a) Perform the following calculations on the measurements and express your answers to reasonable number of significant figures and decimal places.
i) 108.7 cm + 0.35 cm- 0.105 cm
ii) 103.47 g m/L* 20.3 mL
b) Explain why uncertainty of measurement is important in science and engineering.
c) With the aid of an illustration, explain the meaning of accuracy and precision

Solution

a)I) We have an additions and subtractions

$$108.7 \text{ cm} + 0.35 \text{ cm} - 0.105 \text{ cm} = 108.94500\text{cm}$$

The answer will need to be rounded to have one place to the right of the decimal to match 107.8, whence we get

$$108.7 \text{ cm} + 0.35 \text{ cm} - 0.105 \text{ cm} = 108.9\text{cm}$$

II) This is multiplication.

$$103.47 \frac{\text{g}}{mL} * 20.3\, mL = 2100{,}441\text{g}$$

The answer will need to be rounded to 3 significant figures to match 20.3, whence we get

$$103.47 \frac{\text{g}}{mL} * 20.3\, mL = 2.10 \times 10^3 g$$

b) In metrology, measurement uncertainty is a central concept quantifying the dispersion one may reasonably attribute to a measurement result. Such an uncertainty can also be referred to as a measurement error. In daily life, measurement uncertainty is often implicit(expressing a mass as "10 kg," it would more correctly be "10 kg, plus or minus 30 g, with a 95% probability." ☺), while for any serious use an explicit statement of the measurement uncertainty is necessary. The expected measurement uncertainty of many measuring instruments (scales, oscilloscopes, force gages, rulers, thermometers, etc.) is often stated in the manufacturer's specification.

In physics the Heisenberg uncertainty principle forms the basis of modern quantum mechanics and predicts the many interesting results in superconductivity, quantum optics etc.

The many branches of knowledge (science modeling, weather forecast, etc.), which predict the future events, are very depending on input data, whence the uncertainty is very important

c)

Accuracy is defined as, "The ability of a measurement to match the actual value of the quantity being measured". If in reality it is 0.0C outside and a temperature sensor reads 0.0C, then than sensor is accurate.

Precision is defined as, "(1) The ability of a measurement to be consistently reproduced" and "(2) The number of significant digits to which a value has been reliably measured". If on several tests the temperature sensor matches the actual temperature while the actual temperature is held constant, then the temperature sensor is precise. By the second definition, the number 2.718281828 is more precise than the number 2.7183.

An example of a sensor with GOOD accuracy and BAD precision: Suppose a lab refrigerator holds a constant temperature of 0 C. A temperature sensor is tested 8 times. The temperatures from the test yield the temperatures of: 0.1, -1.0, 0.0, 1.0, -0.6, 0.3, 0.2, 0.0 C. This distribution shows no impressive tendency toward a particular value (lack of precision) but each value does come close to the actual temperature (high accuracy).

http://www.AssignmentExpert.com/