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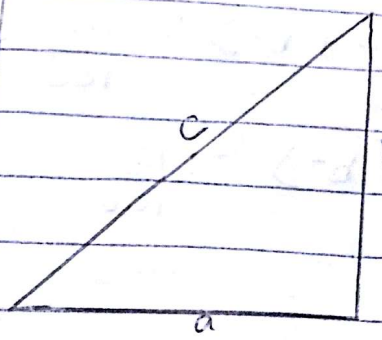
1) The hypotenuse of a right-angled triangle is denoted as c, and the other two sides are denoted as a and b. is ±1.5%, find the maximum possible error in calculating:
a) the area of the triangle, and
b) the length of the hypotenuse

Solution.



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

a) $A = \frac{1}{2}bh = \frac{1}{2}ab.$

$$\partial A/\partial a = \frac{1}{2}b \quad , \quad \partial A/\partial b = \frac{1}{2}a$$

$$\partial A = \frac{\partial A}{\partial a}\partial a + \frac{\partial A}{\partial b}\partial b.$$

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

$$\partial A = \frac{1}{2}ab\left(\frac{1.5}{100} + \frac{1.5}{100}\right)$$
$$= \frac{1}{2}ab\left(\frac{3}{100}\right)$$
$$= A\left(\frac{3}{100}\right)$$
$$\partial A = \pm 3\%\, A.$$

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

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

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

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

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

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

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

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

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

$\partial c = a^2 \frac{1.5}{100} (a^2+b^2)^{-1/2} + b^2 (a^2+b^2)^{-1/2} \cdot \frac{15}{100}$

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

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

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

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

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

$\partial c = \pm 1.5\% c.$