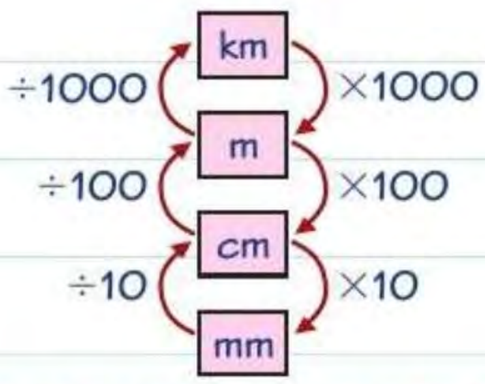
Had a look ☐ Nearly there ☐ Nailed it! ☐

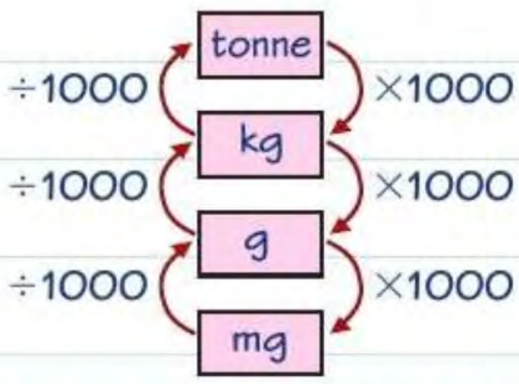
Metric units

You can convert between metric units by multiplying or dividing by 10, 100 or 1000.

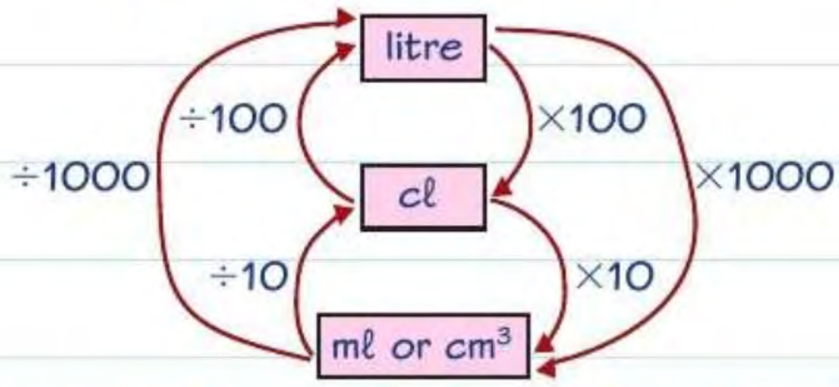
Length



Weight



Volume or capacity



Place value diagrams

You can use a place value diagram to help you multiply and divide by 10, 100 and 1000.

For more on place value look at page 1.

To multiply by 10, 100 or 1000 you move the digits 1, 2 or 3 places to the left.

0.35 × 10 = 3.5
0.35 × 100 = 35
0.35 × 1000 = 350

Hundreds	Tens	Units	•	tenths	hundredths	thousandths
		0	•	3	5	
		3	•	5		
	3	5				
3	5	0				

To divide by 10, 100 or 1000 you move the digits 1, 2 or 3 places to the right.

120 ÷ 10 = 12
120 ÷ 100 = 1.2
120 ÷ 1000 = 0.12

1	2	0				
	1	2				
		1	•	2		
		0	•	1	2	

Worked example

Target grade 3

The weight of a ream of paper is 2.5 kg.
There are 500 sheets of paper in a ream.
Work out the weight, in grams, of one sheet of paper.

2.5 × 1000 = 2500
2.5 kg = 2500 g
2500 ÷ 500 = 5
Each sheet of paper weighs 5 grams.

The whole ream of paper weighs 2500 g and there are 500 sheets of paper, so divide 2500 by 500 to find the weight.

Examiners' report

Students frequently lose marks by converting between different metric units incorrectly.

Start by converting 2.5 kg into grams.

Check it!
A gram is a smaller unit than a kilogram so the number will be larger. ✓

Real students have struggled with questions like this in recent exams – **be prepared!**

Now try this

Target grade 2

1 Change
(a) 3.2 m into cm **(1 mark)**
(b) 0.25 litres into ml **(1 mark)**
(c) 960 mm into cm **(1 mark)**
(d) 1700 g into kg **(1 mark)**

Target grade 3

2 A pile of fifty 20p coins is 8.5 cm high.
Work out the thickness of one 20p coin. Give your answer in mm. **(2 marks)**

Worked solution video

Had a look ☐ Nearly there ☐ Nailed it! ☐

Time and timetables

Time

1 You can write time using the 12-hour clock or the 24-hour clock.

12-hour clock	24-hour clock
8.15 am	08:15
4.50 pm	16:50
12.00 midday	12:00
12.00 midnight	00:00

2 Remember there are 60 minutes in an hour.

Hours	Minutes
$\frac{1}{2}$	30
$\frac{3}{4}$	45
$2\frac{1}{4}$	135

You can also write this as '2 hours and 15 minutes'.
60 + 60 + 15 = 135

Timetables

This table shows part of a bus timetable.

Timetables usually give times using the 24-hour clock.

Crook	08:15	09:15	10:45	11:15
Prudhoe	08:28	09:28	10:58	11:28
Hexham	08:45	09:45	11:15	11:45
Alton	09:00	10:00	11:30	12:00

This bus leaves Crook at 10:45 and arrives in Hexham at 11:15

This bus leaves Prudhoe at 11:28 and arrives in Alton at 12:00
11:28 to 11:30 = 2 minutes
11:30 to 12:00 = 30 minutes
The journey time is 32 minutes.

