Worksheet 1 — Straight-Line Graphs and Rates of Change — 8 questions

BRONZE **1.**

Gradient, yintercept and equation of a drawn line

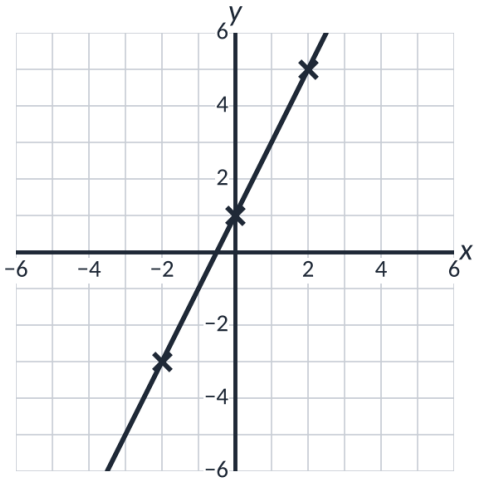
The straight line is drawn on the grid.

(a) Write down the yintercept of the line.

(b) Work out the gradient of the line.

(c) Write down the equation of the line.

(d) Does the point (10, 21) lie on the line? Show how you know.



BRONZE **2.**

Gradient, yintercept and equation of a drawn line

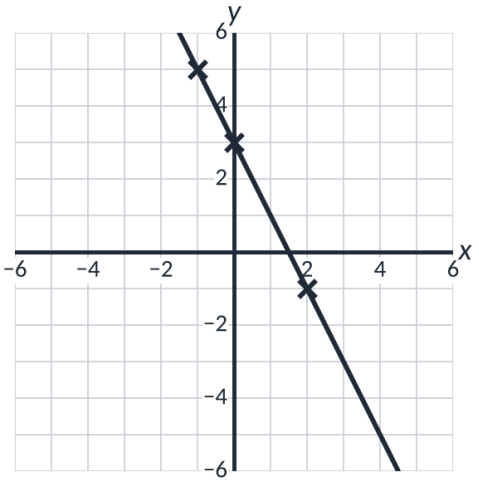
The straight line is drawn on the grid.

(a) Write down the yintercept of the line.

(b) Work out the gradient of the line.

(c) Write down the xcoordinate of the point where the line crosses the xaxis.

(d) The point (k, −11) lies on the line. Work out the value of k.



BRONZE **3.**

Gradient, yintercept and equation of a drawn line

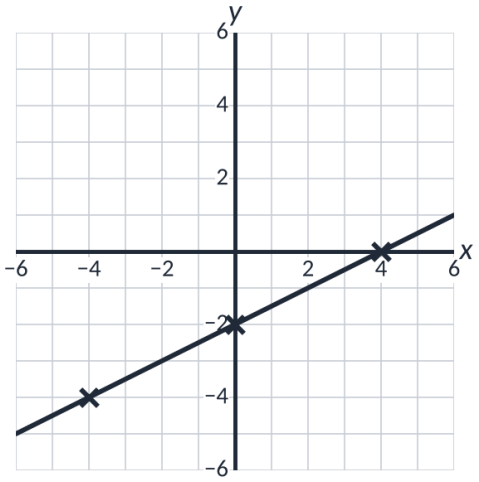
The straight line is drawn on the grid.

(a) Write down the yintercept of the line.

(b) Work out the gradient of the line.

(c) Write down the equation of the line.

(d) Work out the value of y when x = 10.



BRONZE **4.**

Gradient, yintercept and equation of a drawn line

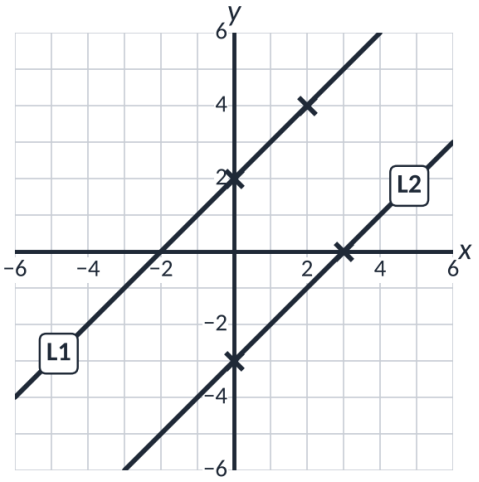
Two straight lines, L1 and L2, are drawn on the grid.

(a) Work out the gradient of each line.

(b) Write down the equation of each line.

(c) What do the two gradients tell you about the lines?

