Long division is a method of dividing numbers without using a calculator. The method breaks down larger divisions into smaller, more manageable pieces.

Method

1. Write the numbers in the 'bus shelter' format.

    For a question such as 'what is a divided by b?' we call 'a' the dividend (the number that is being divided), and we call 'b' the divisor (the number that we are dividing by). We write them in the format:

    Divisor | Dividend

    This is called long division format, or 'bus shelter' format, as it looks like the dividend is inside a bus shelter.

2. The next step is best shown through an example. Let us try '125 ÷ 5':

    Firstly, we write it in the bus shelter format:

    5 | 1   2   5

    We now look at the highest digit of the dividend, which in this case is 1. We divide the first digit by the divisor. If the answer would be a decimal, we instead divide to find a remainder.

    $1 \div 5 = 0$, remainder 1.

    Here, the 0 is called the quotient.

    We take the quotient and write it above the digit we divided:

    ```
        0
    5 | 1   2   5
    ```

    We take the remainder and write it with the next digit of the dividend:

    ```
        0
    5 | 1̶   12   5
    ```

3. Repeat this process with the second digit of the dividend.

In the above example, we are now dividing 12 by 5.

$12 \div 5 = 2$, remainder 2.

We write the quotient above the digit we divided:

```
        0    2
5 |  1   12    5
```

and write the remainder with the next digit:

```
        0    2
5 |  1   12   25
```

4. Repeat this process as many times as necessary.

In the above example, this means we divide 25 by 5:

$25 \div 5 = 5$, remainder 0.

Therefore, we write:

```
        0    2    5
5 |  1   12   25
```

So, we have found that $125 \div 5 = 25$.

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Decimal answers

There may be cases when the divisor doesn't go into the dividend as nicely, so we get a decimal answer. There are two ways we may handle this:

- Follow the above method until there are no more digits to divide in the dividend. When we perform the final division ($x \div b = y$, remainder d) and get a remainder, we write the answer as '$a \div b = c$, remainder d'.

- We could also write '.000…' next to the dividend under the bus shelter, and continue dividing through and moving the remainders along. For many divisions, the number of decimal places needed to provide a perfectly accurate answer will be too many to calculate by hand, so we just stop when we have reached a suitable level of accuracy.

For example, we calculate '$57 \div 4$'.

1. We write the calculation into the bus shelter format:

$$4 \enclose{longdiv}{5 \quad 7}$$

2. We divide the first digit:

$5 \div 4 = 1$, remainder 1

Then, we write this into the bus shelter:

$$\begin{array}{c} \quad 1 \\ 4 \enclose{longdiv}{\,\,\cancel{5} \quad 17} \end{array}$$

3. We repeat this with the next digit:

$17 \div 4 = 6$, remainder 1

$$\begin{array}{c} \quad 1 \quad\quad 4 \\ 4 \enclose{longdiv}{\,\,\cancel{5} \quad 17} \end{array}$$

4. We can now use either of the two methods for dealing with the remainder. We could say that the question is already answered, and that $57 \div 4 = 14$ remainder 1.

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Alternatively, we add a .0 under the bus shelter:

```
        1    4    .
   4  | 5̶   17   .   0
```

We write in the remainder from the previous step:

```
        1    4    .
   4  | 5̶   1̶7̶   .   10
```

We divide the digit:

$10 \div 4 = 2$, remainder 2

```
        1    4    .   2
   4  | 5̶   1̶7̶   .   10
```

We now have another remainder, so we repeat this process:

```
        1    4    .   2
   4  | 5̶   1̶7̶   .   10   0
```

We write in the remainder:

```
        1    4    .   2
   4  | 5̶   1̶7̶   .   1̶0̶   20
```

Now we divide the digit:

$20 \div 4 = 5$, remainder 0

```
        1    4    .   2    5
   4  | 5̶   1̶7̶   .   1̶0̶   2̶0̶
```

Therefore, we have found that $57 \div 4 = 14.25$.

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