Putting the Jigsaw Together

Practical strategies for assisting apprentices with numeracy issues

Working with Decimals
A trainer’s resource

Manufacturing a skilled Australia
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Guide for trainers

It is recommended that you read the Trainer's Guide for a full understanding of how to use this tool.

How to use this tool

Each tool has been designed to support vocational trainers working with apprentices and assisting them with numeracy skills and it focuses on a specific area of numeracy. Tools should be contextualised to match the workplace of the apprentice and the sample activities framed within a workplace context.

This tool focuses on decimals and the use of decimals in the metals industry. Skill development in working with decimals begins at Australian Core Skills Framework (ACSF) level 1 where the apprentice is able to understand place value and uses money in personally relevant contexts. At ACSF numeracy level 2, the apprentice should be able to use simple, everyday decimals, such as 0.5, 0.25. It is not until ACSF numeracy level 3, that the apprentice is able to use every day or routine decimals and be able to convert, where appropriate, between equivalent forms. Calculation with decimals and flexibly using equivalent forms is a numeracy skill acquired at ACSF level 4.

This tool covers basic mathematical calculations (addition, subtraction, multiplication, division). The examples and activities within this tool can be easily contextualised to support apprentices with numeracy issues in other industries.

Topic content has been provided as background information for each numeracy task. This information can be worked through with the apprentice, or the trainer can go straight to the work examples and activities.

Apprentices may often question why they need to perform certain calculations manually rather than using a calculator. Some examples of times when it is useful to be able to perform manual calculations are:

- the battery in the calculator is flat
- the apprentice left the calculator at home
- the answer on the calculator looks ‘wrong’
- the apprentice may have entered the incorrect details/numbers
- the apprentice may be using an incorrect application on the calculator.

As a trainer, you may be able to provide other examples relevant to the apprentice’s workplace.
The numeracy examples for each task have been designed in small incremental steps to assist the apprentice to build up to the final answer. It is intended that there is no assumed knowledge. The tool may, where appropriate, point to foundation numeracy topics which can be found on the MSA website. The tool may also support numeracy units from the Foundation Skills Training Package.

Sample activities are provided as practice for the numeracy task. These can be completed either with support from the trainer or alone by the apprentice. Worked answers are provided for each activity at the rear of the tool to assist the trainer to monitor the apprentice’s understanding and progress.

A word list has been provided to support the pre-teaching and/or review of specific numeracy terms. As the trainer you may want to provide your own definition of these words and/or add other words as required. You may also use the word list to encourage the apprentice to develop their own definitions which will assist in demonstrating their understanding of the numerical concepts being developed.

You may use additional activities or replace the sample activities with activities relevant to the apprentice. In some instances, you may want to focus on a particular area in which the apprentice is experiencing difficulty.

For the more advanced apprentice, this tool could be provided as a self-paced learning resource.
Functions are indicated by the following icons

1. **Information**
   - Information is provided that is relevant to the concepts, activities or workplace that the apprentice is engaged in.
   - ‘Why we do this’ offers the apprentice an explanation regarding the relevance of the knowledge, skill or activity to the work they are engaged in.

2. **FACT**
   - A true statement.

3. **Example**
   - An example of a function or calculation. Worked examples are given to assist the trainer to break down the steps involved in an activity.
   - A hint that can make things easier. Hints are an important part of the learning process for apprentices as they usually are based on the trainer’s own experiences.
   - A proposed theoretical activity for apprentices. This activity is designed to embed the underpinning mathematical concepts needed to complete a task.

4. **Calculator**
   - Use a calculator.

5. **No Calculator**
   - Do not use a calculator.

6. **Hands-on**
   - Hands-on activity for apprentices. This activity is designed to engage the apprentice in a practical activity that consolidates conceptual learning.
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Decimals

The word list below is designed to introduce or review the words/terms commonly used with decimals.

There may be other words/terms which the apprentice can add to this list.

