GCSE Mathematics

Distance-Time and Speed-Time Graphs

AQA Exam Preparation Worksheet

Yolymatics Tutorials

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Student Name: _____

Date: _____

Show all working clearly. Draw graphs using a ruler and pencil.
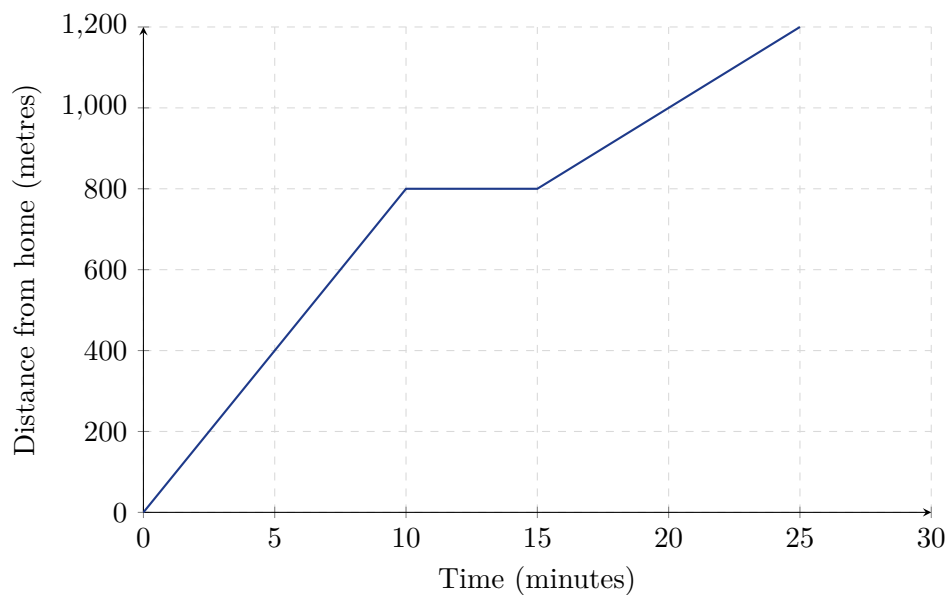
Part 1: Distance-Time Graphs — Understanding the Basics

Key Points

Remember:

- The **gradient (slope)** of a distance-time graph = **speed**

- A **horizontal line** means stationary (not moving)

- A **steeper line** means faster speed

- Speed $= \frac{\text{distance}}{\text{time}}$

Problem 1: Reading distance-time graphs

The graph below shows Sarah's journey to school.

(a) How far is Sarah's school from her home?

(b) How long did Sarah's whole journey take?

(c) For how long did Sarah stop during her journey?

(d) Calculate Sarah's speed during the first 10 minutes. Give your answer in metres per minute.

(e) Calculate Sarah's speed for the final part of her journey (from 15 to 25 minutes).

(f) During which part of the journey was Sarah travelling fastest? Explain your answer.

Part 1 continued: Distance-Time Graphs

Problem 2: Calculating speed from distance-time graphs

Tom cycles from home to the library. The distance-time graph shows his journey.
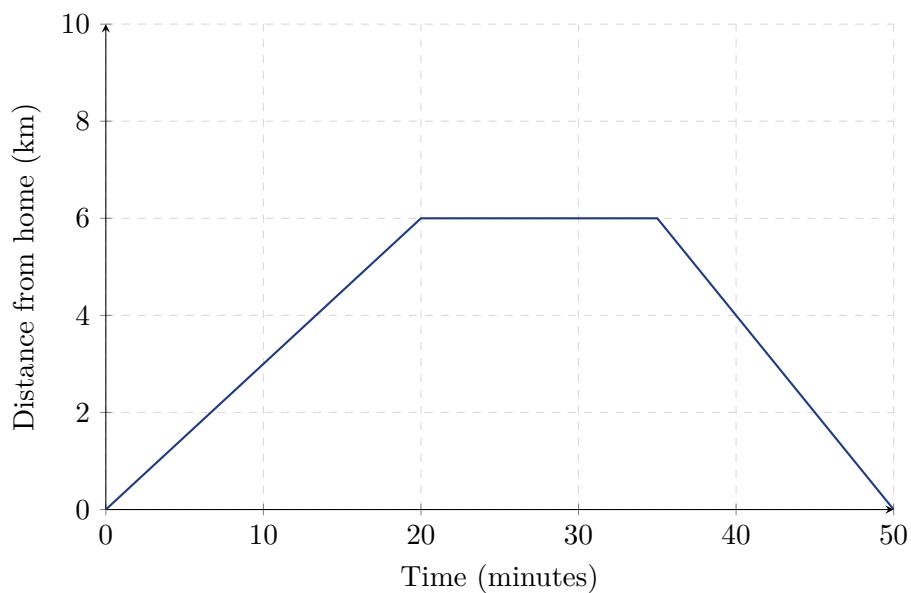
(a) How far is the library from Tom's home?

(b) Calculate Tom's speed on his way to the library. Give your answer in km/h.

(c) How long did Tom spend at the library?

(d) Calculate Tom's speed on his journey home. Give your answer in km/h.

