Tutorial – How to present a calculation example

When presenting a calculation example, students should:

- Summarize the data needed to complete the calculation.
- Show all steps of the calculation.
- Present and derive all the necessary formulas.
- Always carry units.
- Keep several significant figures and only round off numbers when presenting the final result.
- Clearly highlight the final result.

Example 1 – Volume of a sphere

The diameter of a sphere was measured using a vernier caliper: $D = (26.75 \pm 0.05)\text{mm}$. Calculate the volume of the sphere in m^3.

Calculating the volume of a sphere

	Comments
Diameter of the sphere: $D = (26.75 \pm 0.05)\text{mm}$	*We start by summarizing the data needed for this calculation.*
$V = \frac{4\pi R^3}{3}$	*The formula for the volume of a sphere of radius R.*
$V = \frac{4\pi(D/2)^3}{3} = \frac{\pi D^3}{6} = \frac{\pi(26.75\ \text{mm})^3}{6} = 10022.3596\ \text{mm}^3$	*We use the fact that the radius is half the diameter . We keep several significant figures at this stage.*
$\frac{\partial V}{\partial D} = \frac{\pi D^2}{2}$	*For the error propagation calculation, we need to calculate the partial derivative $\partial V/\partial D$.*
$\Delta V = \sqrt{\left(\frac{\partial V}{\partial D}\right)^2 \Delta D^2} = \sqrt{\left(\frac{\pi D^2}{2}\right)^2 \Delta D^2} = \frac{\pi D^2 \Delta D}{2}$	*We are using the general formula for error propagation. Again, we keep several significant figures at this stage.*
$\Delta V = \frac{\pi(26.75\ \text{mm})^2(0.05\ \text{mm})}{2} = 56.2001\ \text{mm}^3$	
$\Delta V = 6\ \times 10^1\ \text{mm}^3 = 6\ \times 10^{-8}\ \text{m}^3$	*We now round the off the uncertainty to one significant digit and do the conversion to meter cube.*
$V = 1002 \times 10^1\ \text{mm}^3 = 1002\ \times 10^{-8}\ \text{m}^3$	*We then round off the answer for the volume to the same precision and do the conversion to meter cube.*
$\boxed{V = (1.002 \pm 0.006) \times 10^{-5}\ \text{m}^3}$	*We present and highlight the final answer.*