# M1.11 Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined

## Teacher answers

### Quiz

1. A microscope graticule allows fine-scale measurements to be made under a microscope. If the graticule’s uncertainty is ± 0.5 µm, and a protozoan parasite *Trypanosoma* is measured as 50 µm, calculate the percentage error for this measurement.

Percentage error = $\frac{absolute uncertainty}{measured value}\*100 $= $\frac{0.5}{50}\*100=1\%$

1%

1. Cell cultures of the bacteria *E. coli* can be measured by a spectrophotometer to give an accurate (to within 2%) reading of bacteria cm-3
A sample has been calculated as containing 3 \* 109 bacteria cm-3
Calculate the absolute uncertainty of this measurement.

2% of 3 \* 109 bacteria cm-3 = 2 / 100 x 3 \* 109 bacteria cm-3

Absolute uncertainty = ±6 \* 107 bacteria cm-3

1. A plant shoot is measured for growth over a 5-day time period. Every morning it was measured with a ruler with uncertainty of ±0.5 mm and the height recorded as show below. Calculate the difference in height between days 1 and 5 and state the percentage error in this measurement.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Day** | 1 | 2 | 3 | 4 | 5 |
| **Height (mm)** | 8 | 11 | 16 | 21 | 24 |

Difference in height = 24 - 8 = 16 mm

Percentage error = $\frac{2\* absolute uncertainty}{measured value}\*100 $= $\frac{2\* 0.5}{16}\*100=6.25\%$

**Document updates**

 v1.0 April 2017 Original version.

 v1.1 June 2019 Changed how the word accuracy and uncertainty were used in order to be in line with the ‘Language of measurement’. Changed the method for Question 3.

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