

# Chapter 1 Measurement Foundations Length Units and Estimation

## Teacher Guide and Diagnostic Answer Key

### Teacher Guide

#### Teacher Chapter-at-a-Glance

##### Materials

##### Pacing

Ask: if a ruler shows 17 cm at the end, is the object always 17 cm long? What else do you need to know?

### Mastery Decision Guide

What a missed Tripwire item actually means, and what to do about it before moving on.

#### Confirmation and Fresh Recheck

Confirm with: Ask the student to point to the start mark and end mark and explain which two values must be subtracted.

Fresh recheck: Use a fresh ruler item that starts at 6.4 cm and ends at 18.1 cm; require 11.7 cm and a reasonableness check.

Decision rule: Move forward only when the fresh response is secure and the reasoning survives the changed representation or context.

Missed Tripwire #1 → Using the end mark as the length (Mistake 2). Reports the end mark, such as 18 cm, instead of the distance, such as 12 cm. Review before the next chapter.

### Ready to Learn Check

Quick check before starting. A wrong answer below points to a specific gap worth closing first, not just a miss to shrug off.

1. Which is longer: 1 metre or 1 centimetre?

Correct answer: 1 m is longer.

Likely wrong answer: 1 cm is longer, or they are the same.

Misconception: Not yet having a secure sense of the relative size of metric units.

Next move: Compare a metre stick and a centimetre side by side before starting the chapter.

2. Convert 2 m to centimetres.

Correct answer:  $2\text{ m} = 200\text{ cm}$ .

Likely wrong answer:  $2\text{ m} = 20\text{ cm}$ .

Misconception: Using  $\times 10$  instead of  $\times 100$  when converting metres to centimetres.

Next move: Review the exact metric conversion factors before starting the chapter.

3. An object begins at 5 cm and ends at 12 cm on a ruler. What is its length?

Correct answer:  $12\text{ cm} - 5\text{ cm} = 7\text{ cm}$ .

Likely wrong answer: 12 cm.

Misconception: Treating the end mark as the length without checking the start mark.

Next move: Review basic subtraction to find the distance between two points before the chapter's ruler examples build on it.

## Practice

*Assign the full set or select items for targeted review. Teacher solutions follow each question.*

**1. A rope is 6 metres long. Write the measurement with its number and unit.**

**Solution:** 1. 6 m (A complete measurement includes both parts)

**2. Choose the most reasonable unit for the thickness of a coin: mm, cm, m, or km.**

**Solution:** 2. mm (Think about a very small distance)

**3. Convert 7 m to centimetres.**

**Solution:** 3. 7 m = 700 cm (One metre contains 100 centimetres)

**4. Convert 450 cm to metres.**

**Solution:** 4. 450 cm = 4.5 m (Group the centimetres into hundreds)

**5. Convert 3.5 km to metres.**

**Solution:** 5. 3.5 km = 3500 m (One kilometre contains 1000 metres)

**6. A ribbon begins at 1.7 cm and ends at 9.4 cm on a ruler. Find its length.**

**Solution:** 6.  $9.4\text{ cm} - 1.7\text{ cm} = 7.7\text{ cm}$  (Find the distance between the marks)

**7. A crayon begins at 6 cm and ends at 14 cm on a ruler. Find its length.**

**Solution:** 7.  $14\text{ cm} - 6\text{ cm} = 8\text{ cm}$  (The end mark is not automatically the length)

**8. Explain why kilometres are not a reasonable unit for measuring the width of a notebook.**

**Solution:** 8. Kilometres are too large for a notebook. Centimetres are more reasonable.

**9. A student writes that 2 m = 20 cm. Explain why the conversion is not reasonable.**

**Solution:** 9.  $2\text{ m} = 200\text{ cm}$ , not 20 cm. Centimetres are smaller than metres, so the number should increase.

**10. A hiking trail is 12 km long. Is 12 m a reasonable measurement for the same trail? Explain.**

**Solution:** 10. No. A hiking trail measured in kilometres is much longer than 12 m.

## Chapter Answer Key

### Tripwire Check

1. No.  $19.2\text{ cm} - 7.5\text{ cm} = 11.7\text{ cm}$ . The string begins at 7.5 cm, not zero, so the actual length is 11.7 cm.

