

Edexcel IGCSE Physics – Distance–Time & Velocity–Time Graphs

Reading Comprehension + Exam-Style Questions + Challenging Extension Set

Reading Comprehension

A student investigates the motion of a small trolley on a straight track. She records its position every second and plots a distance–time graph. From 0–4 s, the graph is a straight line with a constant gradient, showing that the trolley moves at a constant speed. Between 4–6 s, the graph becomes horizontal, indicating that the trolley is stationary. From 6–9 s, the graph curves upward, becoming steeper with time. This shows that the trolley is accelerating.

She then draws a velocity–time graph for the same motion. From 0–4 s, the graph is a horizontal line at 0.8 m/s. Between 4–6 s, the velocity drops to 0 m/s. From 6–9 s, the velocity increases uniformly from 0 to 1.5 m/s.

The student wants to calculate the total distance travelled and compare the information shown by the two graphs. She also considers how the area under a velocity–time graph can be used to find distance.

Section A: Multiple Choice

1. What does a horizontal line on a distance–time graph represent?
 - A. Constant speed
 - B. Acceleration
 - C. Stationary object
 - D. Increasing speed

2. On a velocity–time graph, the area under the graph represents:
 - A. Acceleration
 - B. Distance travelled
 - C. Final velocity
 - D. Time taken

Section B: Short-Answer Questions

3. From 0–4 s, the trolley moves at a constant speed. The distance increases from 0 m to 3.2 m. Calculate the speed.

4. Explain how you can tell from the distance–time graph that the trolley is accelerating between 6–9 s.

5. Using the velocity–time graph, calculate the distance travelled between 6–9 s. (The velocity increases uniformly from 0 to 1.5 m/s.)

Section C: Longer-Answer Question

6. Compare the information provided by a distance–time graph and a velocity–time graph.

In your answer, refer to:

- how motion is shown on each graph
- how to determine speed or acceleration
- how to calculate distance

Section D: Multi-Step Calculations (Challenging)

7. The trolley accelerates uniformly from 0 to 1.5 m/s between 6–9 s.

Calculate the acceleration.

8. Using your answer to Q7, calculate the distance travelled using the equation:

$$s = ut + \frac{1}{2}at^2$$

Show that this is consistent with the area-under-the-graph method.

Section E: Graph Interpretation and Reasoning (Challenging)

9. A second student draws a distance–time graph for a different trolley.

Between 0–5 s, the graph is a straight line with a gradient of 0.6 m/s.

Between 5–8 s, the graph slopes downward.

- Explain what the downward slope means physically.
- Suggest one possible real-world reason for this motion.

Section F: Data Analysis and Explanation (Challenging)

10. A velocity–time graph shows a trolley moving at 1.2 m/s for 3 s, then decelerating uniformly to rest in 2 s.

- Calculate the total distance travelled.
- Explain how the shape of the graph shows that the deceleration is uniform.
- The student claims that the trolley experienced a constant braking force.

Discuss whether the graph supports this claim.

Section G: Extended Response (Challenging)

11. A student says:

“Distance–time graphs and velocity–time graphs show the same information, just in different shapes.”

Write a detailed explanation evaluating this statement.

Your answer should include:

- similarities and differences between the two graph types
- what each graph can show that the other cannot
- how gradients and areas relate to physical quantities
- examples from the trolley investigation

Answer Key

Section A

1. C — Stationary object
2. B — Distance travelled

Section B

3. Speed = $3.2 / 4 = 0.8$ m/s
4. The graph curves upward and becomes steeper → gradient increases → speed increases → acceleration.
5. Triangle area = $\frac{1}{2} \times 3 \times 1.5 = 2.25$ m

Section C (model answer)

Distance–time graphs show how distance changes; gradient = speed. Curves indicate changing speed.

Velocity–time graphs show how velocity changes; gradient = acceleration; area = distance. They complement each other but do not show identical information.

Section D

7. $a = 1.5 / 3 = 0.5$ m/s²

8. $s = \frac{1}{2} \times 0.5 \times 3^2 = 2.25$ m

Matches area-under-graph method.

Section E

9a. Downward slope → distance from origin decreases → trolley moves back toward start.

9b. Possible reasons: rolling back down a slope, rebound after collision, pulled backward.

Section F

10a. Constant speed: 3.6 m; Deceleration (triangle): 1.2 m; Total: 4.8 m

10b. Straight-line decrease in velocity → constant rate of change → uniform deceleration.

10c. Yes: constant deceleration implies constant braking force (Newton's 2nd law). But graph cannot show the cause of the force.

Section G (model answer)

Distance–time graphs show distance from start; velocity–time graphs show speed changes. Gradients represent different quantities: speed vs acceleration.

Only velocity–time graphs allow distance to be found from area.

Examples from the trolley investigation show that acceleration is clearer on a velocity–time graph.

Thus, the graphs complement each other but do not show the same information.