(e) During which part of the journey was Tom travelling faster?
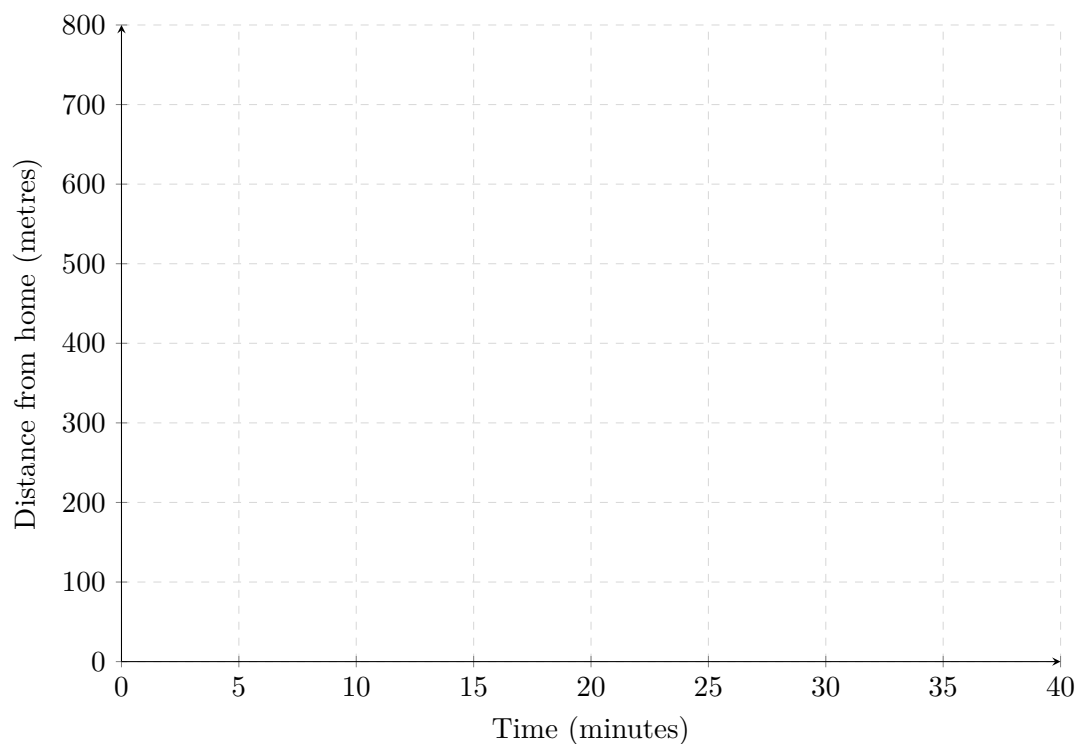
Part 1 continued: Drawing Distance-Time Graphs

Problem 3: Drawing a distance-time graph

Emma walks to the shops. Here is a description of her journey:

- She walks 600m in 10 minutes

- She stays at the shops for 15 minutes

- She walks back home, taking 12 minutes

(a) Draw a distance-time graph to represent Emma's journey on the axes below.

(b) Calculate Emma's speed on her way to the shops in metres per minute.

(c) Calculate Emma's speed on her way home in metres per minute.

(d) During which part of the journey was Emma walking faster?

Part 1 continued: Multi-Stage Journeys

Problem 4: Real-life journey

James drives from Manchester to Birmingham, a distance of 150 km. Here is information about his journey:

- He drives for 1 hour at a constant speed

- He stops at a service station for 30 minutes

- He continues driving for another hour at a constant speed

His journey takes 2.5 hours in total (including the stop).
(a) Draw a distance-time graph for James's journey on the axes below.
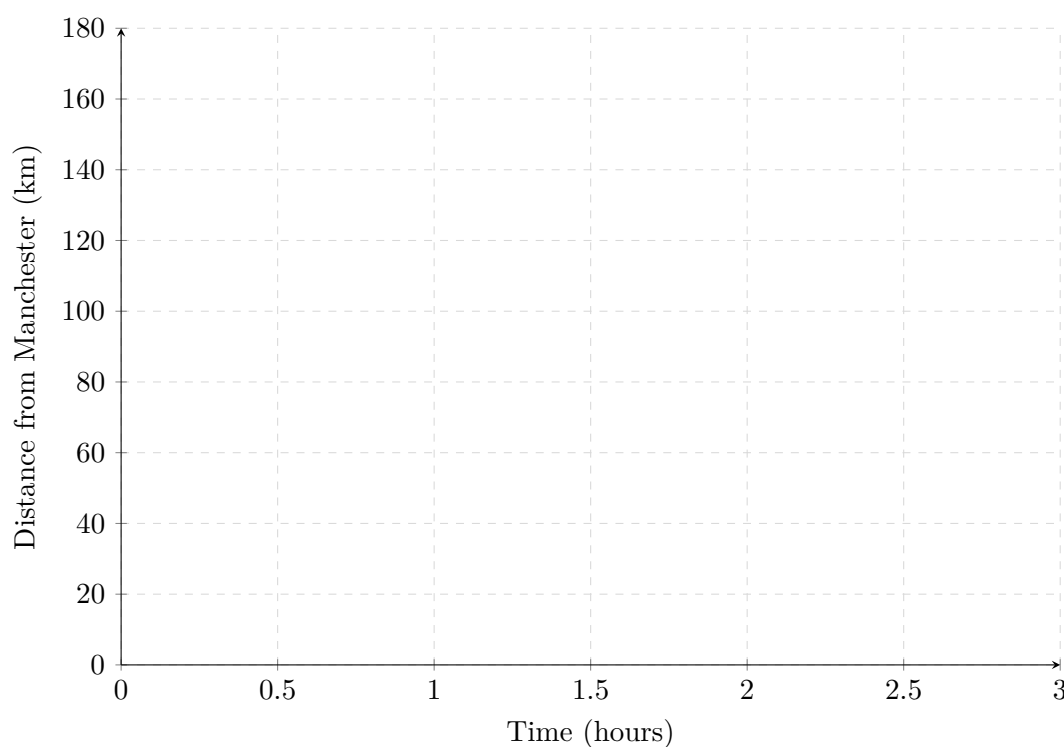
(b) Calculate James's average speed for the whole journey (including the stop). Give your answer in km/h.