Worked example

Target grade 1

Olivia is visiting her sister in Exeter. She leaves home at 11.30 am. She writes down how long each section of her journey takes.

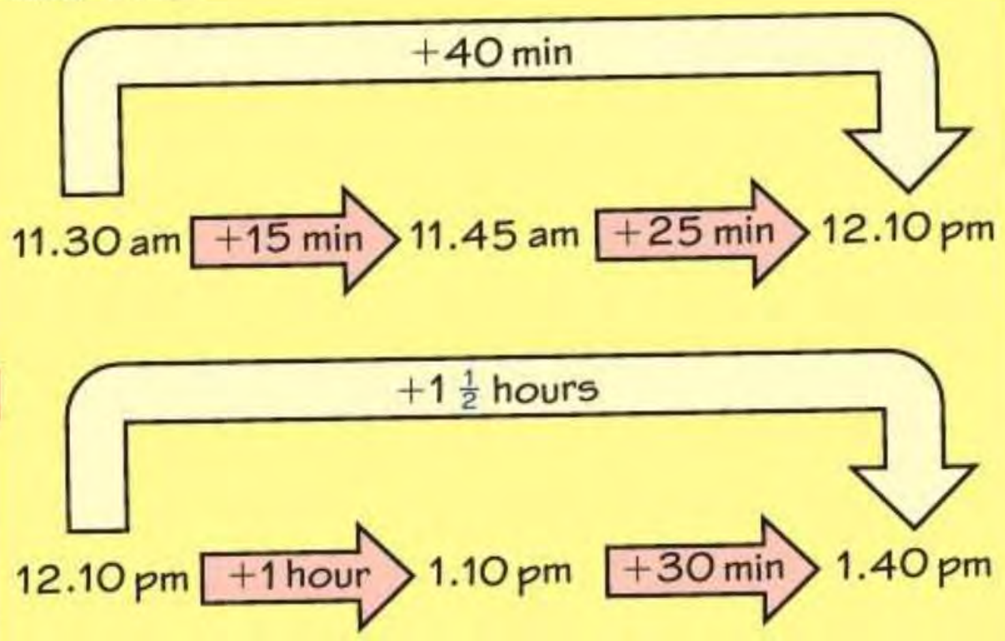
Drive to train station	15 minutes
Wait for train	25 minutes
Train journey	$1\frac{1}{2}$ hours

At what time does Olivia arrive in Exeter?

11.30 am → 11.45 am → 12.10 pm → 1.40 pm

Olivia arrives at 1.40 pm.

Add on each time in steps. Write down each new time.



Now try this

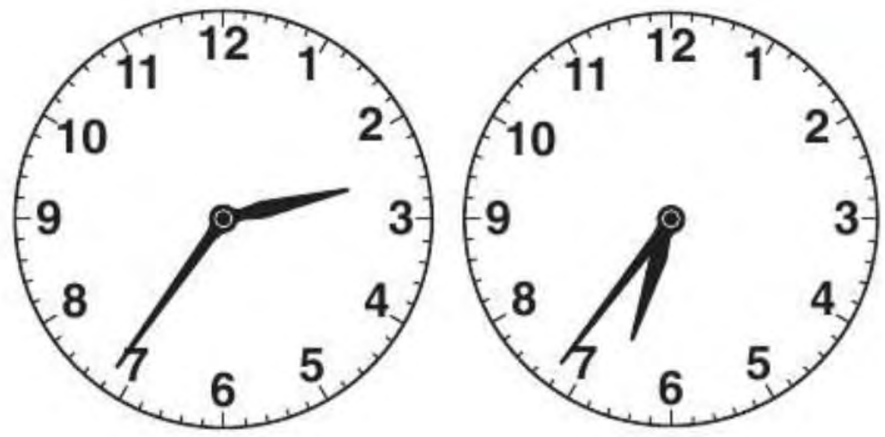
Target grade 1

The clocks show the time in London and San Francisco.
It is afternoon in London.

(a) Write down the time in London using the 24-hour clock. **(1 mark)**
It is morning in San Francisco when it is afternoon in London.
The time in London is ahead of the time in San Francisco.