(d) Write down the equation of the line parallel to L1 that passes through the origin.



Worksheet 1 — Straight-Line Graphs and Rates of Change — 8 questions (page 2)

SILVER **5.**

Work out the scale, the fixed charge and the rate

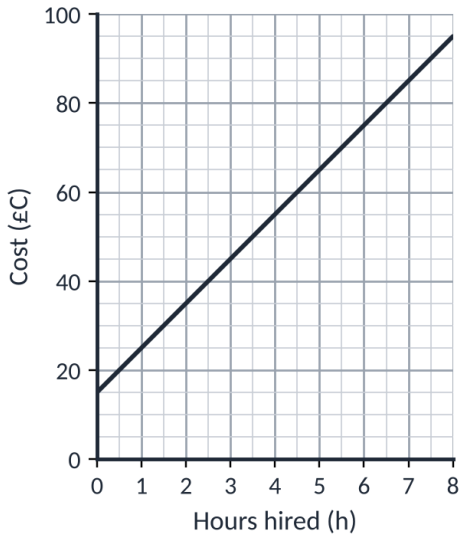
The graph shows the cost, £C, of hiring a kayak for h hours.

(a) How many pounds does one small square stand for on the vertical axis?

(b) Write down the fixed charge.

(c) Work out the gradient of the line and say what it represents.

(d) Write a formula for C in terms of h, then use it to find the cost of hiring a kayak for 6.5 hours.



GOLD **6.**

Rearrange and draw a line; a tank filling and emptying

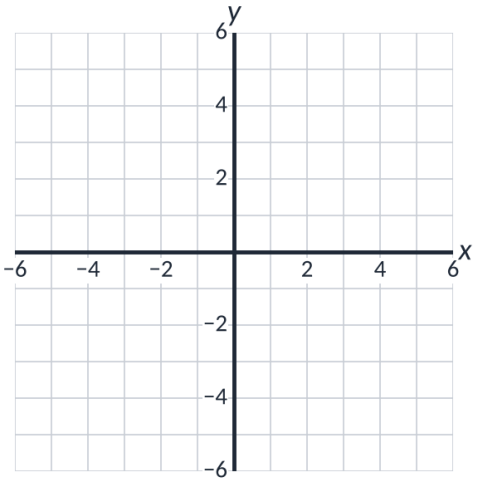
A straight line has the equation 3x + 4y = 12.

(a) Rearrange the equation into the form y = mx + c.

(b) Write down the gradient and the yintercept of the line.

(c) Draw the line on the grid.

(d) Show that the point (8, −3) lies on the line.



GOLD **7.**

Rearrange and draw a line; a tank filling and emptying

A tank holds 240 litres. Water is let out at a steady rate. The graph shows the volume, V litres, after t minutes.

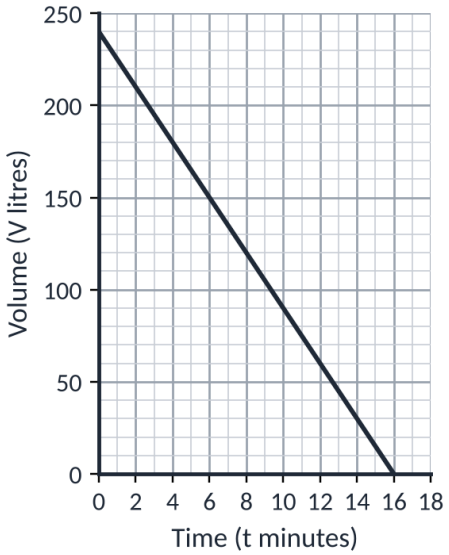
(a) Work out the gradient of the line and say what it means.

(b) Write a formula for V in terms of t.

(c) Use your formula to find when 90 litres are left.

(d) A second tank holds 180 litres and loses 10 litres a minute. Draw its graph.

(e) When do the tanks hold the same volume? What is it?



PLATINUM **8.**

Two taxi tariffs: formula, graph and algebra together

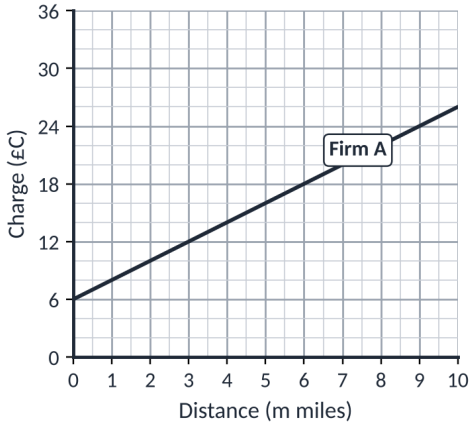
The graph shows the charge, £C, of Firm A for a taxi journey of m miles.

