Essential Skills - Numeracy for Construction

ES LEVEL 1 RESOURCES FOR CONSTRUCTION STUDENTS - APRIL 2010
Acknowledgements
We would like to thank Construction Skills in Northern Ireland who had this resource published. We also acknowledge our colleagues in the construction departments of South Eastern Regional College and South West College for their advice in our research prior to preparing this resource. We have also benefited from the expertise of many friends within the industry.

Aims
It is intended that these vocationally contextualised resources will support Essential Skills Numeracy tutors in their efforts to make programmes for construction students vocationally relevant.

This resource should be used in the context of appropriately planned and structured Essential Skills programmes and should be used and adapted appropriately within that context.

Guidance for Using Resource
It is not intended that these materials should be used as a fixed programme of learning but as a resource which tutors can use to aid them in the planning and delivery of programmes suited to the needs of their particular groups of learners. It is envisaged that tutors will bring their own ideas to these materials and extend and enhance them in order to keep activities refreshed and dynamic for learners.

Essential Skills tutors should ensure that they read and understand the following publication before they develop programmes: ESSENTIAL SKILLS GOOD PRACTICE: THE ASSESSMENT PROCESS. DEL NI, July 2007.

All information on this page is current and up to date at the time of printing (April 2010).

Authors: Paula Philpott and William Smyth.
Essential Skills Numeracy for Construction Students

To qualify in construction at NVQ level 2 you will need Level 1 in Essential Skills Numeracy.

At Level 1 you will need to do a project on a subject you are interested in and you will take an exam at the end of your course.

This booklet will help you practice the skills you will need to achieve your level 1 in Numeracy.

When you see this symbol you may use a calculator to answer the question.
## CONTENTS

### NUMBER

<table>
<thead>
<tr>
<th>TASK NUMBER</th>
<th>PAGE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PLACE VALUE</td>
</tr>
<tr>
<td>2</td>
<td>ADDITION AND SUBTRACTION</td>
</tr>
<tr>
<td>3</td>
<td>PAY</td>
</tr>
<tr>
<td>4</td>
<td>MULTIPLICATION AND DIVISION</td>
</tr>
<tr>
<td>5</td>
<td>BUYING A VAN</td>
</tr>
<tr>
<td>6</td>
<td>JOBS IN CONSTRUCTION</td>
</tr>
<tr>
<td>7</td>
<td>CALCULATIONS</td>
</tr>
<tr>
<td>8</td>
<td>NEGATIVE NUMBERS</td>
</tr>
<tr>
<td>9</td>
<td>FINANCE</td>
</tr>
</tbody>
</table>

Answer Section 38

### MEASURE, SHAPE AND SPACE

<table>
<thead>
<tr>
<th>TASK NUMBER</th>
<th>PAGE NUMBER</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>TIME</td>
</tr>
<tr>
<td>2</td>
<td>MEASURING</td>
</tr>
<tr>
<td>3</td>
<td>CONVERTING BETWEEN METRIC UNITS OF MEASURE</td>
</tr>
<tr>
<td>4</td>
<td>SITE PLANS</td>
</tr>
<tr>
<td>5</td>
<td>MATERIALS</td>
</tr>
<tr>
<td>6</td>
<td>PERIMETER</td>
</tr>
<tr>
<td>7</td>
<td>AREA</td>
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<td>8</td>
<td>PLANS</td>
</tr>
<tr>
<td>9</td>
<td>LAYING A CONCRETE DRIVEWAY</td>
</tr>
<tr>
<td>10</td>
<td>ERECTING A SHED</td>
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<tr>
<td>11</td>
<td>BRICK WALL</td>
</tr>
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<td>MAPS</td>
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<td>13</td>
<td>RENOVATION</td>
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</table>

Answer Section 110
HANDLING DATA

<table>
<thead>
<tr>
<th>TASK NUMBER</th>
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<tbody>
<tr>
<td>1 THE CONSTRUCTION INDUSTRY</td>
<td>152</td>
</tr>
<tr>
<td>2 THE WORKFORCE</td>
<td>156</td>
</tr>
<tr>
<td>3 AVERAGES AND RANGE</td>
<td>159</td>
</tr>
<tr>
<td>4 THE BUILDING TRADE</td>
<td>165</td>
</tr>
<tr>
<td>5 CONSTRUCTION MACHINERY</td>
<td>168</td>
</tr>
<tr>
<td>6 CHANCES ARE...</td>
<td>172</td>
</tr>
<tr>
<td>7 HEALTH AND SAFETY</td>
<td>175</td>
</tr>
</tbody>
</table>

Answer Section 178

USEFUL WEBSITES

<table>
<thead>
<tr>
<th>USEFUL WEBSITES</th>
<th>PAGE NUMBER</th>
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<tbody>
<tr>
<td>USEFUL WEBSITES</td>
<td>205</td>
</tr>
</tbody>
</table>
Number

Tasks and Answers

This section mainly addresses the curriculum area specified, although to allow a more realistic setting for each task, some elements from other curriculum areas may also mentioned. Decimals are addressed in more detail through the section on measurement.
NUMBER TASK 1

PLACE VALUE

Below you will see figures for the construction industry. They are taken from NISRA – Northern Ireland Statistics and Research Agency. The statistics relate to local firms and their turnover. Look at the data and answer the questions below.

In the construction industry in Northern Ireland there are hundreds of thousands of people employed in different jobs and in your job you will be required to work with large numbers for example weights of material, costings for jobs, etc. Therefore it is important that you understand numbers and can work with them.

From the table above you can see that there were 11,015 construction firms in Northern Ireland at the time of the survey.

The number 11,015 has:

<table>
<thead>
<tr>
<th>TEN THOUSAND</th>
<th>THOUSAND</th>
<th>HUNDREDS</th>
<th>TEN</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

When reading large numbers break them into groups of three (starting at the units end). Sometimes these groups of three digits are separated using commas.
1. Complete the table below the first one is completed for you.

<table>
<thead>
<tr>
<th>Millions</th>
<th>Hundred thousands</th>
<th>Ten thousands</th>
<th>Thousand</th>
<th>Hundred</th>
<th>Tens</th>
<th>Units</th>
</tr>
</thead>
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<tr>
<td>2 303 105</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>32 015</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>19 206</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Using the table below answer the questions

<table>
<thead>
<tr>
<th>Turnover (£000) Size Band</th>
<th>Number of Firms</th>
<th>Per Cent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 99</td>
<td>4,430</td>
<td>40%</td>
</tr>
<tr>
<td>100 – 499</td>
<td>4,705</td>
<td>43%</td>
</tr>
<tr>
<td>500 – 1,999</td>
<td>1,345</td>
<td>12%</td>
</tr>
<tr>
<td>2,000 – 4,999</td>
<td>325</td>
<td>3%</td>
</tr>
<tr>
<td>5,000 – 9,999</td>
<td>115</td>
<td>1%</td>
</tr>
<tr>
<td>10,000 +</td>
<td>95</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11,015</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: NISRA – NI Construction Bulletin 1st April to 30th June (Nov 2008)

a. 4,430 firms had a turnover from £0-£99,000. How many firms is this in words?

b. What is the turnover of £99,000 in words?

c. Most construction firms in Northern Ireland have a turnover between £100,000 and £499,000. What is this in words?

3. What do the figures in the table tell you about the construction industry in Northern Ireland?
NUMBER TASK 2

ADDITION AND SUBTRACTION

When costing up a job you will need to be able to add, subtract, multiply and divide. You will have to be able to find a rough estimate and then provide a detailed breakdown of all costs including taxes. If you have others working for you this will mean calculating their wages and keeping accurate records of turnover.

When ordering in materials you will need to ensure that the quantities have been correctly calculated.

Addition
If the numbers are too big to add in your head, write them down in columns. Separate the numbers into units, tens, hundreds and thousands. Always start adding with the units first.

Example
3256 + 275

<table>
<thead>
<tr>
<th>Th</th>
<th>H</th>
<th>T</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Start at the unit column first. If the total is more than 10, carry 1 to the next column.

1. From the table above what is the total number of construction firms with a turnover under £500,000?

2. How many firms have a turnover of £2,000,000 or more?
NUMBER TASK 2

Subtraction
Again line up the numbers so that you subtract units from units, tens from tens etc... Always start subtracting with the units first.

\[
\begin{array}{cccc}
\text{Th} & \text{H} & \text{T} & \text{U} \\
2 & 5 & 6 & 7 \\
1 & 4 & 2 & 5 \\
\hline
1 & 1 & 4 & 2 \\
\end{array}
\]

There are different methods you can use to subtract. Look at the examples below and use the method that is most familiar to you.

Example 1
Start with the units

Start at the unit column first. If the total is more than 10, carry 1 to the next column.

\[
\begin{array}{cccc}
\text{Th} & \text{H} & \text{T} & \text{U} \\
12 & 15 & 6 & 7 \\
1 & 9 & 2 & 7 \\
\hline
6 & 4 & 0 \\
\end{array}
\]

Example 2
Start with the units

You cannot subtract 9 from 5. You will need to borrow 1 from the thousands column to make 15 and pay this back by adding 1 to the thousands column of the number you are subtracting. It becomes 2.
Use whichever method is most familiar to you to answer these questions.

3. A construction company employs 111 men and 27 women. How many more men than women does it employ?

4. A high visibility jacket costs £17.05 and £13.67 from two different suppliers. What is the difference in price?
In the last task we saw how important it is that you can accurately add and subtract.

James works for McLaughlin Builders below and has received his latest payslip. He is worried that the pay is incorrect. Look at the payslip below and answer the questions given.

James is a site manager for a manufacturing firm. His last payslip was:

**McLaughlin Builders**

Randalstown

**Employee name:** James Greeves

<table>
<thead>
<tr>
<th>Payments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic pay</td>
<td>£3026.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deductions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax paid</td>
<td>£497.86</td>
</tr>
<tr>
<td>Employee’s NI Paid</td>
<td>£256.38</td>
</tr>
</tbody>
</table>

**Employee Number:** 25

**Pay date:** 31/5/09

<table>
<thead>
<tr>
<th>Tax code</th>
<th>01 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax code</td>
<td>355 L</td>
</tr>
<tr>
<td>NI Number</td>
<td>NR674590A</td>
</tr>
<tr>
<td>NI Code</td>
<td>D</td>
</tr>
</tbody>
</table>

**NET PAY:** ?????
James has been checking his pay and thinks that it has been incorrectly calculated. He thinks his net pay (the remaining amount of an employee’s gross pay after deductions such as income tax and national insurance are made) should be £1,372.01. His brother Jason and his wife Amy also check to see what they calculate his net pay should be. Their calculations are shown below:

Look at the calculations they have made.

- Who do you think has calculated the net pay correctly and why?
- Who has calculated it incorrectly and what mistake/s did they make?

Fill your answers in the table below:

<table>
<thead>
<tr>
<th></th>
<th>Delete as appropriate</th>
<th>Reason (e.g. what mistake did they make)</th>
</tr>
</thead>
<tbody>
<tr>
<td>James</td>
<td>Correct / incorrect</td>
<td></td>
</tr>
<tr>
<td>Jason</td>
<td>Correct / incorrect</td>
<td></td>
</tr>
<tr>
<td>Amy</td>
<td>Correct / incorrect</td>
<td></td>
</tr>
</tbody>
</table>
When ordering materials for McLaughlin Builders, James has been double checking his calculations to make sure he orders in the correct quantities. He needs to be able to multiply and divide numbers accurately. The methods used are shown below.

You will need to know your multiplication tables to help you work out multiplication and division problems.

<table>
<thead>
<tr>
<th>×</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>10</th>
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<tbody>
<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>6</td>
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<td>10</td>
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<td>54</td>
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<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
</tr>
</tbody>
</table>
NUMBER TASK 4

Multiplication

Example 2

Start with the units

\[
\begin{array}{c}
\times \\
4 \\
6
\end{array}
\]

Start with the units, 8 x 6 + 48. Put 8 in the units column and carry the 4. When you multiply the tens column 4 x 6 = 24, don’t forget to add the 4 you carried to get 24 + 4 + 28.

1. If you need to buy two pairs of safety boots at £29.92, how much will the total cost be?

Estimate your answer first. £29.92 is approximately £30. 2 pairs of boots at £30 would cost £60. Now calculate the actual cost and see if your answer seems reasonable.

Example

A 1kg box of galvanised nails costs £2.43. You need to buy 12 boxes. How much will this come to?

\[
\begin{array}{c}
\times \\
2 \\
4 \\
3
\end{array}
\]

Start by multiplying by the 2.

3 x 2 + 6, then 4 x 2 = 8, then 2 x 2 = 4

This gives the first row of the table.

Next you will multiply the one in the tens column. Put 0 in the units column because you are multiplying tens. Then multiply by 1.

Add them together 4.86 + 24.30 to get £29.16

2. If a site joiner earns £9.25 an hour. How much does he earn for 11 hours work?
Division

If the numbers are too difficult to divide in your head, use a written method. The example below shows you how.

Example
Hard hats cost £9.69 for three. How much does one cost?

- Divide the 9 by the 3 first to get 3. Write this above the 9.
- Divide the 6 by the 3 next to get 2. Write this above the 6.
- Divide the second 9 by the 3 next to get 3. Write this above the second 9.

A hard hat will cost £3.23.

3. A length of wood measuring 2450mm, is cut into 5 equal lengths. How long is each piece of wood?

4. A bill of £1840 is paid in 8 equal payments. How much is each payment?
1. Arrange the list of vans above in order of increasing Straight Deal price.

<table>
<thead>
<tr>
<th>Make/Model/Year</th>
<th>Price (£)</th>
<th>Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 Ford Transit</td>
<td>7595</td>
<td>12635</td>
</tr>
<tr>
<td>2008 Renault Master</td>
<td>7825</td>
<td>31506</td>
</tr>
<tr>
<td>2006 Peugeot Boxer</td>
<td>4995</td>
<td>24382</td>
</tr>
<tr>
<td>2009 Iveco Daily</td>
<td>9475</td>
<td>1465</td>
</tr>
<tr>
<td>2006 Mercedes Sprinter</td>
<td>6995</td>
<td>31056</td>
</tr>
</tbody>
</table>

2. Arrange the list of vans in order of decreasing mileage.

<table>
<thead>
<tr>
<th>Make/Model/Year</th>
<th>Price (£)</th>
<th>Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 Ford Transit</td>
<td>7595</td>
<td>12635</td>
</tr>
<tr>
<td>2008 Renault Master</td>
<td>7825</td>
<td>31506</td>
</tr>
<tr>
<td>2006 Peugeot Boxer</td>
<td>4995</td>
<td>24382</td>
</tr>
<tr>
<td>2009 Iveco Daily</td>
<td>9475</td>
<td>1465</td>
</tr>
<tr>
<td>2006 Mercedes Sprinter</td>
<td>6995</td>
<td>31056</td>
</tr>
</tbody>
</table>

After some consideration John decides to trade in his current van against the 2008 Renault Master. The dealer offers him £1250 for his old Nissan van.
3. Complete the cheque below with the balance John needs to pay.

John later decides to take advantage of an offer of extended warranty which includes free servicing. This is available at a cost of 5% of the Straight Deal price of the Renault van. Calculate the new total he must pay and complete the cheque below giving your answer to the nearest pound. You are given some steps involved in the calculation to help you.

4. What is 10% of the Straight Deal price in pounds and pence?

5. What is 5% of the Straight deal price in pounds and pence? Use the answer above to help you.
6. Round this amount to the nearest pound.

7. Now calculate the new total amount he must pay for the van and the extended warranty and complete the cheque below.
JOBS IN CONSTRUCTION

There are various jobs associated with construction and as your career develops there will be opportunities to earn more. Have a look at the jobs being advertised below and the salaries associated with them. Consider how your salary may change as you gain new qualifications and skills.

Job A: Apprentice bricklayer

1. The company offer to pay time and a half for any overtime you do. What would the hourly rate be for overtime?

2. If you work 40 hours a week what will your weekly salary be?
NUMBER TASK 6

3. If you work 45 hours one week what would you earn?

Job B: Qualified bricklayer

4. What will the weekly salary be?
6. If you got Job A what would your annual salary be for a 40 hour week for 52 weeks? (Use your answer to question 2 where you worked out the weekly salary.)

7. How much more would a qualified bricklayer earn in Job B per year?
8. What is the range in the salary for this job?
9. The successful candidate for this post was given a salary of £27,300. How much does this work out at per month?

Monthly salary =

10. For the annual salary of £27,300 how much will the successful candidate earn per week? Remember there are 52 weeks in a year.

11. If the successful candidate is offered a 10% pay rise at the end of the first year, how much will their annual salary be?

To find 10% of the salary, divide the total salary by 10.

10% pay rise =

Annual salary =
NUMERICAL TASK 7

CALCULATIONS

When you price up a job you will need to consider materials, labour and taxes. Calculations will need to be accurate to ensure that the business operates efficiently and your good reputation is maintained. Over ordering materials will add to your costs and reduce your profits, so it is important to work accurately and check quantities carefully.

Decking

EXAMPLE: To calculate how much decking you need for a deck measuring 4m x 3m, use the table below:
Table showing the number of metres of 144mm deck boards required

<table>
<thead>
<tr>
<th>METRES</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<td>1</td>
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</tr>
<tr>
<td>6</td>
<td>42</td>
<td>84</td>
<td>126</td>
<td>168</td>
<td>210</td>
<td>252</td>
</tr>
</tbody>
</table>

From the table above you can see that a deck measuring 4m x 3m you will need 84m of 144mm wide deck board.