(c) How far had James travelled when he stopped at the service station?

(d) Calculate his speed for the first hour of driving.

## Part 2: Speed-Time Graphs — Understanding the Basics

Key Points

Remember:

- The **gradient (slope)** of a speed-time graph = **acceleration**

- A **horizontal line** means constant speed

- An **upward slope** means accelerating (speeding up)

- A **downward slope** means decelerating (slowing down)

- The **area under the graph = distance travelled**

- Acceleration = $\frac{\text{change in speed}}{\text{time}}$

Problem 5: Reading speed-time graphs

The graph below shows a car's journey.
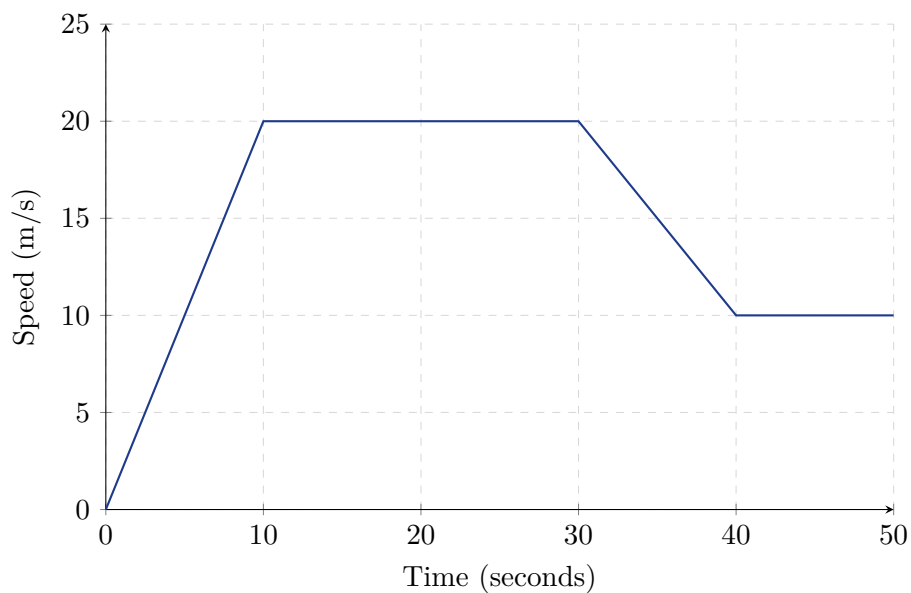
(a) What was the car's maximum speed?

(b) For how long did the car travel at constant speed?

(c) Calculate the car's acceleration during the first 10 seconds. Give your answer in m/s².

(d) Calculate the deceleration between 30 and 40 seconds. Give your answer in m/s².

(e) Describe what happened to the car between 40 and 50 seconds.

Part 2 continued: Calculating Distance from Speed-Time Graphs

Problem 6: Finding distance travelled

A train's journey is shown on the speed-time graph below.
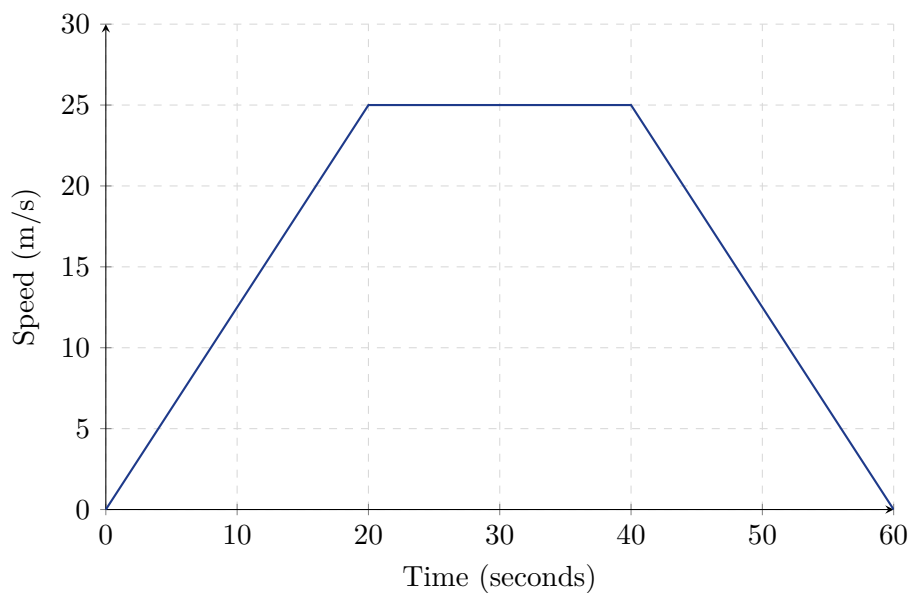
(a) Calculate the train's acceleration during the first 20 seconds.

