

Displacement-time graphs

AS Level

9702 AS Ch.1

Chapter 1: Kinematics

Lesson 1.4

Sections 1.4

Goal: Read velocity from the gradient of a displacement-time graph, including from a tangent to a curve.

01 The big picture

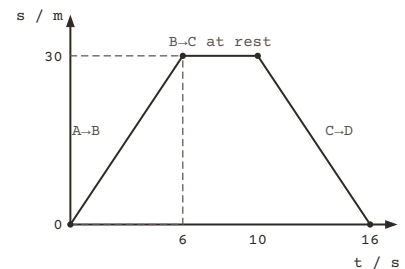
The gradient of a displacement-time graph is the velocity. A straight line means constant velocity; a horizontal line means the object is at rest; a negative gradient means it is moving back towards the start.

A curved line means the velocity is changing. The instantaneous velocity is the gradient of the tangent drawn at that time.

Gradient [paraphrase]

Change in displacement ÷ change in time, read from a large triangle on the line.

Fig. 1 · A displacement-time graph



Steeper line = faster. Flat = at rest. Downward slope = moving back.

02 Key equations

Velocity = gradient

$$v = \frac{\Delta s}{\Delta t}$$

Symbols and units

s displacement m t time s v velocity ms^{-1}

03 Sample problems with solutions

Sample 1 · Reading the graph

Use the graph in Fig. 1 to find the velocity during each of the three stages.

Step 1. A to B:

$$v = \frac{30 - 0}{6 - 0} = 5.0 \text{ ms}^{-1}$$

Step 2. B to C: the line is horizontal, so the object is at rest: $v = 0$.

Step 3. C to D: the gradient is negative, so it is moving back:

$$v = \frac{0 - 30}{16 - 10} = -5.0 \text{ ms}^{-1}$$

Answer: +5.0 m s⁻¹, then 0, then -5.0 m s⁻¹ (back towards the start)

Unit check: $\frac{m}{s} = ms^{-1}$ ✓

04 Practice problems

P1 What does the gradient of a displacement-time graph represent?

Answer: Velocity

P2 A straight line goes from (0 s, 0 m) to (8.0 s, 40 m). Calculate the velocity.

Answer: 5.0 m s⁻¹

P3 What does a horizontal line on a displacement-time graph show?

Answer: The object is at rest

P4 A tangent to a curved s-t graph passes through (1.0 s, 0 m) and (5.0 s, 24 m). Find the velocity there.

Answer: 6.0 m s⁻¹

05 Other useful information

Common mistakes

- ✗ **Wrong:** Read the velocity off the vertical axis.
- ✓ **Right:** The vertical axis gives displacement; velocity is the gradient.

Exam tips

- Use a large gradient triangle; a negative gradient means moving back.

What the syllabus asks

- 9702 topic 2: determine velocity using the gradient of a displacement-time graph. Coursebook 1.4.

Explore: [Distance-Time Graph Explorer \(simulation\)](#) · [Practice questions for this lesson](#)