Working skills for construction Introduction to Module 3

Practical measuring skills are an essential part of many jobs in construction. Learners may be applying measure to real situations for the first time and it is important that their skills are secure. The learning in this module focuses on metric measures and includes centimetres, even though it is understood that millimetres are the standard unit of measure in all construction trades. The rationale for this is that learners in school are taught to use centimetres and most measuring tools are marked in centimetres and millimetres. It is important for teachers to support learners to adjust their thinking to millimetres and metres.

In addition, this module includes some work on using plans and drawings. This is a complex area and needs to be introduced carefully, focusing on the basic concept of a plan and what it represents and some initial work on extracting information.

The focus pages in this module aim to help the learner to:

- understand and use metric measures
- measure length accurately
- calculate using metric units
- estimate materials for a job
- interpret information on plans and drawings
- calculate with time
- mix materials using ratio and proportion.

Practical activities will help learners to understand these skills, so opportunities should be made available for learners to apply the skills they have learned. Learners should also be encouraged to refer to activities that they use in their own work settings and apply the skills they have learned to these.

Skills for construction – Module 3: Working skills for construction					
Theme	**Page reference**	**NOS/NVQ**	**Literacy**	**Numeracy**	**Key Skills**
Metric measures	Co 3:1–3:2	MR123; FCA036		MSS1/E3.8	
Measuring length	Co 3:3–3:5	MR123; FCA036		N1/L1.4; MSS1/L1.7; MSS1/L1.4	N1.2
Calculate with measurements	Co 3:6–3:8	MR123; FCA036		N2/E3.4	
Area	Co 3:9–3:11	MR123; MR371; MR379; FCA036		MSS1/L1.9	N1.2; N1.3
Volume	Co 3:12–3:13	MR270; FCA037		MSS1/L1.10	N1.2
Calculating material	Co 3:14–3:16	MR270; FCA037; Element 1 of many units e.g. MR124; MR184; MR139; MR218; MR375		N1/E3.6; N1/E3.9	
Reading floor plans	Co 3:17–3:18			MSS2/L2.1; MSS2/E2.3; MSS1/L1.6	N2.1
Interpreting plans and drawings	Co 3:19–3:20			MSS2/L2.1; MSS2/E2.3	N2.1
Time and schedules	Co 3:21–3:22	FCA037; MR272; MR214		MSS1/L1.3	N1.1
Mixing materials	Co 3:23–3:24	MR180		N1/L1.7	

Skills checklist

Construction work is practical and 'hands-on', but you still need lots of skills, such as measuring out, working out quantities and mixing materials.

All construction work is planned and drawings are used to show details of the finished structure. If you work in construction you will need to understand these drawings and find the information that you need to complete your work.

The table below shows some of the skills you will need for skilled work in construction. Tick the skills you feel confident about now. Complete the activities in this module to help you improve on the skills you have not ticked. Return to the list later to check any areas where you still need some practice.

Working skills for construction	Now	Later
Understanding and using metric measures		
Measuring accurately		
Working out area		
Working out volume		
Estimating materials for a job		
Interpreting plans and drawings		
Working to schedules		
Mixing materials		

PAGES 3:1–3:2

Metric measures

Occupational setting

The construction industry could not operate without the use of measurement. Measurement of height, length, weight and liquids happens in countless scenarios on a daily basis. Understanding the units used for measuring and their abbreviations is vital underpinning for the development of measuring skills and calculating with measures. The focus for measurement should be metric units, but learners may come across imperial measures and should be aware of these.

Materials

Selection of measuring instruments used in construction, including:

- measuring tapes (a range of tapes to show different markings, but also the standard tape used in their workplace)
- a measuring wheel
- ultrasonic distance measurer (if available)
- any trade-specific measuring devices that are available

Learning outcomes

1 To know the standard metric units of length, weight and capacity including abbreviations (focus page)
2 To know the common imperial units of length, weight and capacity as appropriate to construction (focus page)
3 To choose and use appropriate units and measuring instruments (Tasks 1 and 2)

Suggested teaching activities

Introduction

- Ask learners to consider why things need to be measured. Start with things relating to their own experience (e.g. body weight, speed (of cars, etc.), height). Write these up on the board/flipchart. Ask learners about the importance of accurate measurement in different situations. For example, for personal weight it is probably enough to weigh to the nearest kilogram, but when measuring ingredients for a recipe, it is necessary to measure to the nearest 5 g.
- Note that speed is a compound measure (distance and time). Whilst it may be a familiar measure, it is complex to calculate, requiring a formula, and is a Level 2 skill.
- Extend this discussion to measurement at work. What needs to be measured? Why? How accurate do measurements need to be?

Focus page

- Discuss learners' experiences with measuring tools, at home and at work – which measuring tools have learners used or seen being used at work? What was being measured?
- Look at the range of measuring tools you have collected. Ask what each of them is used to measure. Discuss how advances in technology have brought about new measuring devices (e.g. ultrasonic distance measurers). Demonstrate these if possible. Check learners understand the units of measure used with each measuring tool.
- If you feel it is appropriate and not likely to confuse learners, discuss imperial measures. Have learners come across imperial units at work? Many tape measures show metric and imperial units (show them an example). Distances are recorded in miles. Carpentry requisitions may still refer, at least verbally, to 2″ × 2″ timber. Old oil tanks are measured in gallons. Old pipe work will be of imperial dimensions and metric/imperial connectors may be needed for soldered joints.
- Check learners have an idea of the size of each metric unit relative to familiar quantities – *How does one metre relate to your height? How many kilograms is a standard bag of sugar?*
- Discuss which measuring tool you would use for which purpose (e.g. for measuring a wall, a brick).

- Discuss different construction scenarios in which learners see metric measurements written down (e.g. ordering/purchasing materials, reading labels). Lead into a discussion on abbreviations for metric measures.
- Encourage learners to develop a personal glossary of terms, including names of measures and their abbreviations. This could be in the form of a 'crib card', for consulting in the workplace. If learners have a problem with words for measures, you could develop a card game, matching measures to abbreviations.

Curric. refs	NOS/NVQ	Key Skills
MSS1/E3.8	MR123 FCA036	N/A

Task 1

Decide which metric units are used for which jobs
MSS1/E3.8

- This task assumes that learners have workplace experience. They may need some support to do the task if their experience is limited.
- This task is best conducted as a group activity, ideally combined with a site visit, where the chart could be used to record what is observed on the site.
- The chart could also be used to find information verbally or possibly via research on the Internet.

If the learner has difficulty

- Learners with limited experience will need more support to complete this task, ideally by questions and answer and guided observation.
- Some learners may confuse abbreviations. For instance, measures in millimetres are sometimes referred to verbally as 'mill' ('that gap measures 35 mill'), which may be confused with ml. You may need to discuss this with learners to ensure they understand the different things being measured.
- The abbreviation for litre (l) is potentially visually confusing for learners with poor visual skills. Point out that care needs to be taken when measuring liquids.
- Many of the abbreviations for units of measure involve the letter 'm', which is potentially confusing (e.g. the difference between mm, ml, mg), particularly for dyslexic learners who may have problems differentiating these. Develop a card listing the abbreviations and full words to help.
- Some learners may experience difficulties with the spelling of tonne. Explain the difference between 'ton' – an imperial measure – and the metric weight, tonne (1000 kg).
- If the learner has difficulty completing the table, provide support with spelling so the learner can concentrate on the task.

Extension

- If appropriate, extend this task to include imperial measures.
- Talking about units of measure for temperature may be a useful extension.

Task 2

Know which units are used for measuring different materials
MSS1/E3.8

- This task assumes that learners have experience of workplace materials. They may need some support to do the task if their experience is limited.
- This task is best conducted as a group activity, ideally combined with a visit to a construction site or store, where the chart could be used to record what is observed.
- The chart could also be used to find information verbally or possibly via research on the Internet.

If the learner has difficulty

- Learners with limited experience will need more support to complete this task, ideally by questions and answer and guided observation.
- Learners may need support to understand the technical vocabulary for materials (e.g. skirting board).

Extension

Ask learners to think of three materials used in construction that are purchased by weight, three that are purchased by volume and three that are purchased by length. Which metric units are used to measure these materials?

Theme assessment

Ask learners to make a chart showing a range of the materials (e.g. cement) commonly used in the learners' workplace, with the units of measure used (e.g. kg) and the most usual quantity in which the material is supplied (e.g. 25 kg).

Metric measures

Focus

The whole of the construction industry relies on the use of measurement. Each trade has its own measuring tools and instruments.

Here is just a small selection of the measuring instruments you might come across.





List all the **measuring instruments** you use in your job and what you use them for, in the two columns below.

Instrument **Used for**

The construction industry mainly uses **metric units** for measuring. However, you may come across some older measures called **imperial units**.

Which of these units of measurement have you used at work?

	metric units	imperial units
Units for measuring distance	millimetre (mm) centimetre (cm) metre (m) kilometre (km)	inch (in) foot (ft) yard (yd) mile (m as in mph – miles per hour)
Units for measuring liquids	millilitre (ml) litre (l)	pint (pt) gallon (gal or g as in mpg – miles per gallon)
Units for measuring weight	gram (g) kilogram (kg) tonne (t)	ounce (oz) pound (lb) hundredweight (cwt) ton (t)

Metric measures

Task

Task 1

Put a tick or a cross to show whether the following **metric units** are used (✓) or not used (✗) in your job. Add what they are used for measuring.

Metric unit	Used at work? ✓ or ✗	For measuring …
millimetre (mm) centimetre (cm) metre (m) kilometre (km)		
millilitre (ml) litre (l)		
gram (g) kilogram (kg) tonne (t)		

Task 2

Complete the table below to show which **metric units** are used when you buy the listed materials.

Material	Unit	Abbreviation
skirting board	millimetres **or** metres	mm m
paint		
copper pipe		
plaster (in powder form)		
plasterboard		

PAGES 3:3–3:5

Measuring length

Occupational setting

Workers in construction are expected to use measuring tapes accurately and to measure in millimetres. Although imperial measurements are used less and less, there are still some situations, particularly in the renovation of old buildings, in which imperial measurements may be needed or at least referred to. For this reason 'standard' tapes often display both imperial and metric units. Usually the metric part of these 'standard' tapes is presented in centimetres and metres, with millimetres shown as unlabelled divisions. Translating millimetre measurements from drawings or method statements to centimetres and metres is an integral part of using these tapes. In order to do this effectively, learners need to be confident in multiplication and division by 10, 100 and 1000.

Materials

'Standard' tapes, displaying both metric and imperial

Learning outcomes

1 To recognise measurements are the same whether they are written as mm, cm or m (focus page, Tasks 1 and 2)
2 To convert mm measurements to m and cm (focus page, Tasks 1 and 2)
3 To understand that tapes use cm divisions from 1 to 100 between each marked metre (focus page, Task 1)

Suggested teaching activities

Introduction

- Ask learners to look at both sides of a 'standard' tape and ask if they know of occasions when imperial measurements may be used (they may quote old plumbing, woodworking). Discuss why imperial is not widely used nowadays. Confirm that it is vital not to mix these two systems of measure.
- Look at the metric side of the tape and discuss the features – the marks (longer, bolder lines for metres, etc.) and labels (the numbers and any abbreviations). Confirm what these mean.
- Confirm that the standard unit of measure used in construction is millimetres. Discuss why this might be the case (accuracy).
- Ask learners how they use this side of the tape with main divisions marked in cm and m, when measurements on drawings or method statements are given in mm.
- Remind them that the millimetres are marked but are not labelled – they are the small divisions between the centimetres. Ask how many they can see between each cm.
- Pose simple questions that involve converting between mm and cm: *If there are 10 mm in 1 cm, how many mm in 2 cm? 2.5 cm? 10 cm?,* etc. *How many mm in 5 cm?*, etc. Practise converting between mm and cm, using the tape measure to help.

Focus page

- Ask learners how they multiply/divide by 10. Demonstrate this and give as much practice as appropriate. Repeat for multiplying/dividing by 100 and 1000 with reference to converting between cm and m and between mm and m. Useful support for written methods of multiplication can be found on page 35 of the Adult Numeracy Core Curriculum document.
- It might be useful to make a 'crib' card of these conversions as a permanent reminder for learners to carry with them.
- Give plenty of practice in this skill. Pay particular attention to zero as a place holder (e.g. the value of zero in measures such as 1.05 m and how this is different to 1.50 m).
- Note that converting between units by multiplying or dividing by 10, 100, etc. can be particularly confusing for some learners because when converting to larger units you divide (making something bigger by dividing), and when converting to smaller units you multiply (making something smaller by multiplying).

- Learners need to be familiar with multiplication and division by 10, 100 and 1000 in order to transfer this skill confidently to workplace situations. Learners struggling with this area of work should be supported using *Skills for Life* Numeracy materials Level 1, Unit 1.
- Discuss the use of zero positioned to the right of the decimal point in measures such as 1.0 m. For example: 100.0 cm may be used to record the same measure as 100 cm and 1.500 m may be used to record the same as 1.5 m. Give some practice in this. These zeros to the right of the decimal point identify the accuracy of the measurement (e.g. it is accurate to two or three decimal places).
- Look at the two different ways of noting measures that include metres (i.e. 1 m 50 cm is the same as 1.5 m). Learners need to understand that these are the same and that although they will use the former to locate the position on a tape measure, the latter version is the correct written notation.
- Learners may need a lot of varied practice to confirm measurement skills. It is a good idea for learners to practise writing down measures that are given verbally, to get used to the range of ways measures can be given (e.g. 'seven fifty mill' is 'seven hundred and fifty millimetres' = 750 mm).
- Ask learners to write down 725 mm in centimetres; 3250 mm in centimetres, metres and centimetres, and metres.
- Allow opportunities for practical use of these skills. For example, prepare some cards with measurements in mm. Working in pairs, one learner reads out the measurement. The second learner marks out the measurement using a tape measure. The first learner checks the measurement.
- Ask learners to measure their own workshop or classroom and record the measurements.

Curric. refs	NOS/NVQ	Key Skills
N1/L1.4	MR123	N1.2
MSS1/L1.7	FCA036	
MSS1/L1.4		

Task 1

Recognise equivalent mm measurements
MSS1/L1.4
MSS1/L1.7

- Remind learners that reading a measuring tape accurately requires them to look carefully at the way that units of measurement are presented on that particular tape. Give each learner a tape to examine. Ask for the value of the unlabelled divisions.
- Remind learners that 10 mm = 1 cm, so to convert from mm to cm, you divide by 10. Ensure they understand how to multiply and divide by 10. Learners with problems in this area will need additional support, perhaps with *Skills for Life* materials Level 1, Unit 1.
- Ask learners to confirm their understanding of the decimal point. Ensure they know that the decimal point separates whole units from parts or fractions of a unit.
- Ask learners to convert 10 mm to cm before measuring it out. Repeat converting and measuring for 20 mm, 100 mm, 120 mm, 150 mm and 105 mm.
- Remind learners that 1000 mm = 1 m, so to convert from mm to m, you divide by 1000. Check learners understand how to multiply and divide by 1000. Learners with problems in this area will need additional support, perhaps with *Skills for Life* materials Level 1, Unit 1.
- Ask learners to convert 1000 mm to m before measuring it out. Repeat converting and measuring for 2000 mm, 1500 mm, 1050 mm and 1005 mm.
- Refer to Question 1. Ask learners for the value of the unlabelled divisions on the three tapes (1 mm). Look at the differences in the tapes – it might help to find each measure on a standard tape.
- Ask learners to estimate the length of 250 mm and 1110 mm before starting question 2. You may want to do this as a group activity. Learners need to understand the value of each of the 1s, in particular that the first 1 has the value of one metre (or 1000 mm).

If the learner has difficulty

- Present the learner with smaller measures to establish the concept of equivalent measurements (e.g. 1 cm = 10 mm, 2 cm = 20 mm, etc.). Prepare a series of cards with

equivalent measures in mm/cm/m for learners to match.

- Refer learners to the Remember! box for how to convert from mm to cm and vice versa.
- Use real tape measures and work together on measuring tasks. Explain and exemplify each step. Work through difficulties as they arise, using a step-by-step approach. If possible, use real skirting board and pipes.
- Much over-learning is needed for this skill to ensure learners are confident. Provide further practical measuring tasks to consolidate skills.
- Further work on the decimal point can be found in *Skills for Life* Numeracy materials, Entry 3, Unit 2.
- If difficulties continue to appear at this level, the learner needs additional support starting at a more basic level.
- Learners with visual difficulties may experience problems with the visual discrimination skills required to read small measures. Using a guide (a piece of card, for example) might help.