(a) Write a formula for C in terms of m for Firm A.

(b) Firm B charges £2 plus £3 for every mile. Draw the graph for Firm B on the grid.

(c) Use algebra to work out the length of journey for which the two firms charge the same, and the charge.

(d) Firm C charges £2.50 a mile and no fixed charge. For which journeys is Firm C cheaper than Firm A?



Worksheet 2 — Equations of Lines and Problems on Coordinate Axes — 26 questions

BRONZE Gradient from two points, simple equations and midpoints

SILVER Equation of a line through two points, and parallel lines

GOLD Perpendicular gradients, perpendicular lines and lengths

PLATINUM Perpendicular bisectors, proofs and unknown coordinates

Work out the gradient of the straight line through these two points.

1. **(1, 2) and (5, 14)**
2. **(−2, 7) and (4, −5)**
3. **(3, −1) and (11, 3)**
4. Write down the equation of the line with gradient −3 and yintercept 5.
5. Find the equation of the line with gradient 2 that passes through the point (3, 11).
6. Does the point (6, 17) lie on the line y = 3x − 1? Show your working.
7. Find the midpoint of the line segment AB, where A is (2, 9) and B is (10, −3).

Find the equation of the straight line through these two points.

8. **(1, 5) and (3, 11)**
9. **(−1, 4) and (3, −4)**
10. **(2, 3) and (6, 5)**
11. Rearrange the equation to find the gradient and the yintercept of the line.

    4x + 2y = 10
12. Write down the equation of a line parallel to y = 4x − 7 that passes through (0, 3).
13. Find the equation of the line parallel to y = 2x + 5 that passes through the point (3, 4).
14. The line y = 3x + k passes through the point (2, 11). Work out the value of k.
15. Write down the gradient of a line that is perpendicular to the line y = 4x + 1.
16. Write down the gradient of a line that is perpendicular to the line 2y = 3x − 8.
17. Show that the lines y = 2x + 3 and 2y + x = 10 are perpendicular.
18. Find the equation of the line perpendicular to y = 3x − 2 that passes through (6, 1).
19. Work out the length of the line segment joining A(1, 2) and B(7, 10).
20. Work out the length of the line segment joining A(−3, 1) and B(2, 13).
21. The line y = kx + 3 is parallel to the line 3x + y = 7. Work out the value of k.
22. A is (0, 2), B is (4, 6) and C is (8, 2). Show that triangle ABC has a right angle at B and that AB = BC.
23. Find the equation of the perpendicular bisector of the line segment joining A(1, 2) and B(5, 6).
24. Find the equation of the line that passes through (2, 5) and is perpendicular to the line 3y + 2x = 12.
25. The points (2, 3), (6, 11) and (k, 19) lie on a straight line. Work out the value of k.
26. The lines y = kx + 1 and 3y + 6x = 2 are perpendicular. Work out the value of k.

Worksheet 3 — Distance–Time Graphs — 8 questions

BRONZE **1.**

Read travel graphs: how far, how long stopped, how fast

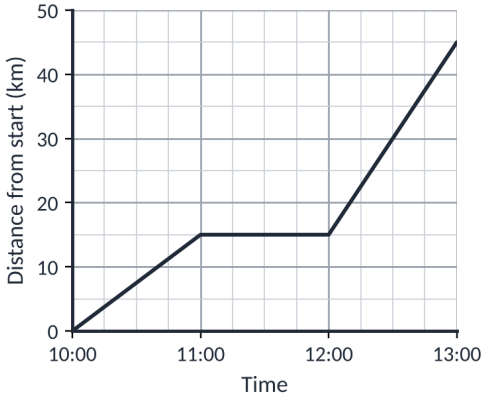
The graph shows Dev's cycle ride from 10:00.

(a) How far from the start was Dev at 11:30?

(b) For how long did Dev stop?

(c) Work out Dev's speed during the last hour.

(d) Dev says, "I went faster in the first hour than in the last hour." Is he right? Explain.



