

Example Error Calculations

1. Example 1

$$q = \frac{m}{L}$$

$$m = 32 \pm 1.6$$

$$L = 10 \pm 0.1$$

$$\frac{\delta q}{q} = \frac{\delta m}{m} \oplus \frac{\delta L}{L} = 0.05 \oplus 0.01 = 0.051$$

$$\delta q = 0.051 * q = 0.051 * 3.2 = 0.163$$

2. Example 2

$$n = \frac{t}{2} \sin \theta$$

$$t = 5 \pm 0.1$$

$$\theta = 41 \pm 0.1^\circ$$

$$\frac{\delta n}{n} = \frac{\delta t}{t} \oplus \frac{\delta \sin \theta}{\sin \theta} = 0.02 \oplus 0.0199 = 0.028$$

Here,

$$\frac{\delta \sin \theta}{\sin \theta} = \frac{|\sin(\theta + \delta \theta) - \sin \theta|}{\sin \theta} = \frac{\sin 42^\circ - \sin 41^\circ}{\sin 41^\circ} = 0.0199$$

$$\delta n = \left(\frac{\delta n}{n} \right) * n = 0.028 * 1.64 = 0.046$$

3. Example 3

$$B = \frac{I^2 R}{x^2 + c^2} = \frac{u}{v}$$

$$I = 100 \pm 2$$

$$R = 10 \pm 0.1$$

$$x = 12.3 \pm 1$$

$$c = 5 \pm 0.00001$$

$$\frac{\delta u}{u} = \frac{2\delta I}{I} \oplus \frac{\delta R}{R} = (2 * 0.02) \oplus 0.01 = 0.041$$

$$\delta v = \delta(x^2) \oplus \delta(c^2) = 2x\delta x \oplus 2c\delta c$$

$$= 24.6 \oplus 0.001 = 24.6$$

$$\frac{\delta v}{v} = \frac{24.6}{12.3^2 + 5^2} = 0.033$$

$$\frac{\delta B}{B} = \frac{\delta u}{u} \oplus \frac{\delta v}{v} = 0.041 \oplus 0.033 = 0.053$$

$$\delta B = B * \left(\frac{\delta B}{B} \right) = 132.2 * (0.053) = 6.94$$