Extension

- Extend the number work to discuss equivalence (e.g. that $\frac{1}{10}$ metre = 10 cm, $\frac{1}{100}$ metre = 1 cm and $\frac{1}{1000}$ metre = 1 mm).
- Learners could work directly from a plan or method statement. They can convert measurements from mm to m and then to m and cm before marking out the measurements using a tape measure.

Task 2

Convert mm measurements into m

MSS1/L1.7

- Discuss the worked examples on the task page. You may need to demonstrate the measures using a tape measure so learners can see and understand the importance of zero as a place holder.
- Ask learners to explain why the zeros in 75.0 cm, 2.000 m and 1 m 5.00 cm can be left off (we would normally say 75 centimetres, 2 metres, and 1 metre 5 centimetres). Can learners think of any situations when it may be preferable to leave the zeros in place? (to show the level of accuracy measured to).
- Ask learners to think of a rule that explains which zeros can be left off the measurement in situations when it is not necessary to indicate the level of accuracy.
- Explain the task and ask learners to say how they will convert mm into m.
- Allow learners to use a real tape measure to check answers, if necessary.

If the learner has difficulty

- Suggest that the learner uses a calculator each time, but do the first number together to ensure that the learner inputs the numbers, including the zeros, in the correct order. Model how to read and record the display.
- Ask the learner to convert the other measurements and to read back the display on the calculator so that you know that the task has been understood.
- Work with the learner to check answers using a tape measure.
- You may need to spend time supporting learners who are unfamiliar with running dimensions used in plans.
- Dyslexic learners may experience difficulty with the order of operations in this kind of calculation (i.e. they know the steps to do, but not the order in which to do them). For instance, they might muddle the process for multiplying by 10 with that of dividing by 10. You may need to give help in devising a strategy for remembering that dividing the number makes it smaller, but multiplying makes it bigger.

Extension

Ask the learner to convert and measure out dimensions given in fractions of a metre (e.g. 1.25 m is converted and measured out as 1 m 25 cm).

Theme assessment

Ask learners to find a set of dimensions shown in millimetres on a plan or method statement relevant to their own area of work. Ask them to convert the dimensions and measure them out on the ground using a standard measuring tape (i.e. with cm and m labelled, mm marked but unlabelled).

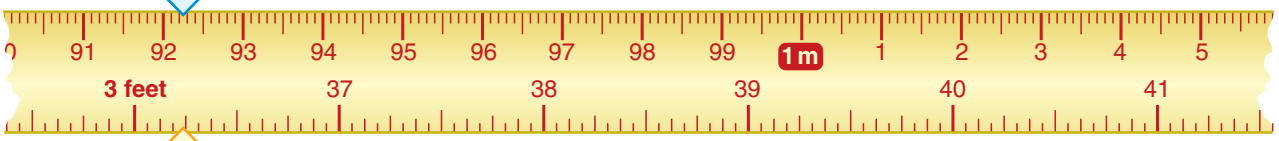
Measuring length

Focus

Tape measures like this one are used on most construction sites.
The standard unit used in construction is millimetres.

One side of the tape shows **metric units**. This is the side of the tape to use. You will notice that:

- **1 metre** is divided into **100 centimetres**
- **1 centimetre** is divided into **10 millimetres.**



The other side of the tape shows **feet** and **inches**. These are **imperial units**. It is unlikely you will need to use this side of the tape.

How do you use this type of measuring tape?

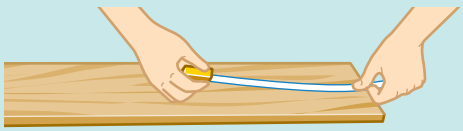
Millimetres are very small measures so there is no space on the tape measure to number them all. To measure out the correct number of millimetres, refer to the centimetres and metres shown on the tape measure.

For example:

These measurements are written in millimetres.

10 mm is equal to **1 cm**
11 mm is equal to **1.1 cm**
34 mm is equal to **3.4 cm**
215 mm is equal to **21.5 cm**
1000 mm is equal to **100 cm** *or* **1 m**
1500 mm is equal to **150 cm** *or* **1 m 50 cm** *or* **1.5 m**

These are the measurements you read on the tape measure.



Tips

1000 mm = 100 cm = 1 m

10 mm = 1 cm	To convert **mm** to **cm**, ÷ by **10** To convert **cm** to **mm**, × by **10**
100 cm = 1 m	To convert **cm** to **m**, ÷ by **100** To convert **m** to **cm**, × by **100**
1000 mm = 1 m	To convert **mm** to **m**, ÷ by **1000** To convert **m** to **mm**, × by **1000**

Remember!

÷ means divide
× means multiply

Measuring length

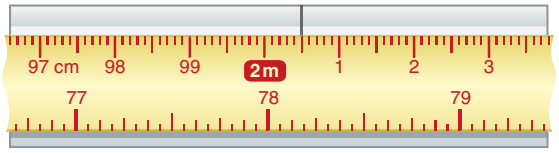
Task

Task 1

1 Which of these skirting boards has been marked at 250 mm?

Tick your choice.

a ☐



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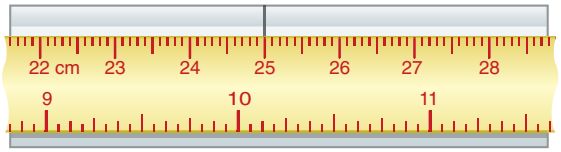

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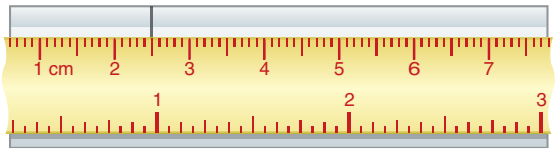


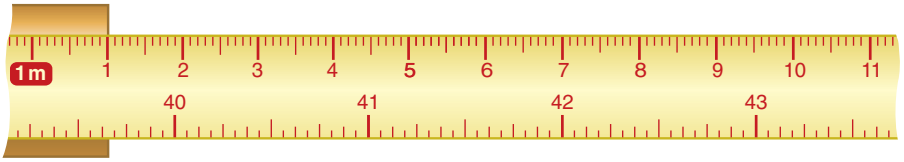
Remember!

10 mm = 1 cm
1000 mm = 1 m

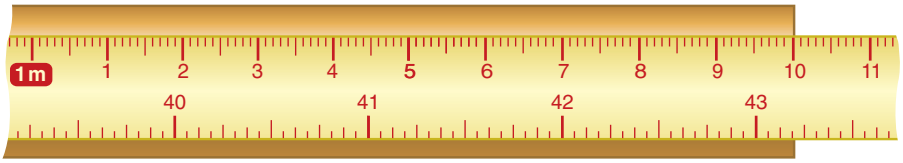
2 Which of the pipes below has been cut to measure 1110 mm?

Tick your choice.

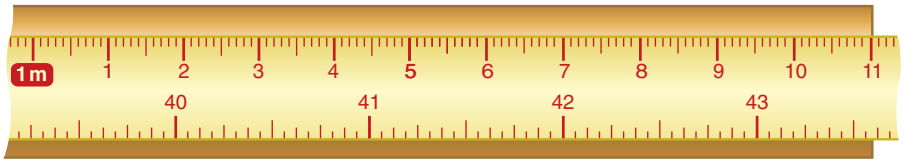
a ☐



b ☐



c ☐



MSS1/L1.4; MSS1/L1.7

Measuring length

Task

When you convert measurements, zeros can be quite tricky.

Some zeros don't make any difference to the measurement, and for quickness, you can leave them out.

For example:

75.0 cm **means the same** as 75 cm
2.000 m **means the same** as 2 m

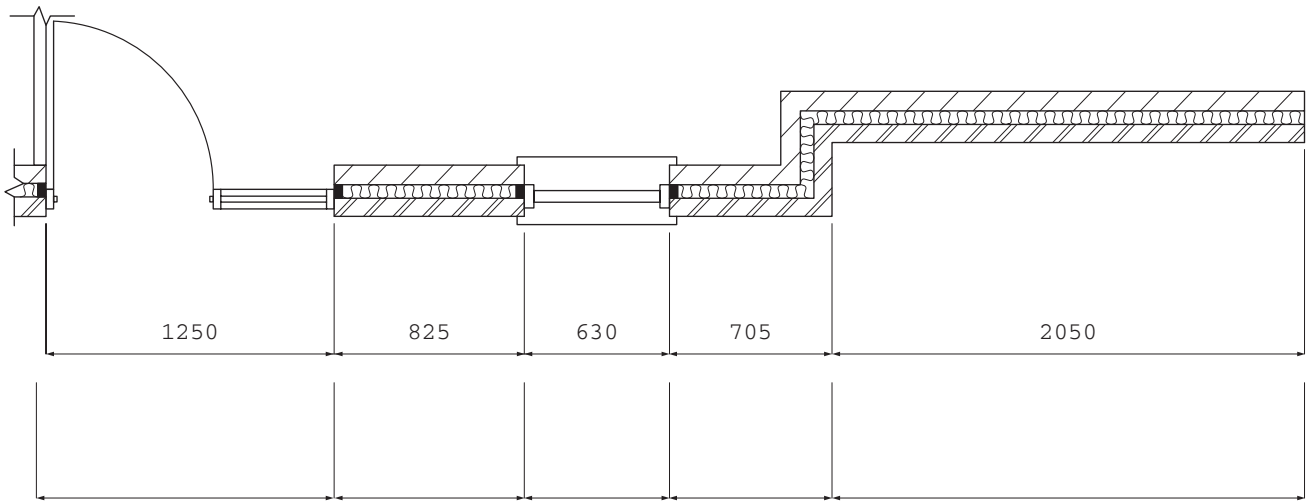
However, some zeros make a huge difference to the measurement.

For example:

1 m 90.5 cm **does not mean the same as** 1 m 9.5 cm.

Task 2

1 Convert the millimetre measurements on this plan into metres.



_____ m _____ m _____ m _____ m _____ m

Remember!

If the zeros don't make any difference to the number, leave them out.

PAGES 3:6–3:8

Calculate with measurements

Occupational setting

Calculations involving measure, often involving large numbers, are commonplace in the construction industry – for ordering materials, interpreting plans and everyday practical measuring tasks. It is important that learners get into the habit of using a calculator to do and check calculations and that they know how to use the calculator and its functions correctly.

Materials

Large basic calculator for demonstrations, ideally on a whiteboard or OHT

A calculator for each learner – ensure this is a straightforward calculator, not programmed to perform scientific functions

Other types of calculator to show a range of formats

Lengths of skirting board to demonstrate calculations

Learning outcomes

1 To know how to use a calculator to calculate using whole numbers and decimals (focus page, Tasks 1 and 2)
2 To know how to key in and interpret metric measurements (focus page, Tasks 1 and 2)
3 To know and use strategies to check answers obtained with a calculator (focus page, Tasks 1 and 2)

Suggested teaching activities

Introduction

- Ask learners about their experience of using a calculator. Do they know how to use all the function keys? (e.g. percentage key, memory keys). You might want to test their skills with a quiz, including knowledge of keys (e.g. *Which key do you press to give you the answer?*) and practical problems to solve. It is important to establish learners' level of knowledge and skill and to identify and correct any misunderstanding.
- Talk about situations, at work and at home, where it is a good idea to use a calculator. Are there any reasons for not using a calculator? You may want to point out the difficulties of calculating with imperial units if learners come across these in their workplace.
- Look at some typical calculators showing different formats and functions. Check learners are using a fairly straightforward calculator.
- Confirm that, whilst calculators often have similar functions, the way in which these work may differ from calculator to calculator (you may want to demonstrate this with, say, the percentage key).

Focus page

- Discuss the advice at the top of the page: 'Measure and check twice. Cut once.' *Why is this good advice? What could happen if you didn't follow this advice?*
- Is it always better to use a calculator? Is it always quicker? (It depends on the size of the numbers and how many are involved.) Ask for volunteers who feel confident with their mental calculation skills to check out their speed against others using calculators. For example, 2 + 2 is much quicker performed as a mental calculation. At what point does it become quicker to use a calculator?
- Is it always appropriate to use a calculator? Discuss that in some scenarios (e.g. estimating how much timber to take from the store) an approximation gained by rounding and mental strategies will be sufficient. In other situations an accurate answer is needed.
- What does each sign or symbol mean? Discuss learners' understanding of the signs and symbols on the calculator keys. Ask learners for different ways to verbalise the four operations (e.g. 'add', 'plus', 'minus', 'take away', 'multiply', 'times,' 'divide', 'share', etc.). Check they know when to use +, –, × and ÷. Give some practice by getting learners to key in some simple calculations that you give them verbally.

- *How do you key in metric measurements? There is no place to key in 'mm' or 'm' – does this matter? How do you key in decimal amounts? Do all the zeros need to be keyed in?* (Refer to exemplification on previous task page.) Point out to learners that if they do not feel confident to decide which zeros do not affect the number, it is better to leave them in, although this is slower (e.g. you get the same answer if you key in 4.00 × 3.0 as when you key in 4 × 3).
- *Does the order in which you enter the numbers matter? When you are subtracting, which number do you key in first? How about when you divide/add/multiply?*
- Discuss the importance of keying in in the correct order when subtracting. Write up the calculations 4 m – 1 m and 1 m – 4 m. Demonstrate how you can start with a 4 m length of skirting board and cut off 1 m, but not vice versa. What is the answer to each calculation using a calculator? (4 –1 = 3 whereas 1 – 4 = –3, or 'E' depending on the calculator). It is impossible to have a 'minus' piece of wood, so an 'E' or a minus answer should alert the calculator user that something has gone wrong.
- Point out the importance of checking that your answer makes sense in the context of the question that was asked.
- Discuss why you have to key in the correct order when you divide. Write the calculations 4 m ÷ 3 and 3 m ÷ 4. Demonstrate the difference between 4 m of skirting board divided into three sections and 3 m of skirting board divided into four sections. Which example matches which calculation? What are the answers to each calculation? What does each answer tell you in the context of the skirting boards? (length of the individual sections)
- Discuss why when you add measurements together, the order in which you do so is not important. Using sections of a skirting board, demonstrate that whichever order you place them end to end, the total length is the same. Check this out on a calculator, each time adding the measurements in the order that the wood is laid out.
- Discuss why when you multiply measurements together, the order in which you do so is not important. Demonstrate with 2 × 3 m sections of skirting board and 3 × 2 m sections of skirting board that the total length is the same. Check this out on a calculator. Check for other lengths.
- Using the calculator, show how to do multiplication by repeated addition (e.g. 6 × 4.3) and division by repeated subtraction (e.g. 12.9 ÷ 6).
- Look at the other keys on the calculator (e.g. percentage function, memory functions). Do learners know what these are and how to use them? If you have time and it seems appropriate, go through these functions, with examples, although the tasks on the following pages do not require this knowledge.
- How do you read the display? Check learners know how to read the display within the context of the calculation they are doing and the particular way their calculator works. Some calculators don't display any zeros at the end of numbers – 12.00 will be displayed as 12, which may be confusing. There are also issues around rounding to the required number of decimal places (to provide answers that are sensible within the context of building) and recurring numbers.
- How do learners check answers, particularly to make sure that they are reasonable? Ask learners to describe the methods they use. Point out that there are many strategies, including using inverse operations, adding or multiplying in a different order, calculating mentally to gain a sense of the approximate size of the answer.
- Note that conversion between units by multiplying or dividing by 10, 100, etc. can be particularly confusing for some learners because when converting to larger units you divide (making something bigger by dividing), and when converting to smaller units you multiply (making something smaller by multiplying).

Curric. refs	NOS/NVQ	Key Skills
N2/E3.4	MR123 FCA036	N/A

Task 1

Use a calculator: convert measures to same units N2/E3.4

- Go through the worked example on the page, demonstrating the need to convert measurements to the same units. Demonstrate on the calculator what would happen if you did not do this (i.e. do 3.1 + 2.5 + 900 + 700, etc). In order to appreciate how wrong this answer is, learners need to have some sense of what is an appropriate amount of skirting board for a room. You might want them to measure the perimeter of the room they are in to confirm this.
- It might be useful to repeat this activity using money expressed in pounds and pennies (e.g. 99p + £1.50) to confirm the point about using the same units on the calculator.
- If learners have successfully completed previous themes in this module, they will understand how to convert between units. Remind them where necessary.
- Proceed to the task on the page.