BRONZE **2.**

Read travel graphs: how far, how long stopped, how fast

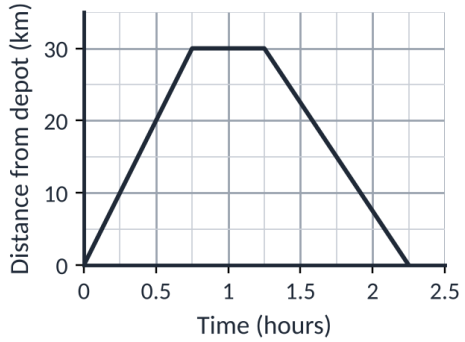
The graph shows a delivery van's journey from its depot.

(a) What is the greatest distance of the van from the depot?

(b) For how many minutes was the van stopped?

(c) Work out the speed of the van, in km/h, on the way out.

(d) Work out the speed of the van, in km/h, on the way back.



BRONZE **3.**

Read travel graphs: how far, how long stopped, how fast

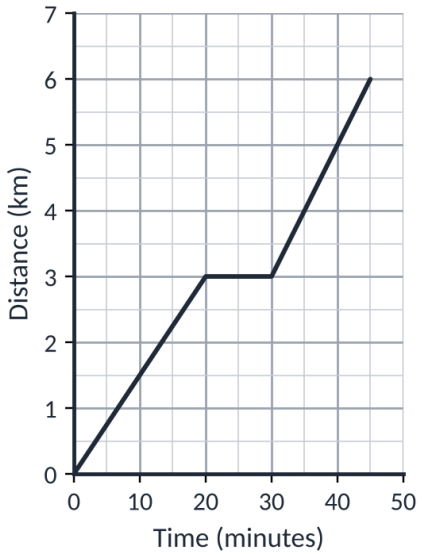
The graph shows Jess's run, in kilometres, against time in minutes.

(a) For how many minutes did Jess stop?

(b) Work out Jess's speed, in km/h, for the first 20 minutes.

(c) Work out Jess's speed, in km/h, for the last 15 minutes.

(d) Work out Jess's average speed, in km/h, for the whole run.



BRONZE **4.**

Read travel graphs: how far, how long stopped, how fast

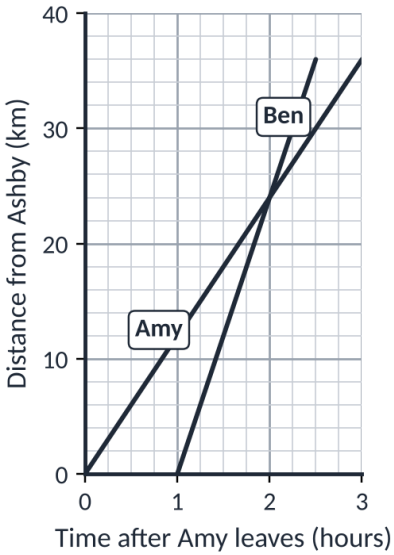
Amy cycles from Ashby to Burton. Ben leaves Ashby one hour later and cycles along the same road. Their journeys are shown on the graph.

(a) Work out Amy's speed, in km/h.

(b) Work out Ben's speed, in km/h.

(c) How long after Amy leaves does Ben catch her up, and how far from Ashby are they?

(d) How far apart are Amy and Ben 1.5 hours after Amy leaves?



Worksheet 3 — Distance–Time Graphs — 8 questions (page 2)

SILVER **5.**

Work out the scale; speeds in m/s and km/h; average speed

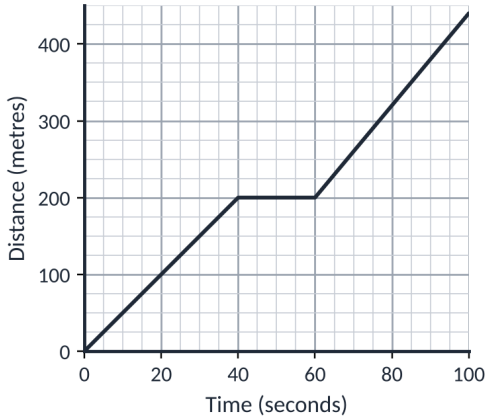
The graph shows Kai's training run on a track, with the distance in metres and the time in seconds.

(a) How many seconds does one small square stand for on the horizontal axis?

(b) Work out Kai's speed, in metres per second, during the first 40 seconds.

(c) Change this speed to kilometres per hour.

(d) Work out Kai's average speed, in metres per second, for the whole run.