If the deck boards you want come in 2.4m lengths, divide 84 by 2.4 = 35. You should buy 35 boards.

The cost of each length of board in B & Q is shown below:

To calculate the total cost of the decking boards using a calculator, the sum is:

35 × £4.46 =
1. The answer on the screen is: 156.1. What does this mean the total cost of the decking is?

2. Using the table below find the number of metres of deck board needed for a decked area measuring 5m by 6m.

Table showing the number of metres of 144mm deck boards required

<table>
<thead>
<tr>
<th>METRES</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>14</td>
<td>21</td>
<td>28</td>
<td>35</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>28</td>
<td>42</td>
<td>56</td>
<td>70</td>
<td>84</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>42</td>
<td>63</td>
<td>84</td>
<td>105</td>
<td>126</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>56</td>
<td>84</td>
<td>112</td>
<td>140</td>
<td>168</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>70</td>
<td>105</td>
<td>140</td>
<td>175</td>
<td>210</td>
</tr>
<tr>
<td>6</td>
<td>42</td>
<td>84</td>
<td>126</td>
<td>168</td>
<td>210</td>
<td>252</td>
</tr>
</tbody>
</table>

Number of metres of deck board required is.....
3. The deck boards you want come in 2.4m lengths. How many lengths of deck board will you need?

Be careful how you round your answer.

4. If each length of deck board costs £4.46, what is the total cost of the deck board?

Total cost
Paul is on his way home after a job. He is already thinking of work tomorrow and about getting tiles. He worked out earlier he needs just under 600 tiles for the next job. A slight detour on the way home would take him past the tile warehouse but as he has no trailer with him he could only fit one pallet in the van. If he needs more than one pallet he will leave it until tomorrow when he could call back with the trailer. It would save quite a bit of time if he could get the tiles today.

He knows from experience that the tiles he needs come in boxes with 4 tiles per box and that the boxes are stacked on the pallet in layers. Each layer has 5 by 6 boxes and there are 6 layers altogether. Paul is trying to work out in his head if this amounts to more than 600 tiles. He knows the calculation he needs to do is $4 \times 5 \times 6 \times 6$.

5. Can you think of a way to answer his question without having to do the calculation in full?

Is $4 \times 5 \times 6 \times 6$ more than 600?

Will he call for the tiles on his way home? Please explain your reasoning.
NEGATIVE NUMBERS

Negative numbers are numbers to the left (or below) zero on a number line. The use of negative numbers in construction is generally related to temperature, finances, height above/below sea level in surveying, direction of rotation e.g., clockwise or anticlockwise or the direction of forces that act in beams, columns, frames etc. You will need to be able work with negative numbers accurately.

In the Celsius temperature scale 0°C represents the freezing point of water. Be careful, it does not mean there is no heat energy present. It just means there isn’t enough heat present for water to exist in liquid form so it freezes. A negative value on the Celsius scale indicates a temperature lower than 0°C where there is less heat energy present and so it feels colder.

1. In the space below construct a temperature scale (a number line) that extends from -5°C to 5°C in steps on 1°C. Use your ruler and work to a scale of 1cm for 1°C. Mark the temperatures -4°C and 2°C
2. In the space below identify the temperatures marked on the scale.

3. If the answers above referred to external temperatures on a cold evening indicate which one is most likely to result in burst water pipes in a building if the heating was off.
Ambient temperature is very important when laying asphalt. According to relevant British Standards the asphalt itself should be at 85°C but the ambient temperature should be no less than -3°C.

Janine has been checking temperatures over a period of two weeks and here are her results.

<table>
<thead>
<tr>
<th>December</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14</td>
</tr>
<tr>
<td>Temp</td>
<td>6 4 6 -5 -3 2 7 1 2 4 5</td>
</tr>
</tbody>
</table>

4. Values for 4th, 6th and 12th December are not shown in the table. The images below show the temperatures for these dates. Make each temperature reading and record the result in the table.
5. Using the graph below plot the remaining points. Join the points using a straight edge to produce a line graph showing how the temperature varied over the two-week period.

6. What was the highest temperature recorded and on which date did this occur?

Highest temperature:

Date:

7. What was the lowest temperature recorded and on which date did this occur?

Lowest temperature:

Date:
8. What is the range of temperature during the second week in December?

9. On 4th December the temperature was -2°C. By the next day it had fallen to -5°C. Use the image below to work out by how many degrees the temperature changed?
Janine wants to work out the average temperature in the second week of December. To calculate the mean she has to add up all the temperatures for that week and divide the total by 7.

10. Janine’s answer is 3.5°C. Her colleague Brendan says that the answer should be 3°C. Who is correct?

Show how you calculated your answer in the space below.

Write the sum of the temperatures here, Total =

Mean temperature = Total ÷ 7 =

Who is correct?

11. On how many days during the two-week period could asphalt not have been laid?
Below is a bank statement for a construction engineering consultancy for the month of April 2009. The consultant wants to check the figures in the statement and this means he will need to look at withdrawals and lodgements on the account. He wants to know whether his account is in credit or debit and if the bank’s calculations are correct.

### Northern Regional Bank
Nicer Branch
Broad St
Lisburn
Co Antrim
Tel: 02890909090

### Statement of Account
Sort: 09-59-01
A/C 555362744
Date 12.04.09

<table>
<thead>
<tr>
<th>Date</th>
<th>Details</th>
<th>Debits</th>
<th>Credits</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Apr</td>
<td>Opening Balance</td>
<td></td>
<td></td>
<td>996.87</td>
</tr>
<tr>
<td>03 Apr</td>
<td>Standing order 001</td>
<td>288.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>04 Apr</td>
<td>Cheque 234016</td>
<td></td>
<td>174.45</td>
<td></td>
</tr>
<tr>
<td>08 Apr</td>
<td>Cash paid in</td>
<td></td>
<td>372.00</td>
<td></td>
</tr>
<tr>
<td>09 Apr</td>
<td>Cheque 234017</td>
<td>277.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Apr</td>
<td>Cheques paid in</td>
<td></td>
<td></td>
<td>540.50</td>
</tr>
<tr>
<td>15 Apr</td>
<td>Standing order 002</td>
<td>569.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Apr</td>
<td>Cash paid in</td>
<td></td>
<td></td>
<td>340.18</td>
</tr>
<tr>
<td>21 Apr</td>
<td>Cheques for salary</td>
<td>840.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 Apr</td>
<td>Cash paid in</td>
<td></td>
<td>540.34</td>
<td></td>
</tr>
<tr>
<td>26 Apr</td>
<td>Cheque paid in</td>
<td></td>
<td></td>
<td>2277.45</td>
</tr>
<tr>
<td>29 Apr</td>
<td>Cash paid in</td>
<td></td>
<td></td>
<td>2480.32</td>
</tr>
<tr>
<td>30 Apr</td>
<td>Closing Balance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Essential Skills - Numeracy for Construction
NUMBER TASK 9

1. Fill in the balance column as far as 29th April. The balance on 29th April should be £5397.65, allowing you to check your answer. Use the space below as well if you need to.

2. On which day was the account at its lowest point and how much did he have in the bank on that date?

   Date:

   Balance:

3. A cheque of £6000 for salaries is withdrawn from the account on 30th April taking the account to -£639.31. What does the negative sign mean?
NUMBER ANSWERS - TASK 1

PLACE VALUE

Below you will see figures for the construction industry. They are taken from NISRA – Northern Ireland Statistics and Research Agency. The statistics relate to local firms and their turnover. Look at the data and answer the questions below.

In the construction industry in Northern Ireland there are hundreds of thousands of people employed in different jobs and in your job you will be required to work with large numbers for example weights of material, costings for jobs, etc. Therefore it is important that you understand numbers and can work with them.

From the table above you can see that there were 11,015 construction firms in Northern Ireland at the time of the survey.

The number 11,015 has:

<table>
<thead>
<tr>
<th>TEN THOUSAND</th>
<th>THOUSAND</th>
<th>HUNDREDS</th>
<th>TEN</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

When reading large numbers break them into groups of three (starting at the units end). Sometimes these groups of three digits are separated using commas.
1. Complete the table below the first one is completed for you.

<table>
<thead>
<tr>
<th></th>
<th>Millions</th>
<th>Hundred thousands</th>
<th>Ten thousands</th>
<th>Thousand</th>
<th>Hundred</th>
<th>Tens</th>
<th>Units</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2 303 105</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>Two million, three hundred and three thousand, one hundred and five</td>
</tr>
<tr>
<td>32 015</td>
<td></td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td></td>
<td>Thirty two thousand and fifteen</td>
</tr>
<tr>
<td>106 045</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td></td>
<td>One hundred and six thousand and forty five</td>
</tr>
<tr>
<td>30 210</td>
<td></td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td></td>
<td>Thirty thousand two hundred and ten</td>
</tr>
<tr>
<td>1 000 025</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>One million and twenty five</td>
</tr>
<tr>
<td>19 206</td>
<td></td>
<td>1</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td></td>
<td>Nineteen thousand, two hundred and six</td>
</tr>
<tr>
<td>45 012</td>
<td></td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td></td>
<td>Forty five thousand and twelve</td>
</tr>
</tbody>
</table>
NUMBER ANSWERS - TASK 1

2. Using the table below answer the questions

<table>
<thead>
<tr>
<th>Turnover (£000) Size Band</th>
<th>Number of Firms</th>
<th>Per Cent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 99</td>
<td>4,430</td>
<td>40%</td>
</tr>
<tr>
<td>100 – 499</td>
<td>4,705</td>
<td>43%</td>
</tr>
<tr>
<td>500 – 1,999</td>
<td>1,345</td>
<td>12%</td>
</tr>
<tr>
<td>2,000 – 4,999</td>
<td>325</td>
<td>3%</td>
</tr>
<tr>
<td>5,000 – 9,999</td>
<td>115</td>
<td>1%</td>
</tr>
<tr>
<td>10,000 +</td>
<td>95</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>11,015</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: NISRA – NI Construction Bulletin 1st April to 30th June (Nov 2008)

a. 4,430 firms had a turnover from £0-£99,000. How many firms is this in words?

Four thousand four hundred and thirty

b. What is the turnover of £99,000 in words?

Ninety nine thousand pounds

c. Most construction firms in Northern Ireland have a turnover between £100,000 and £499,000. What is this in words?

£100,000 One hundred thousand pounds

£499,000 Four hundred and ninety nine thousand pounds

3. What do the figures in the table tell you about the construction industry in Northern Ireland?

Most construction companies in Northern Ireland have a small turnover.
1. From the table above what is the total number of construction firms with a turnover under £500,000?

4430 + 4705 = 9135

2. How many firms have a turnover of £2,000,000 or more?

325 + 115 + 95 = 535
Subtraction
Again line up the numbers so that you subtract units from units, tens from tens etc... Always start subtracting with the units first.

<table>
<thead>
<tr>
<th>Th</th>
<th>H</th>
<th>T</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are different methods you can use to subtract. Look at the examples below and use the method that is most familiar to you.

Example 1
Start with the units

Start at the unit column first. If the total is more than 10, carry 1 to the next column.

<table>
<thead>
<tr>
<th>Th</th>
<th>H</th>
<th>T</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Example 2
Start with the units

You cannot subtract 9 from 5. You will need to borrow 1 from the thousands column to make 15 and pay this back by adding 1 to the thousands column of the number you are subtracting. It becomes 2.
Use whichever method is most familiar to you to answer these questions.

3. A construction company employs 111 men and 27 women. How many more men than women does it employ?

   111 - 27 = 84

4. A high visibility jacket costs £17.05 and £13.67 from two different suppliers. What is the difference in price?

   £17.05 - £13.67 = £3.38
PAY

In the last task we saw how important it is that you can accurately add and subtract.

James works for McLaughlin Builders below and has received his latest payslip. He is worried that the pay is incorrect. Look at the payslip below and answer the questions given.

James is a site manager for a manufacturing firm. His last payslip was:

**McLaughlin Builders**  
Randalstown

Employee name: James Greeves

<table>
<thead>
<tr>
<th>Payments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic pay</td>
<td>£3026.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deductions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax paid</td>
<td>£497.86</td>
</tr>
<tr>
<td>Employee’s NI Paid</td>
<td>£256.38</td>
</tr>
</tbody>
</table>

Employee Number: 25  
Pay date: 31/5/09

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax code</td>
<td>01 2010</td>
</tr>
<tr>
<td>Tax code</td>
<td>355 L</td>
</tr>
<tr>
<td>NI Number</td>
<td>NR674590A</td>
</tr>
<tr>
<td>NI Code</td>
<td>D</td>
</tr>
</tbody>
</table>

NET PAY: ?????
NUMBER ANSWERS - TASK 3

James has been checking his pay and thinks that it has been incorrectly calculated. He thinks his net pay (the remaining amount of an employee’s gross pay after deductions such as income tax and national insurance are made) should be £1,372.01. His brother Jason and his wife Amy also check to see what they calculate his net pay should be. Their calculations are shown below:

Look at the calculations they have made.

- Who do you think has calculated the net pay correctly and why?
- Who has calculated it incorrectly and what mistake/s did they make?

Fill your answers in the table below:

<table>
<thead>
<tr>
<th></th>
<th>Delete as appropriate</th>
<th>Reason (e.g. what mistake did they make)</th>
</tr>
</thead>
<tbody>
<tr>
<td>James</td>
<td>Correct / incorrect</td>
<td>James has added the deductions together correctly but he made a mistake when he subtracted this from the gross pay.</td>
</tr>
<tr>
<td>Jason</td>
<td>Correct / incorrect</td>
<td>Jason added the deductions together corrected and subtracted this total correctly from the gross pay.</td>
</tr>
<tr>
<td>Amy</td>
<td>Correct / incorrect</td>
<td>Amy subtracts incorrectly – she simply takes the smallest digit from the largest in each column. Here she starts off taking 5 from 6 instead of realising it is 5-6 and then borrowing from the tens column and continues with this method throughout.</td>
</tr>
</tbody>
</table>
NUMBER ANSWERS - TASK 4

MULTIPLICATION AND DIVISION

When ordering materials for McLaughlin Builders, James has been double checking his calculations to make sure he orders in the correct quantities. He needs to be able to multiply and divide numbers accurately. The methods used are shown below.

You will need to know your multiplication tables to help you work out multiplication and division problems.

<table>
<thead>
<tr>
<th>×</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>21</td>
<td>24</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>20</td>
<td>24</td>
<td>28</td>
<td>32</td>
<td>36</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>12</td>
<td>18</td>
<td>24</td>
<td>30</td>
<td>36</td>
<td>42</td>
<td>48</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>14</td>
<td>21</td>
<td>28</td>
<td>35</td>
<td>42</td>
<td>49</td>
<td>56</td>
<td>63</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>16</td>
<td>24</td>
<td>32</td>
<td>40</td>
<td>48</td>
<td>56</td>
<td>64</td>
<td>72</td>
<td>80</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>18</td>
<td>27</td>
<td>36</td>
<td>45</td>
<td>54</td>
<td>63</td>
<td>72</td>
<td>81</td>
<td>90</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
</tr>
</tbody>
</table>
NUMBER ANSWERS - TASK 4

Multiplication

Example 2
Start with the units

\[
\begin{array}{c c c}
4 & 8 \\
\times & 4 & 6 \\
\hline
2 & 8 & 8
\end{array}
\]

Start with the units. 8 x 6 + 48. Put 8 in the units column and carry the 4. When you multiply the tens column 4 x 6 = 24, don't forget to add the 4 you carried to get 24 + 4 + 28.

1. If you need to buy two pairs of safety boots at £29.92, how much will the total cost be?

Estimate your answer first. £29.92 is approximately £30. 2 pairs of boots at £30 would cost £60. Now calculate the actual cost and see if your answer seems reasonable.

\[
\begin{align*}
\text{£29.92} \times 2 &= 59.84
\end{align*}
\]

Example
A 1kg box of galvanised nails costs £2.43. You need to buy 12 boxes. How much will this come to?

\[
\begin{align*}
2 & \ . \ 4 \ 3 \\
\times & \ 1 & 2 \\
\hline
4 & \ . \ 8 & 6 \\
+ & 2 & 4 & \ . & 3 & 0 \\
\hline
2 & 9 & \ . & 1 & 6
\end{align*}
\]

Start by multiplying by the 2. 3 x 2 + 6, then 4 x 2 = 8, then 2 x 2 = 4. This gives the first row of the table.

Next you will multiply the one in the tens column. Put 0 in the units column because you are multiplying tens. Then multiply by 1.

Add them together 4.86 + 24.30 to get £29.16

2. If a site joiner earns £9.25 an hour. How much does he earn for 11 hours work?

\[
\begin{align*}
\£9.25 \times 11 &= \£101.75
\end{align*}
\]
Division

If the numbers are too difficult to divide in your head, use a written method. The example below shows you how.

Example

Hard hats cost £9.69 for three. How much does one cost?

- Divide the 9 by the 3 first to get 3. Write this above the 9.
- Divide the 6 by the 3 next to get 2. Write this above the 6.
- Divide the second 9 by the 3 next to get 3. Write this above the second 9.