If the learner has difficulty

- Revisit how to convert mm to m and support learners in these calculations.
- Observe how learners key in numbers and functions to ensure they are doing this correctly. Correct any errors.
- Dyslexic learners may have difficulty keying in numbers or functions in the correct order (e.g. 5.3 instead of 3.5) or with number reversals (e.g. pressing 5 instead of 2).
- Learners might prefer to write down the numbers in a line before keying them in.
- Check learners understand what is meant by 'skirting board'.

Extension

Learners should measure the room they are in and calculate the amount of skirting board that would be needed. Some learners should measure in mm and some in m. Compare answers.

Task 2

Use a calculator: round to quantities that make sense
N2/E3.4

- Go through the worked example on the page, demonstrating the need to interpret the results on the calculator display sensibly. Demonstrate what happens if you do not do this (i.e. the example of two-thirds of a tin of paint). Ask learners for the answer to the question about tins of paint.
- Talk about rounding *up* the number on the display to the nearest whole number. Learners will need to understand the difference between numbers before and after the decimal point in order to do this. Why is rounding down not a good idea? What would happen if the calculation came up with the answer of 2.01? Would two tins of paint be enough?
- Proceed to the task. It might be a good idea to do the first question as a group, keying in the numbers and functions together.
- Stress the need for common sense.

If the learner has difficulty

- Observe how learners key in numbers and functions to ensure they are doing this correctly. Correct any errors.
- Dyslexic learners may have difficulty keying in numbers or functions in the correct order (e.g. 5.3 instead of 3.5) or with number reversals (e.g. pressing 5 instead of 2).
- Learners may not understand which mathematical operation is required here (division) or which number to key in first. Additional specific support may be needed.
- Some learners may need help to understand the questions. If possible, demonstrate with a piece of wood or by referring to the graphics on the page, in order to make the problems real.

Extension

Ask learners to calculate how much wood and how many tiles will be left over.

Theme assessment

Using a set of plans, use the calculator to work out running dimensions, quantities of material required (e.g. skirting board, flooring timber, floor tiles). The calculations should include mixed units, requiring conversion of measures to the same unit. Learners should be able to give measures in mm or m.

Calculate with measurements

Focus

It is a good idea to use a calculator to check calculations.

*Is it **always better** to use a calculator?*

Using a calculator can give a quick solution in the workplace – but you need to understand the calculation first.

Remember!

Measure and check twice.

Cut once!

*How do I key in **metric measurements**?*

Metric measurements are recorded in decimals.

It is usually best to convert measurements in millimetres to metres.

457 mm is **0.457 m**

You key this in as 0.457

*How do I **read** the display?*

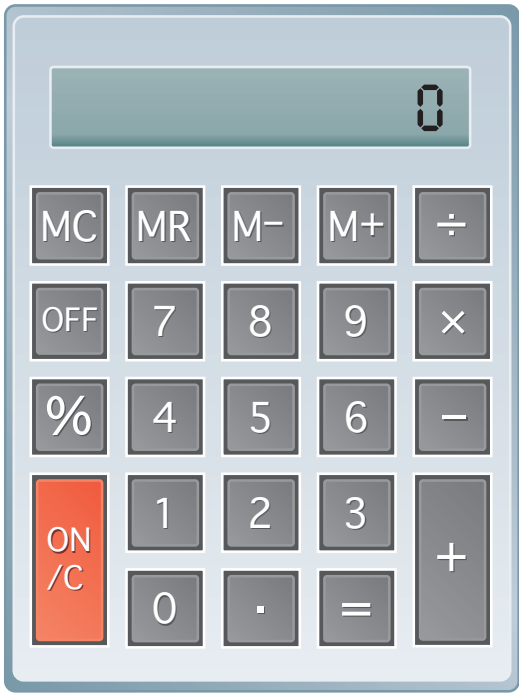
The decimal point separates whole units from parts or fractions of a unit.

66.55333

Numbers may be displayed to more decimal places than you need. Round the number to 1 or 2 decimal places, depending on your needs.

*Does the **order** in which I enter the numbers matter?*

The order in which you enter the numbers and symbols really does matter. Be clear about this before you start.



*Do I know the meaning of each **sign** or **symbol**?*

*How do I **check my answers**?*

- Make an estimate of the answer in your head. Does the answer look right?
- Do the calculation more than once. Do you get the same answer each time?
- Do the calculation in another way, e.g. if 12 + 6 = 18, 18 − 6 = 12.

Calculate with measurements

Task

Two important things must be remembered when using a calculator in the construction industry.

1 Your measurements must be in the same units before you calculate.

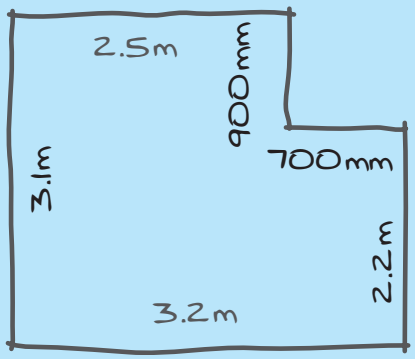
Example:

You have to calculate how much skirting board you need, but the measurements are a mixture of millimetres and metres. You must either:

Convert the millimetre measurements to metres before calculating:
2.5 m + **0.9 m** + **0.7 m** + 2.2 m + 3.2 m + 3.1 m = 12.6 m

or

Convert the metre measurements to millimetres before calculating:
2500 mm + 900 mm + 700 mm + **2200 mm** + **3200 mm** + **3100 mm** = 12 600 mm

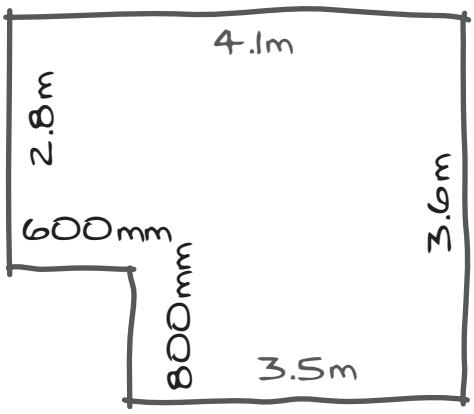


Tip

If you need your answer in **metres**, calculate with **metre** measurements. If you need your answer in **millimetres**, calculate with **millimetre** measurements.

Task 1

Work out how many **metres** of skirting board are needed for this room by adding all the measurements.



Remember!

- Measurements must be in the same units before you calculate.
- Check your answer.

Calculate with measurements

Task

The second important thing that should be remembered when using a calculator in the construction industry is:

2 Sometimes the answer is more accurate than you need it to be.

Example:

You want enough paint to cover **75** m^2 and you know that 1 tin of paint will cover **32** m^2. You can use a calculator to work out how many tins you need like this:

The answer is 

Of course, it is not possible to buy 2.34 tins of paint!

You need to interpret the answer so that it makes sense in the context of the question.

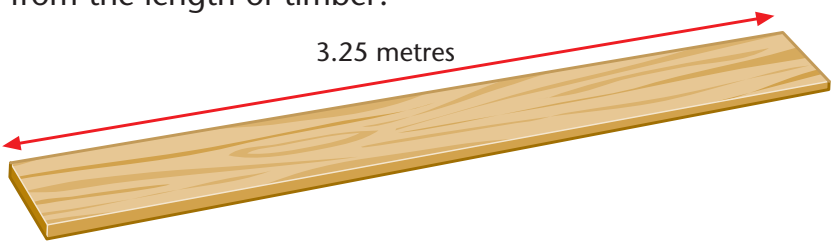
How many tins will you buy? _____ tins

Task 2

Use a calculator to answer these questions.

1 You have a **3.25 metre** length of timber to make some shelves. Each shelf needs to be **0.7 metres** long.

How many shelves, each 0.7 metres long, can you cut from the length of timber?



Remember!

- Remember to interpret the answer in a way that makes sense in the context of the question.
- Check your answer.

2 You want to buy enough wall tiles to cover an area of **15.75** m^2. One pack of tiles will cover an area of 1.2 m^2.

How many packs of tiles should you buy? _____

PAGES 3:9–3:11
Area

Occupational setting

Establishing the amount of materials required to complete a job is essential if the job is to be finished on schedule and within budget. This involves calculating the area of walls and floors from measurements or from drawings. Calculations should be done in metric units, as this is the industry standard; metres and millimetres should be used in calculations, although it is sometimes useful to refer to centimetres in practical contexts.

Materials

Calculator

Simple floor plans and sketches of walls with dimensions in metres

Scale drawings

Learning outcomes

1 To understand that area is a measure of surface (focus page, Tasks 1–3)
2 To understand that measurements are required to calculate the area of a rectangular floor and wall and how to obtain them (focus page, Tasks 1–3)
3 To calculate area in the context of rectangular floors and walls (focus page, Tasks 1–3)
4 To understand that area is measured in square units (focus page, Tasks 1–3)
5 To break down a composite shape into regular shapes (Task 3)

Suggested teaching activities

Introduction

- Ask learners what they understand by the term 'area'. Draw attention to the concept of 'surface' if necessary.
- Ask learners to suggest occasions when they may need to find areas, for example in working out the number of plasterboards they need to cover a ceiling, or the amount of paint or plaster needed to cover a wall or ceiling, or for a whole room.
- Confirm that area is measured in square units – that is in square metres, centimetres or millimetres. Confirm that the industry standard is to use metres or millimetres (not centimetres), and that square metres are used for measuring the areas of walls and floors (not square millimetres). Note that square metres is recorded as m^2 and be aware that dyslexic learners may confuse this with 2 m.
- Ask learners to estimate how many square metres – that is squares with sides of one metre – fit into a range of objects, for example the surface of a door, plasterboard or wall or floor of the workroom. Note that this might be difficult for dyslexic learners with poor spatial skills.
- Ask learners to estimate how many square centimetres there are in pieces of paper, tiles or woodblocks measuring 10 × 10 cm, 20 × 20 cm, 30 × 30 cm, etc. Ask if anyone notices what is happening – you get the same result by multiplying the length of the two sides together as you do by counting the number of squares.

Focus page

- Look at the focus page and discuss the terms length, width and height in turn.
- Review how to calculate the area of walls and floors/ceilings by using the formulae **l** × **h** and **l** × **w**, respectively. Note: when calculating the area of walls in a rectangular room, the formula **l** × **h** may be confusing to some learners (for the shorter walls, learner may perceive this as the width of the room needing to be multiplied by the height). Emphasise that a rectangular surface is a two-dimensional space and that the area is found by multiplying its two linear measurements (whatever the technical term we give to these two measurements).
- Ask learners to reiterate their understanding of the way in which area is measured – that is, in square units. Reinforce this by asking how square millimetres would be written.
- Emphasise the selection of units of measure appropriate to the task in hand. When working out the quantities of paint or wallpaper you

need, it is often best to use square metres. Ask learners to identify the units of measure they would use for different sized areas, such as the surfaces of air bricks or wood blocks.

- Give plenty of practice in calculating the areas of floors and walls, using different measurements. Use whole numbers for oral practice and decimal numbers for written practice. Learners should be able to use calculators for this where necessary. Note that learners experiencing difficulty with decimal numbers may need support using *Skills for Life* Numeracy materials (see below for references).
- Encourage learners to estimate answers where measurements are given in decimal numbers. For example, 2.48 m × 5.92 m is approximately 2.5 m × 6 m, giving an approximate answer of 15 m^2. You may have to talk about rounding numbers in order to do this, if this is a new concept for learners.
- Ask learners what they need to take into account if they are working out the quantity of paint, plaster or wallpaper they need for a wall, for example. Direct attention, if necessary, to what happens if there are doors or windows. Learners should have a clear understanding of the impact of this on their calculations.

Curric. refs	NOS/NVQ	Key Skills
MSS1/L1.9	MR123 MR371 MR379 FCA036	N1.2 N1.3

Task 1

Work out the area of floors
MSS1/L1.9

- Briefly recap the formula for finding the area of a floor.
- Encourage learners to estimate the areas of the three floor spaces by approximating the decimal numbers to the nearest whole number.
- If necessary, review learners' understanding of scale architectural drawings, including standard representations of doors and windows.
- Review learners' understanding of decimal numbers. Ensure that they know that the decimal point separates whole units from parts or fractions of a unit.
- Remind learners of the procedure for multiplying decimal numbers. Ensure they are confident with this. Provide opportunities to consolidate these skills as necessary.

If the learner has difficulty

- Encourage learners to practise area calculations using whole numbers.
- Use matching activities or games with rectangular shapes divided into squares corresponding to the calculation and the area. For example, match a rectangle divided into 20 square units (5 units long and 4 wide) with the calculation needed for the area (5 units × 4 units) and the answer (20 square units).
- Distribute a range of scale drawings and ask learners to interpret the information they provide.
- Further work on the decimal point can be found in *Skills for Life* Numeracy Entry 3, Unit 2.
- Further work on estimating answers can be found in *Skills for Life* Numeracy Level 1.
- Further work on multiplying decimals can be found in *Skills for Life* Numeracy Level 1.
- Learners may use calculators, but should be able to estimate the likely answer and identify any errors, including those relating to the placement of the decimal point and in the use of zero as a placeholder. Support learners with this as necessary.
- Use aids such as metre rules, pieces of card and scale drawings with grid lines demarcating squares to assist learners with visual difficulties.
- Highlight on the diagram the details required for a question. Learners transfer these to a card/sticky note before attempting the calculation.

Extension

Ask learners to find the areas of rectangular floors on plans where measurements are given in millimetres, giving their answers in square metres.

Task 2

Work out the area of a wall
MSS1/L1.9

- Briefly recap the formula for finding the area of a wall.
- Encourage learners to estimate the area of a wall space by rounding the decimal numbers to the nearest whole number. You may need to remind learners about rounding numbers (see focus page) in order to do this.
- Remind learners that this calculation relates to a wall with no doors or windows.

If the learner has difficulty

- As for Task 1

Extension

Ask learners to measure a rectangular wall/door, for example in the workroom, at home, or elsewhere in the building, and find the area in square metres.

Task 3

Work out the area of a wall with doors
MSS1/L1.9

- Remind learners of the previous discussion of what would happen if the wall had doors and/or windows. Extend the discussion to what would happen if there was a door and a window, or more than one of each. Illustrate by referring to the walls in the workroom if necessary.
- Work through the three-step example, at each stage asking learners what they should do next and checking understanding.
- Review learners' understanding of the process of decimal subtraction if necessary.
- Encourage learners to estimate the area at each of the first and second calculations.
- Discuss the impact of the window in the door on the amount of varnish that is likely to be needed. Draw the links between this and the previous calculation (it is necessary to subtract the area of the window from that of the door – just as it was necessary to subtract the area of the door from that of the wall).

If the learner has difficulty

- As for Tasks 1 and 2.
- Further work on subtracting decimal numbers can be found in *Skills for Life* Numeracy Level 1. Encourage learners to use calculators, but support them in estimating their answers and analysing errors.
- Provide further opportunities to practise similar calculations, perhaps using whole numbers until learners understand the concept.
- Encourage learners to use the drawing tools on 'Word' or 'Paint' to explore the visual impact of placing a smaller rectangular shape on a larger one.
- Some learners, for example those with dyslexia or those with memory impairment, may experience difficulty in remembering the sequence of steps needed to perform the entire calculation. They may need frequent prompts in relating the processes, that is multiplying to find the areas of both rectangles, then subtracting the larger area from the smaller. You may want to develop memory cards with numbered steps for the sequence of this calculation.

Extension

- Ask the learner to calculate:
  - the area of a wall with a window and a door, or two windows
  - the area of the floor in an L-shaped room.
- You might like to extend this skill to the area of circles and more complex composite shapes.

Theme assessment

- Encourage learners to use the estimation skills developed in these tasks by estimating the areas of walls and ceilings in their workplace or rooms that they are working on currently.
- Ask learners to measure and work out these areas, taking into account major openings such as doors and windows.
- Set further tasks involving mixed units of measure, or more complex shapes based on rectangles.