GOLD **6.**

Use speeds to complete a travel graph and find when journeys meet

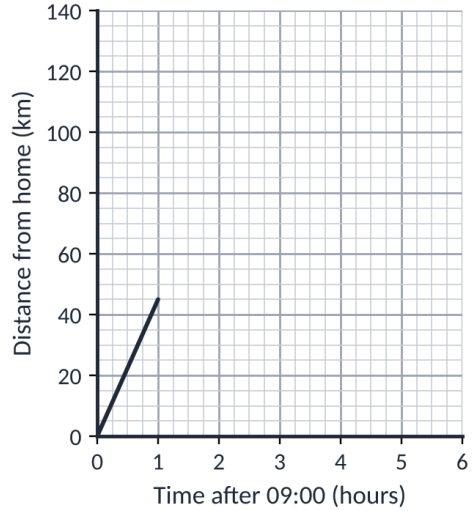
The graph shows the first part of Mo's drive from home. Mo stops for 30 minutes, then drives at 60 km/h for 1.5 hours, then returns home at 45 km/h without stopping.

(a) Work out Mo's speed, in km/h, for the first hour.

(b) Complete the graph of Mo's journey.

(c) How many hours does the return journey take? At what time, if Mo left at 09:00, does he get home?

(d) Work out Mo's average speed for the whole journey.



GOLD **7.**

Use speeds to complete a travel graph and find when journeys meet

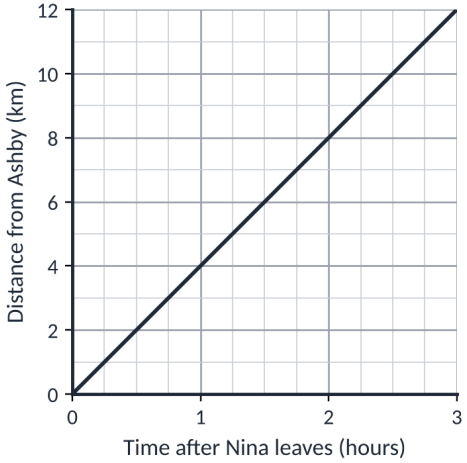
Nina walks from Ashby to Bexley, 12 km along a straight road, at 4 km/h. Omar leaves Bexley one hour after Nina and cycles to Ashby at 12 km/h. Nina's journey is shown on the graph.

(a) Draw Omar's journey on the grid.

(b) How long after Nina leaves do Nina and Omar meet, and how far from Ashby are they?

(c) Omar says, "I cycled twice as fast as Nina." Is he right? Show how you know.

(d) How long does Nina still have to walk when Omar reaches Ashby?



PLATINUM **8.**

Estimate the speed at a point from a tangent to a curve

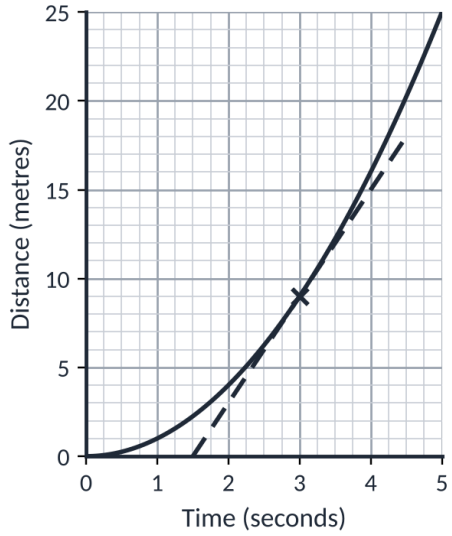
The graph shows how far a sprinter has run in the first 5 seconds of a race. The straight line is a tangent to the curve at 3 seconds.

(a) Use the graph to find how far the sprinter has run after 4 seconds.

(b) Work out the sprinter's average speed over the first 4 seconds.

(c) Work out the gradient of the tangent. What does it represent?

(d) Is the sprinter's speed at 3 seconds greater than or less than the average speed in part (b)? Explain what the shape of the curve tells you.

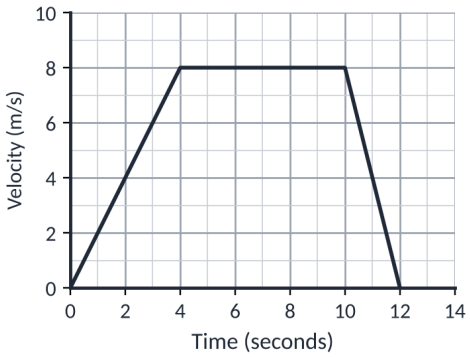


Worksheet 4 — Velocity–Time Graphs — 8 questions

BRONZE **1.**

Read velocity–time graphs: acceleration and distance

The graph shows a cyclist's velocity.