A hard hat will cost £3.23.

3. A length of wood measuring 2450mm, is cut into 5 equal lengths. How long is each piece of wood?

\[
2450 \div 5 = 490\text{mm}
\]

4. A bill of £1840 is paid in 8 equal payments. How much is each payment?

\[
£1840 \div 8 = £230
\]
BUYING A VAN

John is a self-employed plasterer and has decided he needs to change his work van. His local commercial vehicle dealer has the following options available to suit his budget. Read through the information given and help John make up his mind regarding a new work van.

<table>
<thead>
<tr>
<th>Make/Model/Year</th>
<th>Price (£)</th>
<th>Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Straight Deal</td>
<td>Trade-in</td>
</tr>
<tr>
<td>2007 Ford Transit</td>
<td>7595</td>
<td>8295</td>
</tr>
<tr>
<td>2008 Renault Master</td>
<td>7825</td>
<td>8195</td>
</tr>
<tr>
<td>2006 Peugeot Boxer</td>
<td>4995</td>
<td>5295</td>
</tr>
<tr>
<td>2009 Iveco Daily</td>
<td>9475</td>
<td>9995</td>
</tr>
<tr>
<td>2006 Mercedes Sprinter</td>
<td>6995</td>
<td>7295</td>
</tr>
</tbody>
</table>

1. Arrange the list of vans above in order of increasing Straight Deal price.

<table>
<thead>
<tr>
<th>Van</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006 Peugeot Boxer</td>
<td>4995</td>
</tr>
<tr>
<td>2006 Mercedes Sprinter</td>
<td>6995</td>
</tr>
<tr>
<td>2007 Ford Transit</td>
<td>7595</td>
</tr>
<tr>
<td>2008 Renault Master</td>
<td>7825</td>
</tr>
<tr>
<td>2009 Iveco Daily</td>
<td>9475</td>
</tr>
</tbody>
</table>

2. Arrange the list of vans in order of decreasing mileage.

<table>
<thead>
<tr>
<th>Van</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008 Renault Master</td>
<td>31506</td>
</tr>
<tr>
<td>2006 Mercedes Sprinter</td>
<td>31056</td>
</tr>
<tr>
<td>2006 Peugeot Boxer</td>
<td>24382</td>
</tr>
<tr>
<td>2007 Ford Transit</td>
<td>12635</td>
</tr>
<tr>
<td>2009 Iveco Daily</td>
<td>1465</td>
</tr>
</tbody>
</table>

After some consideration John decides to trade in his current van against the 2008 Renault Master. The dealer offers him £1250 for his old Nissan van.
3. Complete the cheque below with the balance John needs to pay.

John later decides to take advantage of an offer of extended warranty which includes free servicing. This is available at a cost of 5% of the Straight Deal price of the Renault van. Calculate the new total he must pay and complete the cheque below giving your answer to the nearest pound. You are given some steps involved in the calculation to help you.

4. What is 10% of the Straight Deal price in pounds and pence?

10% of £7825 = £782.50

5. What is 5% of the Straight deal price in pounds and pence?
   Use the answer above to help you.

5% is half of 10%

half of £782.50 is £391.25
6. Round this amount to the nearest pound.

£391

7. Now calculate the new total amount he must pay for the van and the extended warranty and complete the cheque below.

£6945 + £391 = £7336

![Cheque Image]
JOBS IN CONSTRUCTION

There are various jobs associated with construction and as your career develops there will be opportunities to earn more. Have a look at the jobs being advertised below and the salaries associated with them. Consider how your salary may change as you gain new qualifications and skills.

Job A: Apprentice bricklayer

1. The company offer to pay time and a half for any overtime you do. What would the hourly rate be for overtime?

\[ £5 + \frac{1}{2} (£5) = £5 + £2.50 = £7.50 \]

2. If you work 40 hours a week what will your weekly salary be?

\[ 5 \times 40 = £200 \]
3. If you work 45 hours one week what would you earn?

\[
5 \times 40 = £200 \\
£7.50 \times 5 = £37.50 \\
\text{Total } £200 + £37.50 = £237.50
\]

Job B: Qualified bricklayer

4. What will the weekly salary be?

\[
£8.50 \times 40 = £340
\]
NUMBER ANSWERS - TASK 6

5. Remembering that there are 52 weeks in a year, what is the annual salary?

\[ £340 \times 52 = £17,680 \]

6. If you got Job A what would your annual salary be for a 40 hour week for 52 weeks? (Use your answer to question 2 where you worked out the weekly salary.)

\[ £200 \times 52 = £10,400 \]

7. How much more would a qualified bricklayer earn in Job B per year?

\[ £17,680 - £10,400 = £7,280 \]
Job C: Site Foreman

8. What is the range in the salary for this job?

£35 000 - £25 000 = £10 000
9. The successful candidate for this post was given a salary of £27,300. How much does this work out at per month?

\[
\text{Monthly salary} = \frac{\text{£27,300}}{12} = \text{£2,275}
\]

10. For the annual salary of £27,300 how much will the successful candidate earn per week? Remember there are 52 weeks in a year.

\[
\text{£27,300} \div 52 = \text{£525}
\]

11. If the successful candidate is offered a 10% pay rise at the end of the first year, how much will their annual salary be?

\[
10\%\ \text{pay rise} = \frac{\text{£27,300}}{10} = \text{£2,730}
\]

\[
\text{£27,300} + \text{£2,730} = \text{£30,030}
\]

\[
\text{Annual salary} = \text{£30,030}
\]
NUMBER ANSWERS - TASK 7

CALCULATIONS

When you price up a job you will need to consider materials, labour and taxes. Calculations will need to be accurate to ensure that the business operates efficiently and your good reputation is maintained. Over ordering materials will add to your costs and reduce your profits, so it is important to work accurately and check quantities carefully.

Decking

EXAMPLE: To calculate how much decking you need for deck measuring 4mx3m use the table below:

Table showing the number of metres of 144mm deck boards required

<table>
<thead>
<tr>
<th>METRES</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>14</td>
<td>21</td>
<td>28</td>
<td>35</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>28</td>
<td>42</td>
<td>56</td>
<td>70</td>
<td>84</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>42</td>
<td>63</td>
<td>84</td>
<td>105</td>
<td>126</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>56</td>
<td>84</td>
<td>112</td>
<td>140</td>
<td>168</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>70</td>
<td>105</td>
<td>140</td>
<td>175</td>
<td>210</td>
</tr>
<tr>
<td>6</td>
<td>42</td>
<td>84</td>
<td>126</td>
<td>168</td>
<td>210</td>
<td>252</td>
</tr>
</tbody>
</table>

From the table above you can see that a deck measuring 4mx3m you will need 84m of 144mm wide deck board.

If the deck boards you want come in 2.4m lengths, divide 84 by 2.4 = 35. You should buy 35 boards.

The cost of each length of board in B & Q is shown below:

To calculate the total cost of the decking boards using a calculator, the sum is:

$35 \times £4.46 = £156.10$
NUMBER ANSWERS - TASK 7

1. The answer on the screen is: 156.1. What does this mean the total cost of the decking is?

£156.10

2. Using the table below find the number of metres of deck board needed for a decked area measuring 5m by 6m.

Table showing the number of metres of 144mm deck boards required

<table>
<thead>
<tr>
<th>METRES</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>14</td>
<td>21</td>
<td>28</td>
<td>35</td>
<td>42</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>28</td>
<td>42</td>
<td>56</td>
<td>70</td>
<td>84</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>42</td>
<td>63</td>
<td>84</td>
<td>105</td>
<td>126</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>56</td>
<td>84</td>
<td>112</td>
<td>140</td>
<td>168</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>70</td>
<td>105</td>
<td>140</td>
<td>175</td>
<td>210</td>
</tr>
<tr>
<td>6</td>
<td>42</td>
<td>84</td>
<td>126</td>
<td>168</td>
<td>210</td>
<td>252</td>
</tr>
</tbody>
</table>

Number of metres of deck board required is.....

210m
3. The deck boards you want come in 2.4m lengths. How many lengths of deck board will you need?

210 ÷ 2.4 = 87.5

Be careful how you round your answer.

4. If each length of deck board costs £4.46, what is the total cost of the deck board?

88 × £4.46 = £392.48

Total cost
Paul is on his way home after a job. He is already thinking of work tomorrow and about getting tiles. He worked out earlier he needs just under 600 tiles for the next job. A slight detour on the way home would take him past the tile warehouse but as he has no trailer with him he could only fit one pallet in the van. If he needs more than one pallet he will leave it until tomorrow when he could call back with the trailer. It would save quite a bit of time if he could get the tiles today.

He knows from experience that the tiles he needs come in boxes with 4 tiles per box and that the boxes are stacked on the pallet in layers. Each layer has 5 by 6 boxes and there are 6 layers altogether. Paul is trying to work out in his head if this amounts to more than 600 tiles. He knows the calculation he needs to do is \(4 \times 5 \times 6 \times 6\).

5. Can you think of a way to answer his question without having to do the calculation in full?

<table>
<thead>
<tr>
<th>Is (4 \times 5 \times 6 \times 6) more than 600?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes,</td>
</tr>
<tr>
<td>a. 20 \times 36 is more than 20 \times 30 which is 600</td>
</tr>
<tr>
<td>b. 24 \times 30 is more than 20 \times 30 which is 600</td>
</tr>
</tbody>
</table>

Will he call for the tiles on his way home? Please explain your reasoning

Yes
NEGATIVE NUMBERS

Negative numbers are numbers to the left (or below) zero on a number line. The use of negative numbers in construction is generally related to temperature, finances, height above/below sea level in surveying, direction of rotation e.g., clockwise or anticlockwise or the direction of forces that act in beams, columns, frames etc. You will need to be able work with negative numbers accurately.

We will consider two construction related uses of negative numbers here; temperature and finances (bank statement).

In the Celsius temperature scale 0°C represents the freezing point of water. Be careful, it does not mean there is no heat energy present. It just means there isn’t enough heat present for water to exist in liquid form so it freezes. A negative value on the Celsius scale indicates a temperature lower than 0°C where there is less heat energy present and so it feels colder.

1. In the space below construct a temperature scale (a number line) that extends from -5°C to 5°C in steps on 1°C. Use your ruler and work to a scale of 1cm for 1°C. Mark the temperatures -4°C and 2°C
NUMBER ANSWERS - TASK 8

2. In the space below identify the temperatures marked on the scale.

1°C, -3.5°C and -2°C respectively from left to right

3. If the answers above referred to external temperatures on a cold evening indicate which one is most likely to result in burst water pipes in a building if the heating was off.

-3.5°C
Ambient temperature is very important when laying asphalt. According to relevant British Standards the asphalt itself should be at 85°C but the ambient temperature should be no less than -3°C.

Janine has been checking temperatures over a period of two weeks and here are her results.

<table>
<thead>
<tr>
<th>December</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14</td>
</tr>
<tr>
<td>Temp</td>
<td>6 4 6 -2 -5 -6 -3 2 7 1 2 0 4 5</td>
</tr>
</tbody>
</table>

4. Values for 4th, 6th and 12th December are not shown in the table. The images below show the temperatures for these dates. Make each temperature reading and record the result in the table.
NUMBER ANSWERS - TASK 8

5. Using the graph below plot the remaining points. Join the points using a straight edge to produce a line graph showing how the temperature varied over the two-week period.

6. What was the highest temperature recorded and on which date did this occur?

<table>
<thead>
<tr>
<th>Highest temperature:</th>
<th>7°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>9th December</td>
</tr>
</tbody>
</table>

7. What was the lowest temperature recorded and on which date did this occur?

<table>
<thead>
<tr>
<th>Lowest temperature:</th>
<th>-6°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>6th December</td>
</tr>
</tbody>
</table>
8. What is the range of temperature during the second week in December?

Range = 7 - 0 = 7°C

9. On 4th December the temperature was -2°C. By the next day it had fallen to -5°C. Use the image below to work out by how many degrees the temperature changed?

3°C
Janine wants to work out the average temperature in the second week of December. To calculate the mean she has to add up all the temperatures for that week and divide the total by 7.

10. Janine’s answer is 3.5°C. Her colleague Brendan says that the answer should be 3°C. Who is correct?

Show how you calculated your answer in the space below.

Write the sum of the temperatures here, Total = 2+7+1+2+0+4+5 = 21

Mean temperature = Total ÷ 7 = 21 ÷ 7 = 3°C

Who is correct?

Brendan is correct

11. On how many days during the two-week period could asphalt not have been laid?

2
Below is a bank statement for a construction engineering consultancy for the month of April 2009. The consultant wants to check the figures in the statement and this means he will need to look at withdrawals and lodgements on the account. He wants to know whether his account is in credit or debit and if the bank’s calculations are correct.

<table>
<thead>
<tr>
<th>Date</th>
<th>Details</th>
<th>Debits</th>
<th>Credits</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Apr</td>
<td>Opening Balance</td>
<td></td>
<td></td>
<td>996.87</td>
</tr>
<tr>
<td>03 Apr</td>
<td>Standing order 001</td>
<td>288.44</td>
<td></td>
<td>708.43</td>
</tr>
<tr>
<td>04 Apr</td>
<td>Cheque 234016</td>
<td>174.45</td>
<td></td>
<td>533.98</td>
</tr>
<tr>
<td>08 Apr</td>
<td>Cash paid in</td>
<td></td>
<td>372.00</td>
<td>905.98</td>
</tr>
<tr>
<td>09 Apr</td>
<td>Cheque 234017</td>
<td>277.30</td>
<td></td>
<td>628.68</td>
</tr>
<tr>
<td>11 Apr</td>
<td>Cheques paid in</td>
<td></td>
<td>540.50</td>
<td>1169.18</td>
</tr>
<tr>
<td>15 Apr</td>
<td>Standing order 002</td>
<td>569.45</td>
<td></td>
<td>599.73</td>
</tr>
<tr>
<td>16 Apr</td>
<td>Cash paid in</td>
<td></td>
<td>340.18</td>
<td>939.91</td>
</tr>
<tr>
<td>21 Apr</td>
<td>Cheques for salary</td>
<td>840.37</td>
<td></td>
<td>99.54</td>
</tr>
<tr>
<td>23 Apr</td>
<td>Cash paid in</td>
<td></td>
<td>540.34</td>
<td>639.88</td>
</tr>
<tr>
<td>26 Apr</td>
<td>Cheque paid in</td>
<td></td>
<td>2277.45</td>
<td>2917.33</td>
</tr>
<tr>
<td>29 Apr</td>
<td>Cash paid in</td>
<td></td>
<td>2480.32</td>
<td>5397.65</td>
</tr>
<tr>
<td>30 Apr</td>
<td>Closing Balance</td>
<td></td>
<td></td>
<td>5397.65</td>
</tr>
</tbody>
</table>
1. Fill in the balance column as far as 29th April. The balance on 29th April should be £5397.65, allowing you to check your answer. Use the space below as well if you need to.

2. On which day was the account at its lowest point and how much did he have in the bank on that date?

<table>
<thead>
<tr>
<th>Date:</th>
<th>21st April</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance:</td>
<td>£99.54</td>
</tr>
</tbody>
</table>

3. A cheque of £6000 for salaries is withdrawn from the account on 30th April taking the account to -£602.35. What does the negative sign mean?

The account is overdrawn by the amount £602.35
Measure, Shape & Space

Tasks and Answers

This section mainly addresses the curriculum area specified, however to allow a more realistic setting for each task, some elements from other curriculum areas may also be mentioned.
MEASURE, SHAPE & SPACE TASK 1

TIME

In construction time is money. It is important that you manage time effectively and estimate the time required to complete a job as accurately as possible. It is also important to record time accurately.

On 25 September 2009 an accident occurred on a construction site. The contractor was McClure Construction. Jason Shepherd was on scaffolding when he fell. The accident occurred at 13:09. An ambulance was called for and arrived at 14:06.

With 12 hour clock each day is split into two halves, am (before mid day) and pm (after mid day).

**24 hour clock** is used in digital clocks, timers and timetables. The hours are numbered up to 24 instead of using am and pm, starting at 00:00 for midnight.

4 digits are used when writing times in 24 hour clock:

```
_ _ : _ _
```

Example:

- Twenty five minutes to two in the morning
- 1:35am is the time as 12 hour clock
- 01:35 is the time as 24 hour clock

- Quarter past four in the afternoon
- 4:15pm
- 16:15

Finding the difference between times

Example:

If you start work at 08:15 and stop for lunch at 12:40, how long have you worked for?

- Find the number of minutes to the next hour i.e.
  8:15 to 9:00 => **45 minutes**
- Then find the number of hours and minutes to the final time:
  9:00 to 12:40 => **3 hours and 40 minutes**
- Total the hours and the minutes separately:
  3 hours + 40 minutes + 45 minutes = **3 hours and 45 minutes**

85 minutes = 60 mins + 25 mins
= 1 hour and 25 minutes
MEASURE, SHAPE & SPACE TASK 1

1. What time did the accident occur in 12 hour clock?

2. What time did the ambulance arrive in 12 hour clock?

3. How long after the accident did the ambulance arrive?

4. If the call was placed for the ambulance at 13:51, how long did it take between the ambulance being called and it arriving?