**Word list**

<table>
<thead>
<tr>
<th>Word/term</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole number</td>
<td></td>
</tr>
<tr>
<td>Numeral</td>
<td></td>
</tr>
<tr>
<td>Decimal</td>
<td></td>
</tr>
<tr>
<td>Decimal point</td>
<td></td>
</tr>
<tr>
<td>Decimal place</td>
<td></td>
</tr>
<tr>
<td>Metric system</td>
<td></td>
</tr>
<tr>
<td>Place value</td>
<td></td>
</tr>
<tr>
<td>Multiplier</td>
<td></td>
</tr>
<tr>
<td>Divisor</td>
<td></td>
</tr>
<tr>
<td>Dividend</td>
<td></td>
</tr>
<tr>
<td>Quotient</td>
<td></td>
</tr>
</tbody>
</table>
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What is a decimal?

Working with decimals is a fundamental numeracy skill required to complete an engineering apprenticeship successfully. Throughout this tool you will find information and activities that will assist you to meet the needs of apprentices at all ACSF numeracy levels.

In the ACSF, the apprentice begins to acquire skills in working with decimals at numeracy level 1 when they learn about place value. The information below may assist you in explaining the decimal system at ACSF numeracy level 1.

One of the most widely used mathematical systems is the decimal system. The numbers we use in everyday life are decimal numbers, because there are 10 (deci) of them (0, 1, 2, 3, 4, 5, 6, 7, 8 and 9).

Often a ‘decimal number’ is also used to mean a number that uses a decimal point followed by number digits as a way of showing values less than one.

For example: 2.9 is a decimal number (two and nine tenths).

2.9 is a number where the two (2) is greater than one (1) and the number (0.9) is a number less than one (1). The location or position of the numbers either side of the decimal point gives the numbers their value. This is called ‘place value’.

Most calculators use the decimal system. When using a calculator, it is much easier to work with decimals than with fractions.
At ACSF numeracy level 2, the apprentice should be able to add, subtract, multiply and divide using decimals. At this level the apprentice acquires skills and knowledge through the use of hands-on (concrete) activities and real-life materials, personal experience and prior knowledge. For many apprentices, a car is an essential need. Using examples and activities involving money and cars, such as the example given in this tool, is a good training strategy to develop a strong understanding of decimals.

In the workplace at this level, the apprentice should be able to correctly follow simple instructions and measure content to make up product. This could translate to a workplace activity where the apprentice is required to collect the materials need to complete a job (e.g. steel rods and sheets of different sizes and lengths to build a frame). The apprentice should also be able to work out their gross pay by recording their hours of work, adding them up and then calculating how much they should gross based on their hourly rate. As the trainer, it is important that you choose relevant workplace examples and activities.

The information and activities provided below may be useful examples that can be used to provide assistance to apprentices working at this level.

When the decimal system is used for measurement it is called the metric system. The metric system is the most widely used system of measurement in the world. The metric system is the system of measurement used in Australia.

An example of a decimal system is money. The Australian currency system is dollars and cents where a dollar ($) is 100 cents. On the left of the decimal point are whole dollars. On the right are parts of a dollar, or cents. The third place after the decimal point (thousandths) is so small it is not usually included when talking about money. On the next page is an example of a real-life activity using currency.
This picture shows the price of unleaded, diesel and autogas in cents.

Converted to dollars (x 100):

- Unleaded costs $1.36.9 per litre
- Diesel costs $1.37.9 per litre
- Autogas costs $0.78.9 per litre

The third number after the decimal point is less than a cent. However, if you fill up with 60 litres of petrol this number adds 54 cents to your total price (60 x 0.9 cents = 54 cents).

This is an ACSF level 2 numeracy activity. You could prepare the apprentice for this activity by asking him/her to bring the car’s manual with them and getting them to locate the information in the manual (if they don’t already know what the capacity of their tank is).

a. How much petrol does the tank in your car hold? If you don’t know consider that a car has a 72 litre tank.

b. If you had to fill it up from empty today, how much would it cost you? If you don’t know today’s fuel cost use the example above.
**Adding decimals**

When adding decimal numbers on paper, there are two important points to remember with the setting out:

- The decimal points MUST align with (be underneath) each other.
- When adding, the bottom number must have the same amount of numbers after the decimal point as the top number. This is done by adding zeros as required.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>23.65</td>
<td>23.65</td>
<td></td>
</tr>
<tr>
<td>6.2</td>
<td>Change to</td>
<td>6.20</td>
</tr>
<tr>
<td><strong>29.85</strong></td>
<td><strong>29.85</strong></td>
<td></td>
</tr>
</tbody>
</table>

‘Carrying’ a number

After adding numbers for a while, people will run into a problem where they have to carry a number. This happens when they get an answer of 10 or more when they add the units column together.