(b) Calculate the distance travelled by the train during the first 20 seconds. *(Hint: The area is a triangle. Area of triangle $= \frac{1}{2} \times base \times height$)*

(c) Calculate the distance travelled between 20 and 40 seconds.

(d) Calculate the distance travelled during the final 20 seconds.

(e) What is the total distance travelled by the train?

Part 2 continued: Drawing Speed-Time Graphs
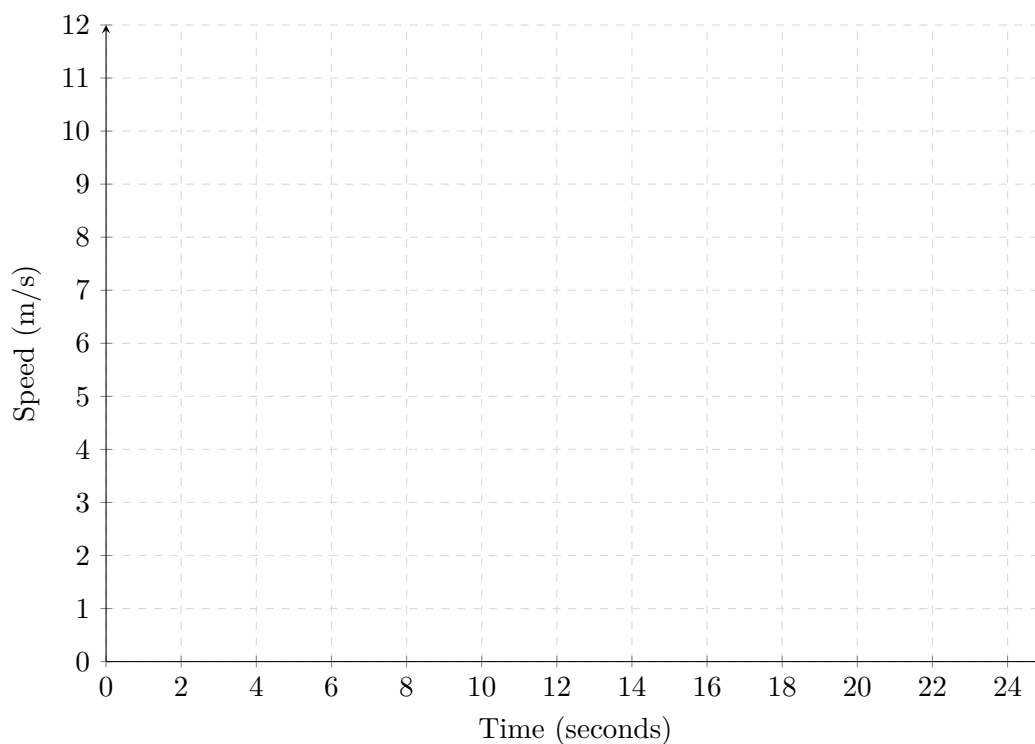
Problem 7: Drawing a speed-time graph

A cyclist's journey is described below:

- She accelerates from rest to 8 m/s in 4 seconds

- She travels at 8 m/s for 10 seconds

- She decelerates uniformly to rest in 6 seconds

(a) Draw a speed-time graph for the cyclist's journey on the axes below.

(b) Calculate the cyclist's acceleration during the first 4 seconds.

(c) Calculate the total distance travelled by the cyclist.

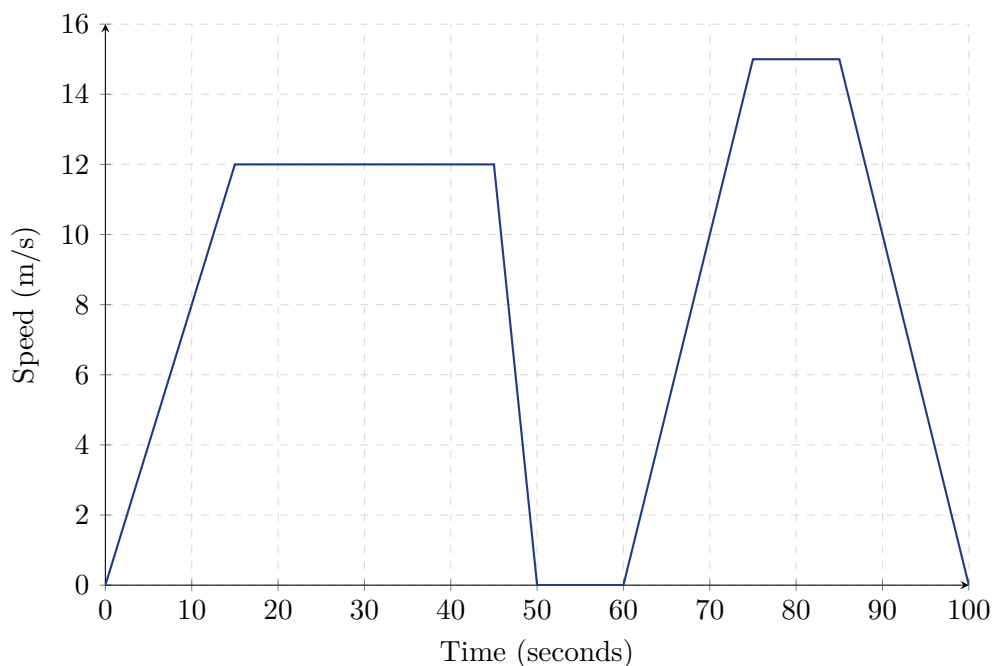**(d)** Calculate the cyclist's average speed for the whole journey.

