Relative Limiting Error

SUM

$$X = X_1 + X_2$$

$$\frac{dX}{X} = \frac{dX_1}{X} + \frac{dX_2}{X}$$

$$\frac{dX}{X} = \frac{dX_1}{X} . \frac{x_1}{x_1} + \frac{dX_2}{X} . \frac{x_2}{x_2}$$

$$\frac{dX}{X} = \frac{dX_1}{x_1} . \frac{x_1}{X} + \frac{dX_2}{x_2} . \frac{x_2}{X}$$

$\pm \delta x_1 or \pm \delta x_2$ Represent limiting error

$$\frac{\delta X}{X} = \pm(\frac{\delta X_1}{x_1} . \frac{x_1}{X} + \frac{\delta X_2}{x_2} . \frac{x_2}{X})$$

Difference

$$X = X_1 - X_2$$

$$\frac{dX}{X} = \frac{dX_1}{X} - \frac{dX_2}{X}$$

$$\frac{dX}{X} = \frac{dX_1}{X} . \frac{x_1}{x_1} - \frac{dX_2}{X} . \frac{x_2}{x_2}$$

$$\frac{dX}{X} = \frac{dX_1}{x_1} . \frac{x_1}{X} - \frac{dX_2}{x_2} . \frac{x_2}{X}$$

$+ \delta x_1 and - \delta x_2$ Worst discrepancy case

$$\frac{\delta X}{X} = \pm(\frac{\delta X_1}{x_1} . \frac{x_1}{X} + \frac{\delta X_2}{x_2} . \frac{x_2}{X})$$

Relative Limiting Error

$\text{Pr}\,\mathit{oduct}$

$$X = X_1 . X_2$$

$$\log X = LogX_1 + LogX_2$$

$$\frac{1}{X} = \frac{1}{X_1}\frac{dX_1}{dX} + \frac{1}{X_2}\frac{dX_2}{dX}$$

$$\frac{dX}{X} = \frac{dX_1}{X_1} + \frac{dX_2}{X_2}$$

$\pm \delta x_1 or \pm \delta x_2$ Represent limiting error

$$\frac{\delta X}{X} = \pm(\frac{\delta X_1}{x_1} + \frac{\delta X_2}{x_2})$$

Devision

$$X = X_1 / X_2$$

$$\log X = LogX_1 - LogX_2$$

$$\frac{1}{X} = \frac{1}{X_1}\frac{dX_1}{dX} - \frac{1}{X_2}\frac{dX_2}{dX}$$

$$\frac{dX}{X} = \frac{dX_1}{X_1} - \frac{dX_2}{X_2}$$

$+\delta x_1 and -\delta x_2$ Worst discrepancy case

$$\frac{\delta X}{X} = \pm(\frac{\delta X_1}{x_1} + \frac{\delta X_2}{x_2})$$

Relative Limiting Error

Power

$$X = X_1^{\,n}$$

$$\log X = nLogX_1$$

$$\frac{1}{X} = n.\frac{1}{X_1}\frac{dX_1}{dX}$$

$$\frac{dX}{X} = n\frac{dX_1}{X_1}$$

$$\pm\,\delta x_1$$

$$\frac{\delta X}{X} = \pm n.\frac{\delta X_1}{x_1}$$

Composites

$$X = X_1^{\,n}.X_2^{\,m}$$

$$\log X = nLogX_1 + mLogX_2$$

$$\frac{1}{X} = n\frac{1}{X_1}\frac{dX_1}{dX} + m\frac{1}{X_2}\frac{dX_2}{dX}$$

$$\frac{dX}{X} = n\frac{dX_1}{X_1} + m\frac{dX_2}{X_2}$$

$\pm\,\delta x_1 and \pm\,\delta x_2$ Represents limiting error

$$\frac{\delta X}{X} = \pm(n\frac{\delta X_1}{x_1} + m\frac{\delta X_2}{x_2})$$

Numerical

Question:
Resistance of a circuit found by measuring current and power fed into it. Find limiting error In measurement when power and current deviates by $\pm$ 1.5 % and current by $\pm$ 1.0%

$$\text{Re}\,sistence = \frac{Power}{(Current)^2}$$

$$R = PI^{-2}$$

$$\frac{\delta R}{R} = \pm(\frac{\delta P}{P} + 2\frac{\delta I}{I})$$

$$\frac{\delta R}{R} = \pm(1.5 + 2 * 1.0) = \pm 3.5\%$$