5. Jason arrived on site that morning at 8:50am. How is this written in 24 hour clock?
6. The site foreman calculates that if Jason arrived on site at 8:50am and the accident occurred at 13:09, then he had been on site:

\[ 13:09 - 8:50 = 4:59 \text{ i.e. 4 hours 59 minutes.} \]

Has he calculated this correctly? If he has made an error, what mistake did he make and what is the correct length of time?

7. The employees on site that day started and finished at the times shown below:

<table>
<thead>
<tr>
<th>EMPLOYEE</th>
<th>START TIME</th>
<th>FINISH TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claire</td>
<td>08:30</td>
<td>Twenty five minutes to five in the afternoon</td>
</tr>
<tr>
<td>Sean</td>
<td>Quarter past eight</td>
<td>4:15</td>
</tr>
<tr>
<td>Peter</td>
<td>09:05</td>
<td>16:41</td>
</tr>
<tr>
<td>Adrian</td>
<td>7:59</td>
<td>Quarter to five in the afternoon</td>
</tr>
<tr>
<td>Dean</td>
<td>08:35</td>
<td>16:30</td>
</tr>
</tbody>
</table>

Calculate how long each employee worked that day.

<table>
<thead>
<tr>
<th>EMPLOYEE</th>
<th>TIME WORKED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claire</td>
<td></td>
</tr>
<tr>
<td>Sean</td>
<td></td>
</tr>
<tr>
<td>Peter</td>
<td></td>
</tr>
<tr>
<td>Adrian</td>
<td></td>
</tr>
<tr>
<td>Dean</td>
<td></td>
</tr>
</tbody>
</table>
8. Peter had started at 08:05 and agrees to start a quarter of an hour earlier the next day. What time will he start at?

9. Dean started work at 08:35. Is this 12 hour or 24 hour clock?

10. 7 days after the accident Jason is well enough to return to work. What date did he return to work?

   Accident date: 25/09/09

   Return to work date:

11. When Jason returns to work he started at 8:05am and worked 7 hours and 50 minutes. What time did he finish?
MEASURE, SHAPE & SPACE TASK 1

12. Jason gets a lift to work with Sean. The journey from Dungannon takes 85 minutes because of delays on the M1. How long did the journey take in hours and minutes?

13. If Jason and Sean arrive on site at 8:05am, what time did they leave Dungannon? (Remember the journey took 85 minutes).

14. In order to make it back to Dungannon for an appointment at quarter to six that evening, what time will Jason need to get the bus from Belfast?

(Note that timetables sometimes omit the colon)
15. How long did the bus take?

16. How much shorter was the journey home than the journey to work?

17. Claire usually works 8 hours 15 minutes each day. How long does she work over the course of the 5 day working week?
MEASURE, SHAPE & SPACE TASK 2

MEASURING

Many trades associated with the construction industry rely on accurate measurements being taken. Where inaccuracies occur this may lead to loss in profit, time or even compromise safety on site.

In Northern Ireland we use miles to measure distance on the road. In the rest of Europe, long distances are measured in kilometres.

1 mile is longer than 1 kilometre

1 km = 1000m

km stands for kilometre
m stands for metre

On a tape measure centimetres and millimetres are marked.

1m = 100cm =1000mm

m stands for metre
cm stands for centimetre
mm stands for millimetre

Some rulers are marked in centimetres and millimetres.

1cm = 10mm

Notice from the ruler that the line is 22mm. This is the same as 2.2cm.
MEASURE, SHAPE & SPACE TASK 2

On site you will measure using various instruments. What do each of the devices below measure and what unit will they measure in?

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Used to measure?</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In construction we mainly use **metric units** for measuring. Where have you come across the metric units below at work?

Fill in examples of where you have come across that unit in work.
### MEASURE, SHAPE & SPACE TASK 2

#### METRIC UNITS

<table>
<thead>
<tr>
<th>Measurement of Length</th>
<th>Abbreviation</th>
<th>Full Name</th>
<th>Equivalent</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>millimetre</td>
<td></td>
<td>10 mm = 1 cm</td>
<td></td>
</tr>
<tr>
<td>cm</td>
<td>centimetre</td>
<td></td>
<td>100 cm = 1 m</td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
<td></td>
<td>1 000 m = 1 km</td>
<td></td>
</tr>
<tr>
<td>km</td>
<td>kilometre</td>
<td></td>
<td>1 000 m = 1 km</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement of Weight</th>
<th>Abbreviation</th>
<th>Full Name</th>
<th>Equivalent</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>g</td>
<td>gram</td>
<td></td>
<td>1000g = 1 km</td>
<td></td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
<td></td>
<td>1kg = 1000g</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>tonne</td>
<td></td>
<td>1t = 1000kg</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement of Capacity</th>
<th>Abbreviation</th>
<th>Full Name</th>
<th>Equivalent</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>ml</td>
<td>millilitre</td>
<td></td>
<td>1l = 1000ml</td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>litre</td>
<td></td>
<td>1l = 1000ml</td>
<td></td>
</tr>
</tbody>
</table>
MEASURE, SHAPE & SPACE TASK 3

CONVERTING BETWEEN METRIC UNITS OF MEASURE

EXAMPLES

700mm = 70cm  
700 ÷ 10 = 70

1200mm = 1.2m  
1200 ÷ 1000 = 1.2

1.3m = 1300mm  
1.3 × 1000 = 1300
MEASURE, SHAPE & SPACE TASK 3

Rulers and tape measures are marked off in cm

1. The arrow is pointing at what measurement? (give your answer in cm and in mm)

2. The arrow is pointing at what measurement? (give your answer in cm and in mm)

3. The arrow is pointing at what measurement? (give your answer in cm and in mm)
4. The arrow is pointing at what measurement? (give your answer in cm and in mm)

5. The arrow is pointing at what measurement? (give your answer in cm and in mm)

6. You have to cut skirting to measure 1010mm. If your tape measure is in cm, what length is 1010 mm in cm?

7. A length of pipe needs to be 1570mm long. What is this length in metres?
SITE PLANS

Karen works for a construction firm and needs to be able to translate the measurements from the plans she has been given to actual lengths on site. This requires her to accurately measure lengths on the drawings and interpret what these lengths mean on the site. Look at the plans below and check your understanding of site plans.

Measurements are in mm

1. What is the overall length of this section of the site?

2. What is 2035mm in metres?

3. The architect thinks he has made a mistake and the 2035mm measurement should be 2.35m. Are these two measurements different? If so, what is the difference?
The plan is changed to incorporate the changed measurement.

4. Calculate the overall length now.

5. There is a measurement missing from the plan above. What is the missing measurement?
6. What is the total overall length shown by the arrow?
MEASURE, SHAPE & SPACE TASK 5

MATERIALS

When working with different materials on site you will need to be able to compare quantities accurately. You will come across weights and lengths frequently on site. From the weight of a steel H section which will need to be accurately counterbalanced when using a crane on site, to quantities of stone and other building materials, you will need to be able to work with metric measurements. Lengths of timber, pipe and steel etc need to be accurately known. Measurements may be given in a variety of units and you need to be able to convert from one unit to another. Test your understanding in the questions below.

1. Put these lengths in ascending order.

1.06m 1200mm 130cm

2. Put these lengths in ascending order.

0.4m 0.36m 0.42m

3. Put these weights in order of size.

23.06kg 23.6kg 23500g
4. Match each of these items to their approximate measurement.

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of door</td>
<td>0.8m</td>
</tr>
<tr>
<td>Width of door</td>
<td>1900mm</td>
</tr>
<tr>
<td>Length of a brick</td>
<td>2250mm</td>
</tr>
<tr>
<td>Height of garden wall</td>
<td>230mm</td>
</tr>
<tr>
<td>Height of garage door</td>
<td>1.2m</td>
</tr>
</tbody>
</table>
MEASURE, SHAPE & SPACE TASK 6

PERIMETER

New firm, RJM joinery, has been asked to quote for replacement skirting for a client. He visits the client, takes preliminary measurements and calculates the quantity of skirting needed.

1. What are the lengths of the two sides where the measurements are missing?

2. Work out the total amount of skirting needed for the room in millimetres.

<table>
<thead>
<tr>
<th>Perimeter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length of skirting required in metres:</td>
</tr>
<tr>
<td>Total length of skirting required in millimetres:</td>
</tr>
</tbody>
</table>
Helen wants to replace the skirting board in her living room. She hasn’t taken any measurements yet but remembers that her living room is identical to the dining room she did a couple of months ago except that the living room has a chimney breast on one wall. Helen believes that since the chimney breast cuts down on floor area she will not need any more skirting for the living room than she did for the dining room. She decides to order the same amount she ordered for the dining room.

3. Use a diagram and/or a calculation in the space below to demonstrate Helen’s mistake.
MEASURE, SHAPE & SPACE TASK 7

AREA

The client would also like to get an estimate for a wooden floor to be laid in their dining room. In order to calculate the estimate he needs to work out the area of the room. This means taking measurements of the length and width of the room and converting measurements to metres in order to find the area in squared metres.

\[
\text{Area} = \text{length} \times \text{width}
\]

Plan of room:

What is the area of the room?

The area of the room to be floored is:
PLANS

Measurements can be taken directly from site plans and used in calculations off site. A site plan is a bird’s eye view of a property that is drawn to scale. A site plan can show:

- Property lines
- Outline of existing and proposed buildings and structures
- Distance between buildings
- Distance between buildings and property lines (setbacks)
- Parking lots, indicating parking spaces
- Driveways
- Surrounding streets
- Landscaped areas
- Easements
- Ground sign location

When working from plans you will need to be able to interpret the plans and the measurements on the plans to accurately calculate quantities.

1. From the upstairs plan what is the perimeter of the room in mm?
MEASURE, SHAPE & SPACE TASK 8

2. What would this be in metres?

3. What is the width of the door for the training room?

4. What length of skirting would be needed for the room? (remember to leave out the door)
Laying a Concrete Driveway

RS Contracts have received an order to lay a concrete driveway for a customer. The dimensions of the driveway have been measured as below:

In order to accurately calculate the quantity of concrete required, RS Contacts need to calculate the volume of concrete required. Follow the steps to complete the calculation.

\[ \text{Volume} = \text{length} \times \text{width} \times \text{height} \]

To order material such as stones for a path or concrete for a driveway or foundations, you need to calculate the volume. Volumes are normally measured in units cubed such as metres cubed.
MEASURE, SHAPE & SPACE TASK 9

EXAMPLE

![Concrete Volume Diagram]

For this example the volume is $4 \times 5 \times 10 = 200\text{m}^3$

To determine the volume of concrete needed, RS contracts multiply the length and width of the driveway by the depth of concrete to be laid, in this case 100mm.

1. What volume of concrete will they need to order?

<table>
<thead>
<tr>
<th>Length of driveway in metres =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width of driveway in metres =</td>
</tr>
<tr>
<td>Depth of concrete in METRES =</td>
</tr>
<tr>
<td>Volume of concrete =</td>
</tr>
</tbody>
</table>

2. As a general rule: one cubic metre of concrete weighs around 2.5 tonnes. Using this method, how many tonnes of concrete will you need to order?
ERECTING A SHED

A client wants you to erect a garden shed.

The shed they have chosen is from B & Q and costs £589. Until the end of the week there is an offer of 25% off all garden buildings.

In addition to erecting the shed you will have to build a concrete base. The amount of concrete required for the base will need to be calculated. Follow the steps below to cost the job.

1. What is 25% as a fraction?

2. What does the discount on the shed work out at?

3. What is the price of the shed with the 25% discount taken off?
MEASURE, SHAPE & SPACE TASK 10

To build a garden shed you will need to lay a concrete pad that is 25mm smaller on all sides than the base of the shed, to create an overhang and prevent water accumulating around the timber floor and runners.

The dimensions of the shed are: 2000mm by 1750mm by 3475mm

4. What would the dimensions of the concrete base need to be?
see the diagram below for help

The dimensions of the concrete slab would be:

Length =

Width =
5. If the concrete for the slab needs to be 100mm thick, what volume of concrete will be needed in metres cubed?

REMEMBER: $Volume = length \times width \times height$

length in m =
width in m =
height in m =
Volume =

6. Concrete costs approximately £60 per metre cubed including VAT. What will the cost be for the concrete?

7. The labour costs work out at £130 including VAT. What is the total costing for the client for the purchase and erection of the shed?

Labour costs:
Cost of shed:
Cost of concrete:
The total costs will be:
BRICK WALL

James is an apprentice and has been asked to build a small garden wall for a family member. This is the first time he has undertaken a project from start to finish. He needs to do a range of calculations for instance the amount of brick, mortar, concrete etc. required to complete the job. The task below will take him through the various stages of each calculation.

Each brick measures:

21.5 cm x 10.25 cm x 6.5 cm

1. What are the dimensions of the brick in mm?

The first bricks have been laid as shown above.

2. If the thickness of mortar is 10mm. What is length of the wall so far?

3. Mortar is made up from 1 part cement to 4 parts sand.
   How much sand would be needed to mix with 2 buckets of cement?

<table>
<thead>
<tr>
<th>1 part cement</th>
<th>to</th>
<th>4 parts sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 buckets of cement</td>
<td>to</td>
<td>_____________ buckets of sand</td>
</tr>
</tbody>
</table>
MEASURE, SHAPE & SPACE TASK 11

4. When the wall around the garden is completed it will contain 120 bricks. Each brick costs 40p. How much will all the bricks required for the wall cost?

For a small garden wall, a foundation is dug as shown below.

The width of the foundation is twice the width of a brick plus 10mm.

5. If a brick is 102.5mm wide, what will the width of the foundation be?
MEASURE, SHAPE & SPACE TASK 11

6. What are the dimensions of the foundation in metres?

Length =
Width =
Height =

7. What volume of concrete will you need for the foundation?

Volume of cuboid =
length × width × height

Volume of concrete = m³

8. The concrete for the foundation is made up 1 part cement: 3 parts sand: 5 parts 10mm aggregate. If you have 8 buckets of cement, how many buckets of sand and aggregate will you need?

<table>
<thead>
<tr>
<th>1 part cement</th>
<th>:</th>
<th>3 parts sand</th>
<th>:</th>
<th>5 parts 10mm aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 buckets of cement</td>
<td>:</td>
<td>3 parts sand</td>
<td>:</td>
<td>5 parts 10mm aggregate</td>
</tr>
</tbody>
</table>
Chris lives in Newry and is a construction engineer for a large local firm. He has to make a visit to three of the company’s sites tomorrow. The first site is in Ballycastle and Chris is trying to work out how far away it is. He takes out a map similar to the one you see below and begins to estimate the distance from Newry to Ballycastle.

1. Use a ruler to estimate the distance “as the crow flies” from Newry to Ballycastle if the map has a scale of 1cm to 4.5 miles.

Round the ruler measurement to the nearest cm

Convert this to miles using the scale given above
Chris realises this method is not very accurate so he attempts to use a slightly different approach. He breaks the journey into three “as the crow flies” legs.

- Newry to Belfast
- Belfast to Ballymena
- Ballymena to Ballycastle

2. Use the map again to calculate an improved estimate of the distance from Newry to Ballycastle and show your working in the space below

<table>
<thead>
<tr>
<th>Distance</th>
<th>Ruler Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Newry to Belfast</strong></td>
<td><strong>Ruler measurement in cm</strong></td>
</tr>
<tr>
<td></td>
<td>Circle one option</td>
</tr>
<tr>
<td></td>
<td>4.0cm</td>
</tr>
<tr>
<td></td>
<td>4.5cm</td>
</tr>
<tr>
<td></td>
<td>5.0cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Belfast to Ballymena</strong></th>
<th><strong>Ruler measurement to nearest cm</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circle one option</td>
</tr>
<tr>
<td></td>
<td>3.0cm</td>
</tr>
<tr>
<td></td>
<td>3.5cm</td>
</tr>
<tr>
<td></td>
<td>4.0cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Ballymena to Ballycastle</strong></th>
<th><strong>Ruler measurement to nearest cm</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Circle one option</td>
</tr>
<tr>
<td></td>
<td>3.0cm</td>
</tr>
<tr>
<td></td>
<td>3.5cm</td>
</tr>
<tr>
<td></td>
<td>4.0cm</td>
</tr>
</tbody>
</table>

Add up the three measurements:

Total journey in cm =

Total journey in miles =

![Calculator Image]
3. Round your answer above to the nearest 5 miles.

An internet search on www.multimap.com for this journey gives an answer of 92 miles.

4. Round this figure to the nearest 5 miles

The difference in the previous two answers could be described as the error in Chris’s method.

5. What is the error in miles?
6. Which of the following answers do you feel best describes the percentage error in Chris’s method? Don’t do any further actual calculations to answer this.

<table>
<thead>
<tr>
<th>Error in miles = (answer to question 5)</th>
<th>Correct answer in miles = (answer to question 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle one option</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>33%</td>
</tr>
<tr>
<td>50%</td>
<td>100%</td>
</tr>
<tr>
<td>Reason:</td>
<td></td>
</tr>
</tbody>
</table>

After Chris visits the Ballycastle site he has to go to Magherafelt where his company are upgrading the spectator seating at a local rugby ground. From Magherafelt he will travel to a site in Armagh where his company are building a new shopping centre. After that he will go back to Newry.

7. Use the mileage chart below to calculate how far Chris will have travelled altogether by the time he returns home again in the evening.

