

# Measure twice, cut once.

A feeder only fits together if every part is the right size. Practise reading a steel rule, measuring accurately and marking out from a drawing.



name:

teacher/class:

date:

## WE ARE LEARNING TO

- measure accurately in millimetres
- understand tolerance
- extract sizes from a working drawing to mark out

## I CAN

- ☐ convert between mm, cm and m
- ☐ read a steel rule to the nearest mm
- ☐ measure lines and objects within  $\pm 1$  mm
- ☐ say whether a part is within tolerance
- ☐ mark out from a datum using a drawing

## 01 Know your units

10 mm = 1 cm · 100 cm = 1 m · 1000 mm = 1 m

Designers, engineers and woodworkers in the UK give **every size in millimetres (mm)**. One unit for everything means there is no confusion.

**Reading tip:** measure from the **0** line, not the worn end of the rule. Look **straight down** on the mark: looking from the side makes it seem to move (this is called *parallax*).

1a Convert these measurements.

(6 marks)

4 cm =  mm

25 cm =  mm

1.5 m =  mm

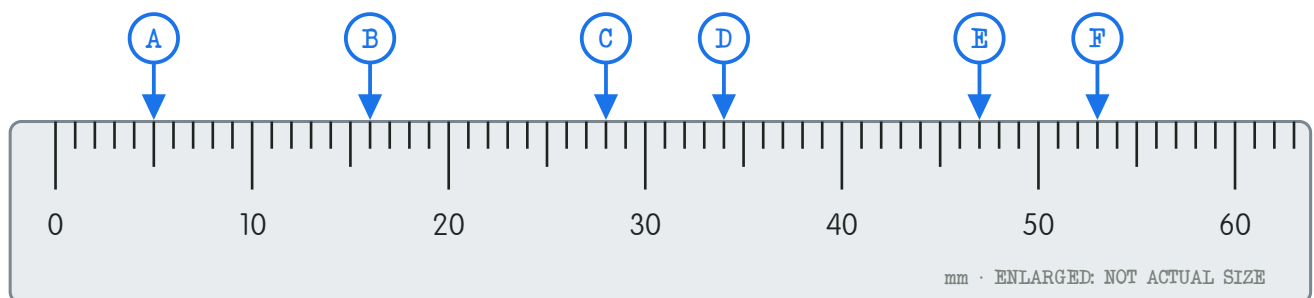
68 mm =  cm

327 mm =  cm

2150 mm =  m

1b This steel rule has been **enlarged**. Write the reading, in mm, at each arrow.

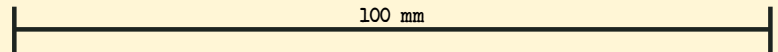
(6 marks)