If the units column said 8+4, that gives a total of 12, and a need to carry. In order to carry, there is a need to follow three steps very carefully.

First, after adding the number, you need to split the number up into two separate digits. Do not go to write anything yet; just do this step mentally. For example, if the number is 12 for the answer to the first part of the problem, it would look as 1 and 2 (two separate digits).

Secondly, take the units digit of the number you just split up, and write it in the units column of your answer.

Lastly, here’s the different step: take the tens’ digit of the number you just split up, and write it at the top of the tens’ column in the addition problem.

```
1
1 8 = 12
+ 4
---
2
```

All that is left to do is add together the numbers in the tens’ column now. Notice that after carrying the 1, there are now two numbers in the tens’ column. In this problem, they are both 1. Add these two numbers together, and place the answer in the tens’ column of the calculation. It would look like this:

```
1
```
18
+ 4
---
22

More advanced addition problems with the addition of two digit plus two digit numbers with the need to carry are calculated by the very same method:

\[
\begin{array}{c}
47 \\
+ 39 \\
\hline
86
\end{array}
\]

Start this as you would an addition problem, with the units’ column. Notice when you add the units column together that you get a number higher than ten, which means you have to carry. Carry the same way as above. Split up the number and write the units digit under the units’ column beneath the answer bar, and write the tens’ digit above the tens’ column in the addition problem.

\[
\begin{array}{c}
1 \\
47 \\
+ 39 \\
\hline
6
\end{array}
\]

Now, go ahead and add the tens’ column together. Notice that now there are three numbers in the tens’ column that you must add together, 1 + 4 + 3.

\[
\begin{array}{c}
1 \\
48 \\
+ 39 \\
\hline
86
\end{array}
\]
Complete the following addition activities.

The setting out is important to get the correct answer.

a. \[ 1.36 + 2.364 = \]

b. \[ 1.26 + 0.5 = \]

c. \[ 1259.02 + 0.3 = \]

*Check your answers to this activity in the last section*
Subtracting decimals

When subtracting decimal numbers on paper, there are two important points to remember with the setting out:

- The decimal points MUST align with (be underneath) each other.

- When subtracting, the top number must have the same amount of numbers after the decimal point as the bottom number. This is done by adding zeros as required.

```
29.3  -  Change to  29.300
  19.325       19.325
  9.975        9.975
```

'Borrowing' a number

Sometimes problems appear that don’t seem possible, where the units column does not subtract properly. When this happens, it means there is a need to ‘borrow’ from the next digit in order to be able to subtract.

```
  2  6
-  9
```

In the units column, we are trying to subtract 9 from 6, which seems impossible!

In order to do this, there is a need to ‘borrow’ from the 2 (the number in the tens’ column). Borrowing only has a few steps, but they have to be done in the right order for the problem to work out. The steps are listed below.

E.g. cross out the digit in the tens’ column. In our example, it is a 2.

```
  2  6
-  9
```

Above the number you just crossed out, write the number that is one less than the one you crossed out. For example, if you cross out a 3, write 2; if you cross out a 2, write 1, and so on. We are going to write our new number in red as well.
In front of the units digit, write a 1. This is actually making it a two digit number so the 6 becomes 16, 2 becomes 12, and so on. For our example, it started with 2, so we put a 1 (in red) in front of the 6 to make it 16.

```
  1
 2  6
-  9
```

Start your subtraction over again, starting with the units' column. Your new subtraction problem is 16 – 9. We know that 16 – 9 = 7, so we write 7 in the units column in the answer.

```
  1
 2  6
-  9
  7
```