(b) How many hours is London ahead of San Francisco? **(1 mark)**

Worked solution video

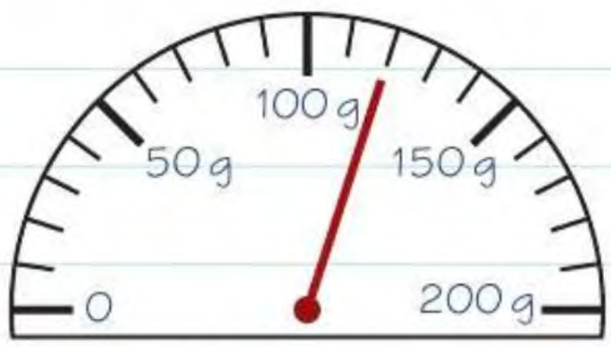


Had a look ☐ Nearly there ☐ Nailed it! ☐

Reading scales

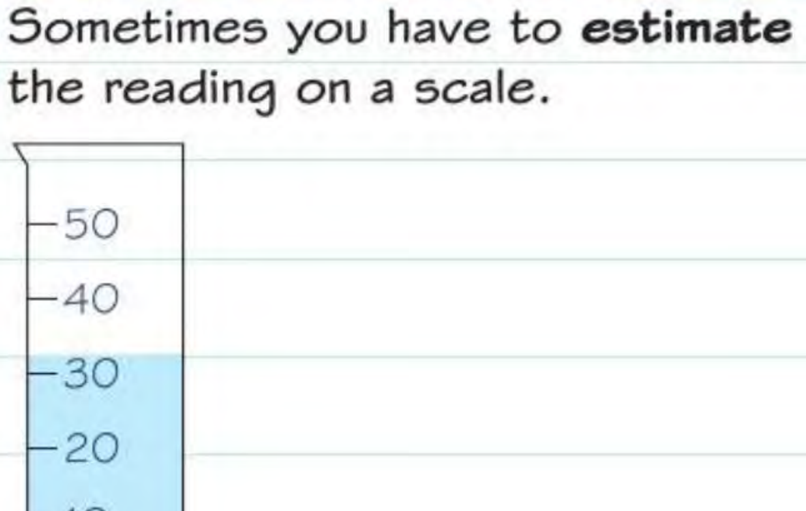
Here are three things you need to watch out for when reading scales.

1 You need to be able to read scales and number lines. Begin by working out what each division on a scale represents.



There are 5 divisions between 100 g and 150 g.
Each division represents 10 g.
The scale reads 120 g.

2 Not all divisions represent 1 unit or 10 units.

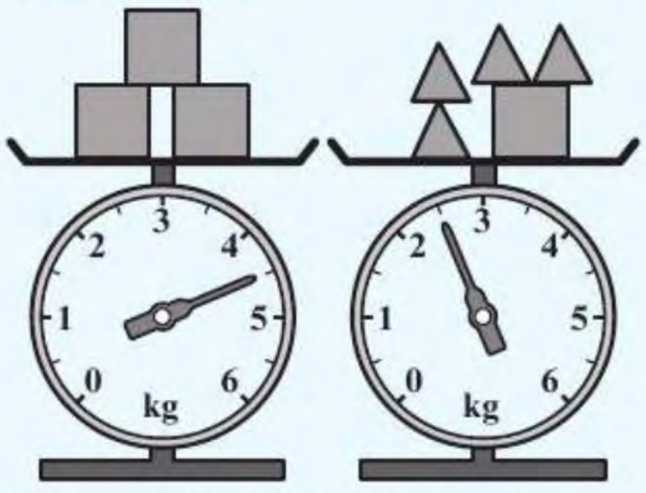


There are 5 divisions between 3.9 m and 4 m.
0.1 ÷ 5 = 0.02
Each division represents 0.02 m.
This wall is 3.92 m long.

Worked example

Target grade 1

The diagram below shows 4 identical cubes and 4 identical tetrahedrons.



Work out the weight in kg of one tetrahedron. **(3 marks)**

4.5 ÷ 3 = 1.5 so 1 cube = 1.5 kg
2.5 − 1.5 = 1
1 ÷ 4 = 0.25 so 1 tetrahedron = 0.25 kg

3 Sometimes you have to **estimate** the reading on a scale.

The water doesn't come up to an exact mark but you can make an estimate.
The water is closer to 30 ml than 40 ml.
32 ml would be a good estimate.

Problem solved! Plan your strategy before you start.

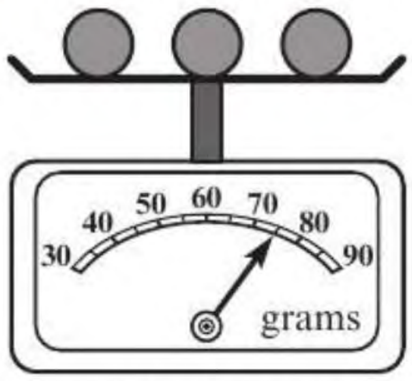
1. Divide the total on the first scale by 3 to work out the weight of one cube.
2. Subtract that from the reading on the second scale.
3. Divide the remainder by 4 to work out the weight of one tetrahedron.

Make sure you write down your working so you can show the strategy you used.

Now try this

Target grade 1

This scale has 3 identical spheres on it.



Work out the weight in grams of one sphere. **(2 marks)**

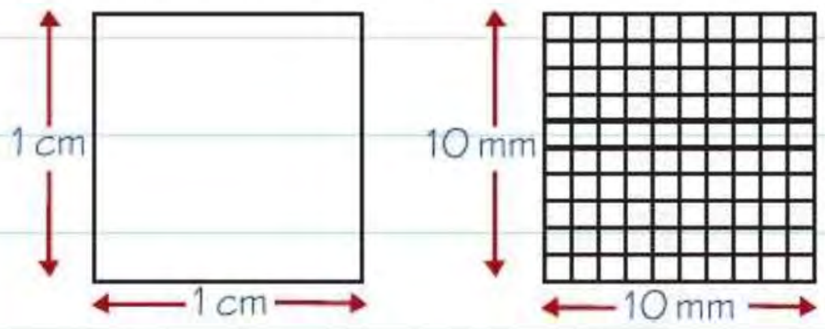
Had a look ☐ Nearly there ☐ Nailed it! ☐