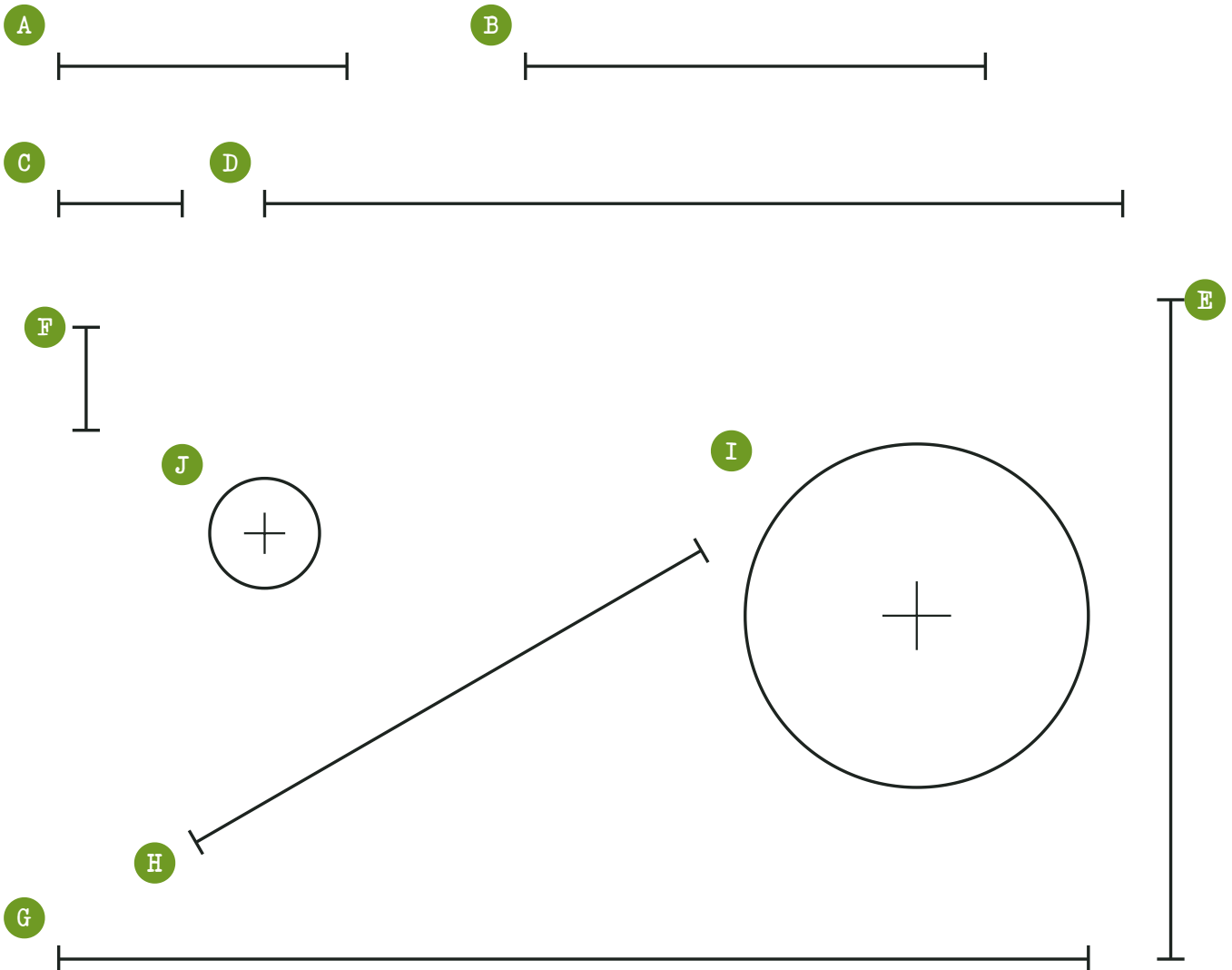
A  mm   B  mm   C  mm   D  mm   E  mm   F  mm

## 02 Measure the lines

**Print check:** this page must be printed at **100%** ("actual size", not "fit to page"). Measure the bar below. It should be exactly **100 mm**. If it is not, tell your teacher.



**2a** Use a steel rule to measure each line **A–H** (between the end marks), the **diameter** of circle **I** and the **diameter** of circle **J**. Answers to the nearest mm. (10 marks)



|   |                         |   |                         |   |                         |   |                         |   |                         |
|---|-------------------------|---|-------------------------|---|-------------------------|---|-------------------------|---|-------------------------|
| A | <input type="text"/> mm | B | <input type="text"/> mm | C | <input type="text"/> mm | D | <input type="text"/> mm | E | <input type="text"/> mm |
| F | <input type="text"/> mm | G | <input type="text"/> mm | H | <input type="text"/> mm | I | <input type="text"/> mm | J | <input type="text"/> mm |

Did you notice? Many of these are real sizes from your bird feeder.

### 03 Estimate, then measure

Good makers can **estimate** sizes by eye. First write your estimate, then measure with a steel rule or tape measure. Work out the difference.