Part 2 continued: Complex Speed-Time Graphs

Problem 8: Real-life scenario — Bus journey

A bus journey is shown on the speed-time graph below.

(a) What was the maximum speed of the bus?

(b) For how long was the bus stationary (stopped)?

(c) Calculate the acceleration during the first 15 seconds.

(d) Calculate the total distance travelled by the bus. *(Hint: Split the graph into shapes — triangles, rectangles, and trapeziums)*

Part 3: Comparing Distance-Time and Speed-Time Graphs

Problem 9: Two runners

Ali and Ben run a 400m race. The distance-time graph shows their race.
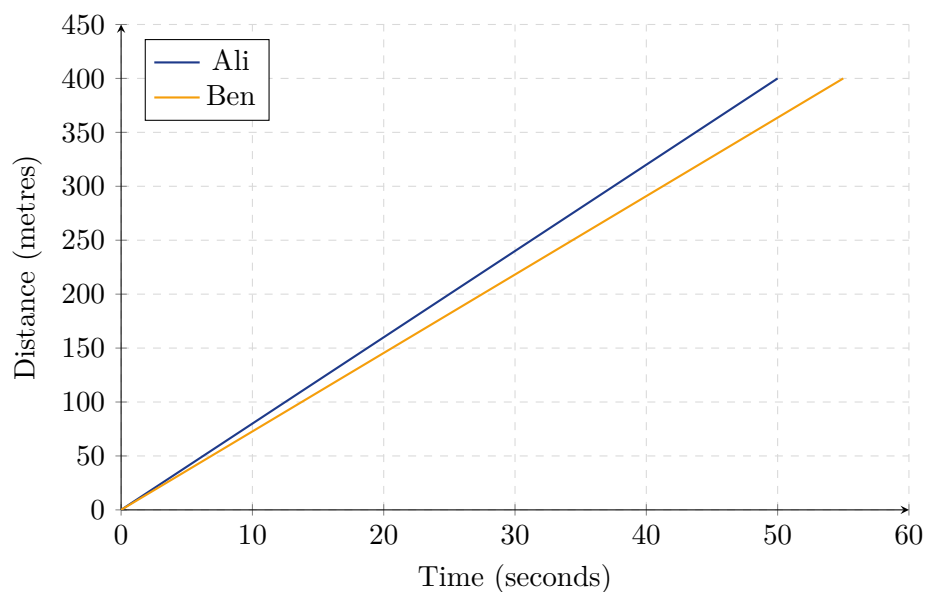
(a) Who won the race?

(b) What was the time difference between the two runners?

(c) Calculate Ali's speed in metres per second.

(d) Calculate Ben's speed in metres per second.

(e) Who was running faster? By how much?

Part 3 continued: Interpreting Multiple Journeys

Problem 10: Car overtaking

Two cars, Car A and Car B, are travelling along a motorway. The speed-time graph shows their motion.
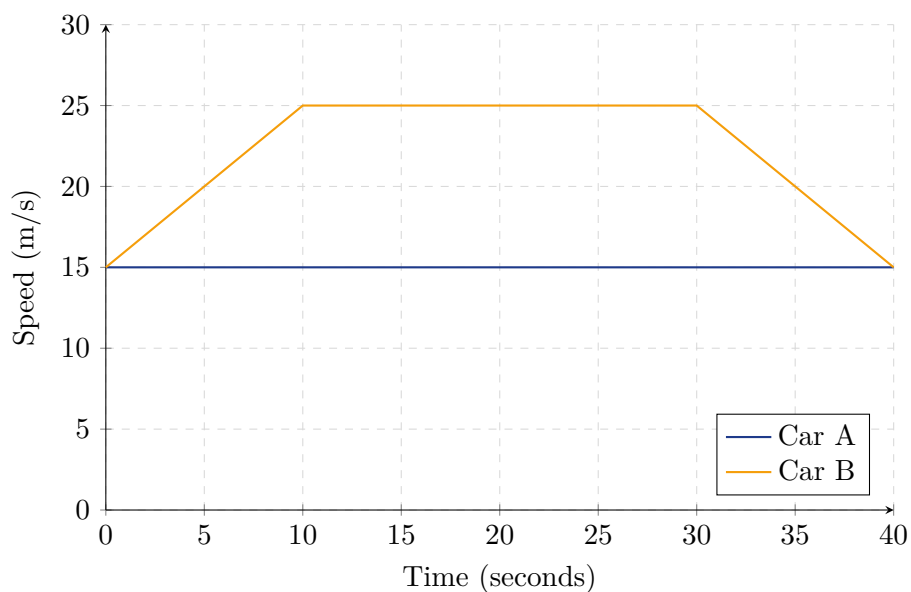
(a) What was Car A's speed throughout the journey?

(b) Calculate Car B's acceleration during the first 10 seconds.

(c) Calculate the distance travelled by Car A during the 40 seconds.

(d) Calculate the distance travelled by Car B during the 40 seconds.

(e) Which car travelled further? By how much?