Now it is possible to continue with the rest of the subtraction, which is in the tens' column. Since there is only one digit in the tens' column, the number can be brought straight down into the tens' column of the answer.

```
  1
 2  6
-  9
   ↓
1  7
```
Subtracting two digit numbers

A two digit subtraction problem looks like this:

\[
\begin{array}{c}
7 \\
4 \\
\hline
3 \\
8
\end{array}
\]

In the units column we are trying to subtract 8 from 4 which cannot be done because 8 is bigger than 4. There is a need to go ‘borrow’ from the digit in the tens’ column, which is the 7 in this example.

\[
\begin{array}{c}
7 \\
4 \\
\hline
3 \\
8
\end{array}
\]

Cross out the 7 and write 6 above the crossed out number.

\[
\begin{array}{c}
6 \\
7 \\
4 \\
\hline
3 \\
8
\end{array}
\]

In front of the units’ digit, write a 1. You are actually making it a 2-digit number when you do this, so 4 becomes 14:

\[
\begin{array}{c}
6 \\
7 \\
14 \\
\hline
3 \\
8
\end{array}
\]
Start your subtraction over again, starting with the units column. Your new subtraction problem is
14 – 8. We know that 14 – 8 = 6, so we write 6 in the units column in the answer.

\[
\begin{array}{cccc}
6 & \quad & 14 \\
- & & 3 & 8 \\
\hline
& & 6 \\
\end{array}
\]

Continue with the rest of the subtraction, which is in the tens’ column. This is where the step differs
from before.

Previously, the number was just brought the top number straight down, because there was only
one digit in the tens’ column. Now, there are two digits in the tens’ column, so we can subtract
them. In the tens’ column, we have 6 – 3, which equals 3. Therefore enter a 3 in the tens’ column.

\[
\begin{array}{cccc}
6 & \quad & 14 \\
- & & 3 & 8 \\
\hline
3 & & 6 \\
\end{array}
\]
Complete the following subtraction activities.

The setting out is important to get the correct answer.

**Subtraction**

a. $2 - 1.36 =$  

b. $9.362 - 6.3 =$

\[ \underline{\phantom{0000}} \quad \underline{\phantom{0000}} \]

\[ \underline{\phantom{0000}} \quad \underline{\phantom{0000}} \]

\[ \underline{\phantom{0000}} \quad \underline{\phantom{0000}} \]

\[ \underline{\phantom{0000}} \quad \underline{\phantom{0000}} \]

c. $258.3 - 10.369 =$

\[ \underline{\phantom{0000}} \quad \underline{\phantom{0000}} \]

\[ \underline{\phantom{0000}} \quad \underline{\phantom{0000}} \]

\[ \underline{\phantom{0000}} \quad \underline{\phantom{0000}} \]

*Check your answers to this activity in the last section*
Multiplying decimals

When multiplying decimals on paper, it is easier to remove the decimal points, and then put the decimal point into the answer later.

**Step 1:** Multiply the numbers as if they were whole numbers, ignoring the decimal point.

\[
\begin{array}{c}
10.13 \times 3.6 = \\
1 0 1 3 \\
\times \ \\
3 6 \\
\hline
6 0 7 8 \\
1 0 1 3 \times 6 \\
3 0 3 9 0 \\
\hline
3 6 4 6 8
\end{array}
\]

Move over one (1) space and multiply by three (3)

Add the two (2) responses together for the result

**Step 2:** Count the numbers after the decimal point in both numbers

3.6 has one number after the decimal place (.6)

10.13 has two numbers after the decimal place (.1 3)

*Therefore* you have to move the decimal place 3 places (1 + 2)

**Step 3:** Move the decimal point 3 places to the left in the result.

Answer: 36.468

When multiplying always count the number of decimal points that have been used in the calculation. Move the decimal point that many places to the left of the calculated answer.
Most of the time in engineering these calculations will be carried out on a calculator.

In engineering while multiplying decimals is not something that the apprentice will use often in their work, it remains a skill that is needed. The instance where the apprentice is most likely to use this skill is in checking their pay slip.

