length given Number of Theoretical Plates and Width of Peak

$$fx \quad L_{cl} = \left( \frac{W_{NandL}}{4} \right) \cdot (\sqrt{N})$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$ex \quad 9.882118m = \left( \frac{12.5}{4} \right) \cdot (\sqrt{10})$$

#### 7) Column Length given Standard Deviation and Plate Height

$$fx \quad L_c = \frac{(\sigma)^2}{H}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$ex \quad 138.9241m = \frac{(40.83)^2}{12m}$$



### 8) Distribution Ratio

$$fx \quad D_{\text{actual}} = \left( \frac{C_o}{C_{\text{aq}}} \right)$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$ex \quad 1.25 = \left( \frac{50\text{mol/L}}{40\text{mol/L}} \right)$$

### 9) Distribution Ratio of Solute A given Separation Factor

$$fx \quad D_{\text{RA}} = (\beta \cdot D_{\text{B}})$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 182 = (7 \cdot 26)$$

### 10) Distribution Ratio of Solute B given Separation Factor

$$fx \quad D_{\text{RB}} = \left( \frac{D_{\text{A}}}{\beta} \right)$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 7.428571 = \left( \frac{52}{7} \right)$$

### 11) Plate Height given Standard Deviation and Length of Column

$$fx \quad H_{\text{SD}} = \frac{(\sigma)^2}{L}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b\_img.jpg\)](#)

$$ex \quad 168.3928\text{m} = \frac{(40.83)^2}{9.9\text{m}}$$



## 12) Separation Factor of two solutes A and B

$$fx \quad \beta_{sp} = \left( \frac{D_A}{D_B} \right)$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$ex \quad 2 = \left( \frac{52}{26} \right)$$

## 13) Standard Deviation given Length of Column and Number of Theoretical Plates

$$fx \quad \sigma_{L \text{ and } N} = \frac{L}{\sqrt{N}}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$ex \quad 3.130655 = \frac{9.9m}{\sqrt{10}}$$

## 14) Standard Deviation given Plate Height and Length of Column

$$fx \quad \sigma_{H \text{ and } L} = \sqrt{H \cdot L}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$ex \quad 10.89954 = \sqrt{12m \cdot 9.9m}$$

## 15) Width of Peak given Number of Theoretical Plates and Length of Column

$$fx \quad W_{N \text{ and } L} = \frac{4 \cdot L}{\sqrt{N}}$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$ex \quad 12.52262 = \frac{4 \cdot 9.9m}{\sqrt{10}}$$



## Variables Used





- $C_{aq}$  Concentration in Aqueous Phase (Mole per Liter)
- $C_o$  Concentration in organic phase (Mole per Liter)
- $D_A$  Distribution Ratio of Solute A
- $D_{actual}$  Actual Distribution Ratio
- $D_B$  Distribution Ratio of Solute B
- $D_{RA}$  Distribution Ratio A
- $D_{RB}$  Distribution Ratio B
- $H$  Plate Height (Meter)
- $H_{SD}$  Plate Height given SD (Meter)
- $L$  Length of Column (Meter)
- $L_c$  Chromatographic Column Length (Meter)
- $L_{cl}$  Chromatographic Column Length given NP and WP (Meter)
- $N$  Number of Theoretical Plates
- $R$  Resolution
- $w_{1/2av}$  Half of Average Width of Peaks (Second)
- $w_{av}$  Average Width of Peaks (Second)
- $w_{NandL}$  Width of Peak N and L
- $\beta$  Separation Factor
- $\beta_{sp}$  Separation Factor A and B
- $\Delta t_{r_H}$  Change in Retention Time given H (Second)
- $\Delta t_{r_{RandW}}$  Change in Retention Time given R and W (Second)



- $\Delta V_{r\_RandW}$  Change in retention volume given Rand W (Milliliter)
- $\sigma$  Standard Deviation
- $\sigma_{HandL}$  Standard Deviation given H and L
- $\sigma_{LandN}$  Standard Deviation given L and N








## Constants, Functions, Measurements used

- **Function:** **sqrt**, sqrt(Number)  
*Square root function*
- **Measurement:** **Length** in Meter (m)  
*Length Unit Conversion* 
- **Measurement:** **Time** in Second (s)  
*Time Unit Conversion* 
- **Measurement:** **Volume** in Milliliter (mL)  
*Volume Unit Conversion* 
- **Measurement:** **Molar Concentration** in Mole per Liter (mol/L)  
*Molar Concentration Unit Conversion* 





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