**3a** Complete the table. Your teacher will set out the items.

(8 marks)

| Item                           | Measure the... | Estimate (mm) | Measured (mm) | Difference (mm) |
|--------------------------------|----------------|---------------|---------------|-----------------|
| Your steel rule                | overall length |               |               |                 |
| A pencil                       | length         |               |               |                 |
| This A4 sheet                  | short edge     |               |               |                 |
| This A4 sheet                  | long edge      |               |               |                 |
| Feeder timber                  | width          |               |               |                 |
| Feeder timber                  | thickness (T)  |               |               |                 |
| Drill bit for the feeding hole | diameter       |               |               |                 |
| Your choice: _____             |                |               |               |                 |

**3b** Which estimate was closest? How could you get better at estimating?

(1 mark)

### 04 How accurate is accurate enough?

Nothing can be made **exactly** to size. The **tolerance** is the biggest amount a part is allowed to be bigger or smaller than the size on the drawing.

The housing joints on your feeder must hold an **18 mm** thick part. A drawing might say **18 ± 0.5 mm**. That means any width from **17.5 mm** to **18.5 mm** is acceptable.

**Too narrow?** The part will not fit, or it will split the wood when forced in.

**Too wide?** The part is loose and wobbly, and the joint is weak.

**Within tolerance?** A snug fit.

**4a** A class measured their housing joints. The tolerance is **18 ± 0.5 mm**. Tick whether each one passes or fails.

(5 marks)

| Housing width | Pass                     | Fail                     |
|---------------|--------------------------|--------------------------|
| 17.6 mm       | <input type="checkbox"/> | <input type="checkbox"/> |
| 18.4 mm       | <input type="checkbox"/> | <input type="checkbox"/> |
| 18.7 mm       | <input type="checkbox"/> | <input type="checkbox"/> |
| 17.3 mm       | <input type="checkbox"/> | <input type="checkbox"/> |
| 18.0 mm       | <input type="checkbox"/> | <input type="checkbox"/> |

**4b** The back panel must be **215 ± 1 mm** long. What are the smallest and largest acceptable lengths?

(2 marks)

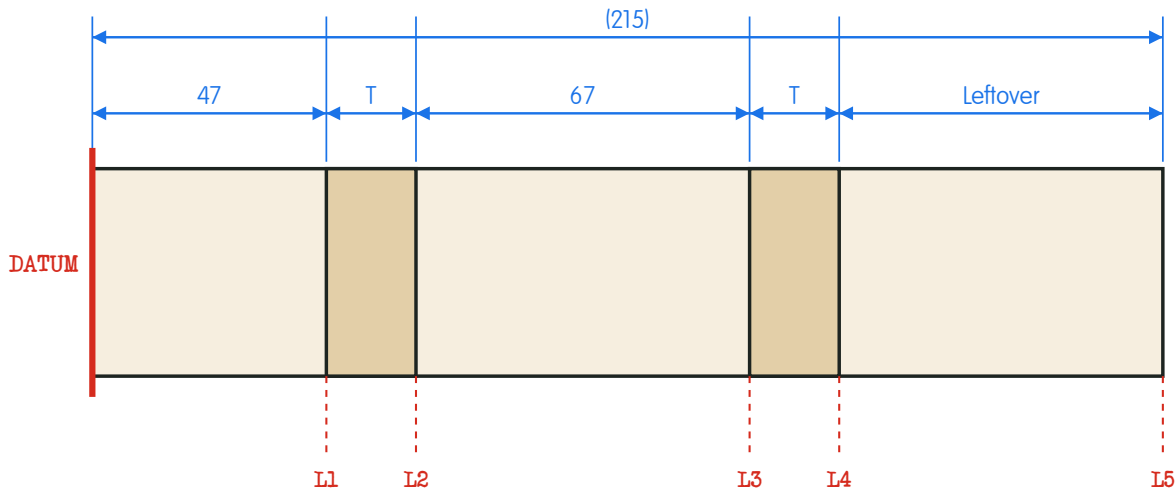
SMALLEST  mm LARGEST  mm



## 05 Mark out from the drawing

Below is the **back panel** of the bird feeder with its two housing joints. **T** is the thickness of the timber: **18 mm**. The size in brackets **(215)** is the overall length.