### Multiply the following numbers without using a calculator.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $1.25 \times 5$</td>
<td>b. $10.35 \times 5.36$</td>
<td>c. $0.985 \times 151.3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Now check your answers with a calculator.*

*Check your answers to this activity in the last section*
Multiplying decimals by 10, 100, 1000

Numbers without decimal points are whole numbers. The decimal point is always after the whole number. For example, 6 can be written 6.0

Check this with your calculator. It will always show a decimal point after every whole number (e.g. 6.)

To multiply

To multiply a decimal by 10, 100 or 1000 we need to look at the number of zeros in the multiplier and move the decimal point to the right by that many places.

\[ 6.23 \times 10 = 62.3 \]

In the calculation above there is one zero in the number 10 so the decimal point is moved one place to the right.

\[ 69.3653 \times 1000 = 69365.3 \]

In the calculation above there are three zeros in the number 1000 so the decimal point is moved three places to the right.

Sometimes there are not enough numbers to move the decimal point past so we need to add one or more zeros after the last number. When the zero is used in this way it does have a numerical value.

\[ 25.63 \times 1000 = 25630 \]
In the calculation above the decimal point had to move three places so one zero was required after the last number. Your calculator may also show a zero after the decimal point.

**Adding zeros**

Adding zeros to the end of a decimal number does not change its value.

For example, 3.5 can be written as 3.500 and it means the same.

In engineering, when a measurement is written this way it means that a higher level of accuracy is needed for any process within the task. For example, if measuring steel for a job, if the specifications (measurements) are written on the drawing to three decimal places, then the task requires you to make measurements equal to three decimal places.

Adding zeros to the front of a decimal does change its value.

Changing 0.3 to 0.03 decreases the value of the 3 by **ten** to one tenth of its original value.

Changing 0.3 to 0.003 decreases the value by **100** or one hundredth of its value.

**Remember**: for decimal numbers:

- Each movement of the decimal point to the left *decreases* the number by 10 times the value and each movement of the decimal point to the right *increases* the number by 10 times the value.
- The level of accuracy required may be different depending on the situation. The more decimal places the more accurate the answer must be.
Complete the following activities:

(The first line has been done for you.)

<table>
<thead>
<tr>
<th></th>
<th>X 10</th>
<th>X 100</th>
<th>X 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.62</td>
<td>6.2</td>
<td>62</td>
<td>620</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>73.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52.45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Answer these questions. (The first has been done for you.)

a. What happens to the decimal point when a number is multiplied by 10?

   It moves one place to the right

b. What happens to the decimal point when a number is multiplied by 100?

   

c. What happens to the decimal point when a number is multiplied by 1000?
Complete the following multiplications. You don’t need a calculator to do this.

a. 12.36 x 10 = 

b. 1.2 x 100 = 

c. 12.36 x 1000 = 

Check your answers to these activities in the last section
Dividing decimals

At ACSF level 2, the apprentice would be expected to perform simple division using decimals. That is, they should be able to divide a whole number (e.g. 4 by a simple decimal amount such as 0.5).

To perform division using decimals both as the divisor and/or the dividend is an ACSF numeracy level 3 skill. At this level the apprentice would be required to perform division by decimal values and long division using a calculator. However, in engineering it is important that the apprentice be able to perform these calculations without a calculator. This enables them to check the reasonableness of their answer on the calculator.