Tricky Topic

Units of area and volume

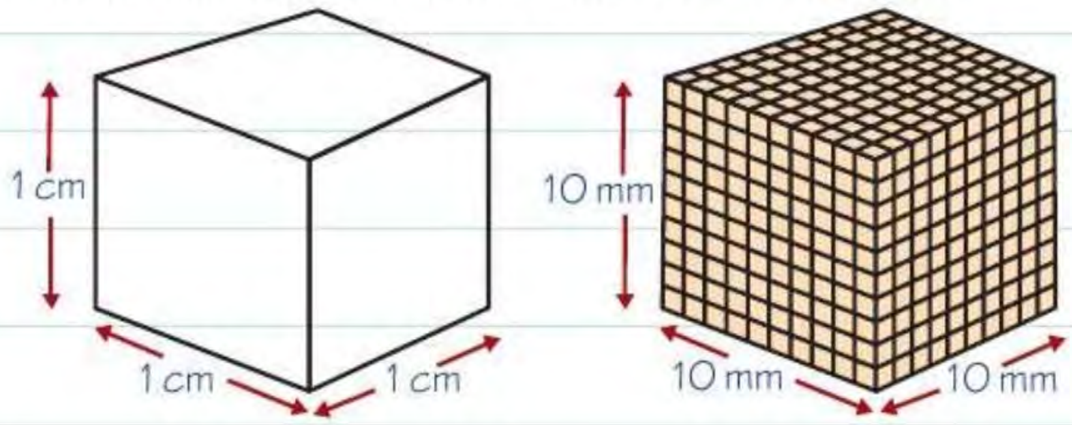
Converting units of area or volume is trickier than converting units of length. You need to remember your area and volume conversions for your exam.

These two squares have the same area.



So $1\,cm^2 = 100\,mm^2$.

These two cubes have the same volume.



So $1\,cm^3 = 1000\,mm^3$.

Area conversions

$1\,cm^2 = 10^2\,mm^2 = 100\,mm^2$

$1\,m^2 = 100^2\,cm^2 = 10\,000\,cm^2$

$1\,km^2 = 1000^2\,m^2 = 1\,000\,000\,m^2$

Volume conversions

$1\,cm^3 = 10^3\,mm^3 = 1000\,mm^3$

$1\,m^3 = 100^3\,cm^3 = 1\,000\,000\,cm^3$

$1\ litre = 1000\,cm^3$

$1\,ml = 1\,cm^3$

There is more on converting metric units on page 61.

Worked example

Target grade 4

Lead has a density of 11350 kg/m^3.
An antique lead model has a volume of 400 cm^3.
Calculate the mass of the model in kg.

(3 marks)

$400 \div 100^3 = 0.0004$

Volume $= 0.0004\,m^3$

Mass = Density × Volume

$= 11350 \times 0.0004$

$= 4.54\,kg$

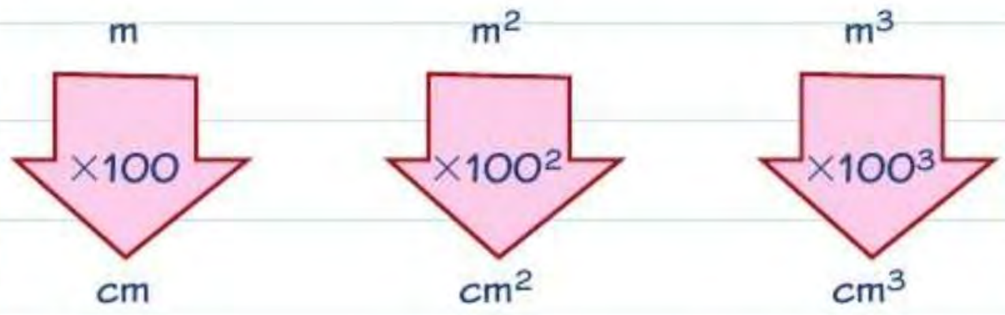
Problem solved!

You need to be really careful with the **units** when you are solving any problem involving measures. The units of density are given in kg/m^3, so you need to convert 400 cm^3 into m^3 before you calculate. You are converting to a larger unit, so **divide** by 100^3.

For a reminder about density look at page 65.

Unit conversion checklist

- ✓ The multiplier for an area conversion is the length multiplier squared.
- ✓ The multiplier for a volume conversion is the length multiplier cubed.



Now try this

Worked solution video

1 Convert
(a) 2.3 m^2 into cm^2 **(1 mark)**
(b) 400 mm^3 into cm^3 **(1 mark)**

Target grade 4

Target grade 5

2 Convert 0.35 m^3 to mm^3, giving your answer in standard form. **(2 marks)**

Target grade 4

3 Jenny applies a force of 600 N to the floor. The total area of her feet is 160 cm^2. What is the pressure, in N/m^2, between her and the floor if she stands on both of her feet? **(3 marks)**

Revise pressure on page 66.