Part 4: Exam-Style Questions

Problem 11: Multi-part exam question (Higher Tier)

A delivery van travels from a warehouse to a shop and back. The speed-time graph shows the van's journey.
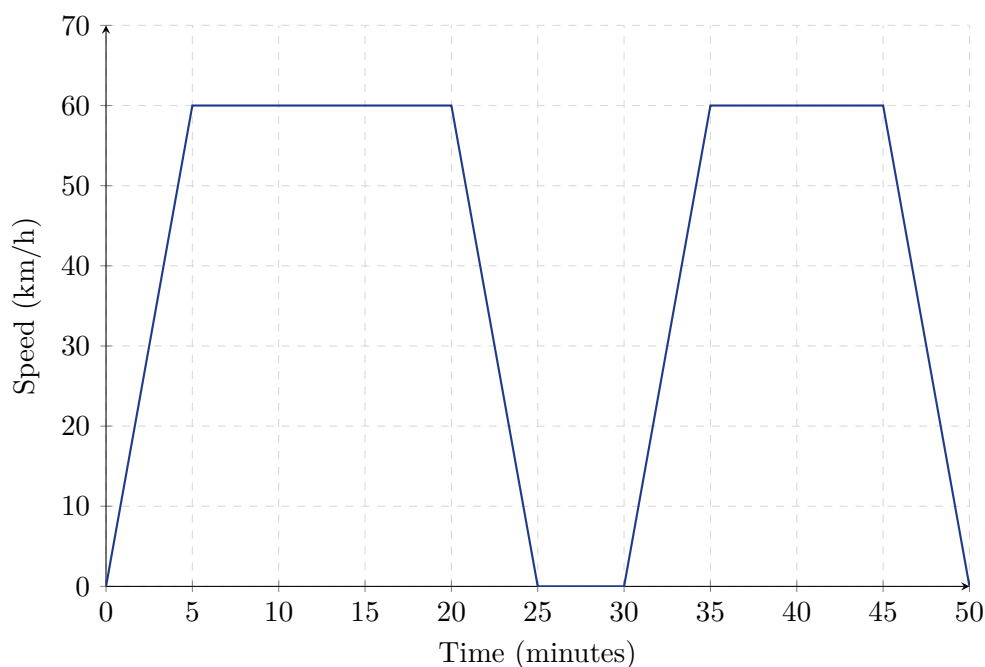
(a) Calculate the van's acceleration during the first 5 minutes. Give your answer in km/h per minute.

(b) Calculate the distance travelled by the van during the first 20 minutes. *(Remember: Area under graph = distance. You may need to convert units)*

(c) For how long was the van stationary during the whole journey?

(d) Calculate the total distance travelled during the whole 50-minute journey.

Part 4 continued: Challenge Questions

Problem 12: Creating your own graph

Lucy walks from home to the park, stays at the park, then walks back home. The distance from her home to the park is 1.5 km. Here is information about her journey:

- She walks to the park at 5 km/h

- She stays at the park for 30 minutes

- She walks home at 4 km/h

(a) Calculate how long it takes Lucy to walk to the park. Give your answer in minutes.

(b) Calculate how long it takes Lucy to walk home. Give your answer in minutes.

(c) Draw a distance-time graph for Lucy's complete journey on the axes below.
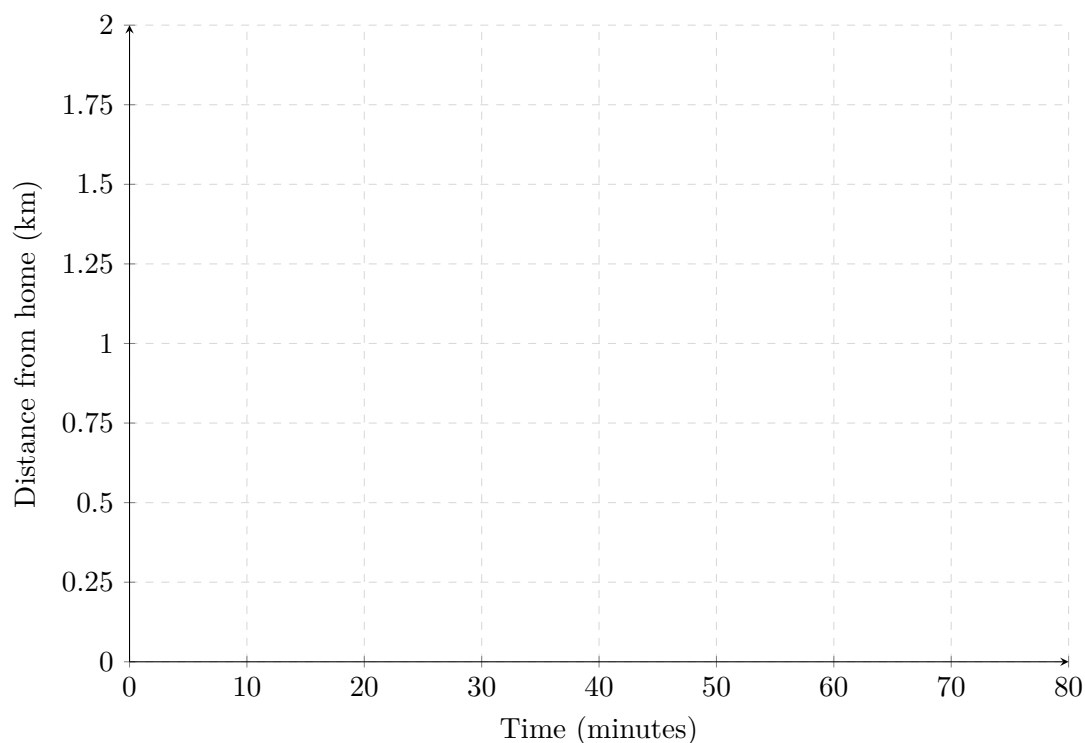
(d) Calculate Lucy's average speed for the whole journey (including the time at the park).