Area

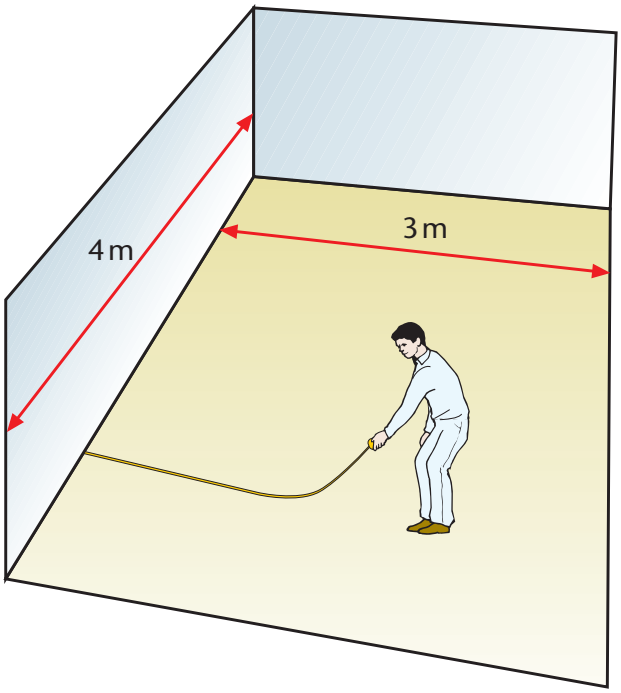
Focus

To find out how much material it will take to cover a surface such as a floor or a wall, you need to calculate its **area**.

To calculate the area of a rectangular **floor**:

- measure the length of the floor
- measure the width of the floor
- multiply the length by the width (l × w).

Example: This **floor** has an area of
$4 \times 3 = 12\,m^2$



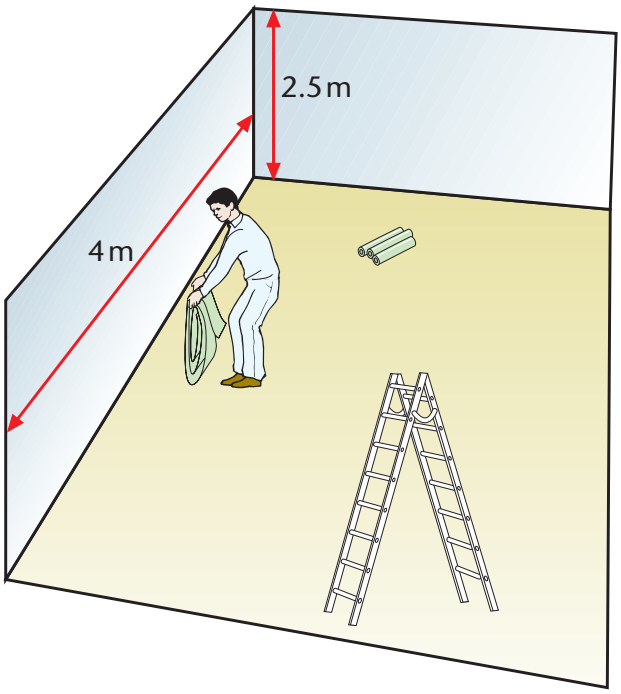
Remember!

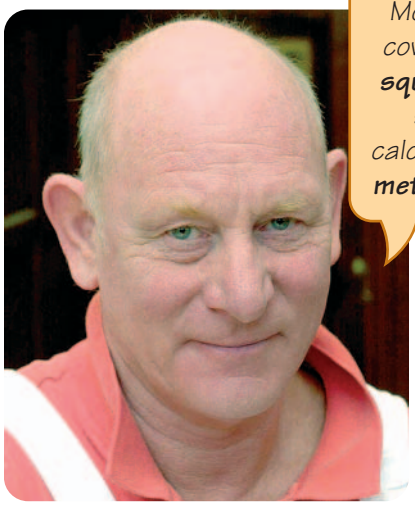
Area is measured in **square units**.
m^2 means **square metres**.

To calculate the area of a rectangular **wall**:

- measure the length of the wall
- measure the height of the wall
- multiply the length by the height (l × h).

Example: This **wall** has an area of
$4 \times 2.5 = 10\,m^2$





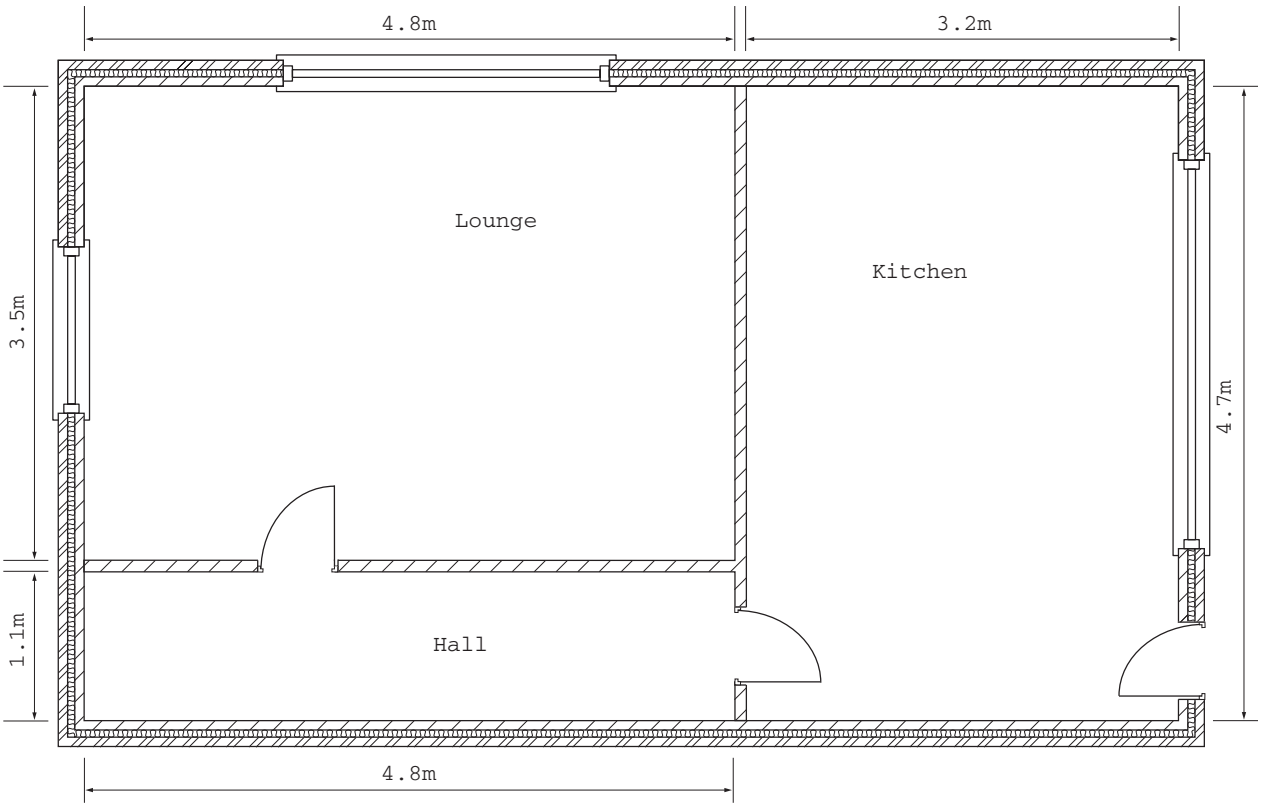
*Most floor and wall coverings are sold in **square metres** (m^2), so it is best to calculate an **area** with **metre** measurements.*

Area

Task

Task 1

Use the floor plan to answer the following questions.



1 What is the area of the floor in the **kitchen**?

_____ m × _____ m = _____ m²

2 What is the area of the floor in the **lounge**?

_____ m × _____ m = _____ m²

3 What is the area of the floor in the **hall**?

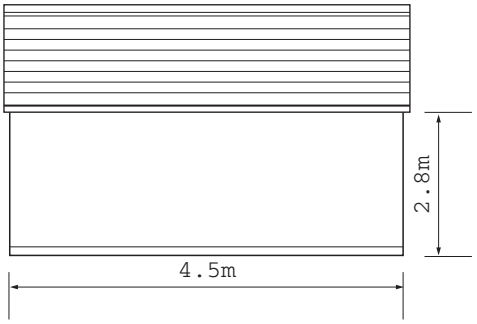
_____ m × _____ m = _____ m²

Remember!
Area of a rectangular floor = length × width

Task 2

This wall needs to be rendered. What is the area?

_____ m × _____ m = _____ m²

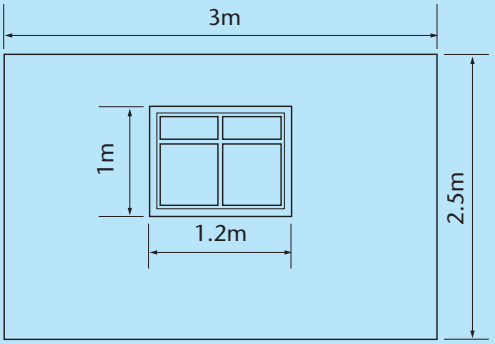


Remember!
Area of a rectangular wall = length × height

Area

Task

To calculate the area of a wall that needs painting, you need to subtract the area of any windows and doors.

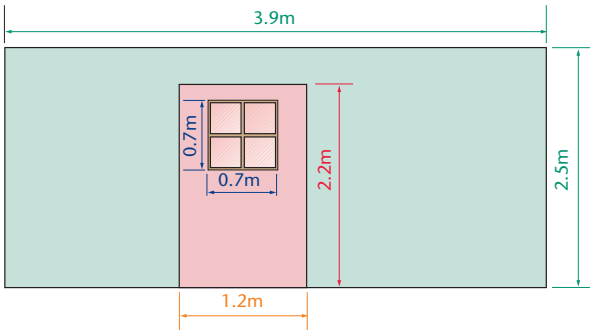


Step 1: Find the area of the whole wall.
Area of whole wall = length × height
= 3 m × 2.5 m
= 7.5 m^2

Step 2: Find the area of the window.
Area of the window = length × height
= 1.2 m × 1 m
= 1.2 m^2

Step 3: Subtract the area of the window from the area of the whole wall to get the area that needs painting.
Area that needs painting = 7.5 m^2 – 1.2 m^2 = 6.3 m^2

Task 3



1 The **wall** shown above needs painting. What is the area to be painted?

a Area of the whole wall = _____ m × _____ m = _____ m^2

b Area of the door = _____ m × _____ m =_____ m^2

c Area that needs painting = _____ m^2 – _____ m^2 = _____ m^2

2 This **door** shown above needs varnishing. What is the area to be varnished?

a Area of the whole door = _____ m × _____ m = _____ m^2

b Area of the glass panel = _____ m × _____ m = _____ m^2

c Area that needs varnishing = _____ m^2 – _____ m^2 = _____ m^2

Tip
Subtract the area of the door from the area of the wall.

Tip
Subtract the area of the glass panel from the area of the door.

PAGES 3:12–3:13
Volume

Occupational setting

Establishing the amount of materials required to complete a job is essential if the job is to be finished on schedule and within budget. This means calculating the volume of items likely to be purchased in cubic metres (m^3), such as concrete.

Materials

Examples of materials measured in m^3, for example, a load of concrete (this may need to be during a site visit) or delivery notes showing quantities

Learning outcomes

1 To understand that volume is a measure of space (focus page, Task 1)
2 To understand the measurements required to calculate the volume and how to obtain them (focus page, Task 1)
3 To understand that measurements must be in the same units before calculating volume (focus page, Task 1)
4 To calculate the volume of a cuboid using the formula length × width × height (or depth) (focus page, Task 1)
5 To recognise that volume is measured in cubic units (focus page, Task 1)

Suggested teaching activities

Introduction

- Remind learners that area is a measure of surface. Ask them what they understand by the term 'volume'. Explain that volume is a measurement of space, in this case the space enclosed by a shape. What sorts of things might be measured in this way? Guide learners to mention liquids, which cannot be measured using linear measure.
- Check learners' understanding of the terms 'cube' and 'cuboid'. Draw examples on board/OHT if necessary. Ask for examples of objects that are these shapes.
- Confirm that volume is measured in cubic units – cubic metres or centimetres for example. Explain that each side and surface of a cubic unit has the same measurement. Confirm that cubic metres are the unit most commonly used in construction.
- Explain that all the measurements must be in the same units – for example all in metres or millimetres. Ask learners what they should do if, for example, they were given measurements in both millimetres and metres.
- Ask learners to estimate the number of cubic metres in the workroom. How about cubic millimetres in a brick?

Focus page

- Look at the focus page and review the terms length, width and height (or depth) in turn.
- Explain the calculation of the volume of a shape using the formula length × width × height (or depth).
- Reinforce learners' understanding of the way in which volume is measured, that is in cubic units. Ensure learners know how to write cubic metres and millimetres.
- Give learners practice in calculating volumes using whole numbers. Start by mental calculations using single-digit numbers and/or two-digit multiples of 10. Progress to written calculations using two- or three-digit numbers. Remind learners that the order in which the figures are multiplied is not important.
- Refer to the example on the focus page. Point out that one of the numbers (0.3) is a decimal number.
- Remind learners to use units of measure appropriate to the task in hand. In this instance, concrete is measured in cubic metres, so all the linear measurements should be expressed in metres.
- Give learners practice in converting between metres and centimetres, and vice versa (using a calculator if necessary). Review the concept of multiplying and dividing decimal numbers by 100, if necessary.

Curric. refs	NOS/NVQ	Key Skills
MSS1/L1.10	MR270 FCA037	N1.2

Task 1

Work out volumes
MSS1/L1.10

- Briefly recap the formula for working out the volume of a cuboid.
- If necessary, review learners' understanding of decimal numbers. Ensure they know that the decimal point separates whole units from parts or fractions of a unit.
- Ensure learners feel confident in multiplying decimal numbers. Provide opportunities to consolidate this skill as necessary.

If the learner has difficulty

- Give learners further examples to practise calculating volumes using whole numbers. Gradually introduce decimal numbers by including one, then two, then three decimal numbers. For example, 2 m × 3 m × 5 m, then 2 m × 3 m × 0.5 m; 2 m × 0.3 m × 0.5 m; 0.2 m × 0.3 m × 0.5 m. Ask learners to explain the impact of including an additional decimal number each time.
- Further work on the decimal point can be found in *Skills for Life* Numeracy Entry 3, Unit 2.
- Further work on multiplying decimals can be found in *Skills for Life* Numeracy Level 1.
- Encourage learners struggling with the calculations to use calculators. Ensure they are able to identify any errors, including those relating to the placement of the decimal point, and the use of zero as a placeholder. Check understanding and support learners as necessary.
- Use aids such as wooden blocks, cardboard boxes, bricks and dice to assist learners with visual difficulties. Use aids such as wood blocks, boxes, etc. to help dyslexic and other learners understand the concept of volume.

Extension

Give learners volumes to calculate in cubic metres where some of the measurements are given in millimetres and/or fractions of a metre (e.g. 3300 mm, $4\frac{1}{2}$ m).

Theme assessment

- Ask learners to estimate quantities of products needed in their workplace for particular jobs (where those products are measured in cubic metres).
- Set more complex tasks involving mixed units of measure, including those where the learner has to gauge which unit is the most appropriate for the calculation.

Volume

Focus

If you order material such as gravel for a path or concrete for foundations, you need to calculate the **volume**.

Volume is the amount of three-dimensional space that a substance occupies.

To calculate volume:

- measure the length
- measure the width
- measure the height (or the depth)
- multiply the three measurements together.

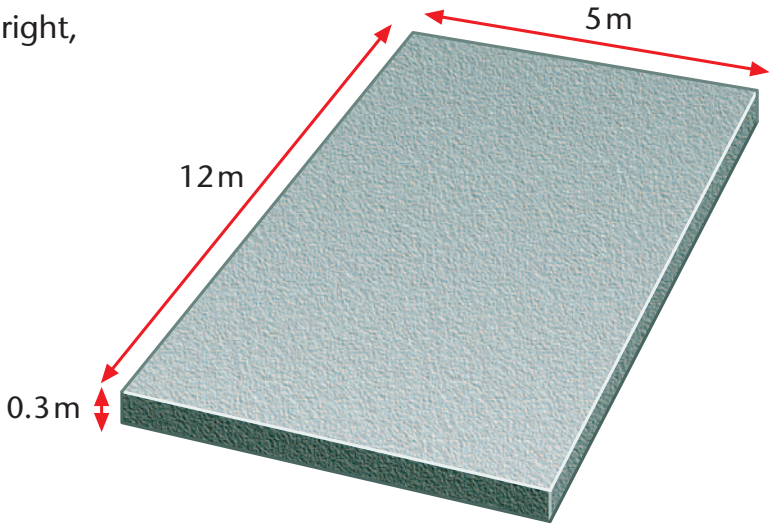
Volume = length × width × height
(**or** length × width × depth)

Tip
You can multiply the three measurements in any order.