<table>
<thead>
<tr>
<th></th>
<th>Armagh</th>
<th>Ballycastle</th>
<th>Magherafelt</th>
<th>Newry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armagh</td>
<td></td>
<td>95</td>
<td>33</td>
<td>19</td>
</tr>
<tr>
<td>Ballycastle</td>
<td>95</td>
<td></td>
<td>52</td>
<td>92</td>
</tr>
<tr>
<td>Magherafelt</td>
<td>33</td>
<td>52</td>
<td></td>
<td>51</td>
</tr>
<tr>
<td>Newry</td>
<td>19</td>
<td>92</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

Mileage covered in total:
He arrives in Ballycastle just as the workers are having a tea break. Bill and Malachy are having a conversation about an article in the newspaper. The article includes the chart shown below.

Bill says Construction has received twice as much investment as manufacturing. Malachy agrees and thinks the retail sector has received very little indeed.

8. **Comment on these statements in the space below.**

Construction received twice as much as Manufacturing:

Retail sector received very little:
There is an article in this paper about the rugby ground Chris’s company are in the process of upgrading. The article states that the finished stadium is to have a seating capacity of 380,000 people and that 15,000 tonnes of concrete will have been used in the construction of it. According to the article the project was initially tendered at a cost of £18,000,000 but is due to come in over budget by 50% making the final total £18,900,000.

9. State whether or not you think these statistics are reasonable and if not indicate what may be wrong.

Capacity of 380,000 people

15000 tonnes of concrete

£18,000,000 increased by 50% gives £18,900,000
RENOVATION

John is going to put down a concrete floor and replace the beams in an old barn behind his house. He takes some measurements with a tape and finds the barn floor is rectangular with dimensions 4.45m by 3.92m.

1. Round these values up the nearest metre in order to make the volume calculation easier and allow for some wastage.

4.45m rounded up is
3.92m rounded up is

A builder has told him the floor needs to be at least 3" deep. John decides to use 4" to ensure he orders enough concrete and also because he knows that 4" comes out at a round number when converted to cm. What is the number he is thinking of?

2. First of all use the fact that 1" = 25mm to convert to mm.

1" = 25mm so 4" = mm

3. Now convert this answer to cm.

10mm = 1cm
John wants to order the concrete for the builder arriving. After doing the volume calculation he rings up to order 200m$^3$ of concrete. The person on the phone asks him if he is sure as that is a very large amount of concrete.

4. Is John correct? If not show how he went wrong in his calculation?

Remember  
Volume = length $\times$ width $\times$ height

John also wants to use steel for the main beams. The table below gives some information on the price of steel beams according to their strength.

<table>
<thead>
<tr>
<th>Beam Type</th>
<th>Max. load per metre in tonnes</th>
<th>Price (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.2</td>
<td>80</td>
</tr>
<tr>
<td>B</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>2.4</td>
<td>160</td>
</tr>
<tr>
<td>D</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>4.8</td>
<td></td>
</tr>
</tbody>
</table>

5. Use the figures given to help fill in the unknown prices. If you need to do some calculations use the space below the table:
Cameron is making a batch of mortar for John to finish some work behind the barn. Mixing sand and cement in different ratios helps produce different kinds of mortar.

A very hard mix as might be used for a floor would use 3:1 of sand to cement. A softer mortar mix such as is used for brickwork might use 6:1.

Cameron is making up a mix using the ratio 4:1 sand to cement. He has a 5 kg bag of cement.

6. How much sand does he need?

7. How much mortar mix will this make altogether?

Later Cameron is asked to make 50kg of mortar mix to the same hardness as the last batch. He wonders if there is a short cut to working out how much sand and cement to use for this batch.

8. Help give Cameron an answer in the space below.
MEASURE, SHAPE & SPACE ANSWERS - TASK 1

TIME

In construction time is money. It is important that you manage time effectively and estimate the time required to complete a job as accurately as possible. It is also important to record time accurately. On 25 September 2009 an accident occurred on a construction site. The contractor was McClure Construction. Jason Shepherd was on scaffolding when he fell. The accident occurred at 13:09. An ambulance was called for and arrived at 14:06.

With 12 hour clock each day is split into two halves, am (before mid day) and pm (after mid day).

24 hour clock is used in digital clocks, timers and timetables. The hours are numbered up to 24 instead of using am and pm, starting at 00:00 for midnight.

4 digits are used when writing times in 24 hour clock:

Example:

- Twenty five minutes to two in the morning
- 1:35am is the time as 12 hour clock
- 01:35 is the time as 24 hour clock

- Quarter past four in the afternoon
- 4:15pm
- 16:15

Finding the difference between times

Example:

If you start work at 08:15 and stop for lunch at 12:40, how long have you worked for?

- Find the number of minutes to the next hour i.e.
  8:15 to 9:00 => 45 minutes
- Then find the number of hours and minutes to the final time:
  9:00 to 12:40 => 3 hours and 40 minutes
- Total the hours and the minutes separately:
  3 hours + 40 minutes + 45 minutes = 3 hours and 85 minutes = 4 hours and 25 minutes

85 minutes = 60 mins + 25 mins = 1 hour and 25 minutes
On 25 September 2009 an accident occurred on a construction site. The contractor was McClure Construction. Jason Shepherd was on scaffolding when he fell. The accident occurred at 13:09. An ambulance was called for and arrived at 14:06.

1. What time did the accident occur in 12 hour clock?

1:09pm

2. What time did the ambulance arrive in 12 hour clock?

2:06pm

3. How long after the accident did the ambulance arrive?

From 1:09pm to 2pm would be 51 minutes
From 2pm to 2:06pm would be 6 minutes
This gives a total of 51 + 6 = 57 minutes

4. If the call was placed for the ambulance at 13:51, how long did it take between the ambulance being called and it arriving?

From 13:51 to 14:00 is 9 minutes
From 14:00 to 14:06 is 6 minutes
This is a total of 9 + 6 = 15 minutes

5. Jason arrived on site that morning at 8:50am. How is this written in 24 hour clock?

08:50
6. The site foreman calculates that if Jason arrived on site at 8:50am and the accident occurred at 13:09, then he had been on site:

13:09 – 8:50 = 4:59 i.e. 4 hours 59 minutes.

Has he calculated this correctly? If he has made an error, what mistake did he make and what is the correct length of time?

Jason subtracted the clock times as though they were decimals.

The correct method is:

From 8:50 to 9:00 is 10 minutes

From 9:00 to 13:09 is 4 hours 9 minutes

The total time is 4 hours and 19 minutes

7. The employees on site that day started and finished at the times shown below:

<table>
<thead>
<tr>
<th>EMPLOYEE</th>
<th>START TIME</th>
<th>FINISH TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claire</td>
<td>08:30</td>
<td>Twenty five minutes to five in the afternoon</td>
</tr>
<tr>
<td>Sean</td>
<td>Quarter past eight</td>
<td>4:15</td>
</tr>
<tr>
<td>Peter</td>
<td>09:05</td>
<td>16:41</td>
</tr>
<tr>
<td>Adrian</td>
<td>7:59</td>
<td>Quarter to five in the afternoon</td>
</tr>
<tr>
<td>Dean</td>
<td>08:35</td>
<td>16:30</td>
</tr>
</tbody>
</table>
Calculate how long each employee worked that day.

<table>
<thead>
<tr>
<th>EMPLOYEE</th>
<th>TIME WORKED</th>
</tr>
</thead>
</table>
| Claire   | 8:30 to 9:00 is 30 minutes  
|          | 9:00 to 4:35pm is 7 hours and 35 minutes  
|          | The total is 30 minutes + 7 hours and 35 minutes = 7 hours and 65 minutes = 8 hours and 5 minutes                                                                                                           |
| Sean     | 8:15 to 9:00 is 45 minutes  
|          | 9:00 to 4:15pm is 7 hours 15 minutes  
|          | The total is 45 minutes + 7 hours and 15 minutes = 7 hours and 60 minutes = 8 hours                                                                                                                          |
| Peter    | 9:05 to 10:00 is 55 minutes  
|          | 10:00 to 16:41 is 6 hours and 41 minutes  
|          | The total is 55 minutes + 6 hours and 41 minutes = 6 hours and 96 minutes = 7 hours and 36 minutes                                                                                                           |
| Adrian   | 7:59 to 8:00 is 1 minute  
|          | 8:00 to 4:45pm is 8 hours and 45 minutes  
|          | The total is 1 minute + 8 hours and 45 minutes = 8 hours and 46 minutes                                                                                                                                    |
| Dean     | 8:35 to 9:00 is 25 minutes  
|          | 9:00 to 16:30 is 7 hours and 30 minutes  
|          | The total is 25 minutes + 7 hours and 30 minutes = 7 hours and 55 minutes                                                                                                                                  |

8. Peter had started at 08:05 and agrees to start a quarter of an hour earlier the next day. What time will he start at?

07:50 or 7:50am or ten minutes to eight in the morning

9. Dean started work at 08:35. Is this 12 hour or 24 hour clock?

24 hour clock
10. 7 days after the accident Jason is well enough to return to work. What date did he return to work?

Accident date: 25/09/09

Return to work date: 2/10/09 or 2nd October 2010

11. When Jason returns to work he started at 8:05am and worked 7 hours and 50 minutes. What time did he finish?

8:05 + 7 hours is 15:05
15:05 + 50 minutes is 15:55
Jason finishes at 15:55 or 3:55pm or 5 minutes to four in the afternoon

12. Jason gets a lift to work with Sean. The journey from Dungannon takes 85 minutes because of delays on the M1. How long did the journey take in hours and minutes?

1 hour and 25 minutes

13. If Jason and Sean arrive on site at 8:05am, what time did they leave Dungannon? (Remember the journey took 85 minutes).

8:05 less 1 hour is 7:05
7:05 less 25 minutes is 6:40
They left at 6:40am or 06:40 or twenty minutes to seven in the morning.
14. In order to make it back to Dungannon for an appointment at quarter to six that evening, what time will Jason need to get the bus from Belfast?

(Note that timetables sometimes omit the colon)

![Bus Timetable]

16:05

15. How long did the bus take?

1 hour less 2 minutes that means 58 minutes
16. How much shorter was the journey home than the journey to work?

The journey took 85 minutes by car and 58 minutes by bus. 85 – 58 = 27 minutes shorter

17. Claire usually works 8 hours 15 minutes each day. How long does she work over the course of the 5 day working week?

8 hours × 5 = 40 hours
15 minutes × 5 = 75 minutes = 1 hour and 15 minutes
Total = 41 hours and 15 minutes
MEASURE, SHAPE & SPACE ANSWERS - TASK 2

MEASURING

Many trades associated with the construction industry rely on accurate measurements being taken. Where inaccuracies occur this may lead to loss in profit, time or even compromise safety on site.

In Northern Ireland we use miles to measure distance on the road. In the rest of Europe, long distances are measured in kilometres.

1 mile is longer than 1 kilometre
1 km = 1000m
km stands for kilometre
m stands for metre

On a tape measure centimetres and millimetres are marked.

1m = 100cm = 1000mm
m stands for metre
cm stands for centimetre
mm stands for millimetre

Some rulers are marked in centimetres and millimetres.
1cm = 10mm
Notice from the ruler that the line is 22mm. This is the same as 2.2cm.
On site you will measure using various instruments. What do each of the devices below measure and what unit will they measure in?

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Used to measure?</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tape Measure</td>
<td>Distance</td>
<td>mm / cm / inches</td>
</tr>
<tr>
<td>Digital Measuring Tape</td>
<td>Distance</td>
<td>mm / m</td>
</tr>
<tr>
<td>Bucket</td>
<td>Volume / capacity</td>
<td></td>
</tr>
<tr>
<td>Ruler</td>
<td>Angle and Distance</td>
<td>Degrees / mm</td>
</tr>
<tr>
<td>String</td>
<td>Length</td>
<td>mm / inches</td>
</tr>
</tbody>
</table>
In construction we mainly use **metric units** for measuring. Where have you come across the metric units below at work?

Fill in examples of where you have come across that unit in work.
## MEASURE, SHAPE & SPACE ANSWERS - TASK 2

### METRIC UNITS

<table>
<thead>
<tr>
<th>MEASUREMENT OF LENGTH</th>
<th>ABBREVIATION</th>
<th>FULL NAME</th>
<th>EQUIVALENT</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>millimetre</td>
<td></td>
<td>10 mm = 1 cm</td>
<td>1 000 mm = 1 m</td>
</tr>
<tr>
<td>cm</td>
<td>centimetre</td>
<td></td>
<td>100 cm = 1 m</td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
<td></td>
<td>1 000 m = 1 km</td>
<td></td>
</tr>
<tr>
<td>km</td>
<td>kilometre</td>
<td></td>
<td>1 000 m = 1 km</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEASUREMENT OF WEIGHT</th>
<th>ABBREVIATION</th>
<th>FULL NAME</th>
<th>EQUIVALENT</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>g</td>
<td>gram</td>
<td></td>
<td>1000g = 1 km</td>
<td></td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
<td></td>
<td>1kg = 1000g</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>tonne</td>
<td></td>
<td>1t = 1000kg</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEASUREMENT OF CAPACITY</th>
<th>ABBREVIATION</th>
<th>FULL NAME</th>
<th>EQUIVALENT</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ml</td>
<td>millilitre</td>
<td></td>
<td>1l = 1000ml</td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>litre</td>
<td></td>
<td>1l = 1000ml</td>
<td></td>
</tr>
</tbody>
</table>
CONVERTING BETWEEN METRIC UNITS OF MEASURE

EXAMPLES

- $700\text{mm} = 70\text{cm}$
  
  $700 \div 10 = 70$

- $1200\text{mm} = 1.2\text{m}$
  
  $1200 \div 1000 = 1.2$

- $1.3\text{m} = 1300\text{mm}$
  
  $1.3 \times 1000 = 1300$
MEASURE, SHAPE & SPACE ANSWERS - TASK 3

Rulers and tape measures are marked off in cm

1. The arrow is pointing at what measurement? (give your answer in cm and in mm)

   1.1 cm = 11 mm

2. The arrow is pointing at what measurement? (give your answer in cm and in mm)

   2.5 cm = 25 mm

3. The arrow is pointing at what measurement? (give your answer in cm and in mm)

   0.8 cm = 8 mm
4. The arrow is pointing at what measurement? (give your answer in cm and in mm)

4.3cm = 43mm

5. The arrow is pointing at what measurement? (give your answer in cm and in mm)

3.7cm = 37mm

6. You have to cut skirting to measure 1010mm. If your tape measure is in cm, what length is 1010 mm in cm?

101cm

7. A length of pipe needs to be 1570mm long. What is this length in metres?

1570 ÷ 1000 = 1.57m
MEASURE, SHAPE & SPACE ANSWERS - TASK 4

SITE PLANS

Karen works for a construction firm and needs to be able to translate the measurements from the plans she has been given to actual lengths on site. This requires her to accurately measure lengths on the drawings and interpret what these lengths mean on the site. Look at the plans below and check your understanding of site plans.

1. What is the overall length of this section of the site?

\[1035 + 2035 + 2015 + 910 = 5995\text{mm}\]

2. What is 2035mm in metres?

\[2.035\text{m}\]

3. The architect thinks he has made a mistake and the 2035mm measurement should be 2.35m. Are these two measurements different? If so, what is the difference?

\[2.35 \text{ m} = 2350\text{mm}\]
\[2350 - 2035 = 315\text{mm}\]
the difference is 315mm
The plan is changed to incorporate the changed measurement.

4. Calculate the overall length now.

1035 + 2350 + 2015 + 910 = 6310mm

5. There is a measurement missing from the plan above. What is the missing measurement?

1270 - 926 = 344mm
6. What is the total overall length shown by the arrow?

450 + 1405 + 600 + 1405 = 3860mm
MEASURE, SHAPE & SPACE ANSWERS - TASK 5

MATERIALS

When working with different materials on site you will need to be able to compare quantities accurately. You will come across weights and lengths frequently on site. From the weight of a steel H section which will need to be accurately counterbalanced when using a crane on site, to quantities of stone and other building materials, you will need to be able to work with metric measurements. Lengths of timber, pipe and steel etc need to be accurately known. Measurements may be given in a variety of units and you need to be able to convert from one unit to another. Test your understanding in the questions below.

1. Put these lengths in ascending order.

   1.06m 1200mm 130cm

   1.06m 1200mm 130cm

2. Put these lengths in ascending order.

   0.36m 0.4m 0.42m

   0.36m 0.4m 0.42m

3. Put these weights in order of size.

   23.06kg 23.6kg 23500g

   23.06kg 23500g 23.6kg
4. Match each of these items to their approximate measurement.

- Height of door: 0.8m
- Width of door: 1900mm
- Length of a brick: 2250mm
- Height of garden wall: 230mm
- Height of garage door: 1.2m
MEASURE, SHAPE & SPACE ANSWERS - TASK 6

PERIMETER

New firm, RJM joinery, has been asked to quote for replacement skirting for a client. He visits the client, takes preliminary measurements and calculates the quantity of skirting needed.