Part 4 continued: Word Problems

Problem 13: Train journey (Exam-style)

A train travels between two stations, A and B, which are 30 km apart.
The train:

- Accelerates uniformly from rest to 25 m/s in 100 seconds

- Travels at 25 m/s for 15 minutes

- Decelerates uniformly to rest in 80 seconds

(a) Draw a speed-time graph for the train's journey. Use the axes below. *(Remember: 15 minutes = 900 seconds)*
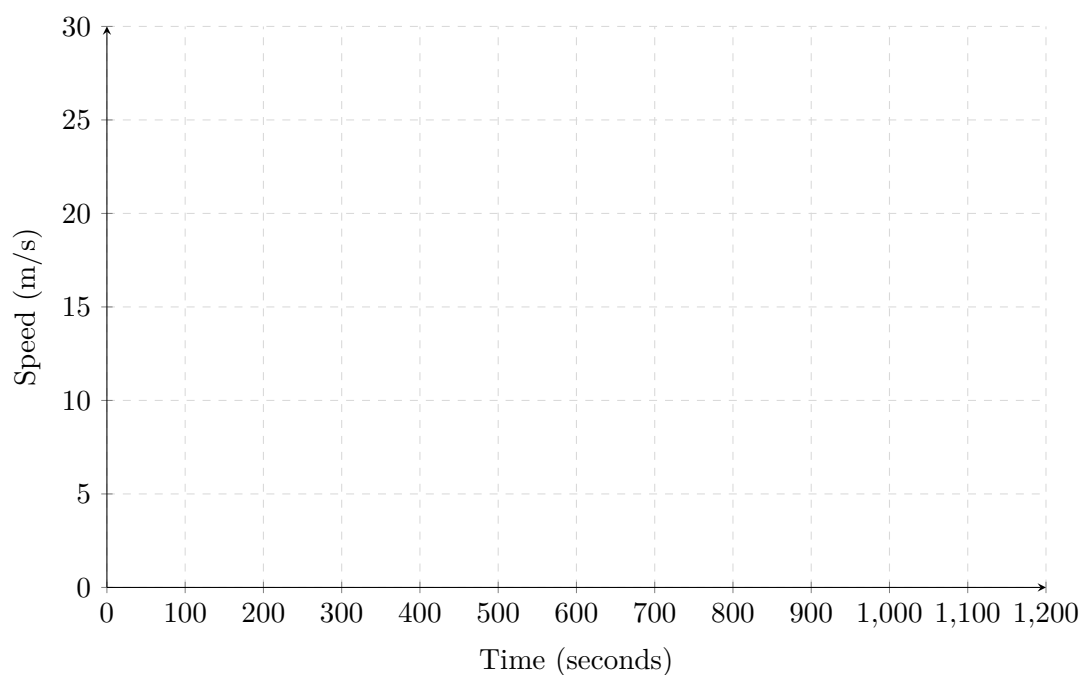
(b) Calculate the train's acceleration.

(c) Calculate the total distance travelled by the train. Give your answer in metres.

**(d)** Convert your answer to part (c) to kilometres.

Part 5: Mixed Practice and Challenge Questions

Problem 14: Cyclist and walker

A cyclist and a walker both leave town A at the same time, heading for town B which is 20 km away.

- The cyclist travels at a constant speed of 16 km/h

- The walker travels at a constant speed of 4 km/h

(a) On the same axes below, draw distance-time graphs for both the cyclist and the walker.
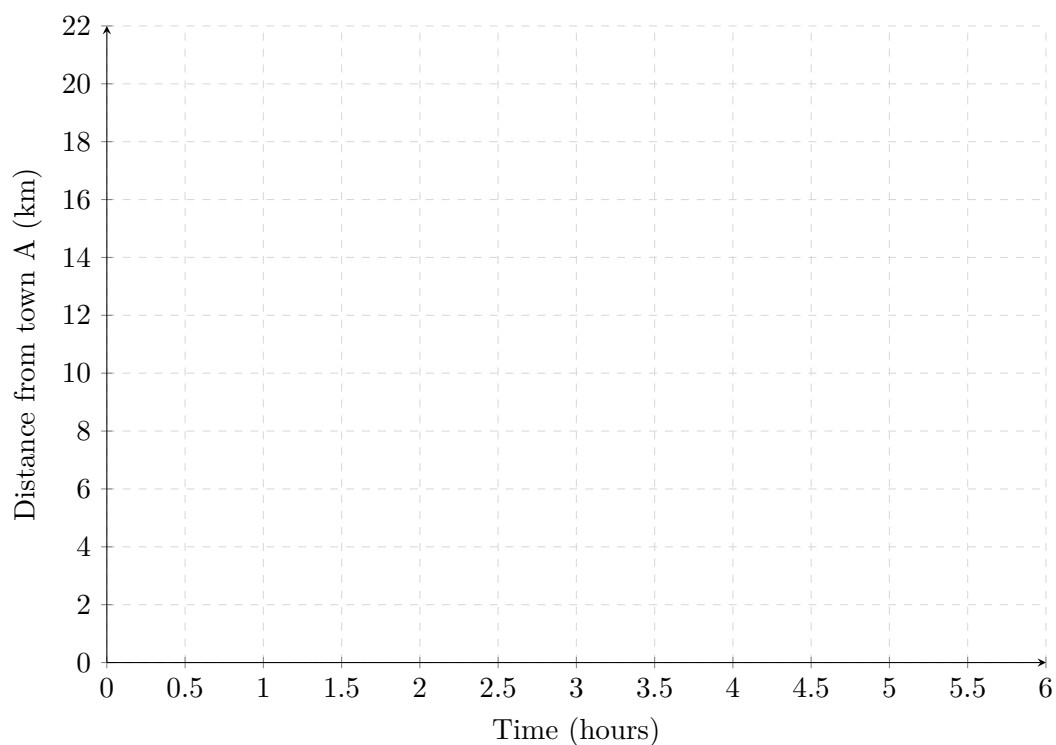
(b) How long does it take the cyclist to reach town B?