11.88 ÷ 36 without a calculator

**Step 1:** The divisor in this example is 36. The dividend is 11.88

```
36 1 1.88
```

**Step 2:** Divide the numbers as you would normally.

```
11.88 ÷ 36
```

<table>
<thead>
<tr>
<th>The calculation</th>
<th>The activity</th>
<th>What happens</th>
</tr>
</thead>
<tbody>
<tr>
<td>36 1 1.88</td>
<td>1 ÷ 36 = 0</td>
<td>The first digit of the dividend (1) is divided by the divisor.</td>
</tr>
</tbody>
</table>
| 0
36 1 1.88       |              | The whole number result is placed at the top. Any remainders are ignored at this point. |
<table>
<thead>
<tr>
<th>The Calculation</th>
<th>The activity</th>
<th>What happens</th>
</tr>
</thead>
</table>
| \[
\begin{array}{c}
36 \\
\underline{1 \text{.} 8 8}
\end{array}
\] | \[
\begin{array}{c}
0 \\
1 1
\end{array}
\] | \[
36 \times 0 = 0
\]
| The answer from the first operation is **multiplied** by the **divisor**. The result is placed under the number divided into. |
| \[
\begin{array}{c}
36 \\
\underline{1 \text{.} 8 8}
\end{array}
\] | \[
\begin{array}{c}
0 \\
1
\end{array}
\] | \[
1 - 0 = 1
\]
| Now we **subtract** the bottom number from the top number. |
| \[
\begin{array}{c}
36 \\
\underline{1 \text{.} 8 8}
\end{array}
\] | \[
\begin{array}{c}
0 \\
1
\end{array}
\] | \[
36 \\
\underline{1 \text{.} 8 8}
\] | \[
\begin{array}{c}
0 \\
1
\end{array}
\] | \[
11 - 0 = 1
\]
| Bring down the next digit of the dividend. |
| \[
\begin{array}{c}
36 \\
\underline{1 \text{.} 8 8}
\end{array}
\] | \[
\begin{array}{c}
0 \\
1
\end{array}
\] | \[
11 \div 36 = 0
\]
| The whole number result is placed at the top. Any remainders are ignored at this point. |
| \[
\begin{array}{c}
36 \\
\underline{1 \text{.} 8 8}
\end{array}
\] | \[
\begin{array}{c}
0 \\
1
\end{array}
\] | \[
36 \times 00 = 0
\]
| We can now **subtract** the bottom number from the top number. |
| \[
\begin{array}{c}
36 \\
\underline{1 \text{.} 8 8}
\end{array}
\] | \[
\begin{array}{c}
0 \\
1
\end{array}
\] | \[
36 \times 00 = 0
\]
| Bring down the next digit of the dividend. |
| \[
\begin{array}{c}
36 \\
\underline{1 \text{.} 8 8}
\end{array}
\] | \[
\begin{array}{c}
0 \\
1
\end{array}
\] | \[
118 \div 36 = 3 \text{ remainder}
\]
| **Divide** this number by the divisor. |
The Calculation | The activity | What happens
--- | --- | ---
36 \[ \begin{array}{c} \underline{36} \\ 0 \hline 1 1.88 \hline 0 \hline 118 \end{array} \] | \begin{array}{c} \underline{36} \\ 0 \hline 1 1.8 \hline 0 \hline 1 08 \end{array} | The whole number result is placed at the top. Any remainders are ignored at this point.

36 \[ \begin{array}{c} \underline{36} \\ 0 \hline 1 1.88 \hline 0 \hline 1 08 \end{array} \] | \begin{array}{c} \underline{36} \\ 0 \hline 1 1.8 \hline 0 \hline 1 08 \end{array} | \begin{array}{c} 36 \times 3 = 108 \\ 118 - 108 = 10 \end{array} \begin{array}{c} \underline{36} \\ 0 \hline 1 1.8 \hline 0 \hline 1 08 \end{array} | \begin{array}{c} \underline{36} \\ 0 \hline 1 1.8 \hline 0 \hline 1 08 \end{array} | \begin{array}{c} \underline{36} \\ 0 \hline 1 1.8 \hline 0 \hline 1 08 \end{array} | 108 \div 36 = 3 \begin{array}{c} \underline{36} \\ 0 \hline 1 1.8 \hline 0 \hline 1 08 \end{array} | The whole number result is placed at the top. Any remainders are ignored at this point.
The Calculation | The activity | What happens
---|---|---

| 36 | 0 | 3 | 3 |
|---|---|---|
| 1 | 1. | 8 | 8 |
| 0 | 1 | 1 | 8 |
| 1 | 0 | 8 |
| 1 | 0 | 8 |

36 x 3 = 108

The answer from the above operation is **multiplied** by the divisor. The result is placed under the last number divided into.