1. What are the lengths of the two sides where the measurements are missing?

\[
\begin{align*}
3.3 - 2.1 &= 1.2m \\
2.5 - 1.2 &= 1.3m \\
\end{align*}
\]

2. Work out the total amount of skirting needed for the room in millimetres.

\[
\text{Perimeter:} \\
2.1 + 1.2 + 1.2 + 1.3 + 3.3 + 2.5 + 11.6m \\
\]

Total length of skirting required in metres: 11.6m

Total length of skirting required in millimetres: 11600mm
Helen wants to replace the skirting board in her living room. She hasn’t taken any measurements yet but remembers that her living room is identical to the dining room she did a couple of months ago except that the living room has a chimney breast on one wall. Helen believes that since the chimney breast cuts down on floor area she will not need any more skirting for the living room than she did for the dining room. She decides to order the same amount she ordered for the dining room.

3. Use a diagram and/or a calculation in the space below to demonstrate Helen’s mistake.

A reduction in area does not necessarily mean a reduction in perimeter.

Living room wall with chimney breast is longer than the “same” dining room wall with no chimney breast.
The client would also like to get an estimate for a wooden floor to be laid in their dining room. In order to calculate the estimate he needs to work out the area of the room. This means taking measurements of the length and width of the room and converting measurements to metres in order to find the area in squared metres.

Plan of room:

What is the area of the room?

\[2.63 \times 3 = 7.89\]

The area of the room to be floored is:

\[7.89\text{m}^2\]
MEASURE, SHAPE & SPACE ANSWERS - TASK 8

PLANS

Measurements can be taken directly from site plans and used in calculations off site. A site plan is a bird’s eye view of a property that is drawn to scale. A site plan can show:

- Property lines
- Outline of existing and proposed buildings and structures
- Distance between buildings
- Distance between buildings and property lines (setbacks)
- Parking lots, indicating parking spaces
- Driveways
- Surrounding streets
- Landscaped areas
- Easements
- Ground sign location

When working from plans you will need to be able to interpret the plans and the measurements on the plans to accurately calculate quantities.

1. From the upstairs plan what is the perimeter of the room in mm?

\[ 9290 + 5305 + 9290 + 5305 = 29190 \text{mm} \]
2. What would this be in metres?

\[ \frac{29190}{1000} = 29.19 \text{m} \]

3. What is the width of the door for the training room?

762mm

4. What length of skirting would be needed for the room? (remember to leave out the door)

\[ 29190 - 762 = 28428 \text{mm} \]
Laying a Concrete Driveway

RS Contracts have received an order to lay a concrete driveway for a customer. The dimensions of the driveway have been measured as below:

\[ \text{Volume} = \text{length} \times \text{width} \times \text{height} \]

To order material such as stones for a path or concrete for a driveway or foundations, you need to calculate the volume. Volumes are normally measured in units cubed such as metres cubed.
EXAMPLE

For this example the volume is $4 \times 5 \times 10 = 200 \text{m}^3$

To determine the volume of concrete needed, RS contracts multiply the length and width of the driveway by the depth of concrete to be laid, in this case 100mm.

1. What volume of concrete will they need to order?

Length of driveway in metres = 15.5m

Width of driveway in metres = 4m

Depth of concrete in METRES = 0.1m

Volume of concrete = $15.5 \times 4 \times 0.1 = 6.2 \text{m}^2$

2. As a general rule: one cubic metre of concrete weighs around 2.5 tonnes. Using this method, how many tonnes of concrete will you need to order?

a. Using your answer to question 1 $6.2 \times 2.5 = 15.5 = 15.5 \text{ tonnes}$
ERECTING A SHED

A client wants you to erect a garden shed.

The shed they have chosen is from B & Q and costs £589. Until the end of the week there is an offer of 25% off all garden buildings.

In addition to erecting the shed you will have to build a concrete base. The amount of concrete required for the base will need to be calculated. Follow the steps below to cost the job.

1. What is 25% as a fraction?

1/4

2. What does the discount on the shed work out at?

\[ \frac{589}{4} = 147.25 \]

£147.25

3. What is the price of the shed with the 25% discount taken off?

\[ £589.00 - £147.25 = £441.75 \]
To build a garden shed you will need to lay a concrete pad that is 25mm smaller on all sides than the base of the shed, to create an overhang and prevent water accumulating around the timber floor and runners.

The dimensions of the shed are: 2000mm by 1750mm by 3475mm

4. What would the dimensions of the concrete base need to be? see the diagram below for help

The dimensions of the concrete slab would be:

<table>
<thead>
<tr>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 - 50 = 1950mm</td>
<td>1750 - 50 = 1700mm</td>
</tr>
<tr>
<td>LENGTH = 1950mm</td>
<td>WIDTH = 1700mm</td>
</tr>
</tbody>
</table>
5. If the concrete for the slab needs to be 100mm thick, what volume of concrete will be needed in metres cubed?

**REMEMBER:** \( \text{Volume} = \text{length} \times \text{width} \times \text{height} \)

- Length in m = 1.95m
- Width in m = 1.7m
- Height in m = 0.1m

\[
\text{Volume} = 1.95 \times 1.7 \times 0.1 = 0.3315 \text{m}^3
\]

6. Concrete costs approximately £60 per metre cubed including VAT. What will the cost be for the concrete?

\[
£60 \times 0.3315 = £19.89
\]

7. The labour costs work out at £130 including VAT. What is the total costing for the client for the purchase and erection of the shed?

- Labour costs: £130
- Cost of shed: £441.75
- Cost of concrete: £19.89

Total = £591.64

The total costs will be: £591.64
MEASURE, SHAPE & SPACE ANSWERS - TASK 11

BRICK WALL

James is an apprentice and has been asked to build a small garden wall for a family member. This is the first time he has undertaken a project from start to finish. He needs to do a range of calculations for instance the amount of brick, mortar, concrete etc. required to complete the job. The task below will take him through the various stages of each calculation.

Each brick measures:

21.5 cm x 10.25 cm x 6.5 cm

1. What are the dimensions of the brick in mm?

| 215mm by 102.5mm by 65mm |

The first bricks have been laid as shown above.

2. If the thickness of mortar is 10mm. What is length of the wall so far?

16 bricks x 215 = 3440mm
15 x 10 = 150mm
Total = 3590mm

3. Mortar is made up from 1 part cement to 4 parts sand. How much sand would be needed to mix with 2 buckets of cement?

<table>
<thead>
<tr>
<th>1 part cement</th>
<th>to</th>
<th>4 parts sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 buckets of cement</td>
<td>to</td>
<td>8 buckets of sand</td>
</tr>
</tbody>
</table>
MEASURE, SHAPE & SPACE ANSWERS - TASK 11

4. When the wall around the garden is completed it will contain 120 bricks. Each brick costs 40p. How much will all the bricks required for the wall cost?

120 \times 40 = 4800\text{p} = \£48

For a small garden wall, a foundation is dug as shown below.

The width of the foundation is twice the width of a brick plus 10mm.

5. If a brick is 102.5mm wide, what will the width of the foundation be?

102.5 \times 2 = 205\text{mm}

205 + 10 = 215\text{mm}
6. What are the dimensions of the foundation in metres?

**Length** = 5m

**Width** = 0.215m

**Height** = 0.2m

7. What volume of concrete will you need for the foundation?

\[
\text{Volume of cuboid} = \text{length} \times \text{width} \times \text{height}
\]

\[5 \times 0.215 \times 0.2 = 0.215\]

Volume of concrete = 0.215m³

8. The concrete for the foundation is made up 1 part cement : 3 parts sand : 5 parts 10mm aggregate. If you have 8 buckets of cement, how many buckets of sand and aggregate will you need?

<table>
<thead>
<tr>
<th>1 part cement</th>
<th>:</th>
<th>3 parts sand</th>
<th>:</th>
<th>5 parts 10mm aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8 buckets of cement</strong></td>
<td>:</td>
<td><strong>24 buckets</strong></td>
<td>:</td>
<td><strong>40 buckets</strong></td>
</tr>
</tbody>
</table>
Chris lives in Newry and is a construction engineer for a large local firm. He has to make a visit to three of the company’s sites tomorrow. The first site is in Ballycastle and Chris is trying to work out how far away it is. He takes out a map similar to the one you see below and begins to estimate the distance from Newry to Ballycastle.

1. Use a ruler to estimate the distance “as the crow flies” from Newry to Ballycastle if the map has a scale of 1cm to 4.5 miles.

Round the ruler measurement to the nearest cm
Less than 9.5cm so rounds to 9cm

Convert this to miles using the scale given above

\[ 9 \times 4.5 = 40.5 \text{ miles} \]
Chris realises this method is not very accurate so he attempts to use a slightly different approach. He breaks the journey into three “as the crow flies” legs.

- Newry to Belfast
- Belfast to Ballymena
- Ballymena to Ballycastle

2. Use the map again to calculate an improved estimate of the distance from Newry to Ballycastle and show your working in the space below

<table>
<thead>
<tr>
<th>Distance</th>
<th>Ruler Measurement in cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newry to Belfast</td>
<td>Circle one option 4.0cm 4.5cm 5.0cm</td>
</tr>
<tr>
<td>Belfast to Ballymena</td>
<td>Circle one option 3.0cm 3.5cm 4.0cm</td>
</tr>
<tr>
<td>Ballymena to Ballycastle</td>
<td>Circle one option 3.0cm 3.5cm 4.0cm</td>
</tr>
</tbody>
</table>

Add up the three measurements:

Total journey in cm = 4.5 + 3.0 + 3.0 = 10.5cm

Total journey in miles = 10.5 x 4.5 = 47.25 miles
3. Round your answer above to the nearest 5 miles.

\[47.25 = 45 \text{ miles to the nearest 5 miles}\]

An internet search on www.multimap.com for this journey gives an answer of 92 miles.

4. Round this figure to the nearest 5 miles

\[92 = 90 \text{ miles to the nearest 5 miles}\]

The difference in the previous two answers could be described as the error in Chris’s method.

5. What is the error in miles?

\[90 - 45 = 45 \text{ miles}\]
6. Which of the following answers do you feel best describes the percentage error in Chris’s method? Don’t do any further actual calculations to answer this.

<table>
<thead>
<tr>
<th>Error in miles = 45</th>
<th>Correct answer in miles = 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle one option</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>33%</td>
</tr>
<tr>
<td>50%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Reason:
45 is half of 90 and ½ = 50%

After Chris visits the Ballycastle site he has to go to Magherafelt where his company are upgrading the spectator seating at a local rugby ground. From Magherafelt he will travel to a site in Armagh where his company are building a new shopping centre. After that he will go back to Newry.

7. Use the mileage chart below to calculate how far Chris will have travelled altogether by the time he returns home again in the evening.

<table>
<thead>
<tr>
<th></th>
<th>Armagh</th>
<th>Ballycastle</th>
<th>Magherafelt</th>
<th>Newry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armagh</td>
<td></td>
<td>95</td>
<td>33</td>
<td>19</td>
</tr>
<tr>
<td>Ballycastle</td>
<td>95</td>
<td></td>
<td>52</td>
<td>92</td>
</tr>
<tr>
<td>Magherafelt</td>
<td>33</td>
<td>52</td>
<td></td>
<td>51</td>
</tr>
<tr>
<td>Newry</td>
<td>19</td>
<td>92</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

Mileage covered in total:
92 + 52 + 33 + 19 = 196 miles
He arrives in Ballycastle just as the workers are having a tea break. Bill and Malachy are having a conversation about an article in the newspaper. The article includes the chart shown below.

Bill says Construction has received twice as much investment as manufacturing. Malachy agrees and thinks the retail sector has received very little indeed.

8. Comment on these statements in the space below.

**Construction received twice as much as manufacturing:**
Construction bar is twice as long as Manufacturing hence Bill’s error as the axis does not start at 0.

**Retail sector received very little:**
Relative to other bars the Retail bar looks insignificant. However in reality over £30 million has been invested in that sector but the axis not starting at 0 is misleading at a glance.
MEASURE, SHAPE & SPACE ANSWERS - TASK 12

There is an article in this paper about the rugby ground Chris’s company are in the process of upgrading. The article states that the finished stadium is to have a seating capacity of 380,000 people and that 15,000 tonnes of concrete will have been used in the construction of it. According to the article the project was initially tendered at a cost of £18,000,000 but is due to come in over budget by 50% making the final total £18,900,000.

9. State whether or not you think these statistics are reasonable and if not indicate what may be wrong.

Capacity of 380,000 people

Too large by a factor of 10. 38,000 is a much more realistic figure.

15,000 tonnes of concrete

Reasonable

£18,000,000 increased by 50% gives £18,900,000

Miscalculation: 50% of 18,000,000 is £9,000,000 and not £900,000 giving £27,000,000 instead of £18,900,000
RENovation

John is going to put down a concrete floor and replace the beams in an old barn behind his house. He takes some measurements with a tape and finds the barn floor is rectangular with dimensions 4.45m by 3.92m.

1. Round these values up the nearest metre in order to make the volume calculation easier and allow for some wastage.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Rounded Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.45m</td>
<td>5m</td>
</tr>
<tr>
<td>3.92m</td>
<td>4m</td>
</tr>
</tbody>
</table>

A builder has told him the floor needs to be at least 3” deep. John decides to use 4” to ensure he orders enough concrete and also because he knows that 4” comes out at a round number when converted to cm. What is the number he is thinking of?

2. First of all use the fact that 1” = 25mm to convert to mm.

\[ 1” = 25mm \quad \text{so} \quad 4” = 4 \times 25 = 100mm \]

3. Now convert this answer to cm.

\[ 10mm = 1cm \]
\[ 100mm = 10cm \]
John wants to order the concrete for the builder arriving. After doing the volume calculation he rings up to order 200m$^3$ of concrete. The person on the phone asks him if he is sure as that is a very large amount of concrete.

4. Is John correct? If not show how he went wrong in his calculation?

<table>
<thead>
<tr>
<th>Remember</th>
<th>Volume = length x width x height</th>
</tr>
</thead>
<tbody>
<tr>
<td>No he is not correct. John calculated $= 5 \times 4 \times 10 = 200$ because he forgot to change 10cm to 0.1m before doing his calculation. He should have got 2m$^3$.</td>
<td></td>
</tr>
</tbody>
</table>

John also wants to use steel for the main beams. The table below gives some information on the price of steel beams according to their strength.

<table>
<thead>
<tr>
<th>Beam Type</th>
<th>Max. load per metre in tonnes</th>
<th>Price (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.2</td>
<td>80</td>
</tr>
<tr>
<td>B</td>
<td>1.8</td>
<td>120</td>
</tr>
<tr>
<td>C</td>
<td>2.4</td>
<td>160</td>
</tr>
<tr>
<td>D</td>
<td>3.0</td>
<td>200</td>
</tr>
<tr>
<td>E</td>
<td>4.8</td>
<td>320</td>
</tr>
</tbody>
</table>

5. Use the figures given to help fill in the unknown prices. If you need to do some calculations use the space below the table:
Cameron is making a batch of mortar for John to finish some work behind the barn. Mixing sand and cement in different ratios helps produce different kinds of mortar.

A very hard mix as might be used for a floor would use 3:1 of sand to cement. A softer mortar mix such as is used for brickwork might use 6:1.

Cameron is making up a mix using the ratio 4:1 sand to cement. He has a 5 kg bag of cement.

6. How much sand does he need?

He needs 4 x 5 = 20kg of sand.

7. How much mortar mix will this make altogether?

5 + 20 = 25kg

Later Cameron is asked to make 50kg of mortar mix to the same hardness as the last batch. He wonders if there is a short cut to working out how much sand and cement to use for this batch.

8. Help give Cameron an answer in the space below.

By direct proportion if 25 kg needs 20kg of sand and 5kg of cement

then 50 kg needs 40kg of sand and 10kg of cement
Handling Data

Tasks and Answers

This section mainly addresses the curriculum area specified, although to allow a more realistic setting for each task, some elements from other curriculum areas may also mentioned.
THE CONSTRUCTION INDUSTRY

Statistics in the construction sector allow changes and trends to be analysed. They give a perspective of trends in the construction industry in the Northern Ireland and allow some international comparisons. It also helps to determine initiatives that may influence the future.

Statistics can be used by insurance companies to set premiums.

For businesses, statistics allow them to forward plan by looking at current trends.

BAR CHARTS

Remember that bar charts are one way of displaying information.

When you draw a bar chart, you need to decide what it is you want your chart to illustrate. Then you need to consider:

1. What will the title be?
2. How many bars will you need?
3. What scale will you need for the other axis?
4. Draw and label the two axes.
5. Draw the bars.

Look at the bar chart below taken from http://www.statistics.gov.uk
HANDLING DATA TASK 1

Section 1

Look at the information in the chart on the construction industry from the source material. Decide whether these statements are true or false.

1. The bar chart shows how many people were employed in the construction industry in Northern Ireland from 2003 to 2009.
   True / False

2. One thousand three hundred people were employed in the construction industry in 2006.
   True / False

3. The biggest increase in the number of people employed in the construction industry was seen between 2005 and 2006.
   True / False

PIE CHARTS

Pie charts are useful to compare different parts of a whole amount. Pie charts are circles divided into segments, where each segment represents a fraction of the total amount.

The pie chart below shows the proportion of males and females employed in the construction sector in the UK in 2009.
HANDLING DATA TASK 1

Section 2

Look at the information in the pie chart.

1. What labels should go on the right hand side? Write your answer on the chart.

Decide whether these statements are true or false.