**Work from a datum.** Choose one end as your **datum** (starting edge) and measure **every** line from it. If you measure each piece from the **last** mark instead, small errors add up.



**5a** Work out the distance from the datum to each line **L1** to **L5**. (5 marks)

**L1**  mm **L2**  mm **L3**  mm **L4**  mm **L5**  mm

How long is the **leftover** part?  mm (1 mark)

**5b** Sam marked out 5 lines. He measured each one from the **last** mark, and each time he was **1 mm too long**. (1 mark)

How far out is his **last** line?

mm

**5c** On the full drawing, a **6 mm gap** is left between parts. Why must a gap be left between parts when marking out? (1 mark)

**5e** The full strip of timber for one feeder is: back panel **(215)**, a **6 mm gap**, a shelf **50 mm**, a **6 mm gap**, a shelf **50 mm**. Calculate the **minimum** length of timber needed. Show your working. (2 marks)

## 06 Read the lines

Working drawings use different **line types** so everyone reads them the same way. These rules are set out in a British Standard (BS 8888).

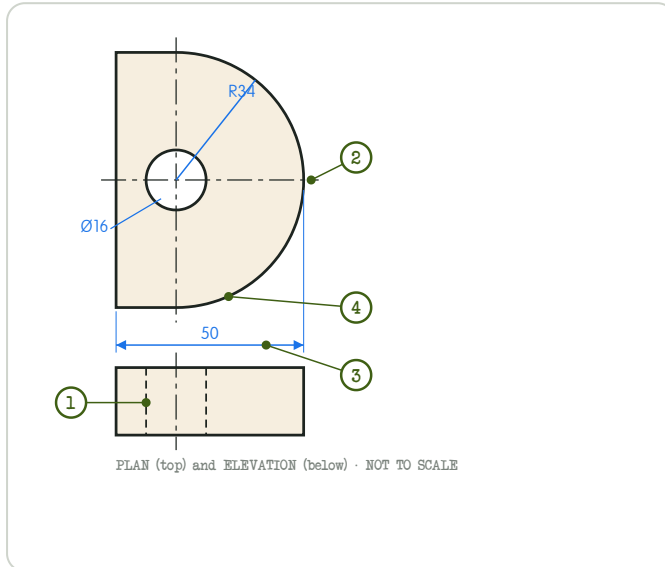
**5d** Drawings use different **line types**. Name the line types 1–4 on the drawing of the feeder's shelf. Use the word bank. (4 marks)

Outline

Centre line

Hidden detail line

Dimension line



1

2

3

4

Hint: Ø means diameter; R means radius.

## 07 Now mark out for real

Mark out the back panel on your own timber. Use a **try square** and a sharp pencil, and measure every line from your datum. Then ask a **partner** to check each line with a steel rule. Is it within **±1 mm**?

| Line | Target from datum (mm) | Partner measured (mm) | Within ±1 mm?            |
|------|------------------------|-----------------------|--------------------------|
| L1   |                        |                       | <input type="checkbox"/> |
| L2   |                        |                       | <input type="checkbox"/> |
| L3   |                        |                       | <input type="checkbox"/> |
| L4   |                        |                       | <input type="checkbox"/> |
| L5   |                        |                       | <input type="checkbox"/> |

CHECKED BY:

| How did I do?                                | Not yet                  | Nearly                   | Got it!                  |
|----------------------------------------------|--------------------------|--------------------------|--------------------------|
| I can convert between mm, cm and m           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I can read a steel rule to the nearest mm    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I can measure lines and objects within ±1 mm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I can say whether a part is within tolerance | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I can mark out from a datum using a drawing  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Total: \_\_\_\_ / 52