<table>
<thead>
<tr>
<th>36</th>
<th>0</th>
<th>0.</th>
<th>3</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

108 − 108 = 0

Now we **subtract** the bottom number from the top number.

**Step 3:** Put the decimal point in the quotient (answer) directly above the decimal point in the dividend.

36

| 0 | 0. | 3 | 3 |

Answer: 0.33

In engineering, most times you will do these calculations on a calculator. However, being able to calculate the answer without a calculator is a useful skill as it allows you to check that the answer on the calculator is correct.
**Example**

\[ \frac{10.332}{36} = \]

This can also be written as \[ 36 \overline{10.332} \]

Divide the numbers as you would normally.

\[
\begin{array}{c|ccccl}
 & 0 & 0 & 2 & 8 & 7 \\
\hline
3 & 6 & 1 & 0 & 3 & 2 \\
\hline
 & 1 & 0 & 3 \\
 & 7 & 2 \\
\hline
 & 3 & 1 & 3 \\
 & 2 & 8 & 8 \\
\hline
 & 2 & 5 & 2 \\
 & 2 & 5 & 2 \\
\hline
 & 0 \\
\end{array}
\]

**Answer:** 2.87

---

**Divide the following numbers without using your calculator:**

a. \[ \frac{1.25}{5} \]

\[
\begin{array}{c|c}
 & 0 \cdot 2 \\
\hline
5 & 1 \\
\hline
 & 2 \\
\hline
 & 0 \\
\end{array}
\]

b. \[ \frac{10.07}{5.3} = \]

\[
\begin{array}{c|ccccl}
 & 1 & 0 & 0 & 7 & \\
\hline
5 & 3 & 1 & 0 & 7 & 2 \\
\hline
 & 1 & 0 & 0 & 7 & \\
 & 1 & 0 & 0 & 7 \\
\hline
 & 1 & 0 & 0 & 7 \\
\end{array}
\]

**Answer:** 1.91
c. A fabricator normally works for 38.5 hours per week. In a particular week the fabricator has worked 11 hours overtime. All overtime is paid at 1.6 the normal hourly rate of $22.75. **How much extra** will the fabricator be paid for the overtime?

Now check your answers using your calculator.

**Check your answers to this activity in the last section**
Dividing decimals by 10, 100, 1000

To divide a decimal by 10, 100 or 1000, the decimal point moves to the left by the same number of zeros.

\[
\begin{align*}
36.2 \div 10 &= 3.62 \\
69.23 \div 1000 &= 0.06923
\end{align*}
\]

Note: A zero was added to the front to allow the 3 spaces

At times there are not enough numbers to move the decimal point past so we need to add one or more zeros in front of the first number. This time your calculator would show a zero in front of the decimal point as well as adding one after the decimal point.

Complete the following divisions.

\[
\begin{align*}
a. \quad 12.3 \div 10 &= \phantom{0000} \\
b. \quad 1265.36 \div 100 &= \phantom{0000} \\
c. \quad 12.36 \div 1000 &= \phantom{0000}
\end{align*}
\]

Check your answers to this activity in the last section
**Rounding a decimal**

An answer displayed on a calculator can have many numbers after the decimal point. The more numbers after the decimal point the more accurate the final answer is.

5.284769213

In manufacturing different projects can need different levels of measurement accuracy.

When basic materials such as bar stock or sheet metal are discussed it will be in metres or millimetres.

<table>
<thead>
<tr>
<th>Round steel</th>
<th>Sheet metal</th>
<th>General manufacture</th>
<th>Fine machining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length - metres</td>
<td>Length - metres</td>
<td>Fabrication - mm</td>
<td>Fine machining – mm (thousands and 10 thousands)</td>
</tr>
<tr>
<td>Diameter - mm</td>
<td>Width - metres</td>
<td>Machining – mm (hundredths) E.g. 3.24 or 1.76 etc.</td>
<td>E.g. 4.563 or 2.4984</td>
</tr>
</tbody>
</table>

Sometimes decimal numbers can be very long and these types of accuracies are not needed. To work out where to stop depends on the accuracy required. With the big number above if we only needed three decimal places we could simply stop at three – 5.284. But, if we look closely the fourth number is a 7 which means the third decimal (4) place is closer to a 5 than a 4. Therefore for better accuracy we can write the number as 5.285. Increasing any decimal number like this is called **ROUNDING UP**.