(a) What is the greatest velocity of the cyclist?

(b) For how many seconds does the cyclist travel at this velocity?

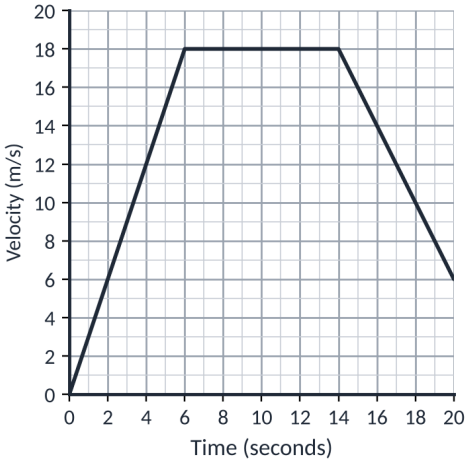
(c) Work out the acceleration during the first 4 seconds.

(d) Work out the deceleration during the last 2 seconds.

BRONZE **2.**

Read velocity–time graphs: acceleration and distance

The graph shows a car's velocity.



(a) Work out the acceleration of the car during the first 6 seconds.

(b) Work out the deceleration of the car in the last 6 seconds.

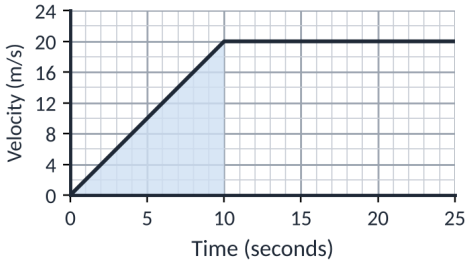
(c) At what time does the car first reach a velocity of 12 m/s?

(d) At what time does the car slow down to a velocity of 12 m/s?

BRONZE **3.**

Read velocity–time graphs: acceleration and distance

The graph shows a sprinter's velocity. The shaded triangle shows the distance travelled in the first 10 seconds.



(a) Work out the sprinter's acceleration in the first 10 seconds.

(b) Work out the area of the shaded triangle. What does it tell you?

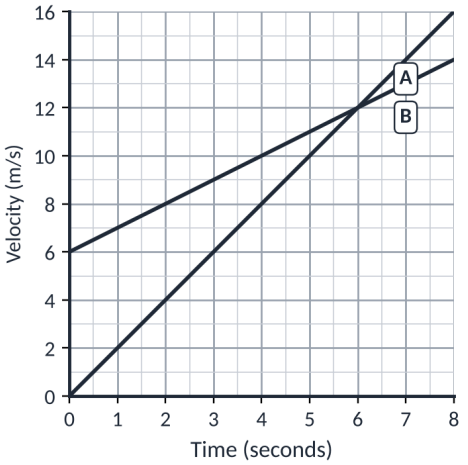
(c) How far does the sprinter run in the next 15 seconds at 20 m/s?

(d) Work out the total distance run in the 25 seconds.

BRONZE **4.**

Read velocity–time graphs: acceleration and distance

The graph shows the velocities of two vehicles, A and B, over 8 seconds.



(a) Work out the acceleration of A.

(b) Write down the starting velocity of B and work out its acceleration.

(c) After how many seconds do A and B have the same velocity, and what is it?

(d) Which vehicle has the greater velocity after 8 seconds, and by how much?

Worksheet 4 — Velocity–Time Graphs — 8 questions (page 2)

SILVER **5.**

Work out the time scale, then acceleration and total distance

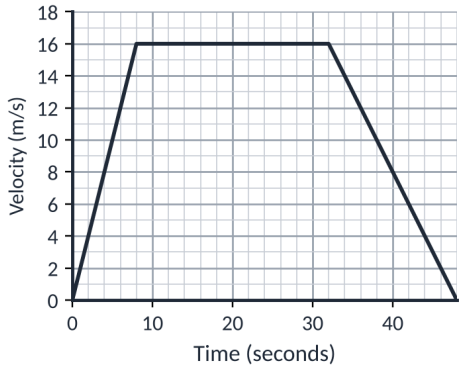
The graph shows a tram's journey between two stops.

(a) How many seconds does one small square stand for on the horizontal axis?

(b) Work out the acceleration of the tram during the first 8 seconds.

(c) Work out the deceleration of the tram in the last 16 seconds.

(d) Work out the distance between the two stops.