(c) How far apart are the cyclist and walker after 30 minutes?

(d) The cyclist rests at town B for 45 minutes, then cycles back towards town A at 16 km/h. Add this to your graph above. At what time do the cyclist and walker meet?

Part 5 continued: Challenge Problem
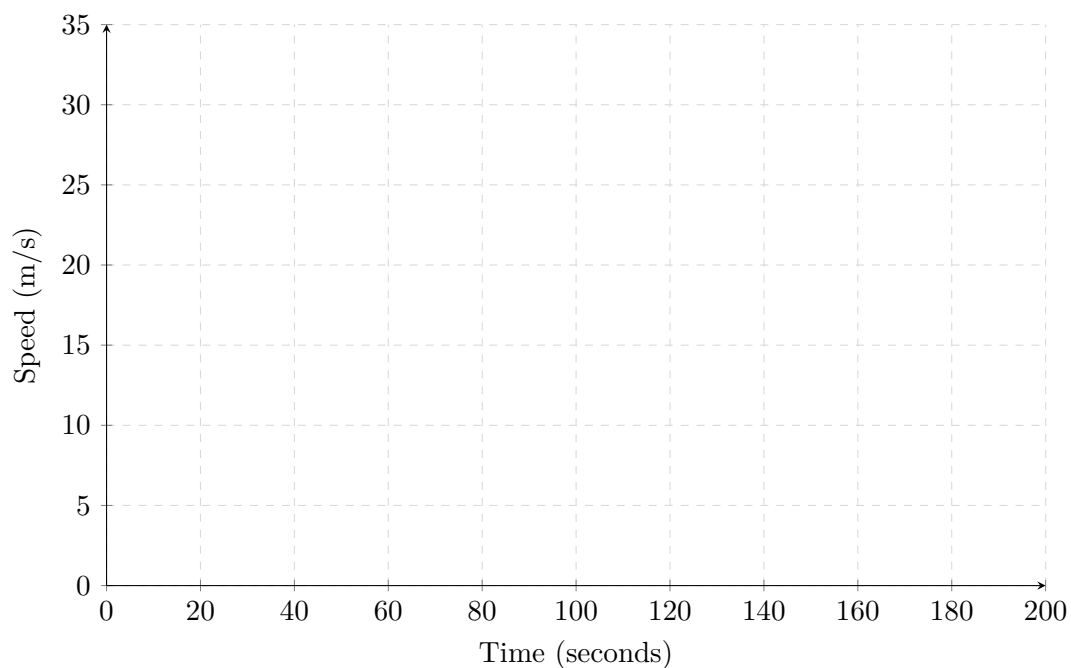
Problem 15: Ultimate challenge (Higher Tier)

A car journey consists of three stages:
Stage 1: The car accelerates from rest to 30 m/s in 15 seconds
Stage 2: The car travels at 30 m/s for 2 minutes
Stage 3: The car decelerates to 10 m/s in 10 seconds, then continues at 10 m/s for 45 seconds
(a) Draw a speed-time graph for the complete journey on the axes below.

(b) Calculate the total time for the journey.

(c) Calculate the acceleration in Stage 1.

(d) Calculate the deceleration in Stage 3.

(e) Calculate the total distance travelled during the entire journey.

Summary — Key Formulas and Tips

Distance-Time Graphs:

- Gradient = Speed
- Horizontal line = Stationary
- Steeper line = Faster speed
- Speed = $\frac{\text{Distance}}{\text{Time}}$

Speed-Time Graphs:

- Gradient = Acceleration
- Horizontal line = Constant speed
- Area under graph = Distance travelled
- Acceleration = $\frac{\text{Change in speed}}{\text{Time}}$

Important Conversions:

- 1 km = 1000 m
- 1 hour = 60 minutes = 3600 seconds
- To convert km/h to m/s: divide by 3.6
- To convert m/s to km/h: multiply by 3.6

Area Formulas:

- Rectangle: length × width
- Triangle: $\frac{1}{2}$ × base × height
- Trapezium: $\frac{1}{2}$ × (sum of parallel sides) × height

Excellent Work!

You have completed comprehensive practice on distance-time
and speed-time graphs for your GCSE exam preparation.

Yolymatics Tutorials
yolymatics007@gmail.com

Good luck with your AQA GCSE Mathematics exam!