If the number after the decimal place you want is 5 or more, the number you want is taken up to the next number.
To round this number to two decimal places 6.346

**Step 1:** Find the second number after the decimal point 6.346
**Step 2:** Look at the next number 6.346
This is a 6 so we round the previous number up by 1 to 5.

**Answer:** 6.35

To round this number to three decimal places 6.326474

**Step 1:** Find the third number after the decimal point 6.326474
**Step 2:** Look at the next number 6.326474
This is a 4 so we leave the previous number the same.

**Answer:** 6.326

The same principle is applied when rounding to any number of decimal places.

**Warning** - You should only round up the final answer. Continual rounding up during a calculation can produce a significant error.

10.
a. Round to 1 decimal place.

a. 1.32658 = __________  
b. 1.5536 = __________  
c. 1.999 = __________
b. Round to 2 decimal places.

a. \(2.3336 = \) __________ \\
b. \(36.306 = \) __________ \\
c. \(2.3626 = \) __________ \\

c. Round to 3 decimal places.

a. \(2.3012547 = \) __________ \\
b. \(235.032159 = \) _______ \\
c. \(3.141592 = \) __________ \\

*Check your answers to this activity in the last section*
Answers to activities

1. a. Individual student answer
   b. \(a \times 136.9 = \ldots \ldots \ldots \ldots \)

2. Addition
   a. 3.724
   b. 1.76
   c. 1259.32

3. Subtraction
   a. 0.64
   b. 3.062
   c. 247.931

4. a. 
   
   \[
   \begin{array}{c}
   125 \\
   \hline
   5 \\
   \hline
   625
   \end{array}
   \]
   b. 
   
   \[
   \begin{array}{c}
   1035 \\
   \hline
   536 \\
   \hline
   6210
   \end{array}
   \]
   c. 
   
   \[
   \begin{array}{c}
   985 \\
   \hline
   1513 \\
   \hline
   7565
   \end{array}
   \]

   two decimals to right so answer is 6.25

   Four decimals to right in both number so answer is 55.476

   Four decimals to right in both number so answer is 149.0305
### Putting the Jigsaw Together

#### Working with Decimals

<table>
<thead>
<tr>
<th></th>
<th>X 10</th>
<th>X 100</th>
<th>X 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.62</td>
<td>6.2</td>
<td>62</td>
<td>620</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>600</td>
<td>6000</td>
</tr>
<tr>
<td>17</td>
<td>170</td>
<td>1700</td>
<td>17000</td>
</tr>
<tr>
<td>73.8</td>
<td>738</td>
<td>7380</td>
<td>73800</td>
</tr>
<tr>
<td>4.56</td>
<td>45.6</td>
<td>456</td>
<td>4560</td>
</tr>
<tr>
<td>52.45</td>
<td>524.5</td>
<td>5245</td>
<td>52450</td>
</tr>
</tbody>
</table>

#### 6

a. *It moves one place to the right*

b. It moves two places to the right

c. It moves three places to the right

#### 7

a. 123.6  
b. 120    
c. 12360
a. 1.9

Put the decimal point in the quotient directly above the decimal point in the dividend.

Answer: 1.9

b. 4

Put the decimal point in the quotient directly above the decimal point in the dividend.

Answer: 4

c. $\frac{22.75}{0.6} = 37.92$  
$\frac{13.65}{1} = 13.65$

d. $\frac{2400}{202} = 11.88$  
$\frac{1188}{100} = 11.88$  
Answer = 11

9

a. 1.23  
b. 12.6536  
c. 0.1236

10

A. Round to 1 decimal place
   a. 1.3  
b. 1.6  
c. 2.0

B. Round to 2 decimal places
   a. 2.33  
b. 36.31  
c. 2.36

C. Round to 3 decimal places
   a. 2.301  
b. 235.032  
c. 3.142