3. There are more males than females employed in the construction sector in 2009.
   True / False

3. About one quarter of the total people employed in the construction industry is female.
   True / False

COMPARISON BAR CHART

The Comparison bar chart is used when we want to represent two sets of data on the same chart. We can put the bars side by side or we may put the bars of one set of data on top of the bars of the other set of data.
HANDLING DATA TASK 1

Section 3

When the comparison bar chart was drawn the labels were missing. They are below. Can you write in where they should be on the chart?

<table>
<thead>
<tr>
<th>Year</th>
<th>Number employed in the construction industry in the UK in thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
</tr>
<tr>
<td></td>
<td>Females</td>
</tr>
</tbody>
</table>

Chart showing the numbers of males and females employed in the construction industry.

Did your chart look like this?

Look at the information in the comparison bar chart. Decide whether these statements are true or false.

1. The percentage of people employed in the construction sector as plumbers is greater in the UK than in Northern Ireland.
   True / False

2. The percentage of people employed in the construction sector as architects / technical engineers is greater in Northern Ireland than in the UK.
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THE WORKFORCE

It is important for a company to monitor the makeup of their workforce both those directly employed by the company and also any subcontracted staff. This allows them to identify areas where there may be a high turnover of staff or where it has been difficult to get suitable qualified employees. Where there is a skill shortage companies need to forward plan. This may mean diversifying the skills of current employees to meet the shortage in the longer term.

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</tr>
<tr>
<td>Other</td>
<td>27</td>
</tr>
</tbody>
</table>

1. Display this information on a Bar chart.
The engineers worked the following hours last month:

181 203 217 184
179 221 233 165
194 0

2. What is the mean number of hours worked last month by the engineers?

Total hours worked by all 10 engineers =

Mean number of hours worked = Total hours worked ÷ number of engineers

3. What is the range of hours worked last month by the engineers?
4. A new engineer joined the company this month and she worked 204 hours. What is the mean number of hours worked this month by the engineers if the others worked the same number of hours as in the previous month?

Total hours worked by all 11 engineers =

Mean number of hours worked = Total hours worked ÷ number of engineers

5. What is this figure rounded to the nearest hour?

6. How has the arrival of the new employee affected the mean number of hours worked?

7. How has the range of hours worked been affected?
HANDLING DATA TASK 3

AVERAGE AND RANGE

Averages look at what we mean when we think of the "typical" value in a collection of data. The concept is extremely important and we encounter it frequently in construction, because we regularly work with numerical quantities. For example, the average number of bricks needed for a wall with particular dimensions or before accepting a job, you might want to know what a typical salary is for someone in that position. The concept of "typical" or "average" is an important one in the construction sector.

Mean

The average is a typical value. In this section when we talk about average we are talking about mean. There are other types of average but we want to look at mean.

It is easy to calculate: Just add up all the numbers, then divide by how many numbers there are.

\[
\text{Mean} = \frac{\text{Total}}{\text{Number of values}}
\]

Example

The lengths of off cuts of wood in a workshop are:

400mm 200mm 150mm 330mm

To find the average (mean) length of wood we:

Total = 400 + 200 + 150 + 330 = 1080mm

Number of values = 4

Mean = \[ \frac{1080}{4} = 270 \text{mm length} \]

Check your answer is correct by doing the reverse calculation. 270 \times 4 = 1080

1. Four site operatives earn £6.50 an hour and the site foreman earns £15 an hour. What is the mean wage?
2. Does this wage represent the salaries that those on the site earn i.e. is it a typical value?

3. The ages of students on a joinery course are shown below. What is the average (mean age)?

16 17 19 17 18 16 30

4. Employees at a builder’s yard are paid the hourly wages listed below. What is the mean hourly wages?

£5.15, £8.95, £5.75, £5.50, £5.25, £5.40.
Range

The range is the difference between the highest and lowest values in a set of numbers. It tells you how spread out the values are.

To find it, **subtract the lowest number in the set of numbers from the highest**.

Range = highest value – lowest value

**Example**

The ages of students on a joinery course are shown below. What is the range in ages?

16 17 19 17 18 16 23 30

Range = highest value – lowest value

Range = 30 – 16 = **14 years**
5. The prices for a tape measure are shown below. Find the price range?

<table>
<thead>
<tr>
<th>Description</th>
<th>Product 1</th>
<th>Product 2</th>
<th>Product 3</th>
<th>Product 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5m (16R): Blade armour protection on first 8&quot; for resistance to breakage on susceptible areas. 22mm wide blade for easy reading. Blade hook grabs on top or bottom for versatility.</strong></td>
<td><strong>5.29</strong></td>
<td><strong>£17.79</strong></td>
<td><strong>£9.99</strong></td>
<td><strong>£25.65</strong></td>
</tr>
<tr>
<td><strong>Highly accurate, professional Tape Measure. Metric and imperial. Spring return mechanism and 3 rivet tru-zero' hook for accurate readings.</strong></td>
<td><strong>£15.99</strong></td>
<td><strong>£24.99</strong></td>
<td><strong>£19.99</strong></td>
<td><strong>£29.99</strong></td>
</tr>
<tr>
<td><strong>30m x 13mm Tape coated with acrylic polymers. Easy-to-read bold black numbers.</strong></td>
<td><strong>£34.99</strong></td>
<td><strong>£59.99</strong></td>
<td><strong>£49.99</strong></td>
<td><strong>£69.99</strong></td>
</tr>
<tr>
<td><strong>10m (33'). Blade armour protection on first 8'. 32mm wide blade for easy reading. Blade hook grabs on top or bottom.</strong></td>
<td><strong>£29.99</strong></td>
<td><strong>£54.99</strong></td>
<td><strong>£44.99</strong></td>
<td><strong>£64.99</strong></td>
</tr>
</tbody>
</table>
6. Employees at a builder’s yard are paid the hourly wages listed below. What is the range of these hourly wages?

£7.50, £9.25, £8.75, £9.50, £7.25, £8.50.

7. The hours worked on site for 5 employees are shown below. What is the range of hours worked and what is the mean number of hours worked.

36  32  40  39  38
A building contractor employs 10 construction tradespersons on a full-time basis. All skilled construction trade employees are paid the same basic annual salary of £25,250. As managing director he pays himself an annual salary of £99,500. He is looking to take on another full-time bricklayer and advertises in the jobs section of a trade publication. The advertisement claims that the average salary in the company is £32,000.

8. Is this claim correct?

Total salary bill for company for 10 tradespersons and the managing director

= 

Mean salary = Total salary ÷ 11

= 

9. Is this advertisement fair? If not why not?
HANDLING DATA TASK 4

BUILDING TRADE

The following table shows the volume of sales revenue (£000’s) last year for five building supplies businesses chosen at random in Northern Ireland, Republic of Ireland and England.

<table>
<thead>
<tr>
<th>Northern Ireland (£)</th>
<th>Republic of Ireland (€)</th>
<th>England (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>356</td>
<td>203</td>
<td>215</td>
</tr>
<tr>
<td>413</td>
<td>645</td>
<td>6305</td>
</tr>
<tr>
<td>167</td>
<td>909</td>
<td>451</td>
</tr>
<tr>
<td>48</td>
<td>396</td>
<td>87</td>
</tr>
<tr>
<td>192</td>
<td>302</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

1. Use the conversion graph below to convert the figure for Republic of Ireland from € to £ so a comparison can be made.

Currency Conversion (Euro v Sterling)

2. Did you convert each value individually or did you use an alternative method?

3. Now complete the table above so the totals are in £.
HANDLING DATA TASK 4

4. Calculate the mean revenue for building supplies businesses in the separate regions.

**Northern Ireland**

Total revenue =

Mean = Total revenue ÷ 5 =

What does the displayed by your calculator mean in terms of money?

**Republic of Ireland**

Total revenue =

Mean = Total revenue ÷ 5 =

What does the displayed by your calculator mean in terms of money?

**England**

Total revenue =

Mean = Total revenue ÷ ? =

What does the displayed by your calculator mean in terms of money?
5. Determine an all-Ireland national average (mean) and compare it to the figure you already have for England.

<table>
<thead>
<tr>
<th>All-Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total revenue =</td>
</tr>
<tr>
<td>Mean = Total revenue ÷ ?</td>
</tr>
</tbody>
</table>

Compare:

6. Which region had the largest range in revenues last year according to the data in the table above?

If you are able to answer this without having to do any calculations please explain why:
On site you will encounter a wide range of plant machinery from dozers to excavators to loaders and lorries. Each has a specific function on site and that function will determine the design and specification of the vehicle. Below are cards showing a range of plant machinery and their dimensions. Compare the vehicles and look at the weight, lengths and power of each. The cards can be used to play a game of trumps later.

**LARGE DOZER**
- Engine power: 259 kW
- Max. Operating Weight: 38,488 kg
- Overall length: 5.6m
- Fuel tank: 643 litres

**TRACKED EXCAVATOR**
- Engine power: 124kW
- Max. Operating Weight: 20,003 kg
- Overall length: 8.37m (Transport length)
- Fuel tank: 253 litres

**SKID STEER LOADERS**
- Engine power: 52kW
- Max. Operating Weight: 2,650 kg
- Overall length: 3.27m
- Fuel tank: 80 litres

**MEDIUM DOZER**
- Engine power: 93kW
- Max. Operating Weight: 13,460kg
- Overall length: 4.7m
- Fuel tank: 295 litres

**WHEELED LOADER**
- Engine power: 180kW
- Max. Operating Weight: 25,400kg
- Overall length: 8.1m
- Fuel tank: 210 litres

**MOBILE CRANE**
- Engine power: 205kW
- Max. Operating Weight: 29,000kg
- Overall length: 10.5m (Transport position)
- Fuel tank: 300 litres
HANDLING DATA TASK 5

**DUMP TRUCK**

- Engine power – 246 kW
- Max. Operating Weight – 53,140kg
- Overall length – 6.9 m
- Fuel tank – 410 litres

**VIBRATING ROLLER**

- Engine power – 100 kW
- Max. Operating Weight – 11,550kg
- Overall length – 4.5 m
- Fuel tank – 200 litres

**ROLLER**

- Engine power – 97 kW
- Max. Operating Weight – 11,300kg
- Overall length – 5.4 m
- Fuel tank – 300 litres

**BACKHOE LOADER**

- Engine power – 74.2kW
- Max. Operating Weight – 8,660kg
- Overall length – 5.9 m
- Fuel tank – 160 litres
HANDLING DATA TASK 5

Using the cards for construction machinery, answer the questions below.

1. What is the range of engine powers in the vehicles?

2. Round each of the lengths to the nearest metre.

<table>
<thead>
<tr>
<th>VEHICLE</th>
<th>LENGTH ROUNDED to nearest metre</th>
<th>VEHICLE</th>
<th>LENGTH ROUNDED to nearest metre</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Bulldozer</td>
<td></td>
<td>F. Mobile Crane</td>
<td></td>
</tr>
<tr>
<td>B. Tracked Excavator</td>
<td></td>
<td>G. Dump Truck</td>
<td></td>
</tr>
<tr>
<td>C. Skid steer Loaders</td>
<td></td>
<td>H. Vibrating Roller</td>
<td></td>
</tr>
<tr>
<td>D. Medium Dozer</td>
<td></td>
<td>I. Roller</td>
<td></td>
</tr>
<tr>
<td>E. Wheeled Loader</td>
<td></td>
<td>J. Backhoe Loader</td>
<td></td>
</tr>
</tbody>
</table>

3. For the two dozers (A) and (D), what is the average (mean) engine power?

4. What is the range in lengths of the construction vehicles?
5. Work out the order of the cards based on the actual overall length of each vehicle. You don't need to write out the name of each vehicle, simply use the letters on each card A to J.

<table>
<thead>
<tr>
<th>Vehicles - smallest to largest overall lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

6. What is the range in lengths of the construction vehicles?

7. What is the range in sizes of the fuel tanks?

8. What is the operating weight of the mobile crane in tonnes?
CHANCES ARE

Probability is an area of mathematics used to measure uncertainty. In life the outcome of many events is not predictable but it is possible to get an idea of how likely some things are to happen. Being able to tell how likely something is to happen is very important in construction especially when it comes to health and safety. Insurance companies base their premiums directly on probabilities.

A scale is used to represent probability with “impossible” at one end and “certain” at the other. All other outcomes can be placed somewhere on the scale between these two extremes. Things that are unlikely are placed near the impossible end whilst things likely to happen are placed near the certain end. We can use common sense to place some outcomes on the scale….

1. For example, place the following outcomes on the probability scale below

A. Someone chosen at random from a construction trade is a man
B. Someone who follows all safety guidelines has an accident
C. A mortar mixture will harden if someone forgot to add cement
D. A warm but poorly insulated building will lose heat on a cold day
E. Someone chosen at random from the community is a woman

Sometimes we cannot just tell from common sense how likely an outcome is or whether one outcome is more likely than another. In order to tell if some outcomes are more likely than others we need to represent probabilities using fractions. The top of the fraction is the number of favourable outcomes and the bottom of the fraction is the number of possible outcomes.

\[
\text{Probability} = \frac{\text{Number of favourable outcomes}}{\text{Number of possible outcomes}}
\]
2. Complete the following table to help you practice working with different kinds of fractions and then you can try to answer some probability questions.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
<th>Percentage</th>
<th>Outcome description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>0%</td>
<td>Impossible</td>
</tr>
<tr>
<td>0.1</td>
<td>0.1</td>
<td>10%</td>
<td>Unlikely</td>
</tr>
<tr>
<td>1/2</td>
<td>0.5</td>
<td>50%</td>
<td>Just as likely as not to happen</td>
</tr>
<tr>
<td>0.75</td>
<td>0.75</td>
<td>75%</td>
<td>Very likely</td>
</tr>
<tr>
<td>1</td>
<td>1.0</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Use the definition of probability given above to determine how probable the following events are to happen.

3. McAteer and Bushe, a local construction company, have purchased 4 brand new lorries. Only one of them has air-conditioning for the cab. If a driver chooses a lorry to drive at random what is the probability it will have air-conditioning.

4. What is the probability it won't have air-conditioning?
5. If you have not already done so express your answers to the latter two questions in percentage form.

6. What do you notice about the answers when you add them together?

7. The probability of a lorry breaking down in service is 0.05. Use what you have learned in the previous question to determine the probability that a lorry will not break down in service.

8. Write down a rule to help you find the probability of something not happening if you already know the probability of it happening.
HEALTH AND SAFETY

As mentioned in the previous task, one important use of probability in the construction sector is linked to the management of health and safety. You can now try to apply what you have learned above to the following scenario:

A Safety at Work study (figures not official) has been carried out for the construction industry. It has been determined there is a 1% chance an operative (18-65 years old) will have an accident whilst driving machinery.

1. What is the probability that an operative will not have an accident whilst driving machinery?

2. If 1% of the 30000 operatives working in Northern Ireland have an accident when using machinery, how many would that be?
The study also looked at safety of pneumatic drills and found that there is a 1 in 50 (that’s 2%) chance an operative will have an accident whilst using one.

3. Which of the activities appears to be more accident prone, driving machinery or using a pneumatic drill?

Of the 30000 operatives referred to above, 1500 of them are over 50 years old.

4. What is the probability that an operative is over 50?

There are ten different tasks given to operatives in one company. Five involve driving machines, two involve using pneumatic drills and three involve the use of hand tools.

5. What is the probability an operative will be given a task involving a hand tool?
6. What is the probability that the operative will NOT be given a task involving a hand tool?

7. What is the probability that theoperative will be given a task involving use of a pneumatic drill?
HANDLING DATA ANSWERS - TASK 1

THE CONSTRUCTION INDUSTRY - ANSWERS

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\]

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<p>| | | | |</p>
<table>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>181</td>
<td>203</td>
<td>217</td>
<td>184</td>
</tr>
<tr>
<td>179</td>
<td>221</td>
<td>233</td>
<td>165</td>
</tr>
<tr>
<td>194</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. What is the mean number of hours worked last month by the engineers?

Total hours worked by all 10 engineers =

\[
181 + 203 + 217 + 184 + 179 + 221 + 233 + 165 + 194 + 0 = 1777 \text{ hrs}
\]

Mean number of hours worked = Total hours worked ÷ number of engineers

\[
177 \div 10 = 177.7 \text{ hrs (178 hrs)}
\]

3. What is the range of hours worked last month by the engineers?

\[
233 - 0 = 233 \text{ hrs}
\]
4. A new engineer joined the company this month and she worked 204 hours. What is the mean number of hours worked this month by the engineers if the others worked the same number of hours as in the previous month?

Total hours worked by all 11 engineers =

\[ 1777 + 204 = 1981 \]

Mean number of hours worked = Total hours worked ÷ number of engineers =

\[ 1981 ÷ 11 = 180.0909091 \] (calculator display)

5. What is this figure rounded to the nearest hour?

180 hrs

6. How has the arrival of the new employee affected the mean number of hours worked?

It has increased

7. How has the range of hours worked been affected?

unaffected
AVERAGES look at what we mean when we think of the “typical” value in a collection of data. The concept is extremely important and we encounter it frequently in construction, because we regularly work with numerical quantities. For example, the average number of bricks needed for a wall with particular dimensions or before accepting a job, you might want to know what a typical salary is for someone in that position. The concept of “typical” or “average” is an important one in the construction sector.

Mean

The average is a typical value. In this section when we talk about average we are talking about mean. There are other types of average but we want to look at mean.