Example:

To work out how much concrete to order for the foundations shown on the right, calculate as follows:

Volume = length x width x depth
= **12 m** × **5 m** × **0.3 m**
= **18 m^3**



Remember!
Volume is measured in **cubic units**.
m^3 means **cubic metres**.

*Concrete is sold in **cubic metres** (**m^3**), so it is best to calculate the **volume** that you need using **metre** measurements. Make sure **all** your measurements are in metres before you multiply them together.*

Volume

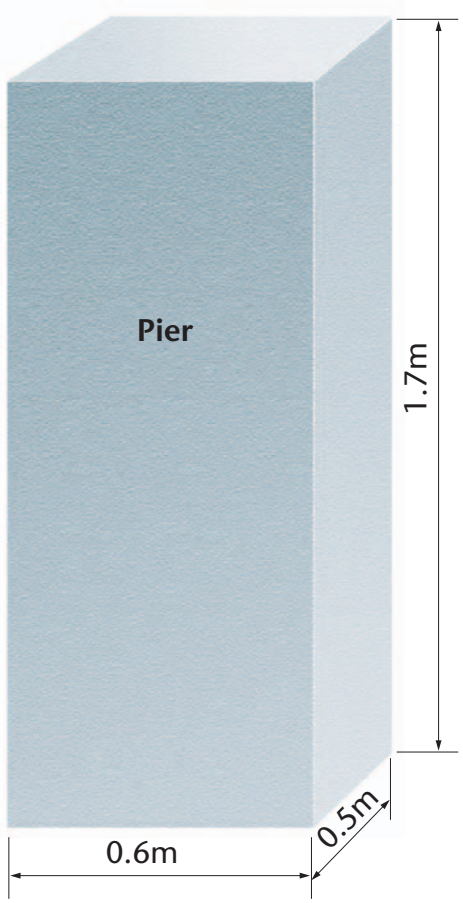
Task

Task 1

Calculate the volume of material you need to make the concrete pier and raft foundation shown below.

Remember!
Volume = length × width × height (or depth)

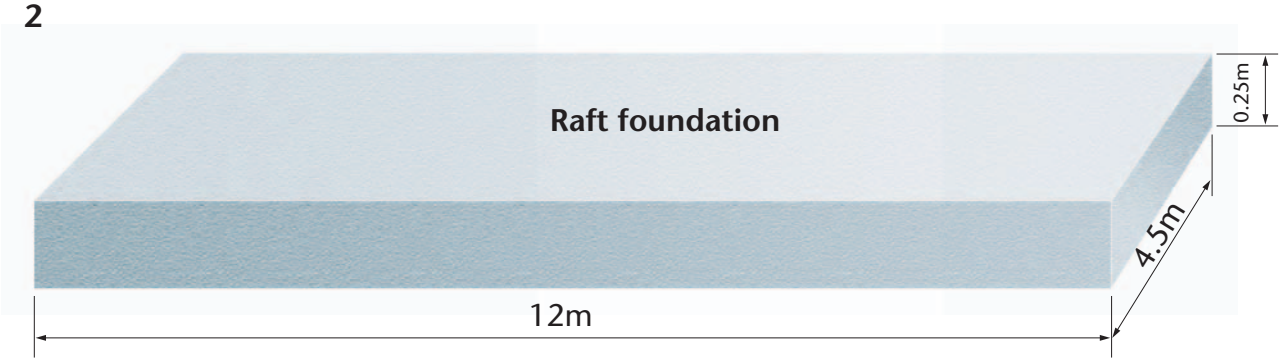
1



The volume of the pier is:

_____ m × _____ m × _____ m = _____ m^3

2



The volume of the raft foundation is:

_____ m × _____ m × _____ m = _____ m^3

PAGES 3:14–3:16

Calculating material

Occupational setting

Establishing the amount of materials required to complete a job is vital if the job is to be completed on time and within budget. Buying too much material is wasteful and expensive; buying too little will waste time. Selecting resources is a common element in many units of the Occupational Standards. This includes selecting the correct quantity of materials, as well as choosing the correct tools and equipment. This theme contributes to the underpinning knowledge and level of competence required for this element.

Materials

Calculators

Builders' catalogues

Learning outcomes

1 To solve problems in context (focus page, Tasks 1 and 2)
2 To interpret remainders (Tasks 1 and 2)
3 To check calculations (focus page, Tasks 1 and 2)

Suggested teaching activities

Introduction

- Ask learners to explain how they would work out how much wallpaper they would need for a room, or how many plasterboards they would need to cover a ceiling.
- Record the steps on the board/flipchart.
- Ask learners what else they would need to know in order to work out how many tins of paint they would need for a room with total surface area of 50 m^2 (i.e. the coverage of each tin).
- Ask learners how many packs of wallpaper they would need if they needed 20 rolls of paper that are sold in packs of four. Practise with a similar range of questions.

Focus page

- Look at the focus page. Remind learners of the importance of having the appropriate measuring tools to hand (a tape measure in this instance).
- Refer to the instruction on rounding measurements up. Practise rounding a series of decimal numbers up to the next whole number. Practise further using an activity based on matching whole numbers to decimal numbers.
- Discuss the responses to the question on the reasons for rounding up, rather than down.
- Review the information given in Step 2. Note: inclusion of the 22 mm thickness may confuse some learners. Emphasise that they need this information to ensure they have selected the right product, but not to work out how much they need.
- Explain the importance of checking answers. Ask learners what the consequences might be if they make mistakes in the calculation. Suggest that if they are working with large numbers, they can use a calculator, but it is always worth repeating the operation to ensure they have not made a mistake. Some learners may need help to develop or confirm checking strategies that work for them (e.g. reversing calculations; asking questions about whether this seems about the right quantity – is it a sensible amount of timber?; using a calculator).
- Give plenty of practice with different total lengths of pipe insulation and a range of pack sizes. Encourage learners to use mental calculations for the smaller numbers.

Curric. refs	NOS/NVQ	Key Skills
N1/E3.6 N1/E3.9	MR270 FCA037 Element 1 of many units e.g. MR124 MR184 MR139 MR218 MR375	N/A

Task 1

Calculate quantities of materials
N1/E3.6
N1/E3.9

- Ask learners what they should do if they know the total length of items they need for a job, and the length of each individual item. Give examples if necessary. More able learners may wish to consider how the amount required is calculated to include an allowance for wastage.
- Ask what learners understand by 'standard length'.
- If necessary, review learners' understanding of rounding up decimal numbers.
- Review learners' understanding of decimal numbers. Ensure they understand that the decimal point separates whole units from parts or fractions of a unit.
- Review learners' understanding of division, especially in relation to expressing remainders as decimal numbers.
- Discuss how to interpret remainders in the context of buying the correct number of battens/lengths of guttering. Ask what would happen in this example if the number was rounded down to 43 battens. Would this quantity of battens be sufficient?
- Ask learners to compare this answer with the one they obtain when they check if 44 battens is sufficient.

If the learner has difficulty

- Give more practice in rounding up decimal numbers, including numbers with two decimal places. Try matching activities or games in which learners have to match decimal numbers with their nearest whole number (rounded up).
- Further work on division where remainders are expressed as decimal numbers can be found in *Skills for Life* Numeracy Entry 3.
- Further work on the decimal point can be found in *Skills for Life* Numeracy Entry 3.
- Some learners, including those with dyslexia, may have difficulty carrying out the operations in the correct sequence. Develop strategies to assist them in identifying the correct order of operations. For example, write the steps on separate pieces of card and number them on the back. Encourage learners to put them in the right sequence and then to use the cards as memory aids.

Extension

- Ask learners to measure the work room and calculate how many tins of paint are needed for two coats, if the area to be covered is 70 m^2 and each tin covers 8 m^2.
- Discuss with learners what they will do with leftover paint and materials. Are there any environmental issues? How does the cost of waste impact on profits?

Task 2

Calculate materials to cover areas
N1/E3.6
N1/E3.9

- Review understanding of area. If necessary, remind learners of the formula: length × width/height. Remind learners that area is measured in square units, for example m^2.
- Check learners' understanding of the architectural drawing.
- Check learners understand that in this instance 'standard pack' refers to the roll of roof felt. Ask for (and provide) other examples of standard packs of items used in construction.
- Review learners' understanding of how to calculate the number of rolls of roof felt/pallets of tiles by dividing and rounding up decimal numbers to the nearest whole number.
- Discuss how to interpret remainders in the context of buying the correct number of rolls of roof felt/pallets of tiles.
- Remind learners of the checking procedure.

If the learner has difficulty

- As Task 1.
- Use paper-based or on-line catalogues from builders' merchants to assist learners who are struggling with the concept of buying in packs, rolls, etc.
- Give additional practice in interpreting remainders in realistic contexts.

Extension

Ask learners to list other materials that will be needed for this job and to cost the job using a builders' catalogue.

Theme assessment

- Measure lengths/areas of walls, ceilings or floors in the workplace and calculate amounts of covering materials required.
- Calculate quantities of materials needed for building projects, using different materials sold in a range of lengths, quantities and packages.

Calculating material

Focus

Make sure you have enough material by following the steps below. Having too much material is wasteful and expensive. Not having enough material will waste time.

Step 1

*Work out how much material you need **before you start** the job.*

*Measure with a **tape measure**. If you round measurements, always **round them up**.*

Here's an example:

*I need to insulate some pipes. They measure **11.6 metres** in total, but I'll round it up to **12 metres**, a number that is much easier to remember.*

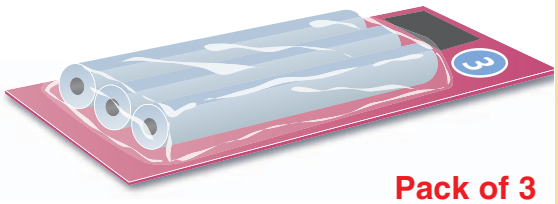
Q1 Why is it better to round measurements **up** rather than **down** when you calculate the materials you need for a job?

Step 2

*Next, find the **quantity of material** that you get in a standard pack.*

Pipe insulation

22 mm thick × **1 m long**



Pack of 3

Q2 How much insulation is in this pack?

Step 3

*Now **divide** the quantity you need by the quantity in one standard pack. This tells you how many packs to buy.*

*I need **12 metres** of pipe insulation.*
1 pack** contains 3 × 1 metre = **3 metres
***12 ÷ 3 = 4**, so I need to buy **4 packs**.*

Step 4

*Finally, **check your answer** to make sure you have enough material.*

4** packs × **3** metres per pack = **12 metres

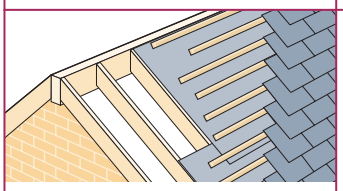
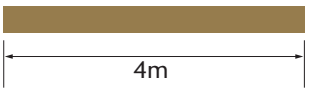
This is enough, as I calculated that I needed 12 m.

Q3 You need **18 metres** of pipe insulation. How many packs will you buy?

Calculating material

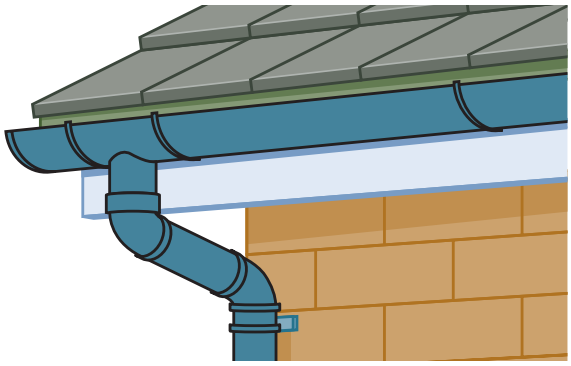
Task

Follow the steps below when ordering materials that are **sold in single lengths**.

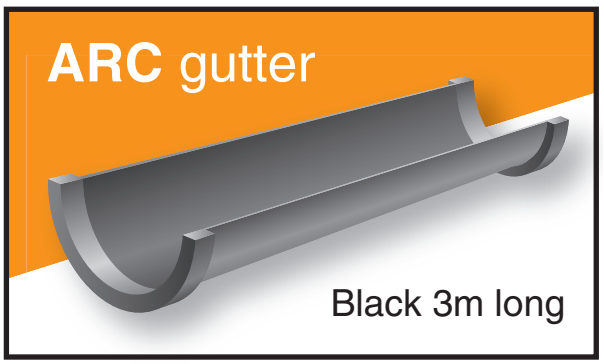
Step 1	Step 2	Step 3	Step 4
Find **how much material** you need for the job.	Find the **standard length of 1 item of material**.	**Divide** the length required by the length of 1 standard item to find how many items to buy. **Round up** to the next whole number.	**Check** to make sure you have enough material.
 **Job requires 175 m of roof battens (allowing for wastage)**	Roof batten  **1 standard roof batten = 4 m**	**175 ÷ 4 = 43.75** You can't buy 43.75 roof battens, so buy **44**.	**Check** **44 × 4 m = 176 m** **Require 175 m** 44 battens will be enough material for the job.

Task 1

Calculate **how many** lengths of guttering you need to buy for this job.



Job requires 35 metres of guttering



Total length of guttering required for this job = _____ m

Length of 1 section of guttering = _____ m

Calculation: _____ ÷ _____ = _____

Buy _____ sections of 3 metre long guttering.

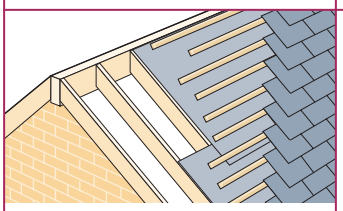
Remember!

- Round **up** if necessary.
- Check your answer.

Calculating material

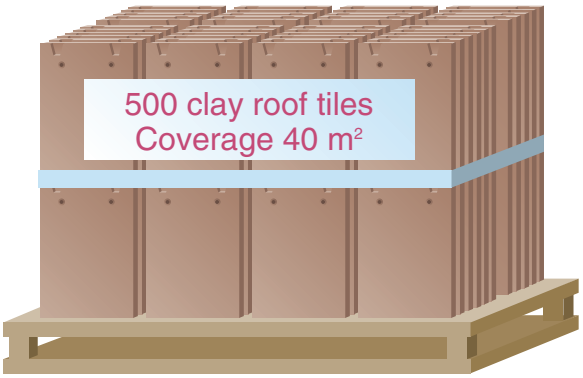
Task

Follow the steps below when ordering materials that are **sold in square metres**.

Step 1	Step 2	Step 3	Step 4
Find the **area of the surface you need to cover**. Remember! Area = length × width	Find out the **area that a standard pack will cover**.	**Divide** the area to be covered by the area of the covering material to find how much to buy. **Round up** to the next whole number.	**Check** to make sure you have enough material.
 **Job requires 113 m² of roof felt**	 **1 roll of roof felt covers 5 m²**	**113 ÷ 5 = 22.6** You can't buy 22.6 rolls of roof felt, so buy **23**.	**Check** **23 × 5 m² = 115 m²** **Require 113 m²** 23 rolls will be enough material for the job.

Task 2

Calculate how many pallets of roof tiles you will need to cover the same roof.



Area of the roof = _____ m²

Area covered by 1 pallet of tiles = _____ m²

Calculation: _____ ÷ _____ = _____

Buy _____ pallets of tiles.

Remember!

- Round **up** if necessary.
- Check your answer.

PAGES 3:17–3:18

Reading floor plans

Occupational setting

Effective reading of plans and drawings depends on a sound understanding of the symbols used to represent components and features, and an ability to interpret them. It is also important to understand how measurements are shown on plans. This theme develops the skills needed to interpret plans at this level. Further work in this area can be found in Module 3 of *Trowel occupations*.