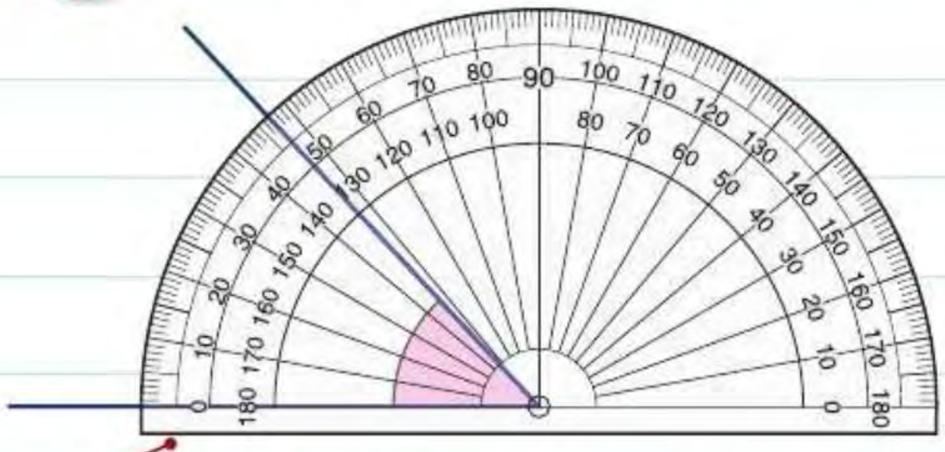
Had a look ☐ Nearly there ☐ Nailed it! ☐

Measuring and drawing angles

You should only measure angles in your exam if you are told that a diagram is drawn accurately.

Measuring angles

1 A protractor measures angles in degrees.



Use the scale that starts with 0 on one of the lines of the angle.

Here, use the outside scale.

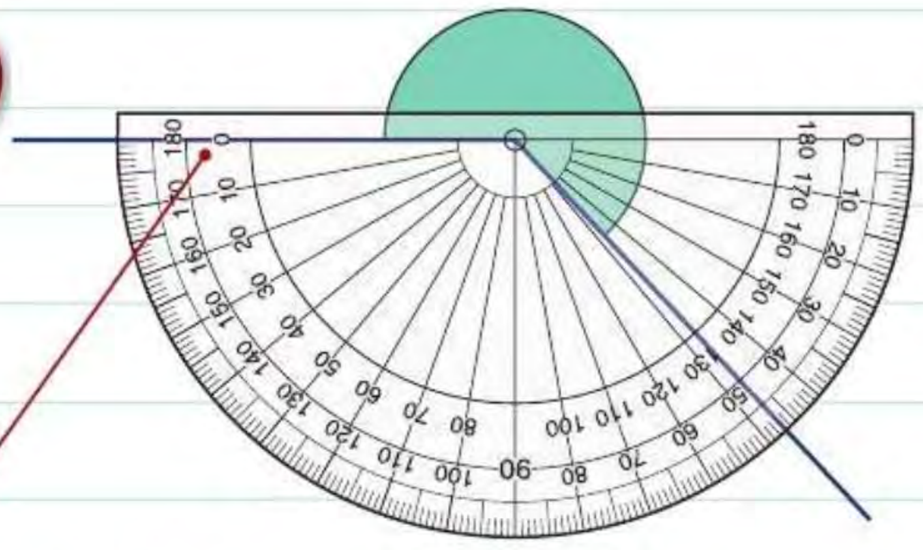
Place the centre of the protractor on the point of the angle.

Line up the zero line with one line of the angle.

Read the size of the angle off the scale.

This angle is 47°.

2



Use the scale that starts with 0 on one of the lines of the angle.

Here, use the inside scale.

To measure an angle bigger than 180° measure the smaller angle then subtract the answer from 360°.

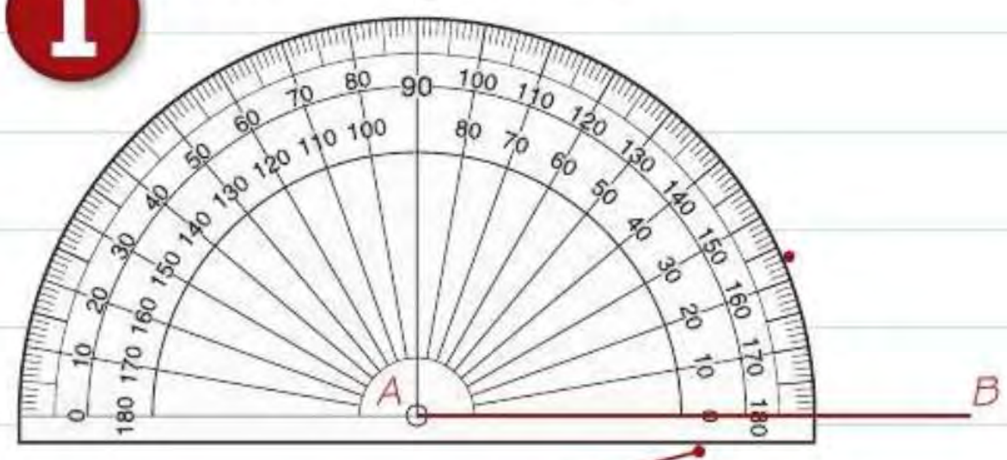
360 − 133 = 227

The marked angle is 227°.

Estimate the size of an angle before measuring it. This lets you check that your answer is sensible.

Drawing angles

1 Draw an angle of 23°.



Use the scale that starts with 0 on one of the lines of the angle.

Here, use the inside scale.

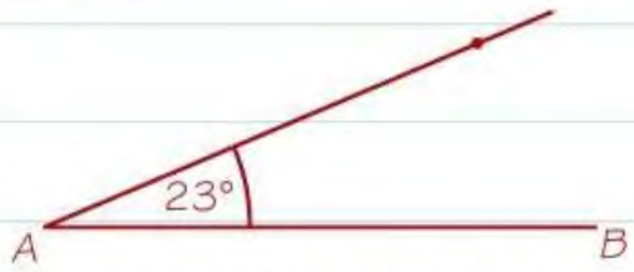
Use a ruler to draw one line of the angle, *AB*.