It is easy to calculate: Just add up all the numbers, then divide by how many numbers there are.

\[
\text{Mean} = \frac{\text{Total}}{\text{Number of values}}
\]

**Example**

The lengths of off cuts of wood in a workshop are:

400mm 200mm 150mm 330mm

To find the average (mean) length of wood we:

\[
\text{Total} = 400 + 200 + 150 + 330 = 1080\text{mm}
\]

\[
\text{Number of values} = 4
\]

\[
\text{Mean} = \frac{1080}{4} = 270\text{mm length}
\]

Check your answer is correct by doing the reverse calculation. 270 × 4 = 1080

1. Four site operatives earn £6.50 an hour and the site foreman earns £15 an hour. What is the mean wage?

\[
£6.50 + £6.50 + £6.50 + £6.50 + £15 = £41
\]

\[
£41 ÷ 5 = £ 8.20
\]
2. Does this wage represent the salaries that those on the site earn i.e. is it a typical value?

£8.20 is more than the rate most of the employees on site earn.

3. The ages of students on a joinery course are shown below. What is the average (mean age)?

16 17 19 17 18 16 30

\[16 + 17 + 19 + 17 + 18 + 16 + 30 = 133\]
\[133 \div 7 = 19\]
Mean age 19

4. Employees at a builder’s yard are paid the hourly wages listed below. What is the mean hourly wages?

£5.15, £8.95, £5.75, £5.50, £5.25, £5.40.

\[£5.15 + £8.95 + £5.75 + £5.50 + £5.25 + £5.40 = £36\]
\[£36 \div 6 = £6\]
Range

The range is the difference between the highest and lowest values in a set of numbers. It tells you how spread out the values are.

To find it, subtract the lowest number in the set of numbers from the highest.

Range = highest value – lowest value

Example

The ages of students on a joinery course are shown below. What is the range in ages?

16  17  19  17  18  16  30

Range = highest value – lowest value

Range = 30 – 16 = 14 years
5. The prices for a tape measure are shown below. Find the price range?

£25.65 - £9.99 = £15.66
6. Employees at a builder’s yard are paid the hourly wages listed below. What is the range of these hourly wages?

£7.50, £9.25, £8.75, £9.50, £7.25, £8.50.

£9.50 - £7.25 = £2.25

7. The hours worked on site for 5 employees are shown below. What is the range of hours worked and what is the mean number of hours worked.

36  32  40  39  38

36 + 32 + 40 + 39 + 38 = 185

185 ÷ 5 = 37 hours

Range = 40 - 32 = 8 hours
A building contractor employs 10 construction tradespersons on a full-time basis. All skilled construction trade employees are paid the same basic annual salary of £25,250. As managing director he pays himself an annual salary of £99,500. He is looking to take on another full-time bricklayer and advertises in the jobs section of a trade publication. The advertisement claims that the average salary in the company is £32,000.

8. Is this claim correct?

Total salary bill for company for 10 tradespersons and the managing director

10 x 25,250 = 252,500

99,500 + 252,500 = £352,000

Mean salary = Total salary ÷ 11 = £352,000 ÷ 11 = £32,000

The claim is correct.

9. Is this advertisement fair? If not why not?

No it is not fair. The large director’s salary enhances the mean. The advert should not have used the director’s salary in a calculation of the mean salary for the tradespersons.
BUILDING TRADE - ANSWERS

The following table shows the volume of sales revenue (£000's) last year for five building supplies businesses chosen at random in Northern Ireland, Republic of Ireland and England.

<table>
<thead>
<tr>
<th></th>
<th>Northern Ireland (£)</th>
<th>Republic of Ireland (€)</th>
<th>England (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>356</td>
<td>179</td>
<td>215</td>
</tr>
<tr>
<td>2nd</td>
<td>413</td>
<td>568</td>
<td>6305</td>
</tr>
<tr>
<td>3rd</td>
<td>167</td>
<td>800</td>
<td>451</td>
</tr>
<tr>
<td>4th</td>
<td>48</td>
<td>348</td>
<td>87</td>
</tr>
<tr>
<td>5th</td>
<td>192</td>
<td>266</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1176</strong></td>
<td>**Total <strong>€2455</strong></td>
<td><strong>Total 7058</strong></td>
</tr>
</tbody>
</table>

1. Use the conversion graph below to convert the figure for Republic of Ireland from € to £ so a comparison can be made.

   Currency Conversion (Euro v Sterling)

![Currency Conversion Graph]

2. Did you convert each value individually or did you use an alternative method?

   Note: on account of the scale of graph answers are necessarily approximate as estimation is required.

   Alternative method is to first total Euro in table to get €2455.

   Approximate this as €2400 because 2400 = 3 x 800 and €800 to £700 is a very straightforward conversion on the graph as it lies on a grid point.

   Then by direct proportion 3 x 700 = £2100. This compares quite well with the ‘exact’ amount of £2161.
3. Now complete the table above so the totals are in £.

4. Calculate the mean revenue for building supplies businesses in the separate regions.

<table>
<thead>
<tr>
<th>Region</th>
<th>Total Revenue</th>
<th>Mean</th>
<th>Value in £</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Ireland</td>
<td>1176</td>
<td>235.2</td>
<td>£235,200</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>2161</td>
<td>432.2</td>
<td>£432,200</td>
</tr>
<tr>
<td>England</td>
<td>7058</td>
<td>1411.6</td>
<td>£1,411,600</td>
</tr>
</tbody>
</table>
5. Determine an all-Ireland national average (mean) and compare it to the figure you already have for England.

<table>
<thead>
<tr>
<th>All-Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total revenue = 1176 + 2161 = 3337</td>
</tr>
<tr>
<td>Mean = Total revenue ÷ ? = 3337 ÷ 10 = 333.7</td>
</tr>
<tr>
<td>Compare:</td>
</tr>
<tr>
<td>All-Ireland</td>
</tr>
<tr>
<td>England</td>
</tr>
</tbody>
</table>

6. Which region had the largest range in revenues last year according to the data in the table above?

If you are able to answer this without having to do any calculations please explain why:

England, quite easy to see as England had one company whose revenue was much larger than any other company in the table (£6,305,000) and another company whose revenue was £0.
CONSTRUCTION MACHINERY

On site you will encounter a wide range of plant machinery from dozers to excavators to loaders and lorries. Each has a specific function on site and that function will determine the design and specification of the vehicle. Below are cards showing a range of plant machinery and their dimensions. Compare the vehicles and look at the weight, lengths and power of each. The cards can be used to play a game of trumps later.

<table>
<thead>
<tr>
<th>Large Dozer</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine power: 259 kW</td>
<td></td>
</tr>
<tr>
<td>Max. Operating Weight: 38,488 kg</td>
<td></td>
</tr>
<tr>
<td>Overall length: 5.6m</td>
<td></td>
</tr>
<tr>
<td>Fuel tank: 643 litres</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tracked Excavator</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine power: 124kW</td>
<td></td>
</tr>
<tr>
<td>Max. Operating Weight: 20,003 kg</td>
<td></td>
</tr>
<tr>
<td>Overall length: 8.37m (Transport length)</td>
<td></td>
</tr>
<tr>
<td>Fuel tank: 253 litres</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skid Steer Loaders</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine power: 52kW</td>
<td></td>
</tr>
<tr>
<td>Max. Operating Weight: 2,650 kg</td>
<td></td>
</tr>
<tr>
<td>Overall length: 3.27m</td>
<td></td>
</tr>
<tr>
<td>Fuel tank: 80 litres</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium Dozer</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine power: 93kW</td>
<td></td>
</tr>
<tr>
<td>Max. Operating Weight: 13,460kg</td>
<td></td>
</tr>
<tr>
<td>Overall length: 4.7m</td>
<td></td>
</tr>
<tr>
<td>Fuel tank: 295 litres</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wheeled Loader</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine power: 180kW</td>
<td></td>
</tr>
<tr>
<td>Max. Operating Weight: 25,400kg</td>
<td></td>
</tr>
<tr>
<td>Overall length: 8.1m</td>
<td></td>
</tr>
<tr>
<td>Fuel tank: 210 litres</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mobile Crane</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine power: 205kW</td>
<td></td>
</tr>
<tr>
<td>Max. Operating Weight: 29,000kg</td>
<td></td>
</tr>
<tr>
<td>Overall length: 10.5m (Transport position)</td>
<td></td>
</tr>
<tr>
<td>Fuel tank: 300 litres</td>
<td></td>
</tr>
</tbody>
</table>
HANDLING DATA ANSWERS - TASK 5

---

**DUMP TRUCK**

- Engine power – 246 kW
- Max. Operating Weight – 53,140 kg
- Overall length - 6.9 m
- Fuel tank – 410 litres

---

**VIBRATING ROLLER**

- Engine power – 100 kW
- Max. Operating Weight – 11,550 kg
- Overall length - 4.5 m
- Fuel tank – 200 litres

---

**ROLLER**

- Engine power – 97 kW
- Max. Operating Weight – 11,300 kg
- Overall length - 5.4 m
- Fuel tank – 300 litres

---

**BACKHOE LOADER**

- Engine power – 74.2 kW
- Max. Operating Weight – 8,660 kg
- Overall length - 5.9 m
- Fuel tank – 160 litres
HANDLING DATA ANSWERS - TASK 5

Using the cards for construction machinery, answer the questions below.

1. **What is the range of engine powers in the vehicles?**

   \[259 - 52 = 207\text{kw}\]

2. **Round each of the lengths to the nearest metre.**

<table>
<thead>
<tr>
<th>VEHICLE</th>
<th>LENGTH ROUNDED to nearest metre</th>
<th>VEHICLE</th>
<th>LENGTH ROUNDED to nearest metre</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Bulldozer</td>
<td>6m</td>
<td>F. Mobile Crane</td>
<td>11m</td>
</tr>
<tr>
<td>B. Tracked Excavator</td>
<td>8m</td>
<td>G. Dump Truck</td>
<td>7m</td>
</tr>
<tr>
<td>C. Skid steer Loaders</td>
<td>3m</td>
<td>H. Vibrating Roller</td>
<td>5m</td>
</tr>
<tr>
<td>D. Medium Dozer</td>
<td>5m</td>
<td>I. Roller</td>
<td>5m</td>
</tr>
<tr>
<td>E. Wheeled Loader</td>
<td>8m</td>
<td>J. Backhoe Loader</td>
<td>6m</td>
</tr>
</tbody>
</table>

3. **For the two dozers (A) and (D), what is the average (mean) engine power?**

   \[259 + 93 = 352\]
   \[352 \div 2 = 176\text{kw}\]

4. **What is the range in lengths of the construction vehicles?**

   \[53,140 - 2650 = 50,490\text{kg}\]
5. Work out the order of the cards based on the actual overall length of each vehicle. You don't need to write out the name of each vehicle, simply use the letters on each card A to J.

<table>
<thead>
<tr>
<th>Vehicles - smallest to largest overall lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 C</td>
</tr>
<tr>
<td>2 H</td>
</tr>
<tr>
<td>3 D</td>
</tr>
<tr>
<td>4 I</td>
</tr>
<tr>
<td>5 A</td>
</tr>
<tr>
<td>6 J</td>
</tr>
<tr>
<td>7 G</td>
</tr>
<tr>
<td>8 E</td>
</tr>
<tr>
<td>9 B</td>
</tr>
<tr>
<td>10 F</td>
</tr>
</tbody>
</table>

6. What is the range in lengths of the construction vehicles?

\[10.5 - 3.27 = 7.23\text{m}\]

7. What is the range in sizes of the fuel tanks?

\[643 - 80 = 563\text{litres}\]

8. What is the operating weight of the mobile crane in tonnes?

\[29,000 \div 1000 = 29\text{tonnes}\]
CHANCES ARE - ANSWERS

Probability is an area of mathematics used to measure uncertainty. In life the outcome of many events is not predictable but it is possible to get an idea of how likely some things are to happen. Being able to tell how likely something is to happen is very important in construction especially when it comes to health and safety. Insurance companies base their premiums directly on probabilities.

A scale is used to represent probability with “impossible” at one end and “certain” at the other. All other outcomes can be placed somewhere on the scale between these two extremes. Things that are unlikely are placed near the impossible end whilst things likely to happen are placed near the certain end. We can use common sense to place some outcomes on the scale….

1. For example, place the following outcomes on the probability scale below

A. Someone chosen at random from a construction trade is a man
B. Someone who follows all safety guidelines has an accident
C. A mortar mixture will harden if someone forgot to add cement
D. A warm but poorly insulated building will lose heat on a cold day
E. Someone chosen at random from the community is a woman

A. Very likely so very near the certain end.
B. Unlikely but not impossible, quite near impossible end.
C. Impossible.
D. Certain.
E. Equally likely as unlikely so in the middle of the scale.
Sometimes we cannot just tell from common sense how likely an outcome is or whether one outcome is more likely than another. In order to tell if some outcomes are more likely than others we need to represent probabilities using fractions. The top of the fraction is the number of favourable outcomes and the bottom of the fraction is the number of possible outcomes.

\[ \text{Probability} = \frac{\text{Number of favourable outcomes}}{\text{Number of possible outcomes}} \]

2. Complete the following table to help you practice working with different kinds of fractions and then you can try to answer some probability questions.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
<th>Percentage</th>
<th>Outcome description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Impossible</td>
</tr>
<tr>
<td>1/10</td>
<td>0.1</td>
<td>10</td>
<td>Very unlikely</td>
</tr>
<tr>
<td>1/4</td>
<td>0.25</td>
<td>25</td>
<td>Unlikely</td>
</tr>
<tr>
<td>1/2</td>
<td>0.5</td>
<td>50</td>
<td>Just as likely as not to happen</td>
</tr>
<tr>
<td>3/4</td>
<td>0.75</td>
<td>75</td>
<td>Likely</td>
</tr>
<tr>
<td>9/10</td>
<td>0.9</td>
<td>90</td>
<td>Very likely</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>100</td>
<td>Certain</td>
</tr>
</tbody>
</table>

Use the definition of probability given above to determine how probable the following events are to happen.

3. McAteer and Bushe, a local construction company, have purchased 4 brand new lorries. Only one of them has air-conditioning for the cab. If a driver chooses a lorry to drive at random what is the probability it will have air-conditioning.

\[ \frac{1}{4} \]

4. What is the probability it won’t have air-conditioning?

\[ \frac{3}{4} \]
HANDLING DATA ANSWERS - TASK 6

5. If you have not already done so express your answers to the latter two questions in percentage form.

25% and 75%

6. What do you notice about the answers when you add them together?

They add to 100%

7. The probability of a lorry breaking down in service is 0.05. Use what you have learned in the previous question to determine the probability that a lorry will not break down in service.

0.1 = 10%

10% + 90% = 100%

So required probability is 90%

8. Write down a rule to help you find the probability of something not happening if you already know the probability of it happening.

Probability of happening + probability of not happening = 100%
HEALTH AND SAFETY

As mentioned in the previous task, one important use of probability in the construction sector is linked to the management of health and safety. You can now try to apply what you have learned above to the following scenario:

A Safety at Work study has been carried out for the construction industry in another EU country. It has been determined there is a 1% chance an operative (18-65 years old) will have an accident whilst driving machinery.

1. What is the probability that an operative will not have an accident whilst driving machinery?

100 – 1 = 99%

or

1 - 0.01 = 0.99

2. If 1% of the 30000 operatives working in Northern Ireland have an accident when using machinery, how many would that be?

30000 ÷ 100 = 300
The study also looked at safety of pneumatic drills and found that there is a 1 in 50 (that’s 2%) chance an operative will have an accident whilst using one.

3. Which of the activities appears to be more accident prone, driving machinery or using a pneumatic drill?

2% is more than 1% so
Pneumatic drill is more accident prone

Of the 30000 operatives referred to above, 1500 of them are over 50 years old.

4. What is the probability that an operative is over 50?

\[
\frac{1500}{30000} = \frac{15}{300} = \frac{1}{20} \text{ (because } 20 \times 15 = 300) \\
\text{or } \frac{15}{300} = \frac{5}{100} = \frac{1}{20} \\
\text{or } \frac{15}{300} = \frac{3}{60} = \frac{1}{20}
\]

There are ten different tasks given to operatives in one company. Five involve driving machines, two involve using pneumatic drills and three involve the use of hand tools.

5. What is the probability an operative will be given a task involving a hand tool?

\[
\frac{3}{10}
\]
6. What is the probability that the operative will NOT be given a task involving a hand tool?

7/10

7. What is the probability that the operative will be given a task involving use of a pneumatic drill?

2/10 = 1/5
Useful Websites
There are many useful websites you can use to help you practice your skills.

http://rwp.qia.oxi.net/embeddedlearning/
This site contains *Skills for Life* Materials for Embedded Learning aiming to help you improve the literacy, language or numeracy skills you need for work. There are some interactive materials set in everyday contexts and giving practice in some of the literacy and numeracy skills developed in the paper-based materials.

http://www.bbc.co.uk/skillswise/
This website has factsheets, worksheets and interactive quizzes to help you practice your numeracy skills.

Link takes you to a site where you can practice your skills in recognising and working with 2D and 3D shapes.

http://www.counton.org/
This site has numeracy activities at a variety of levels. There are interactive activities letting you practice your skills as you play.

http://www.oswego.org/ocsd-web/games/Mathmagician/mathsmulti.html
This link takes you to a game to help you practice your tables.