GOLD **6.**

Draw a velocity–time graph and compare two runners

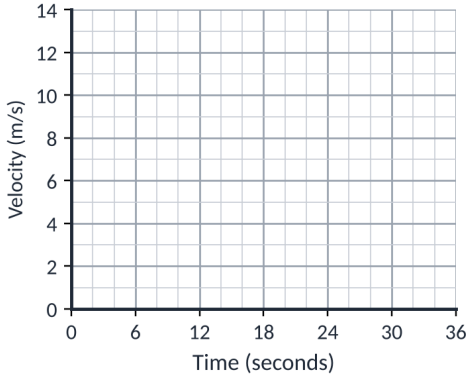
A tram leaves a stop and accelerates at 1.5 m/s² for 8 seconds. It then travels at a constant velocity for 20 seconds, then slows down at a constant rate and stops after a further 6 seconds.

(a) Work out the greatest velocity of the tram.

(b) Draw the velocity–time graph on the grid.

(c) Work out the deceleration of the tram.

(d) Work out the total distance the tram travels.



GOLD **7.**

Draw a velocity–time graph and compare two runners

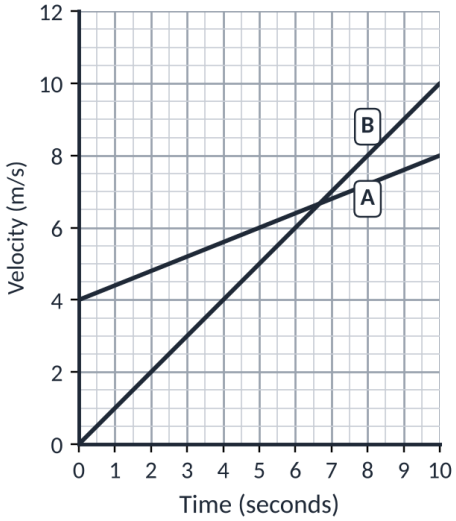
Two runners, A and B, start together. Their velocities for the first 10 seconds are shown on the graph.

(a) Work out the acceleration of A.

(b) Write down B's starting velocity and work out B's acceleration.

(c) Work out the distance each runner travels in 10 seconds.

(d) Which runner is in front after 10 seconds, and by how many metres?



PLATINUM **8.**

Form and solve an equation from the area under a graph

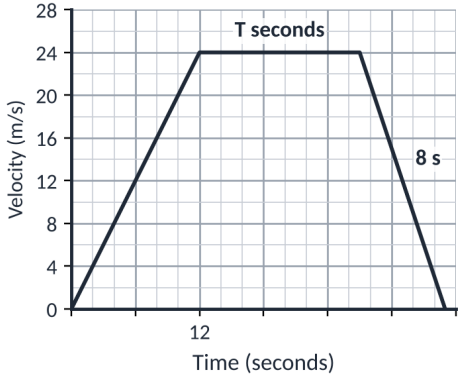
The graph shows a car's journey. The car accelerates from rest to 24 m/s in 12 seconds, travels at 24 m/s for T seconds, then slows down to rest in 8 seconds. The total distance travelled is 600 metres.

(a) Work out the acceleration of the car during the first 12 seconds.

(b) Work out the deceleration of the car.

(c) Show that the distance travelled is (240 + 24T) metres.

(d) Work out the value of T.



ANSWERS

WS 1 — Straight-Line Graphs and Rates of Change

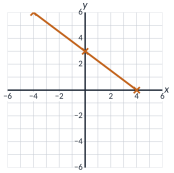
BRONZE

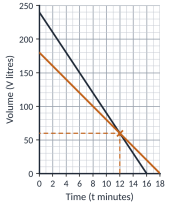
1. (a) 1 (b) 2 (c) y = 2x + 1 (d) Yes: 2 × 10 + 1 = 21
2. (a) 3 (b) −2 (c) 1.5 (d) k = 7
3. $(a)\ -2 \quad (b)\ \frac{1}{2} \quad (c)\ y = \frac{1}{2}x - 2 \quad (d)\ 3$
4. (a) 1 and 1 (b) L1: y = x + 2; L2: y = x − 3 (c) They are parallel (d) y = x

SILVER

5. (a) £5 (b) £15 (c) 10: the charge is £10 per hour (d) C = 10h + 15; £80

GOLD

6. 

7. 