Materials

A selection of drawings and plans from the workplace

Learning outcome

To obtain meaning from symbols used on plans and drawings (focus page, Task 1)

Suggested teaching activities

Introduction

- If you haven't already done so, ask learners about their experience of plans and their understanding of what they represent.
- Look at a selection of workplace plans, ideally for a building that learners are familiar with (to make it easier to relate symbols on the plan to the actual features).

Focus page

- Check learners recognise all the symbols. You could make this into a quiz. You will need to look at the symbol for a door in more detail, in order that they can answer the question on the page.
- Ask learners to study a workplace plan and to name the features. Can they work out any features not shown on the focus page? (e.g. for light switches) Draw attention to the fact that different symbols are used to represent different features.
- Focus on precise language for describing location and relative position. Directional vocabulary – left, right, next to, etc. – is important here (see next theme Interpreting plans and drawings for further work).
- This theme has a small amount on measuring (also covered elsewhere in this module). It is important that learners understand how measures are shown on plans (arrows showing the extent of the measure) and that measures are recorded almost invariably in mm. One of the questions on the task page is about running dimensions, which require addition skills. Work on running dimensions is covered elsewhere in this module and further work can be found in the *Trowel occupations* materials for Embedded Learning.
- Look at the questions on the focus page – these are best done orally.

Curric. refs	NOS/NVQ	Key Skills
MSS2/L2.1		N2.1
MSS2/E2.3		
MSS1/L1.6		

Task 1

Use a floor plan to answer questions
MSS2/L2.1
MSS1/L1.6

Encourage learners to look carefully at the plan before answering the questions. They will need to understand the use of symbols. There are also questions involving running dimensions.

If the learner has difficulty

- An aspect of directionality skill is required to answer the question about pushing and pulling doors (as well as understanding the symbol). Learners with poor directional skills (perhaps dyslexic learners) may struggle with this, as it requires you to place yourself in three dimensions within a two-dimensional model. Turning the page to help the learner orientate him/herself may help.
- It might help to draw a 'stick man' to show left/right, push and pull.

- Learners struggling with the measuring aspect of the task can be supported with materials elsewhere in this module.

Extension

Ask learners to develop a key showing symbols and their meanings, for use with workplace plans.

Theme assessment

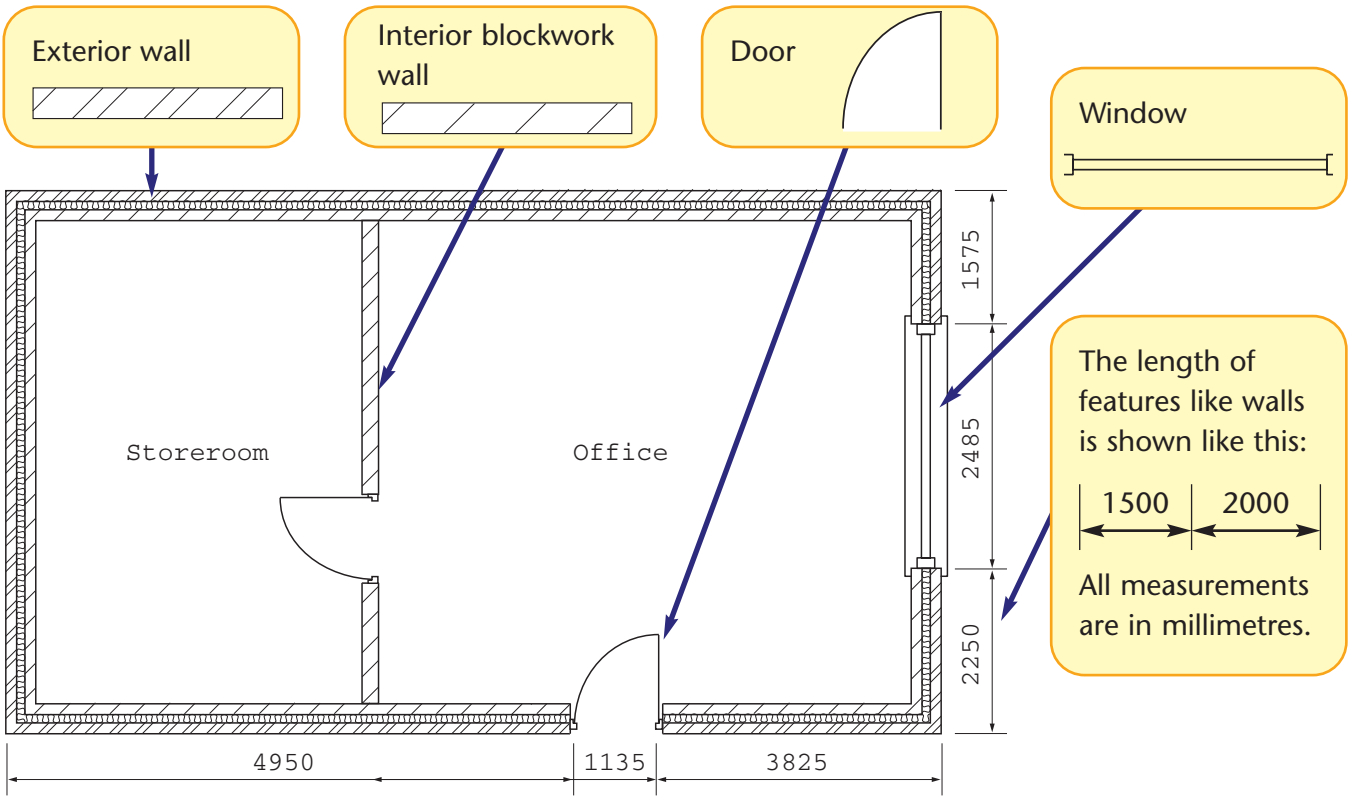
- Set similar questions based on a workplace plan.
- Ask learners to develop a plan for the classroom or a building that they are familiar with (e.g. their home), showing all features in the correct relationship, using appropriate symbols.

Reading floor plans

Focus

Floor plans use symbols to represent different features such as walls and windows. You need to know what each symbol means in order to read the information contained in a floor plan.

The most common symbols used on floor plans are shown below:



You can use the symbols on the plan above to work out the following:

The **number** and **position** of windows and doors

Try this: Which room has a **window**?

The length of **individual features** such as walls, windows and doors

Try this: How **wide** is the outside **door** opening?

Combined lengths of features

Example:
The building is 9910 mm long
(4950 + 1135 + 3825 = 9910)

Try this: What is the **width** of the building?

The **direction that doors open**

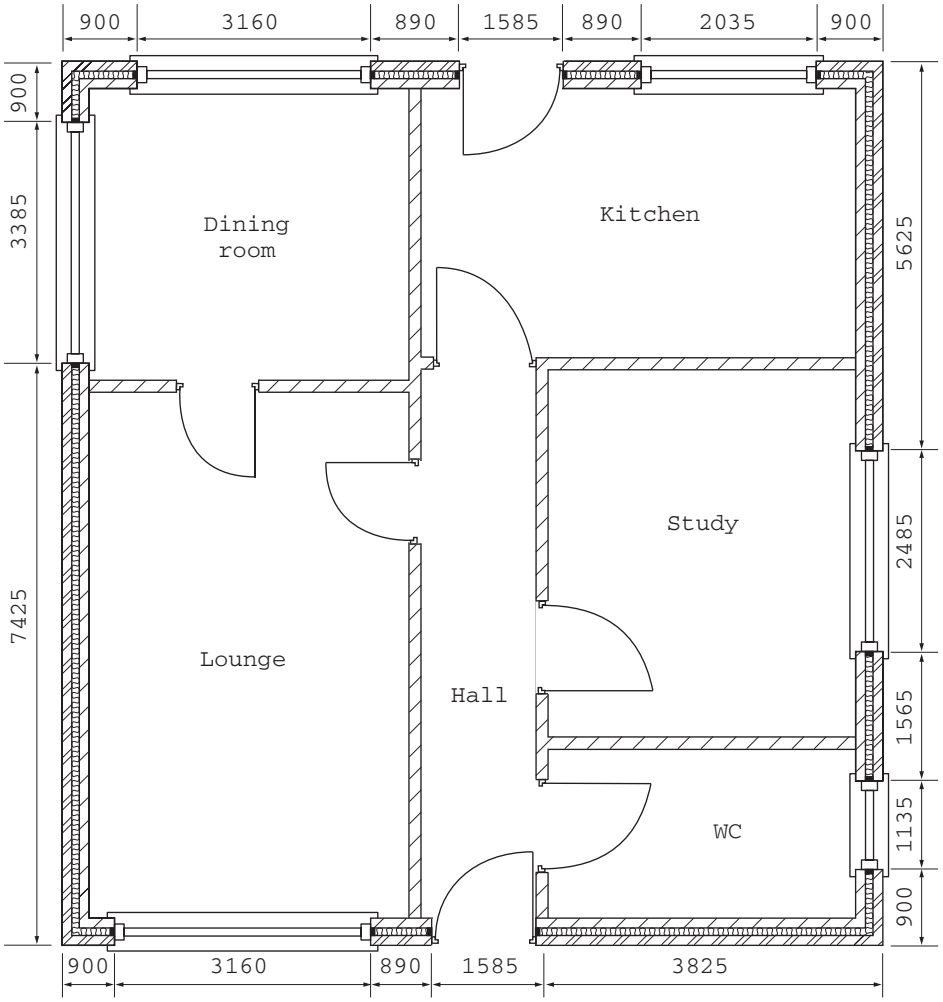
Try this: Do you **push** or **pull** the door to go out of the office into the storeroom?

Reading floor plans

Task

Task 1

Use this floor plan to answer the questions below.



1 How many doors are there in total? _____

2 Which room does not have a window? _____

3 Which room has two windows? _____

4 Do you push or pull the door to go out of the lounge into the dining room? _____

5 Do you push or pull the door to go out of the hall into the study? _____

6 What is the length of the window in the kitchen? _____ mm

7 What is the overall length of the building? _____ mm

8 What is the overall width of the building? _____ mm

PAGES 3:19–3:20

Interpreting plans and drawings

Occupational setting

Being able to understand plans and working drawings is a critical skill for all areas of construction. An understanding of how drawings provide each trade with the necessary information to contribute to the overall structure, and the concept of how drawings work is essential to the progression of the learner and his/her efficiency in the workplace. Good spatial skills are required for this. Module 3 of the *Trowel occupations* Embedded Learning file covers this area of work in greater depth.

Materials

Plans and working drawings from the workplace
Plans and drawings from the Source material (0:29)

Learning outcomes

1 To understand that drawings show several different views of the same construction (focus page, Task 1)
2 To know the basic features of elevations, plan views and cross-sections (focus page)
3 To recognise how different views relate to one another in three-dimensional form (focus page, Task 1)

Suggested teaching activities

Introduction

- Ask learners about their experience of plans and working drawings. Have they seen any? What are they used for? Why are they important?
- Look at a range of plans from the workplace. Gauge learners' understanding of the format of plans.
- Learners need to become familiar with the language used to describe drawings, in particular: elevation, floor plan and cross-section.

Focus page

- Look at the drawings on the focus page. *What building is this plan for? How did you find this out?*
- Discuss how plans are a way of representing a real life object on paper. Explain that, because it is not possible to make detailed drawings in three dimensions, the building is drawn from several different views in order to provide all the necessary information. Discuss the different types of drawing and the characteristics and features of each – *What does an elevation show? What is a floor plan? What is a cross-section? How is this different from an elevation?*
- Point out that the drawings are all views of the same building – can learners describe the building from the front, rear, left side, right side? Is it a one-, two- or three-storey building? How can they tell?
- Discuss the 'Try this' box. Can learners match the parts of the building? Learners may find it useful to cut out the different views from the Plans and drawings in the Source material and physically move them together to understand how two-dimensional drawings provide a representation of a three-dimensional building. Provide enlarged photocopies of the drawings for this purpose.
- Look at the floor plan in detail. Explain how floor plans provide a view looking down on the building – like a bird's-eye view. Using questioning, ask learners to describe the features of this plan (e.g. *Which rooms are next to the lounge?*).
- Look at the elevations in detail. *Which elevations have the same roof shape? Why is that? Which elevation belongs to which side of the plan view? How can you work it out?*
- Look at the cross-section in detail. *What is being depicted? How does the cross-section relate to the elevations?*
- During discussion, encourage learners to use the correct terminology to describe plans.

- Directional vocabulary is a critical part of this skill (e.g. left/right, above, next to, rear, front). It is vital that learners know this vocabulary and can use it correctly. Look out in particular for learners who confuse left and right – they will need to devise a strategy for confirming their choice (e.g. I write with my right hand …).
- It is also important that learners can interpret directions in relation to the plans – this is a more complex directional skill, requiring the learner to place him/herself in the listener's or viewer's position. Set up a quiz or test (perhaps along the lines of 'Simon says') to practise this skill, for example 'Point with your left hand to his right shoulder'; 'Show me what feature is to the left of the front door as I face it from inside/outside.' Be aware that many dyslexic learners will find this difficult (even stressful).

Curric. refs	NOS/NVQ	Key Skills
MSS2/L2.1		N2.1
MSS2/E2.3		

Task 1

Find information from drawings to answer questions

MSS2/L2.1

MSS2/E2.3

Learners need to look carefully at the drawings on the page in order to answer the questions. You may want them to work in pairs.

If the learner has difficulty

- Support learners who have problems with directional vocabulary.
- Orientation may be problematic. Three-dimensional construction of the plans will probably help, as may the use of a 'stick man' for left/right.
- Make a copy of the drawings and allow learners to place them in the correct relationship with each other in order to answer the questions.

Extension

- Set further similar questions based on workplace drawings to ensure understanding is transferred into workplace situations.
- If appropriate, use the teaching and learning material from Module 3 of *Trowel occupations* to confirm and extend learning.

Theme assessment

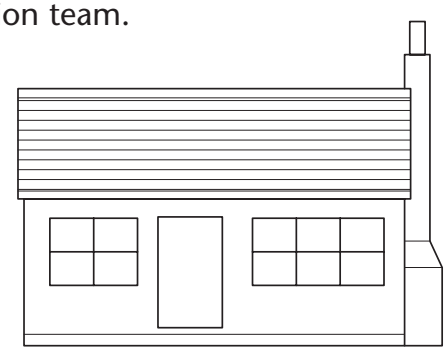
Ask learners to sketch the elevations, floor plan and a cross-section of their own house or the classroom.

Interpreting plans and drawings

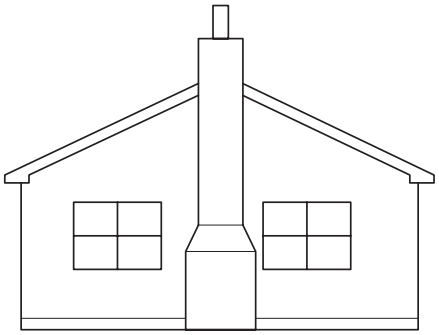
Focus

Plans and drawings are used to show different views of a building to the construction team.

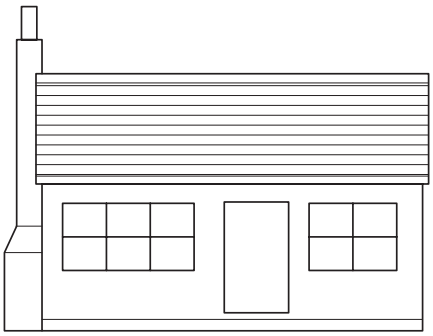
Elevations show how the building will look from all four sides (front, rear, left and right).



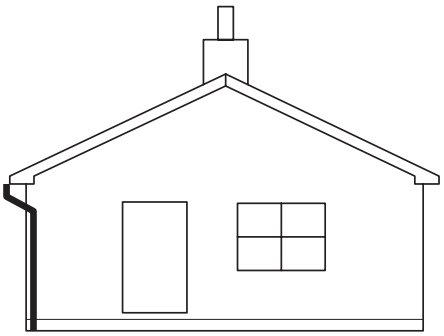
Rear



Left side



Front elevation



Right side

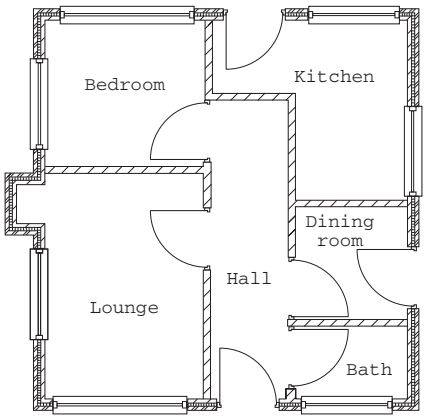
Try this

These are different views of the ***same*** building.