Exit Ticket

1.  $2.6\text{ m} = 260\text{ cm}$

2. m

3.  $15.4\text{ cm} - 3.9\text{ cm} = 11.5\text{ cm}$

### Worksheet 1: Guided Practice

1. m

2. 300 cm

|            |           |
|------------|-----------|
| 3. 8 cm    | 4. mm     |
| 5. 6 m     | 6. 9 cm   |
| 7. km      | 8. 5000 m |
| 9. 6 cm    | 10. cm    |
| 11. 4 cm   | 12. 9 cm  |
| 13. mm     | 14. 90 mm |
| 15. 5.6 cm |           |

## Worksheet 2: Independent Practice

|                                                                  |                                                           |
|------------------------------------------------------------------|-----------------------------------------------------------|
| 1. 800 cm                                                        | 2. 15 cm                                                  |
| 3. m                                                             | 4. 1.25 km                                                |
| 5. 9.3 cm                                                        | 6. No. 12 m = 1200 cm.                                    |
| 7. 4200 m                                                        | 8. 10.8 cm                                                |
| 9. km                                                            | 10. 7.5 cm                                                |
| 11. Yes. 2000 mm = 200 cm = 2 m, which is reasonable for a door. | 12. 15.4 cm                                               |
| 13. 640 cm                                                       | 14. 0.15 km = 150 m, which is much too long for a pencil. |
| 15. 17 cm                                                        |                                                           |

## Worksheet 3: Mixed Practice & Application

### Item 14 (Non-Routine)

**Correct answer:**  $19.1\text{ cm} - 6.4\text{ cm} = 12.7\text{ cm}$ . The broken piece does not matter because length is the distance between the start and end marks, not the numbers themselves.

**Likely wrong answer:** 17.7 cm ( $12.7\text{ cm} + 5\text{ cm}$ , trying to account for the broken piece).

**Misconception:** Believing the missing or broken portion of the ruler must be added into the measurement, instead of recognizing that length only depends on the distance between the two marks actually used.

**Next move:** Show that length = end mark – start mark works no matter where the ruler physically begins; the broken piece is irrelevant information.

### Item 15 (Non-Routine)

**Correct answer: Student B is correct:  $21.7\text{ cm} - 8.3\text{ cm} = 13.4\text{ cm}$ . The strip does not begin at zero, so the length is the difference between the two marks.**

**Likely wrong answer: Student A is correct (21.7 cm).**

**Misconception: Assuming the end mark alone always gives the length, without checking whether the object begins at zero.**

**Next move: Return to the ruler diagram from Common Mistakes and have the student identify the start mark before accepting any ruler reading.**

|                                                                                  |                                                                                                        |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| 1. $36\text{ m} = 3600\text{ cm}$                                                | 2. $2.4\text{ m} = 240\text{ cm}$ . The $2.4\text{ m}$ board is longer than the $180\text{ cm}$ board. |
| 3. $17.5\text{ cm}$                                                              | 4. $112\text{ mm} = 11.2\text{ cm}$                                                                    |
| 5. $900\text{ cm} = 9\text{ m}$ .                                                | 6. a. mm; b. m; c. km; d. cm                                                                           |
| 7. $17.7\text{ cm}$                                                              | 8. No. $3 \times 5 = 15$ , so $3\text{ cm}$ on the map represents $15\text{ km}$ , not $15\text{ m}$ . |
| 9. $190\text{ cm}$                                                               | 10. $15.65\text{ cm}$                                                                                  |
| 11. $8\text{ m}$ is reasonable. A classroom is not thousands of kilometres long. | 12. $6000\text{ m}$                                                                                    |
| 13. A tape measure and metres are most useful.                                   | 14. (see diagnostic above)                                                                             |
| 15. (see diagnostic above)                                                       |                                                                                                        |

## Variation Lab — Expected Ideas

1. Same end mark does not mean same length:  $0 \rightarrow 14$  is  $14\text{ cm}$ , while  $5 \rightarrow 14$  is  $9\text{ cm}$ .
2.  $0.15\text{ km} = 150\text{ m}$ , impossible for a pencil; a sensible description is about  $15\text{ cm}$  (or  $150\text{ mm}$ ).
3. Any correct example works if end – start =  $8.5\text{ cm}$ , e.g.,  $12.0 - 3.5 = 8.5\text{ cm}$ .

## Transfer Check — Suggested Responses

Familiar:  $12.5\text{ cm}$ . Altered:  $13.3\text{ cm}$ ; the missing zero end does not matter. Non-routine:  $1.8\text{ m} = 180\text{ cm}$ , so it is  $15\text{ cm}$  longer. Repair: subtract the start mark;  $18.9 - 7.4 = 11.5\text{ cm}$ .

## Exit Ticket — Answers

1.  $260\text{ cm}$
2. m
3.  $15.4 - 3.9 = 11.5\text{ cm}$