$(a)\ y = -\frac{3}{4}x + 3$

(b) gradient $-\frac{3}{4}$, $y$intercept 3

(c) line through (0, 3) and (4, 0), also (−4, 6)

(d) 3 × 8 + 4 × (−3) = 24 − 12 = 12

(a) −15: the tank loses 15 litres every minute

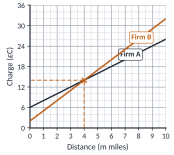
(b) V = 240 − 15t

(c) after 10 minutes

(d) line from (0, 180) to (18, 0)

(e) after 12 minutes: 60 litres

PLATINUM

8. 

(a) C = 2m + 6

(b) line from (0, 2) to (10, 32)

(c) 2m + 6 = 3m + 2, m = 4 miles; £14

(d) less than 12 miles

WS 2 — Equations of Lines and Problems on Coordinate Axes

BRONZE

1. 3
2. −2
3. $\frac{1}{2}$
4. y = −3x + 5
5. y = 2x + 5
6. Yes: 3 × 6 − 1 = 17
7. (6, 3)

SILVER

8. y = 3x + 2
9. y = −2x + 2
10. $y = \frac{1}{2}x + 2$
11. gradient −2, yintercept 5
12. y = 4x + 3
13. y = 2x − 2
14. k = 5

GOLD

15. $-\frac{1}{4}$
16. $-\frac{2}{3}$
17. Gradient $-\frac{1}{2}$; $2 \times (-\frac{1}{2}) = -1$
18. $y = -\frac{1}{3}x + 3$
19. 10
20. 13
21. k = −3

PLATINUM

22. gradients 1 and −1, 1 × (−1) = −1; AB = BC = √32
23. y = −x + 7
24. $y = \frac{3}{2}x + 2$
25. k = 10
26. $k = \frac{1}{2}$

WS 3 — Distance–Time Graphs

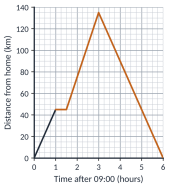
BRONZE

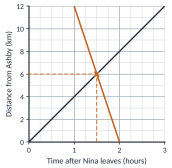
1. (a) 15 km (b) 1 hour (c) 30 km/h (d) No: the last section is steeper (30 km/h, not 15 km/h)
2. (a) 30 km (b) 30 minutes (c) 40 km/h (d) 30 km/h
3. (a) 10 minutes (b) 9 km/h (c) 12 km/h (d) 8 km/h
4. (a) 12 km/h (b) 24 km/h (c) 2 hours; 24 km (d) 6 km

SILVER

5. (a) 5 seconds (b) 5 m/s (c) 5 × 3.6 = 18 km/h (d) 440 ÷ 100 = 4.4 m/s

GOLD

6. 

7. 

(a) 45 km/h

(b) (1, 45) to (1.5, 45) to (3, 135) to (6, 0)

(c) 135 ÷ 45 = 3 hours; 15:00

(d) 270 ÷ 6 = 45 km/h

(a) line from (1, 12) to (2, 0)

(b) 1.5 hours; 6 km

(c) No: 12 ÷ 4 = 3, three times as fast

(d) 1 hour

PLATINUM

8. (a) 16 metres (b) 16 ÷ 4 = 4 m/s (c) 18 ÷ 3 = 6: the speed at 3 seconds (6 m/s) (d) Greater (6 > 4): the curve gets steeper, so the sprinter is speeding up

WS 4 — Velocity–Time Graphs

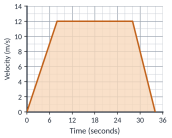
BRONZE

1. (a) 8 m/s (b) 6 seconds (c) 2 m/s² (d) 8 ÷ 2 = 4 m/s²
2. (a) 3 m/s² (b) 12 ÷ 6 = 2 m/s² (c) 4 seconds (d) 17 seconds
3. (a) 2 m/s² (b) ½ × 10 × 20 = 100: the distance run in 10 seconds is 100 m (c) 300 m (d) 400 m
4. (a) 2 m/s² (b) 6 m/s; 1 m/s² (c) 6 seconds; 12 m/s (d) A: 16 − 14 = 2 m/s greater

SILVER

5. (a) 2 seconds (b) 2 m/s² (c) 1 m/s² (d) 576 m

GOLD

6. 

(a) 12 m/s

(b) (0, 0) to (8, 12) to (28, 12) to (34, 0)

(c) 2 m/s²

(d) 324 m

7. (a) 1 m/s² (b) 4 m/s; 0.4 m/s² (c) A: 50 m; B: ½ × (4 + 8) × 10 = 60 m (d) B, by 10 m

PLATINUM

8. (a) 2 m/s² (b) 3 m/s² (c) 144 + 24T + 96 = 240 + 24T (d) 240 + 24T = 600, T = 15