Match the views together to see the building in three-dimensions.

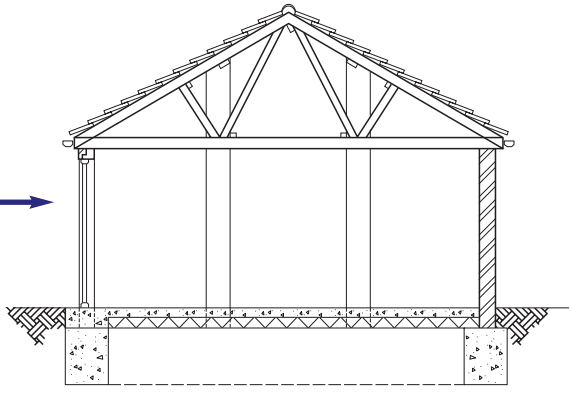
Floor plans show the building as though you are looking from above. They give a bird's-eye view.

For buildings with two or more storeys there will be a floor plan for each storey.



Cross-sections show how the building would look if sliced through from the roof to the ground.

They are useful for showing structural features such as beams, roof angles and footings.



Interpreting plans and drawings

Task

Task 1

Look at the plans and drawings for the building below and answer the questions.

1 What kind of building is it? Circle your answer.

two-bedroom bungalow one-bedroom bungalow

four-bedroom house three-bedroom house

2 How many windows and exterior doors are there?

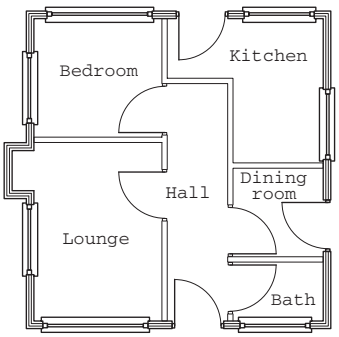
_____ windows _____ external doors

3 Only the front elevation is labelled. Label the rear, left side and right side elevations on the drawings below.

4 Which room does the door shown on the front elevation lead into? _____

5 Which room does the left hand window shown on the front elevation look into? _____

Front elevation



PAGES 3:21–3:22

Time and schedules

Occupational setting

Keeping to schedule is essential on construction sites. Many supervisors are unhappy if their workforce arrives late, and often one gang relies on another completing a job before they can move in. Some jobs on-site have a recommended time scale or productivity rate (e.g. number of blocks/bricks per hour).

Most apprentices have to keep a detailed time sheet that records time spent travelling, at work and at college.

Lastly and most importantly, it is important that learners can check their wages against time worked, especially if they have been working additional or antisocial hours.

Materials

Clocks or watches

Learning outcomes

1 To know the relationship between units of time (e.g. 1 hour = 60 minutes, $\frac{1}{2}$ hour = 30 minutes) (focus page, Tasks 1 and 2)
2 To calculate the duration of different activities (focus page, Task 1)
3 To use a starting time and a time duration to work out the time that an event should happen (focus page, Task 2)

Suggested teaching activities

Introduction

- Discuss reasons for keeping to schedule in relation to work.
- Practise some simple time problems verbally with learners. For example, *What will the time be in 4 hours' time? What time was it 3 hours ago? How long is the interval between 1 pm and 5 pm?*
- Ask learners how many minutes there are in an hour. *How many minutes in 2, 3 or 4 hours? How many in half an hour?*

Focus page

- Look at the focus page. Ask learners how they would work out the time interval between 5:45 and 8:00 am.
- Check learners know how many minutes in $\frac{1}{4}$ hour. Ask how many minutes there are in $\frac{3}{4}$ hour, $1\frac{1}{4}$ hours, $1\frac{1}{2}$ hours, etc.
- Ask learners how they would calculate the time interval between 5:45 am and 4:30 pm.
- Refer to the diagram and explain the 'counting on' method – ask if anyone uses a different method and, if appropriate, to model their method for the others and comment as appropriate. *What difference would there be if you counted on to the next hour and then counted the hours?*
- Ask learners for the time interval between 11 am and 1 pm. How did they reach their answer? Explore further examples of time intervals that span midday for learners to work out.
- Ask learners how many minutes they would be early for work (assuming an 8:00 am start) if they arrived at 7:45, 7:54, etc. Note that the time 7:58 is included on the third box of the story board to provide an opportunity 'in context' for pointing out that 60 minutes = 1 hour.
- Explore the impact of different journey times on arrival time back at the depot in the evening.
- It might be useful to devise an activity for small groups with two packs of cards: Pack A: cards with am/pm times, Pack B: cards with a selection of work tasks that take different amounts of time. Learners select a card from Pack A (the start time) and B (the timed task) and calculate and record the finish time.

Curric. refs	NOS/NVQ	Key Skills
MSS1/L1.3	FCA037 MR272 MR214	N1.1

Task 1

Work out periods of time
MSS1/L1.3

- Practise working out a range of times, including hours and minutes, that span midday.
- Ask learners how they would work out how long a lunch break is if they stop for lunch at 1:00 and start work again at 2:00. *How long would it be if they started work again at 2:30? How about if they stopped work at 12:30 and started again at 1:30? How about if they started again at 1:38?*

If the learner has difficulty

- Give more practice in counting on periods of time in whole hours. Progress to periods of time measured in hours and minutes.
- Give further practice in counting on times spanning lunchtimes.
- Many dyslexic learners have difficulty with time, particularly counting 'over' 12:00 noon. Provide a 'time line' as shown on focus page. This could be in hours only at first.
- Practise converting numbers of minutes to hours and minutes, and vice versa. Play matching games using cards with times expressed in both ways.
- Ensure any learner with visual difficulties understands how to read and measure periods of time. If necessary, provide clocks without glass fronts and timelines with ridged markings.

Extension

- Ask learners to calculate
  - how long the gang worked altogether (excluding their lunch break).
  - the duration of the gang's day, including the journey times.

Task 2

Calculate the duration of activities
MSS1/L1.3

- Explore initial and final mix times with units of one hour.
- Ensure learners are comfortable counting on in $\frac{1}{4}$-, $\frac{1}{2}$- and $\frac{3}{4}$-hour intervals.

If the learner has difficulty

- As Task 1.
- Ensure learners understand the concept and terminology of 'initial' and 'final' setting times.
- Practise converting numbers of minutes to fractions of hours, and vice versa. Play matching games using cards with times expressed in both ways.

Extension

Ask learners to calculate the time interval between initial and final sets. *How long do you have to wait after the first batch of concrete receives its initial mix to mix the second batch?*

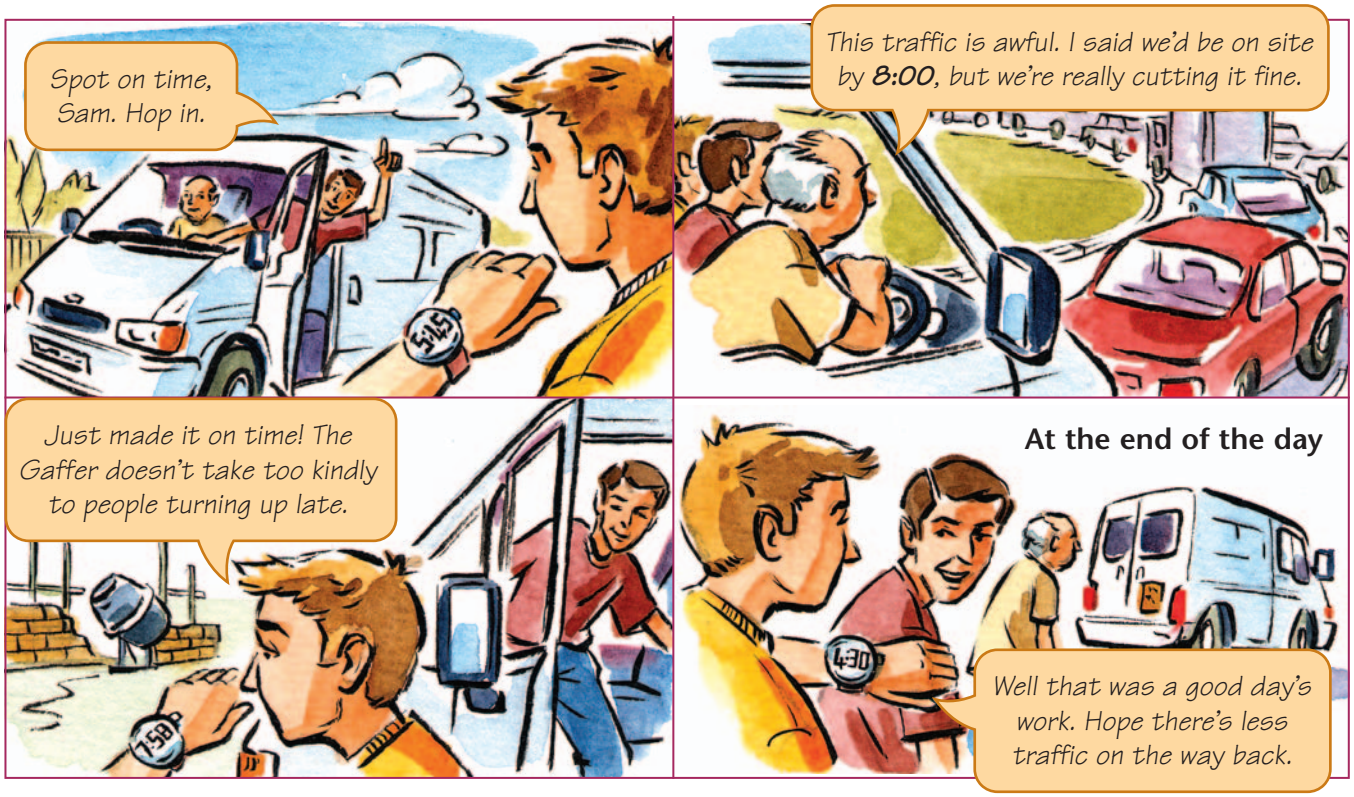
Theme assessment

- Ask learners to work out the duration of their working days, *excluding* breaks and journey times.
- Ask learners to time their working days, *including* breaks and journey times.
- Ask learners to work out the duration of particular jobs at their workplace.

Time and schedules

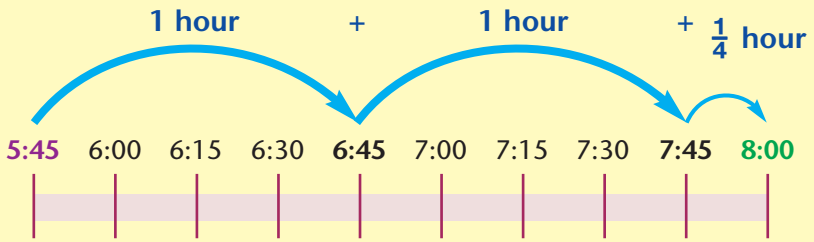
Focus

Time is important – getting to your place of work on time, finishing a job on time or getting paid the correct amount for the time worked. Time means money!



Count the **hours** and **minutes** between two times below to work out how much time has passed.

Example: The gang left the depot at **5:45** to get on site for **8:00**.



They estimated the journey would take $2\frac{1}{4}$ hours

Remember!

60 minutes = 1 hour

15 minutes = $\frac{1}{4}$ hour

30 minutes = $\frac{1}{2}$ hour

45 minutes = $\frac{3}{4}$ hour

Try this

1 The gang clocked on site at 8:00 am and left the site at 4:30 pm. **How long** did they spend on site?

2 The gang left the site at 4:30 pm. The return journey to the depot took $1\frac{3}{4}$ hours. **What time** did the gang arrive back at the depot?

Time and schedules

Task

Task 1

1 This gang started work at 7:30 am.
They stopped for lunch at 12:45 pm.
How long did they work **before their lunch break**?

_____

2 The gang finished their lunch at 1:15 pm.
They worked until 4:30 pm.
How long did they work **after their lunch break**?

_____

3 How long did they spend **on their lunch break**?

_____

Task 2

Use these concrete setting times to answer the questions below.

Concrete Mix

Setting times

Initial set:
30 minutes after mixing

Final set:
10 hours after mixing

Remember!
30 minutes = $\frac{1}{2}$ hour

Tips
- To find the time of the initial set, count on 30 minutes *from the mixing time.*
- To find the time of the final set, count on 10 hours *from the mixing time.*

1 One batch of concrete was mixed at 7:15 am.

a What time will it have its initial set? _____ am

b What time will it have its final set? _____ pm

2 A second batch of concrete was mixed at 8:45 am.

a What time will it have its initial set? _____ am

b What time will it have its final set? _____ pm

PAGES 3:23–3:24

Mixing materials

Occupational setting

Mixing mortar will be a familiar task to most people in the construction industry and this is a task that trainees are often given. They will need to be aware of the different types of mix needed for different tasks on site. They will also need to adjust quantities. Amounts of concrete or mortar to be mixed will vary, but the ratio will remain the same. This theme looks at how to increase the individual amounts of each material in proportion.

Materials

Materials for practical measuring activities (see below)

Calculator or multiplication square

Learning outcomes

1 To understand the meaning of a simple ratio (focus page)
2 To understand the concept of proportion (focus page)
3 To use a ratio to increase amounts of materials in direct proportion (focus page, Tasks 1–3)

Suggested teaching activities

Introduction

- Ask learners for examples of construction materials that must be mixed from a number of different ingredients. Discuss the possible effects of using too much or too little of some ingredients. Does anyone know any of the proportions used for mixing concrete for a particular purpose?
- There will be variations in the quantities given for the same purposes – it may be useful to discuss this as a group. For the purpose of this theme, a standard mix for concrete is given as 1:2:4 cement to sand to aggregate and for bedding mortar is 1:5 cement to sand. Encourage learners to look up other mixes on the Internet, in training manuals or on product labels.

Focus page

- The focus page looks at the meaning of ratio, and the method for increasing in proportion.
- Note that ratio and proportion can be particularly difficult for dyslexic learners. They may need several simple examples in a variety of settings, to build confidence and understanding. Conversely, they may also be exceptionally good at this, as it is a very visual calculation.
- Using the example of concrete, emphasise the importance of the *order* of the ratio. Ask learners to give the correct ratio of sand to cement to aggregate: aggregate to sand to cement, etc.
- Use the example of buckets and shovels to ensure learners understand the basic idea of proportion – that the container used for measuring can be anything from a teaspoon to a lorry-load, but the ratio will remain the same. Conduct practical activities to develop understanding: these could include measuring out dry materials for mortar if in a workshop situation or could be simulated activities such as making cups of tea. For instance, you might need 1 teabag per person, 2 sugar lumps per person and 1 cup per person. These measures remain constant and must be increased proportionally depending on the number of people.
- Work through the example of increasing amounts, again stressing the importance of the order of the ratio. Cement is the first item, so the new amount of two measures must be compared with the original amount of one measure. Ensure learners understand that they are looking for a multiplier.
- Go on to use the multiplier to find each new quantity in the mix, showing that every material must be multiplied by the same number to keep the proportion correct.
- Use other simple examples with the same ratio to ensure that learners are able to find a multiplier.
- Work through the example of increasing the quantity of sand. Again, use other simple examples with the same ratio.

- While going through the examples, ensure learners understand the mathematical process of doubling (× 2) and halving (÷ 2).
- The language used in this theme is important and may be a barrier to some learners. Check that all learners are familiar with expressions such as 'double', 'twice', 'half', 'proportion' and 'ratio'. These can be flagged up and written on the board/flipchart, together with examples or definitions.

Curric. refs	NOS/NVQ	Key Skills
N1/L1.7	MR180	

Task 1

Use simple ratio and direct proportion to change the amounts of materials in a given mix N1/L1.7

- Remind learners that ratio is about keeping the proportion of materials the same.
- Remind learners that, when increasing amounts, they are to find a multiplier.
- Point out the different mixes on the page and make sure learners are clear about the differences.

