

Reading journeys from motion graphs

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These problems train you to read, sketch and interpret distance-time and velocity-time graphs. You will find gradients, calculate areas and combine both to describe a whole journey. They suit GCSE and IGCSE students, O Level and Class 9-10 learners, and they move from reading single values to multi-stage journeys, catch-up problems and error spotting.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** IGCSE 1.2

Problem 1 Graph facts (easy)

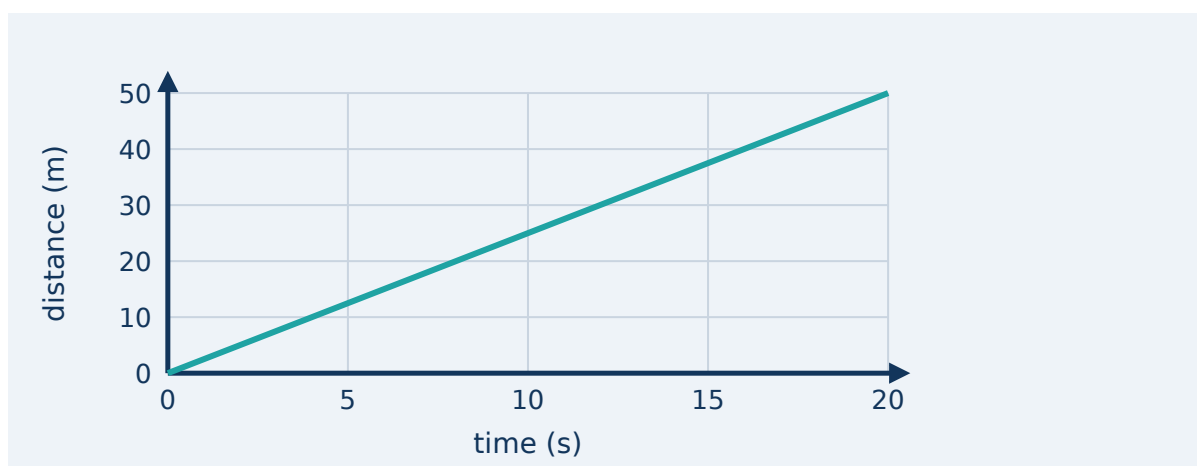
Complete each sentence.

1. The gradient of a distance-time graph equals the ____.
2. The gradient of a velocity-time graph equals the ____.
3. The area under a velocity-time graph equals the ____.
4. A flat line on a distance-time graph means the object is ____.

Problem 2 Reading a straight line (easy)

A student's walk gives the graph shown.

1. Read the distance at 10 s.
2. Calculate the speed.
3. Predict the distance at 16 s if the motion stays the same.



Distance against time for a steady walker.

Problem 3 Gradient from two points (easy)

A straight line on a distance-time graph passes through (2 s, 6 m) and (8 s, 30 m).

1. Calculate the change in distance.
2. Calculate the change in time.
3. Calculate the gradient and state what it means.

Problem 4 Describe the sections (easy)

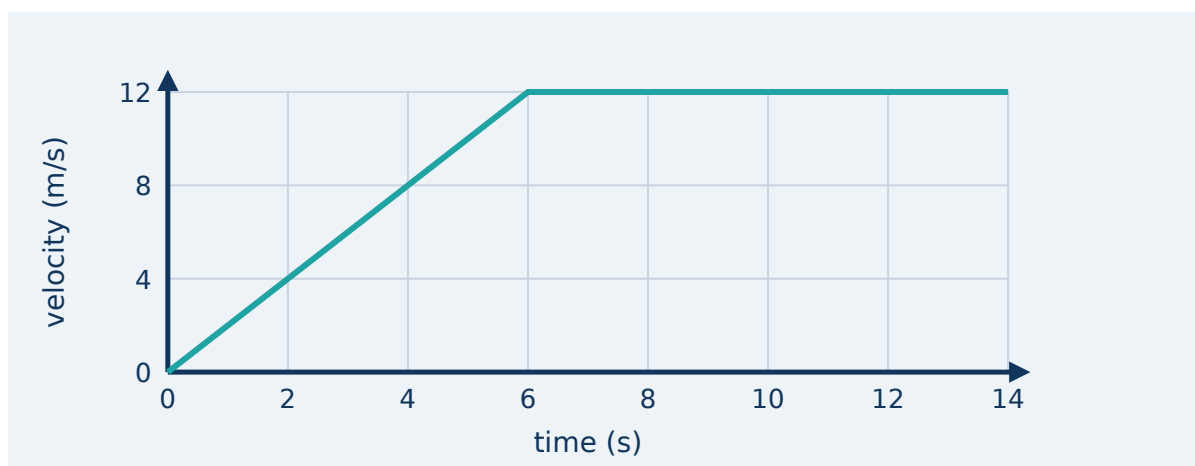
A distance-time graph has three sections: A is horizontal, B is a steep straight line upwards and C is a gentle straight line upwards.

