

Approximation and Estimation

3.1 - Rounding off Numbers to Decimal Places

A) Idea of Rounding

In our daily lives we often come across figures which are **approximations** of the exact values of some quantities. Sometimes, it is easier to remember and other times it may not be possible to obtain the exact values of a quantity due to the limitation of the measuring instrument used.

B) Rounding off Numbers to Decimal Places

The method of rounding off a number to a specified decimal is similar to that of rounding it off to a whole number.

Round off to desired number of decimal places	Digit to consider	Digit is 5 or more	Digit is 4 or less
1 decimal place	Hundredths place	Round up	Round down
2 decimal place	Thousandths place	Round up	Round down
3 decimal place	Ten thousandths place	Round up	Round down

In rounding off decimals, we have to place the cut-off point after the specified decimal place and then round up or round down the number accordingly.

3.2 - Rounding Off Numbers To Significant Figures

In a number, the most significant digit is the **first non-zero digit** (reading from left to right). It is called the **first significant figure**. The digit is called the **second significant figure** and so on.

Take the number 0.004 503. 4 is the first significant figure, 5 is the second, 0 is the third and so on. Note that the first 3 zeros in front of the digit 4 are not significant figures. However, the zero after the digit 4 is a significant figure.

Rounding 0.004 503 to 2 significant figures (2 s.f.) will give us 0.0045, which is the same as rounding it off to 2 decimal places. Rounding it off to 3 significant figures (3 s.f.) will give us 0.004 50.

3.3 - Estimation

A) Estimation in numbers

Estimation is the process of finding an approximate value of a number or a measurement. In our daily life, we often have to make estimations when a calculator is not readily available. We have to use some strategies so that the estimate is close enough to the actual value to meet the purpose. Let us explore how we can do this.

One method of obtaining an estimate is by rounding off. The symbol ‘ \approx ’ means ‘approximately equal to’.

When the numbers involved in an estimation if their sum are close to each other, we can select a **cluster value** to represent each number. For example, take the numbers 3150, 2980 and 3040. All their values are about 3000. Thus, we can take 3000 as the cluster value.

B) Estimation in Measurements

We often want to measure some lengths and distances. If measuring tools are unavailable, how can we get a close estimation?

We can use some references called **benchmarks**, when taking estimates. Like when measuring the width of a room, we can use the arm span or the distance of one walking step as a benchmark.

When an appropriate benchmark is not available, an estimation can be made by dividing the object measured into several parts, making an estimation of each part and finally obtaining an estimate for the whole object. This method is called a **decomposition-recomposition strategy**.

For example, to obtain the height of a 50-storey HDB block, we can assume that the height between 2 adjacent floor levels is 3m then the total estimated height will be $\approx 50 \times 3 = 150\text{m}$.

C) Estimation in Computation Results

We may get an approximate answer or even a wrong answer when using a calculator to compute an expression. This may be due to rounding off errors, pressing the wrong keys or entering the key sequence incorrectly. We must always be alert to the accuracy and check if the answers are reasonable.