insignificant digit to be dropped (the underlined digit in this case) is more than 5, and is left unchanged if the latter is less than 5. But what if the number is 2.74<u>5</u> in which the insignificant digit is 5. Here, the convention is that **if the preceding digit is even, the insignificant digit is simply dropped and, if it is odd, the preceding digit is raised by** 1. Then, the number 2.74<u>5</u> rounded off to three significant figures becomes 2.74. On the other hand, the number 2.73<u>5</u> rounded off to three significant figures becomes 2.74 since the preceding digit is odd.

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In any involved or complex multi-step calculation, you should retain, in intermediate steps, one digit more than the significant digits and round off to proper significant figures at the end of the calculation. Similarly, a number known to be within many significant figures, such as in 2.99792458 × 10^8 m/s for the speed of light in vacuum, is rounded off to an approximate value 3 × 10^8 m/s , which is often employed in computations. Finally, remember that exact numbers that appear in formulae like 2 π in $T = 2\pi\sqrt{\frac{L}{g}}$, have a large (infinite) number of significant figures. The value of π = 3.1415926.... is known to a large number of significant figures. You may take the value as 3.142 or 3.14 for π, with limited number of significant figures as required in specific cases.

Note1

Note2

Note3

> **Example 2.13** Each side of a cube is measured to be 7.203 m. What are the total surface area and the volume of the cube to appropriate significant figures?

Answer The number of significant figures in the measured length is 4. The calculated area and the volume should therefore be rounded off to 4 significant figures.

Surface area of the cube = 6(7.203)^2 m^2
= 311.299254 m^2
= 311.3 m^2

Volume of the cube = (7.203)^3 m^3
= 373.714754 m^3
= 373.7 m^3 ◀

> **Example 2.14** 5.74 g of a substance occupies 1.2 cm^3. Express its density by keeping the significant figures in view.

Answer There are 3 significant figures in the measured mass whereas there are only 2 significant figures in the measured volume. Hence the density should be expressed to only 2 significant figures.

$$\text{Density} = \frac{5.74}{1.2}\ \text{g cm}^{-3}$$
$$= 4.8\ \text{g cm}^{-3}.$$ ◀

2.7.3 Rules for Determining the Uncertainty in the Results of Arithmatic Calculations

The rules for determining the uncertainty or error in the number/measured quantity in arithmetic operations can be understood from the following examples.

(1) If the length and breadth of a thin rectangular sheet are measured, using a metre scale as 16.2 cm and, 10.1 cm respectively, there are three significant figures in each measurement. It means that the length l may be written as

$$l = 16.2 \pm 0.1\ \text{cm}$$
$$= 16.2\ \text{cm} \pm 0.6\ \%.$$

Similarly, the breadth b may be written as

$$b = 10.1 \pm 0.1\ \text{cm}$$
$$= 10.1\ \text{cm} \pm 1\ \%$$

Then, the error of the product of two (or more) experimental values, using the combination of errors rule, will be

$$A = l\,b = 163.62\ \text{cm}^2 \pm 1.6\%$$
$$= 163.62 \pm 2.6\ \text{cm}^2$$

$A = 163.62\ \text{cm}^2$
$\frac{\Delta A}{A} \times 100\% = 1.6\%$
$\Delta A = \frac{1.6}{100} \times A = 2.6\ \text{cm}^2$

This leads us to quote the final result as

$$A = l\,b = 164 \pm 3\ \text{cm}^2$$

Here 3 cm^2 is the uncertainty or error in the estimation of area of rectangular sheet.

(2) **If a set of experimental data is specified to n significant figures, a result obtained by combining the data will also be valid to n significant figures.**

However, if data are subtracted, the number of significant figures can be reduced. Imp

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