Question.

The length of each side of a cube measured with vernier calipers is 30mm. If the vernier calipers can be read with an uncertainty of 0.14mm, what does this give for approximate uncertainty in the value of its volume?

1%
0.005%
0.02%
0.01%

$L = 30 \, mm$
$\Delta L = 0.14 \, mm$
$\dfrac{\Delta V}{V} = ?$

Solution.

$$\Delta V = \frac{\partial V}{\partial L} \Delta L$$

For cube: $V = L^3$

Therefore,

$$\frac{\partial V}{\partial L} = \frac{\partial}{\partial L} L^3 = 3L^2 \rightarrow \Delta V = 3L^2 \Delta L$$

So,

$$\frac{\Delta V}{V} = \frac{3L^2 \Delta L}{L^3} = \frac{3\Delta L}{L}$$

Calculate:

$$\frac{\Delta V}{V} = \frac{3 \cdot 0.14}{30} = 0.014 = 1.4\%$$

Answer.

For cube:

$\dfrac{\Delta V}{V} = \dfrac{3\Delta L}{L} = 0.014 = 1.4\%$