1. Describe the motion in each section.
2. State which section shows the highest speed.

Problem 5 Reading a velocity graph (easy)

The graph shows a delivery bike on a straight road.

1. Read the velocity at 3 s.
2. Calculate the acceleration in the first 6 s.
3. Describe the motion from 6 s to 14 s.



Velocity against time for the bike.

Problem 6 Rectangle area (easy)

A tram in Singapore moves at a constant 5.0 m/s for 12 s.

1. Sketch or describe its velocity-time graph.
2. Calculate the area under the graph.
3. State what the area represents.

Problem 7 Triangle area (medium)

A scooter accelerates uniformly from rest to 9.0 m/s in 6.0 s.

1. Describe the shape of the velocity-time graph.
2. Calculate its acceleration.
3. Calculate the distance covered using the area.

Problem 8 A walk in stages (medium)

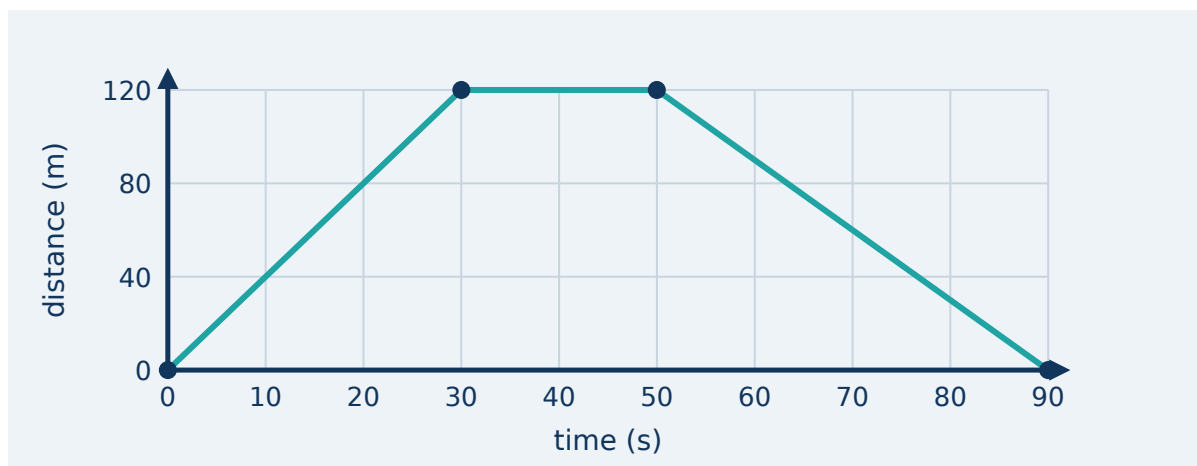
Mei's distance from home: 0 m at 0 s, 30 m at 20 s, 30 m at 50 s, 90 m at 90 s.

1. Calculate her speed in each of the three sections.
2. Calculate her average speed for the whole walk.

Problem 9 Out and back (medium)

Kofi in Accra walks to a bus stop and back. His graph is shown.

1. Calculate his speed on the way out.
2. Calculate his speed on the way back.
3. Calculate the total distance walked and his displacement at 90 s.