Place the centre of your protractor on one end of the line. The zero line needs to lie along your line.

Find 23° on the scale. Draw a dot to mark this point.

Worked solution video

2



Use a ruler to join the end of the line and your dot with a straight line.

Draw in the angle curve and label your angle 23°.

Now try this

Target grade 1

1 Measure the size of each of these angles.

(a) (b)

Extend the lines with a pencil and ruler.

(1 mark) **(1 mark)**

2 Use a protractor to draw an angle of 124°.

(1 mark)

Had a look ☐ Nearly there ☐ Nailed it! ☐

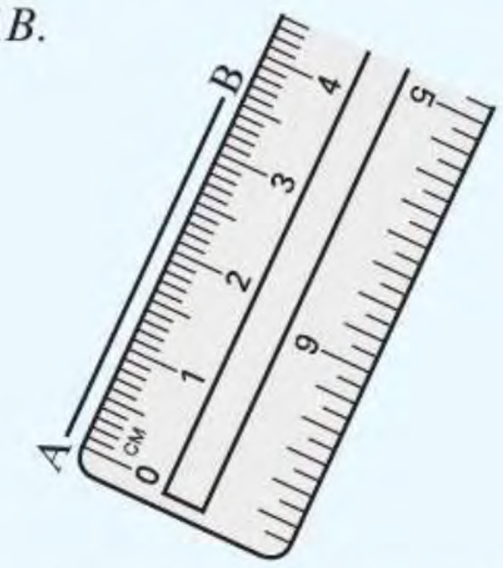
Measuring lines

You need to be able to use a ruler to draw and measure straight lines accurately.
Don't measure lines in your exam unless the question tells you that the diagram is accurate.

Worked example

Target grade 1

Here is a line AB.



Measure the length of the line AB. **(1 mark)**

35 mm

Line up the 0 mark on your ruler carefully with the start of the line at A.

Always measure to the nearest mm.

Make sure your ruler doesn't move while you're measuring the line.

Always write the units with your answer.

This line is 35 mm or 3.5 cm long.

There is more about converting between cm and mm on page 61.

Drawing lines checklist

- ✓ Check whether you are working in cm or mm.
- ✓ Start the line at the 0 mark on your ruler.
- ✓ Hold your ruler firmly.
- ✓ Use a sharp pencil.
- ✓ Draw to the nearest mm.
- ✓ Label the length you have drawn.

Estimating

You can use lengths that you know to estimate other lengths.

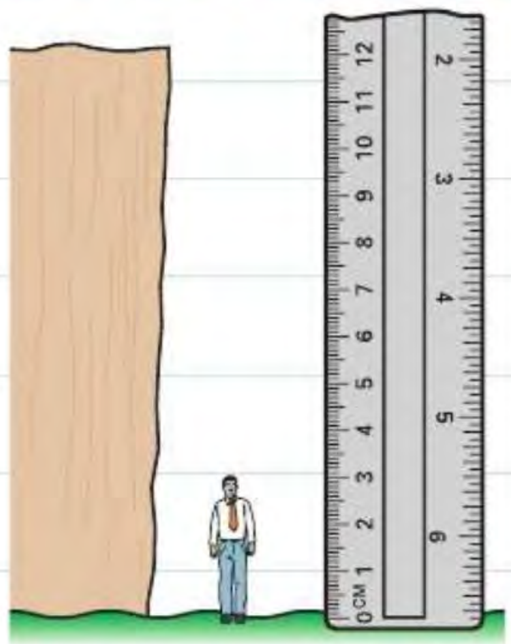
This diagram shows a man standing at the bottom of a cliff.

The man is 3 cm tall in the drawing and the cliff is 12 cm tall.
This means the cliff is 4 times as tall as the man.

A good estimate for the height of an adult male is 1.8 m.

$4 \times 1.8 = 7.2$

This means a good estimate for the height of the cliff is 7.2 m.



Now try this

Target grade 1

1 Measure the lengths of these lines.

(a) _____

(b) _____

(c) _____

(d) _____ **(4 marks)**

Measure to the nearest mm.

2 The picture of a surfboard and a London Bus have been drawn accurately to the same scale. The real length of the surfboard is 5 feet. Estimate the real length of the London Bus. **(3 marks)**

Had a look ☐ Nearly there ☐ Nailed it! ☐

Scale drawings and maps

This is a **scale drawing** of the *Queen Mary II* cruise ship.

Scale = 1 : 1000

You can use the scale to work out the length of the actual ship.

34.5 × 1000 = 34 500

The ship is 34 500 cm or 345 m long.

Map scales

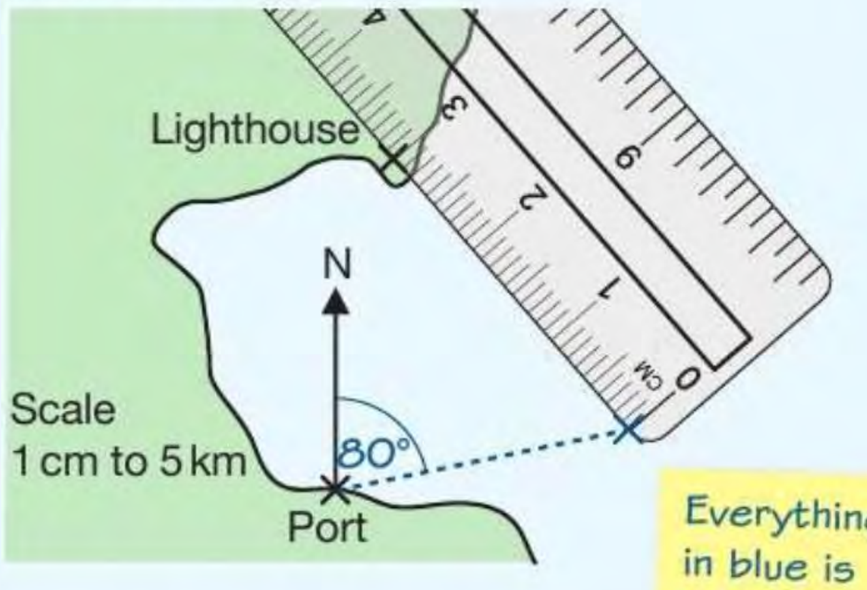
Map scales can be written in different ways:

- 1 to 25 000
- 1 cm represents 25 000 cm
- 1 cm represents 250 m
- 4 cm represent 1 km.

Worked example

Target grade 3

The diagram shows a scale drawing of a port and a lighthouse. This diagram is drawn accurately.



A boat sails 12 km in a straight line on a bearing of 080°.

(a) Mark the new position of the boat with a cross. **(2 marks)**

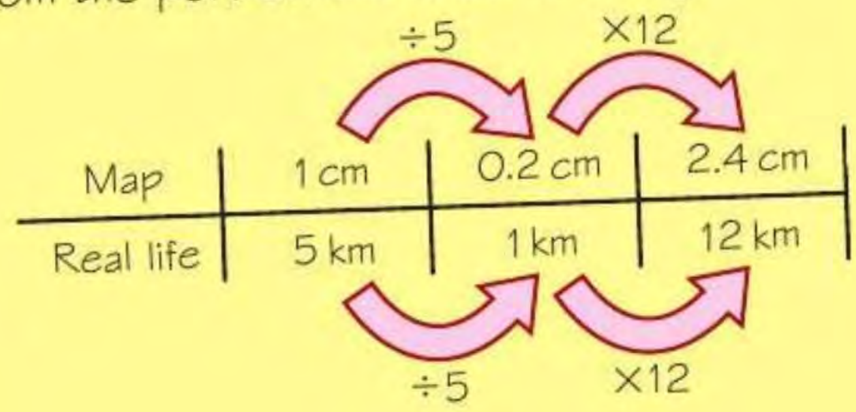
(b) How far away is the boat from the lighthouse? Give your answer in km. **(1 mark)**

15 km

Everything in blue is part of the answer.

You can revise bearings on page 102.

Start by working out how far the boat is from the port on the scale drawing.



Now place the centre of your protractor on the port with the zero line pointing north. Put a dot at 80°. Line up your ruler between the port and the dot. Draw a cross 2.4 cm from the port.

Examiners' report

3 cm on the drawing represents 15 km in real life. Make sure you have a millimetre ruler **and** a protractor with you in the exam.

Real students have struggled with questions like this in recent exams – **be prepared!**

Worked solution video

Now try this

Target grade 3

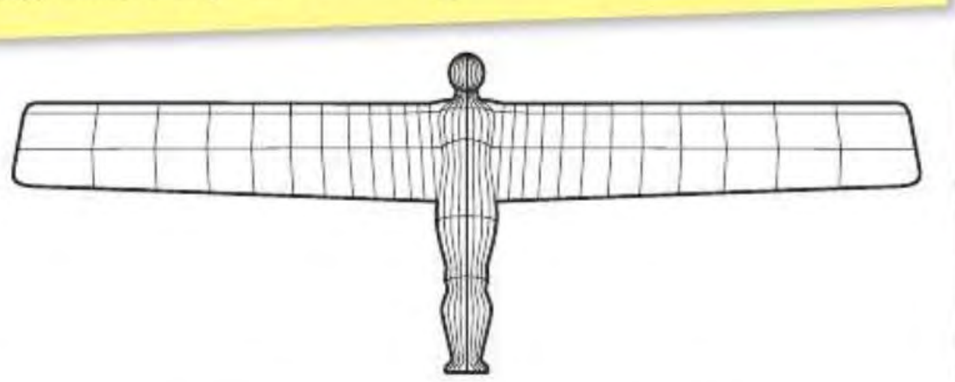
The Angel of the North is a 20 m tall statue.

Penny makes a model of the statue using a scale of 1 : 25

What is the height of the model of the statue?

Give your answer in centimetres. **(2 marks)**

Read the whole question before you start. You need to give your answer in cm, so you could start by converting 20 m into cm.

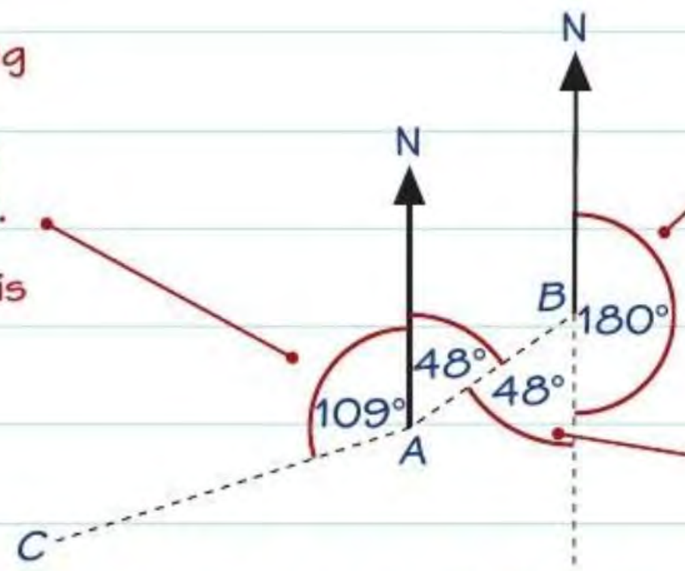


Had a look ☐ Nearly there ☐ Nailed it! ☐

Bearings

Bearings are measured **clockwise** from **north**.

