Larbi Ben M'hidi University
Physical measurements 2st Year
Metrology 2

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Name :..... First name:.....

Ain M'Lila 14/01/2026

Metrology 2 quality 1 exam

Choose the correct answer: (09 pts)

1. In physics, making a measurement means: A. Finding the exact value of a physical quantity B. Estimating a quantity without instruments C. Determining the numerical value of a physical quantity D. Eliminating all measurement errors	**2. Why is it impossible to know the exact (true) value of a quantity?** A. Because instruments do not exist B. Because measurement errors are unavoidable C. Because calculations are incorrect D. Because scientists do not agree
3. Measurement error is defined as: A. The uncertainty of the instrument B. The difference between the measured value and the true value C. The variation of repeated measurements D. The precision of the instrument	**4. Why is the measurement error itself unknown?** A. Because the measured value is incorrect B. Because the instrument is poorly calibrated C. Because the true value is unknown D. Because measurements are not repeated
5. What is used to judge the precision of a measurement? A. The true value B. The measurement error C. The unit of measurement D. The measurement uncertainty	6. Measurement uncertainty represents: A. The exact value of the quantity B. An interval where the true value is likely to be found C. A mistake made during measurement D. The instrument resolution only

1,5 pt | 1,5 pt | 1,5 pt | 1,5 pt | 1,5 pt | 1,5 pt

Problem

Let consider the following equations:

$$f(x,y,z) = x\sqrt{z-y}$$

$$g(x,y,z) = x^3 + \sqrt{y} - \sqrt{z}$$

Data:

With: x = 5.08 ±0.17; y = 12.6±0.2; z =19.31±0.06

- Give the value of $f(x,y,z)$ and its uncertainty (using the GUM method)
- Give the value of $g(x,y,z)$ and its uncertainty (using the GUM method)
- Which error is dominating in $g(x,y,z)$ function?

Pr K Mouche

Problem (Corrected) 4 pt

✓ $f(x,y,z) = x\sqrt{z-y}$ calculation of f : $f = 13,16$ (0,5 pt)

$\frac{\partial f}{\partial x} = \sqrt{z-y}$ (0,5 pt) ; $\frac{\partial f}{\partial y} = -\frac{x}{2\sqrt{z-y}}$ (0,5 pt)

$\frac{\partial f}{\partial z} = \frac{x}{2\sqrt{z-y}}$ (0,5 pt)

$\begin{cases} \partial f/\partial x \approx 2,5 & \text{(0,5 pt)} \\ \partial f/\partial y \approx -0,98 & \text{(0,5 pt)} \\ \partial f/\partial z \approx 0,98 & \text{(0,5 pt)} \end{cases}$

(0,5 pt) $\Delta f = \sqrt{\left(\frac{\partial f}{\partial x}\Delta x\right)^2 + \left(\frac{\partial f}{\partial y}\Delta y\right)^2 + \left(\frac{\partial f}{\partial z}\Delta z\right)^2} = \sqrt{(2,5 \times 0,17)^2 + (0,98 \times 0,2)^2 + (0,98 \times 0,06)^2}$

$\Rightarrow \Delta f = 0,49$ (0,5 pt) so, $f = 13,16 \pm 0,49$ (0,5 pt)

✓ $g(x,y,z) = x^3 + \sqrt{y} - \sqrt{z}$ calculating g : $g = 130,16$ (0,5 pt)

$\partial g/\partial x = 3x^2 \approx 77,4$ (0,5 pt) (0,5 pt)

$\partial g/\partial y = \frac{1}{2\sqrt{y}} \approx 0,141$ (0,5 pt) (0,5 pt)

$\partial g/\partial z = -\frac{1}{2\sqrt{z}} \approx -0,141$ (0,5 pt)

(0,5 pt) $\Delta g = \sqrt{\left(\frac{\partial g}{\partial x}\Delta x\right)^2 + \left(\frac{\partial g}{\partial y}\Delta y\right)^2 + \left(\frac{\partial g}{\partial z}\Delta z\right)^2} = \sqrt{(77,4 \times 0,17)^2 + (0,141 \times 0,2)^2 + (-0,141 \times 0,06)^2}$

(0,5 pt) $\Delta g = 13,16$ so $g = 130,16 \pm 13,16$ (0,5 pt)

✓ the dominating error in g function is $\left[\frac{\partial g}{\partial x}\Delta x\right]$ (0,5 pt)

equal to $77,4 \times 0,17 = 13,158 \approx 13,16$

(0,5 pt)