If the learner has difficulty

- Does the learner understand the concept of ratio? If this is not clear, it will be helpful to exemplify using practical examples with materials, money, food, etc.
- Does the learner understand the processes of multiplication and division as used in this task? Learners having difficulty with multiplying and dividing at this level will need additional specialist support, for example using *Skills for Life* Numeracy materials Entry 3 Unit 1.
- Encourage learners to use a calculator or multiplication square.
- Suggest that learners write down the original ratio, and then write the new given amount in the correct position underneath, as shown on the focus page. This makes it easier to see the direct relationship, and to remember which quantities need to be found.
- Learners may benefit from highlighting corresponding parts in the same colour. So item name and ratio part are coloured the same. This will help them make the connections.

Extension

Ask learners to find other ratios for screed or render and to work out how much cement they will need for a 'full' mix if the mixer will hold 20 shovels in total.

Task 2

Use simple ratio and direct proportion to change the amounts of materials in a given mix N1/L1.7

- Discuss the terms 'lean mix' and 'strong mix' and the situations in which weaker or stronger mixes may be used.
- Remind learners that the proportion of materials must always stay the same, regardless of the quantity.
- Explain that in question 2, they need to start from the basic mortar mix ratio and think about how they can increase the strength of the mix.
- Encourage learners to check that they have used the correct measures and materials.

If the learner has difficulty

- Does the learner understand the processes of multiplication and division as used in this task?
- In this task it is even more important to avoid confusion by writing down the ratio and the known quantity, as on the focus page.

Extension

Ask learners to find out about different mixes used for different jobs, using the Internet or reference material.

Theme assessment

Ask learners to find out by experimenting how many shovels there are in one bag of cement and to work out the total sand that would be needed to make a standard mortar mix using that bag. Depending on learners' ability and understanding, this can lead on to activities around the weight of sand and cement to be ordered for different jobs.

Mixing materials

Focus

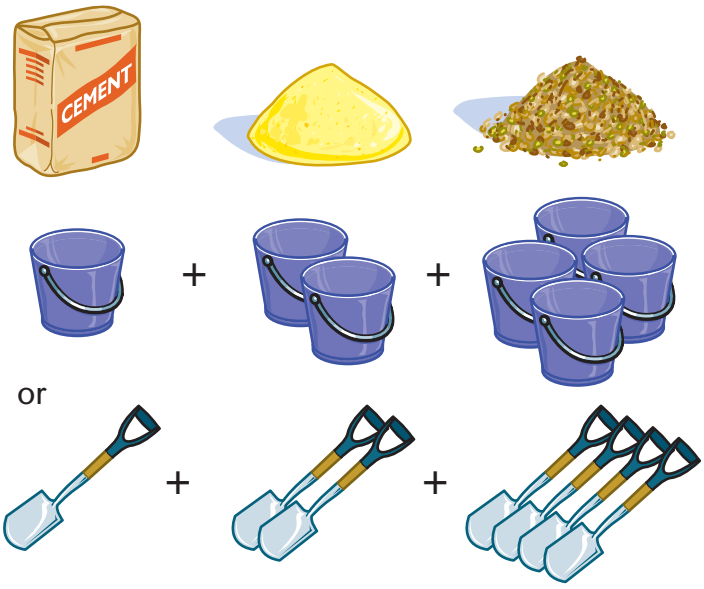
Mortar and concrete mixes vary according to the job: you may be using a mix for foundations, bricklaying or screed. The dry materials for each mix must be measured in the correct proportions.

A general-purpose concrete mix is made from cement, sand and aggregate in the ratio 1:2:4

This symbol means 'to', so the ratio is read as '**one to two to four**'.

The order of the ratio is important. The ratio 1:2:4 for concrete, means for every **one** measure of **cement**, you need **two** measures of **sand**, and **four** measures of **aggregate**.

Any container can be used to measure the materials, but the proportions must always be the same.



You increase the amounts of each material to make up more mix.

To double the amount:
If you use 2 measures of cement, how many measures of sand and aggregate must you add?

2 measures of cement is double the original amount

1:2:4

2:?:?

You need to double the other parts of the ratio:

Sand 2 × **2** = 4
Aggregate 4 × **2** = 8

2:4:8

This means that if you use 2 buckets of cement, you will need to add 4 buckets of sand and 8 buckets of aggregate, using a ratio of 1:2:4.

If you use 4 shovels of cement, how many shovels of sand and aggregate will you need?

A bedding mortar mix is made from cement and sharp sand in the **ratio 1:5**.

If you use 10 shovels of sand, how much cement will you need for this bedding mix?

? cement : 10 sand

10 shovels is **twice** the amount (× 2) of 5.

You need twice the amount of cement as well: 1 × 2 = 2

You need 2 shovels of cement to 10 of sand.

2:10

Mixing materials

Task

Task 1

A bedding mortar mix is made from cement and sharp sand in the ratio 1:5.

A general-purpose concrete mix is made from cement, sand and aggregate in the ratio 1:2:4.

1 If you use 5 buckets of sand to make a mortar mix, how much cement should you use? _____

2 If you use 3 shovels of cement to make a mortar mix, how much sharp sand will you need? _____

3 If you use 8 shovels of sand to make a concrete mix, how much cement and aggregate are needed? _____

4 If you use 12 shovels of aggregate to make a concrete mix, how much cement and sand should you use? _____

Task 2

A lean bedding mix has less cement to sand.

A strong mix has a higher proportion of cement to sand.

1 You are asked to make a lean mix for bedding down paving slabs. The ratio of cement to sand is 1:8. If you use 16 shovels of sand, how much cement will you need for the mix?

2 **a** Write a ratio for a strong mix. _____

b Use this ratio to work out how much cement you would add to 4 buckets of sand.

Amount of cement for 4 buckets of sand _____

Use a ratio to change the amounts of materials needed for a particular mix.

Rt/L1.5; Rt/L1.4; Rt/L1.2; Rw/L1.2

Check it

1 When mixing mortar, which of these units would you use to measure the water?

A kilograms

B litres

C metres

D kilometres

MSS1/E3.8

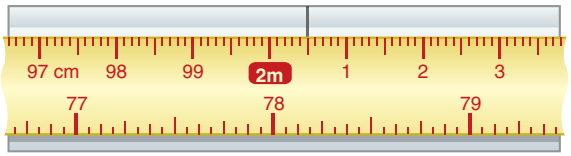
2 What measurement has this skirting board been marked at?

A 2500 mm

B 20 500 mm

C 205 mm

D 2005 mm



N1/L1.4; MSS1/L1.7

3 You want to tile a floor area of 24 m^2. One pack of tiles covers an area of 1.55 m^2. How many packs of tiles should you buy?

A 16

B 15

C 10

D 14

N2/E3.4

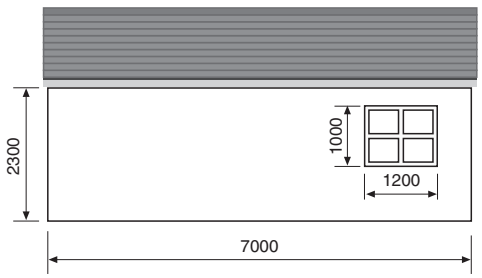
4 The wall of this garage needs to be rendered. What is the area to be rendered?

A 16.10 m^2

B 14.9 m^2

C 1.2 m^2

D 17.3 m^2



MSS1/L1.9

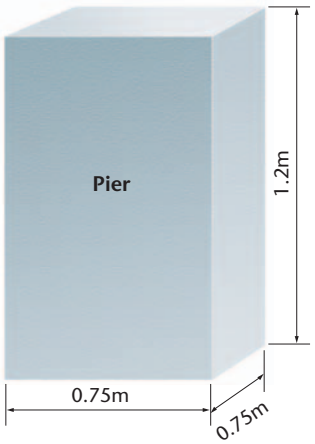
5 What is the volume of this pier?

A 0.675 m^2

B 0.675 m^3

C 0.9 m^3

D 0.5625 m^3



MSS1/L1.10

6 You need 125 m of roof battens for a job you're working on. Roof battens are sold in 4 m lengths. How many lengths will you need?

A 30

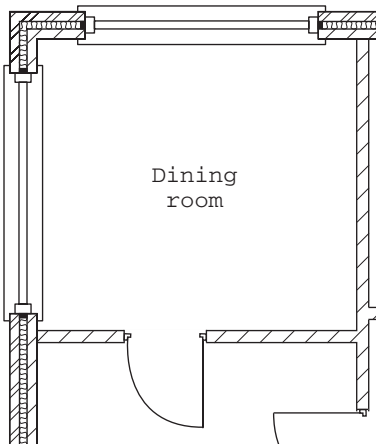
B 31

C 32

D 33

N1/E3.6

7 Look at this floor plan of a dining room. How many windows are there in this dining room?



A 1

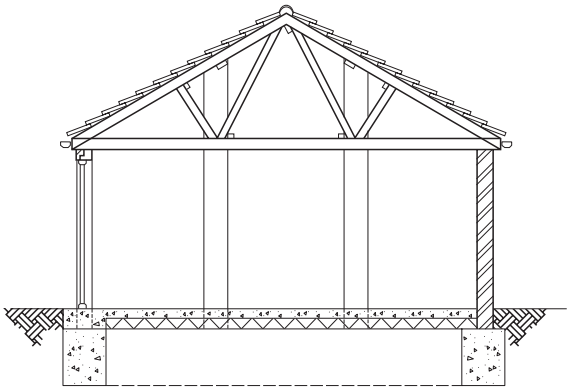
B 2

C 3

D 4

MSS2/L2.1

8 What type of drawing is this?



A front elevation

B cross-section

C left side

D rear elevation

MSS2/L2.1

9 A gang of bricklayers started work at 7:45 am and stopped for lunch at 12:30 pm. How long did they work before their lunch break?

A 4 hours 45 min

B 4 hours 30 min

C 3 hours 45 min

D 4 hours 15 min

MSS1/L1.3

10 A bedding mortar mix is made from cement and sharp sand in the ratio 1:5.

If you used 15 buckets of sand to make the mix, how much cement would you use?

A 3

B 15

C 20

D 25

N1/L1.7

Answers

PAGES 3:1–3:2

Metric measures

Focus page

Show your completed table to your teacher.

Task 1

Show your completed table to your teacher.

Task 2

Material	Unit	Abbreviation
skirting board	millimetres **or** metres	mm m
paint	millilitres **or** litres	ml l
copper pipe	millimetres **or** metres	mm m
plaster (in powder form)	grams **or** kilograms	g kg
plasterboard	millimetres **or** metres	mm m

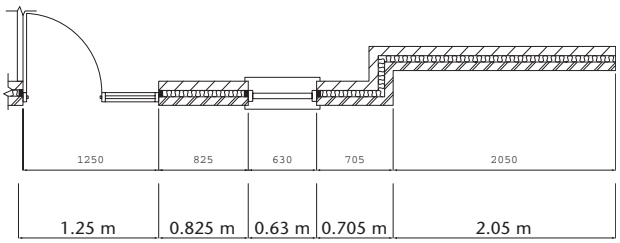
PAGES 3:3–3:5

Measuring length

Task 1

1 Skirting board 'b'
2 Pipe 'c'

Task 2



PAGES 3:6–3:8

Calculate with measurements

Task 1

15.4 metres of skirting board (2.8 m + 4.1 m + 3.6 m + 3.5 m + 0.8 m + 0.6 m)

Example 2

You would need to buy 3 tins of paint.

Task 2

1 **4** shelves (3.25 ÷ 0.7 = 4.6; round down to 4 shelves)
2 **14** boxes of tiles (15.75 ÷ 1.2 = 13.125; round up to 14 boxes)

PAGES 3:9–3:11

Area

Task 1

1 Area of the floor in the kitchen = 4.7 m × 3.2 m = 15.04 m^2
2 Area of the floor in the lounge = 4.8 m × 3.5 m = 16.8 m^2
3 Area of the floor in the hall = 4.8 m × 1.1 m = 5.28 m^2

Task 2

Area of wall = 4.5 m × 2.8 m = 12.6 m^2

Task 3

1
a Area of the whole wall = 3.9 m × 2.5 m = 9.75 m^2
b Area of the door = 2.2 m × 1.2 m = 2.64 m^2
c Area that needs painting = 9.75 m^2 – 2.64 m^2 = 7.11 m^2
2
a Area of the whole door = 2.2 m × 1.2 m = 2.64 m^2
b Area of the glass panel = 0.7 m × 0.7 m = 0.49 m^2
c Area that needs varnishing = 2.64 m^2 – 0.49 m^2 = 2.15 m^2

PAGES 3:12–3:13

Volume

Task 1

1 The volume of the pier is: 0.6 m × 0.5 m × 1.7 m = 0.51 m^3

2 The volume of the raft foundation is: 12 m × 4.5 m × 0.25 m = 13.5 m^3

PAGES 3:14–3:16

Calculating material

Focus page

Q1 By rounding material up, you will have some left over. It is better to have extra material to allow for wastage, rather than to have too little to finish the job.

Q2 1 pack contains **3 metres** of pipe insulation

Q3 You need **18 metres** of pipe insulation and each pack contains **3 metres**, so you need to buy **6 packs.** (18 ÷ 3 = 6)

Task 1

Length of guttering required for this job = 35 m

Length of 1 section of guttering = 3 m

Calculation: 35 ÷ 3 = 11.6

Buy 12 sections of 3 metre long guttering.

(To check: 12 lengths of 3 m guttering has a total length of 12 × 3 = 36 m, which is more than the length of guttering required)

Task 2

Area of roof = 113 m^2

Area covered by 1 pallet of tiles = 40 m^2

Calculation: 113 ÷ 40 = 2.825

Buy 3 pallets of tiles.

(To check: 3 pallets × 40 m^2 (area per pallet) = 120 m^2, which is more than the area of the roof, so this is enough material)

PAGES 3:17–3:18

Reading floor plans

Focus page

The office has a window.

The external door opening is 1135 mm wide.

The building is 6310 mm wide (2250 + 2485 + 1575)

You push the door to go out of the office into the storeroom.

Task 1

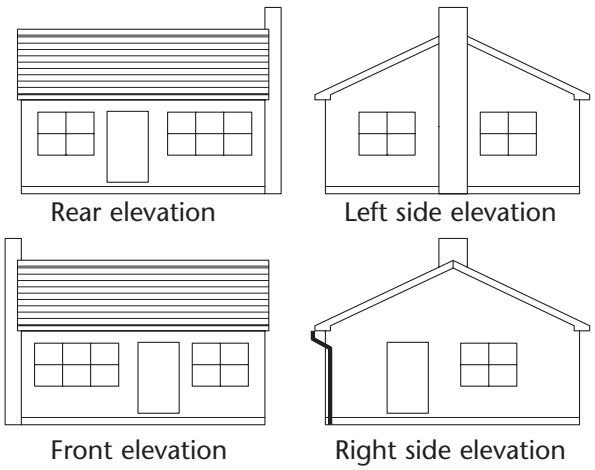
1 7
2 Hall
3 Dining room
4 Pull
5 Push
6 2035 mm
7 11 710 mm (7425 mm + 3385 + 900 mm)
8 10 360 mm (900 mm + 3160 mm + 890 mm + 1585 mm + 3825 mm)

PAGES 3:19–3:20

Interpreting plans and drawings

Task 1

1 One-bedroom bungalow
2 7 windows and 3 external doors
3



4 Hall
5 Lounge

PAGES 3:21–3:22

Time and schedules

Focus page

The gang spent $8\frac{1}{2}$ hours (8 hours 30 minutes) on site.

The gang arrived back at the depot at 6:15 pm.

Task 1

1 $5\frac{1}{4}$ hours (5 hours 15 minutes)
2 $3\frac{1}{4}$ hours (3 hours 15 minutes)
3 $\frac{1}{2}$ hour (30 minutes)

Task 2

1 **a** 7:45 am
b 5:15 pm
2 **a** 9:15 am
b 6:45 pm

PAGES 3:23–3:24

Mixing materials

Focus page

If you use 4 shovels of cement, you need to use 8 shovels of sand and 16 shovels of aggregate

(1 : 2 : 4 cement : sand : aggregate
4 : 8 : 16.) multiply elements of ratio by 4

Task 1

1 1 bucket
2 15 shovels
3 4 shovels of cement and 16 shovels of aggregate (multiply ratio by 4)
4 3 shovels of cement and 6 shovels of sand (multiply ratio by 3)

Task 2

1 2 shovels of cement
2 **a** a suitable ratio for strong mortar mix would be about 1 : 2
b This means that you would use 2 buckets of cement to 4 buckets of sand.

Check it

1 B
2 D
3 A
4 B
5 B
6 C
7 B
8 B
9 A
10 A