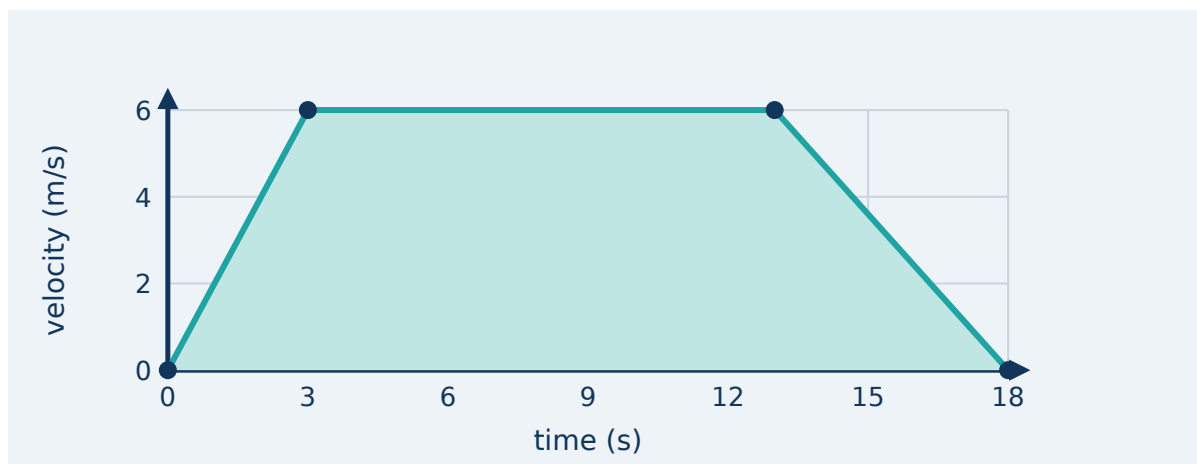


Distance from home against time.

Problem 10 Trapezoid journey (medium)

A cable car's velocity-time graph is shown.

1. Calculate the acceleration in the first 3.0 s.
2. Calculate the acceleration in the last 5.0 s.
3. Calculate the total distance using areas.



Velocity against time for the cable car.

Problem 11 From a table to a graph (medium)

Wanjiru records a cyclist's velocity: 0 m/s at 0 s, 3 m/s at 2 s, 6 m/s at 4 s, 9 m/s at 6 s, 12 m/s at 8 s.

1. Describe the shape of the velocity-time graph.
2. Calculate the acceleration.
3. Calculate the distance covered in 8 s.

Problem 12 Two lines compared (medium)

On the same distance-time axes, line A passes through (0 s, 0 m) and (10 s, 40 m), and line B passes through (0 s, 0 m) and (10 s, 25 m).

1. Calculate the speed of A and of B.
2. Calculate the gap between them at 20 s.

Problem 13 Slowing to rest (medium)

A velocity-time graph shows a van slowing in a straight line from 18 m/s to rest in 9.0 s.

1. Calculate the gradient.
2. Explain the sign of the gradient.
3. Calculate the distance travelled while slowing.

Problem 14 Tangent to a curve (medium)

A coconut falls and its distance-time graph is a curve. A tangent at 2 s passes through (1.0 s, 3.0 m) and (3.0 s, 11.0 m).

1. Calculate the gradient of the tangent.
2. State what it means.
3. State whether the coconut is speeding up and why.

Problem 15 From distance to speed steps (medium)

A runner's distance from the start: 50 m at 10 s, 130 m at 30 s, and 130 m at 40 s (starting at 0 m at 0 s).

1. Calculate her speed in each section.
2. Describe the velocity-time graph.
3. Calculate her average speed over 40 s.

Problem 16 Robot on a rail (hard)

A robot on a straight rail moves at +4.0 m/s for 5.0 s, rests for 3.0 s, then moves at -2.0 m/s for 6.0 s.

1. Calculate its displacement in each stage.
2. Calculate the final displacement and the total distance travelled.
3. Calculate the average speed and the average velocity.

Problem 17 Counting squares (hard)

On a velocity-time graph, one square represents 1.0 m/s by 1.0 s. A curve of an accelerating bus encloses 38 whole squares and 14 part squares.

1. State what one square represents.
2. Estimate the area by treating part squares as halves.
3. State the distance travelled.

Problem 18 Find the top speed (hard)

A tricycle accelerates uniformly from rest for 5.0 s to a top speed V , then travels at V for 15 s. The total distance is 210 m.

1. Write an expression for the area of the triangle and of the rectangle.
2. Form an equation and solve for V .
3. Calculate the acceleration in the first 5.0 s.

Problem 19 Spot the graph errors (hard)

A student says: "A downward sloping line on a distance-time graph means the object is slowing down." Another says: "A horizontal line on a velocity-time graph means the object is stationary."

1. Explain what the first line really shows.
2. Explain what the second line really shows.
3. State which graph feature shows slowing down on a distance-time graph.

Problem 20 Overtaking scooter (hard)

A lorry passes a police scooter at a steady 12 m/s. At that moment the scooter starts from rest and accelerates uniformly at 2.0 m/s^2 .

1. Write the distance travelled by each vehicle after t seconds using areas.
2. Calculate when the scooter catches the lorry.
3. Calculate the scooter's speed at that moment.