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 MECHANICS ENG

① The hypotenuse of a right angled triangle is denoted as c , and the other two sides are denoted as a and b . If the possible error of measuring each of a and b is $\pm 1.5\%$. Find the maximum possible error of calculating;

- a) the area of the triangle
- b) the length of the hypotenuse

Solution
 a) Recall area of triangle = $\frac{1}{2} b \times h$

$$\therefore = \frac{1}{2} b \times a$$

$$\Delta A = \frac{\Delta a}{2} b + \frac{\Delta b}{2} a$$

$$\frac{\Delta A}{A} = \frac{\Delta a}{a} + \frac{\Delta b}{b} ; \Delta a = \pm \frac{3a}{200} ; \Delta b = \pm \frac{3b}{200}$$

$$= \pm \frac{3b}{2} \left[\frac{1}{200} + \frac{1}{200} \right] = \pm A \frac{3}{100} \Rightarrow \pm 3\% \text{ of } A$$

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

$$\Delta C = \frac{\Delta C}{\Delta a} \Delta a + \frac{\Delta C}{\Delta b} \Delta b$$

$$\frac{\Delta C}{\Delta a} = \frac{1}{2} (a^2 + b^2)^{-1/2} (2a) = \frac{a}{\sqrt{a^2 + b^2}} ; \frac{\Delta C}{\Delta b} = \frac{1}{2} (a^2 + b^2)^{-1/2} (2b)$$

$$; \Delta a = \pm \frac{3a}{200} = \frac{3a}{200} ; \Delta b = \pm \frac{3b}{200} = \frac{3b}{200}$$

$$\text{Therefore } \Delta C = \frac{a}{\sqrt{a^2 + b^2}} \pm \frac{3a}{200} + \frac{b}{\sqrt{a^2 + b^2}} \pm \frac{3b}{200} =$$

$$= \pm \frac{3}{200} \frac{a^2 + b^2}{\sqrt{a^2 + b^2}} = \pm \frac{3}{200} \sqrt{a^2 + b^2} = \pm \frac{3}{200} C$$

$\Delta C = 0.015\% \text{ of } C$