Bearings always have **three figures**. You need to add zeros if the angle is less than 100°.
For instance, in this diagram the bearing of *B* from *A* is 048°.



You can measure a bearing bigger than 180° by measuring this angle and subtracting it from 360°.

The bearing of *C* from *A* is 360° − 109° = 251°

You can work out a reverse bearing by adding or subtracting 180°.

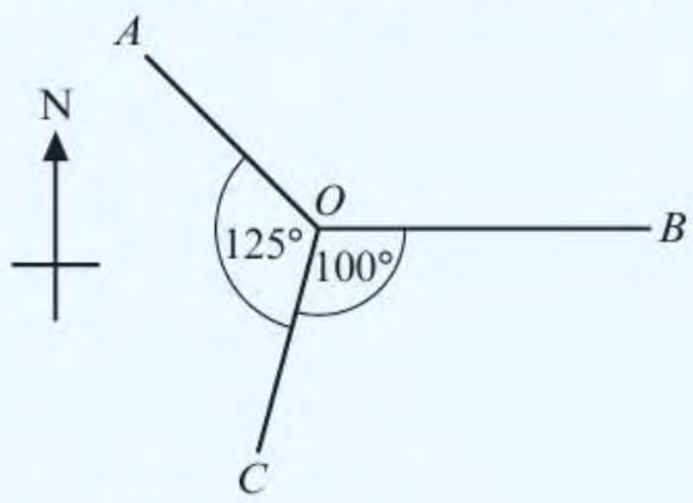
The bearing of *A* from *B* is 180° + 048° = 228°

These are alternate angles.

Worked example

Target grade 3

Three paths meet at *O*. *B* is due east of *O*.



(a) Jake walks from *O* to *A*.
What bearing does he walk on? **(1 mark)**

90° + 100° + 125° = 315°

(b) Delvinder walks from *C* to *O*.
What bearing does she walk on? **(2 marks)**

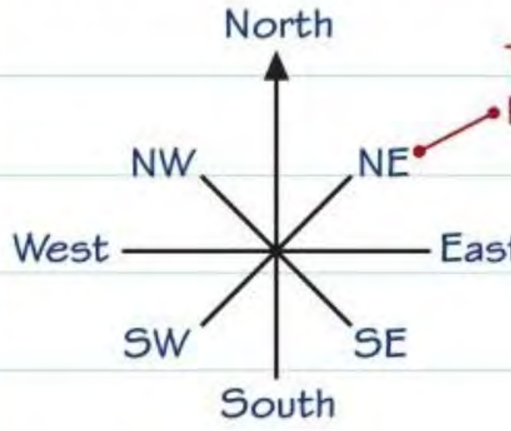
Bearing of *C* from *O* = 90° + 100°
= 190°

Bearing of *O* from *C* = 190° − 180° = 010°

Problem solved! You can work out a **reverse** bearing by adding or subtracting 180°. If the angle is greater than 180° then subtract. Remember to write your final answer as a **three-figure bearing**. You need to write 010°, not just 10°.

Compass points

You need to know the compass points:



The angle between N and NE is 45°.

The angle between N and E is 90°.

Now try this

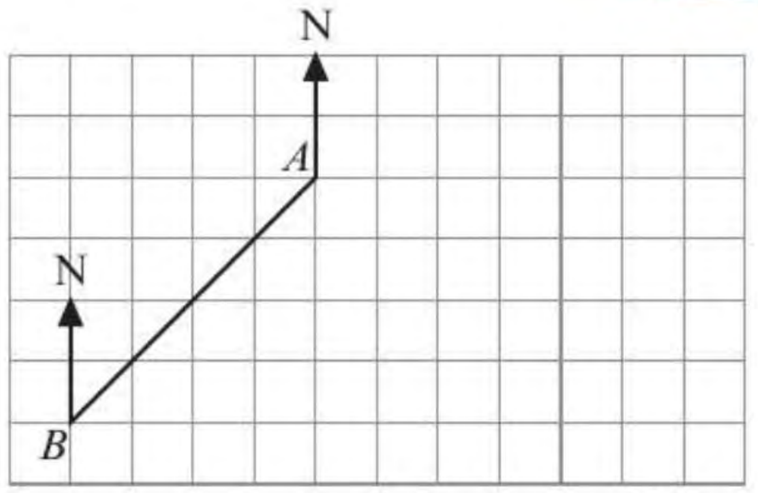
Target grade 3

An aircraft flies from *A* to *B*. The grid shows the positions of *A* and *B*.

(a) Use the grid to work out the actual distance *AB*. **(1 mark)**

(b) Measure and write down the three-figure bearing of *B* from *A*. **(1 mark)**

(c) The aircraft then flies to *C*. The bearing of *C* from *A* is 120°. The bearing of *C* from *B* is 080°.
Mark the position of *C* on the grid. **(3 marks)**



Scale: 1 cm = 100 km