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MECHATRONICS ENGINEERING

NU 17/ENG05/025

ASSIGNMENT 2

The hypotenuse of a right angle triangle is denoted as 'c' and the other two sides are as 'a' and 'b' is ± 1.5%. Find the maximum possible error on calculating!

(i) The area of the triangle

(ii) The length of the hypotenuse

a) Error Percentage = ± 1.5 % = ± 1.5 = ± 0.015
100

Area of Triangle = ½ × a × b = ab
2

$$\delta A = \frac{\partial A}{\partial a}\delta a + \frac{\partial A}{\partial b}\cdot \delta b$$

$$= \frac{b}{2}[\pm 0.015a] + \frac{a}{2}[\pm 0.015b]$$

$$= \frac{ab}{2}[\pm 0.015] + \frac{ab}{2}[\pm 0.015]$$

but $A = \frac{ab}{a}$

$\therefore \delta A = A[\pm 0.015] + A[\pm 0.015]$

$= A[\pm 0.015 + (\pm 0.015)]$

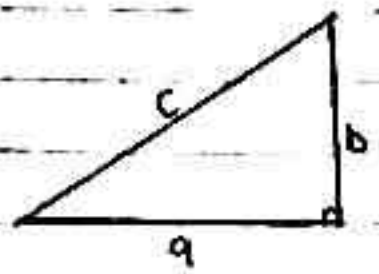
$= A[\pm 0.03]$

$= \pm A(0.02)$

$= \pm A\ 3\%$

$\therefore \delta A = \pm A\ 3\%$ or $\pm A 0.03$ [±3 percent of A]

d) Length of Hypotenuse = c



From pythagoras theorem

$$c^2 = a^2 + b^2$$
$$c = \sqrt{a^2 + b^2}$$
$$c = (a^2 + b^2)^{1/2}$$

Possible error = ± 0.015

$$\delta c = \frac{\partial c}{\partial a} \cdot \delta a + \frac{\partial c}{\partial b} \cdot \delta b$$

$$\frac{\partial c}{\partial a} \cdot \delta a = \left[\frac{1}{2}(a^2+b^2)^{1/2}\right][2a][\pm 0.015a]$$

$$= (a^2+b^2)^{1/2} \cdot (a) \cdot (\pm 0.015a)$$

$$= \frac{a}{(a^2+b^2)^{1/2}} \cdot (\pm 0.015a)$$

$$= \left[\frac{a^2}{(a^2+b^2)^{1/2}}\right](\pm 0.015)$$

$$\frac{\partial c}{\partial b} \cdot \delta b = \frac{1}{2}(a^2+b^2)^{1/2} \cdot (2b) \cdot (\pm 0.015b)$$

$$= (a^2+b^2)^{-1/2} (b)(\pm 0.015b)$$

$$= \frac{b}{(a^2+b^2)} \cdot (\pm 0.015b)$$

$$= \frac{\pm b^2}{(a^2+b^2)^{1/2}}(0.015)$$

$$\therefore \delta c = \frac{a^2}{(a^2+b^2)^{1/2}}(\pm 0.015) + \frac{b^2}{(a^2+b^2)^{1/2}}(\pm 0.015)$$

$$= \frac{\pm a^2(0.015)}{(a^2+b^2)^{1/2}} + \frac{\pm b^2(0.015)}{(a^2+b^2)^{1/2}}$$

$$= \frac{\pm a^2(0.015) + b^2(0.015)}{(a^2+b^2)^{1/2}}$$

$$= \pm \frac{a^2+b^2(0.015)}{(a^2+b^2)^{1/2}}$$

$$= \pm \frac{(a^2+b^2)(0.015)}{(a^2+b^2)^{1/2}}$$

From laws of indices

$$\delta c = \pm (a^2+b^2)^{1-1/2} \cdot [0.015]$$

$$\delta c = \pm (a^2+b^2)^{1/2} \cdot (0.015)$$

but $(a^2+b^2)^{1/2} = c$

$$\therefore \delta c = \pm c(0.015)$$

$$= \pm c(0.015)$$

$$= \pm c[1.5\%]$$

$$\delta c = \pm c[1.5\%] \text{ or } \pm c[0.015]$$