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COLLEGE - ENGINEERING  
DEPARTMENT - MECHANICAL

LEVEL - 200

MAT NO - 17/E/G061029

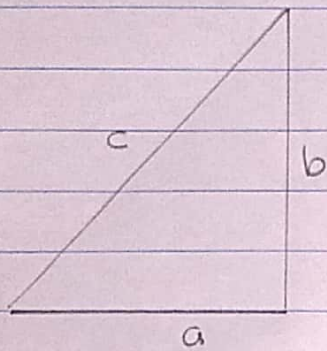
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Question

i. The hypotenuse of a right-angled triangle is denoted as  $c$  and the other two sides are denoted as  $a$  and  $b$  is  $\pm 1.5\%$ . Find the maximum possible error in calculating

a. The area of triangle

b. The length of hypotenuse.



Solution:

a)  $c^2 = a^2 + b^2$

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

$$A = \frac{1}{2}bh = \frac{1}{2}ab$$

$$\frac{\delta A}{\delta a} = \frac{1}{2}b$$

$$\frac{\delta A}{\delta b} = \frac{1}{2}a$$

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

$$\delta A = \frac{1}{2}b \cdot \frac{1.5a}{100} + \frac{1}{2}a \cdot \frac{1.5b}{100}$$

$$\delta A = \frac{1}{2}ab \left( \frac{1.5}{100} + \frac{1.5}{100} \right)$$

$$= \frac{1}{2}ab \left( \frac{3}{100} \right)$$

$$= A \left( \frac{3}{100} \right)$$

$$\delta A = \pm 3\% A$$

b)  $c^2 = a^2 + b^2$

$$c = \sqrt{a^2 + b^2}$$

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

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

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

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

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

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

$$\delta c = a(a^2 + b^2)^{-1/2} \cdot \frac{1.5}{100} a + b(a^2 + b^2)^{-1/2} \cdot 1.5/100 \cdot b$$

$$\delta c = \frac{a^2 \cdot 1.5}{100} (a^2 + b^2)^{-1/2} + \frac{b^2 \cdot 1.5}{100} (a^2 + b^2)^{-1/2}$$

$$\delta c = (a^2 + b^2)^{-1/2} \left( \frac{a^2 \cdot 1.5}{100} + \frac{b^2 \cdot 1.5}{100} \right)$$

$$\delta c = (a^2 + b^2)^{-1/2} \times \frac{1.5}{100} \times [a^2 + b^2]$$

$$\delta c = \frac{1.5}{100} \times (a^2 + b^2) \times (a^2 + b^2)^{-1/2}$$

$$\delta c = \frac{1.5}{100} \times (a^2 + b^2)^{1-1/2}$$

$$\delta c = \frac{1.5}{100} \times (a^2 + b^2)^{1/2}$$

$$\delta c = \pm 1.5\% \text{ of } C$$