

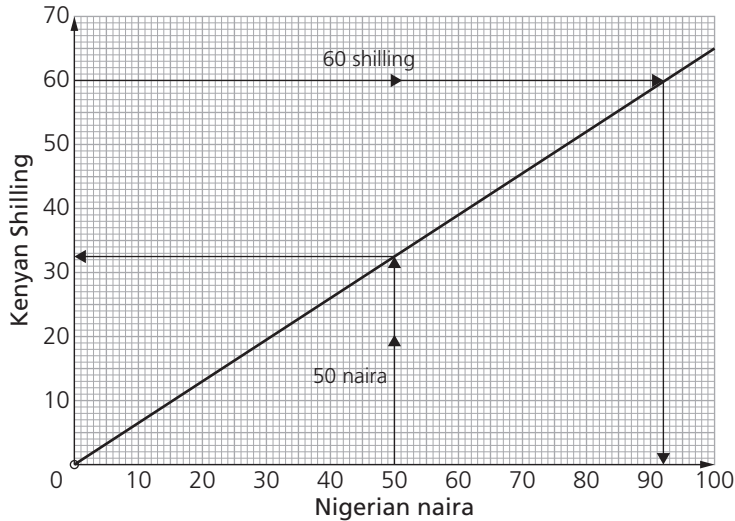
12 Graphs in practical situations

Example

The graph below shows the value of the Nigerian naira against the Kenyan shilling.

Use the graph to find

- how many Kenyan shillings you would get for 50 Nigerian naira
- how many Nigerian naira you would get for 60 Kenyan shillings.



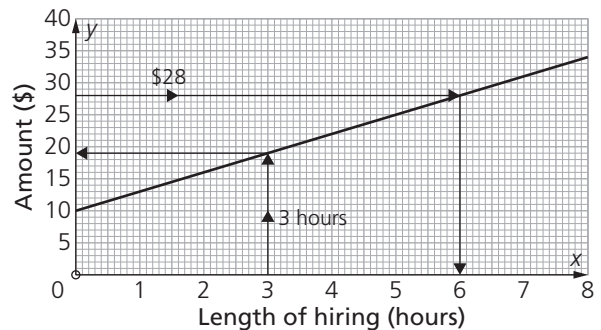
- Draw a vertical line up from 50 naira to the graph and then a horizontal line across to the vertical axis: 50 naira is about 33 shillings.
- Draw a horizontal line across from 60 shillings to the graph and then a vertical line down to the horizontal axis: 60 shillings is about 92 naira.

Example

The graph shows the amount that a shop charges for hiring a bike for up to 8 hours in a day.

There is an initial charge and then an hourly charge.

- What is the initial charge?
 - What is the hourly charge?
 - How much would it cost to hire a bike for 3 hours?
 - How many hours' hire would cost \$28?
- The initial charge is the cost when the time is zero. This is \$10.
 - From the graph you can see that 1 hour costs \$13. So the hourly charge is \$3.
 - Reading off from graph gives \$19.
 - Reading off from graph gives 6 hours.



Distance-time graphs

The gradient on a distance-time graph represents speed.

Exam question

CIE 0580 June '08 Paper 1 Q22

The diagram shows the graph of Rachel's journey on a motorway. Starting at *A*, she drove 24 kilometres to *B* at a constant speed. Between *B* and *C* she had to drive slowly through road works. At *C* she drove a further distance to *D* at her original speed.

- (a) For how many minutes did she drive through the road works?
 (b) At what speed did she drive through the road works?

Give your answer in:

- (i) kilometres/minute
 (ii) kilometres/hour

- (c) What is the total distance from *A* to *D*?

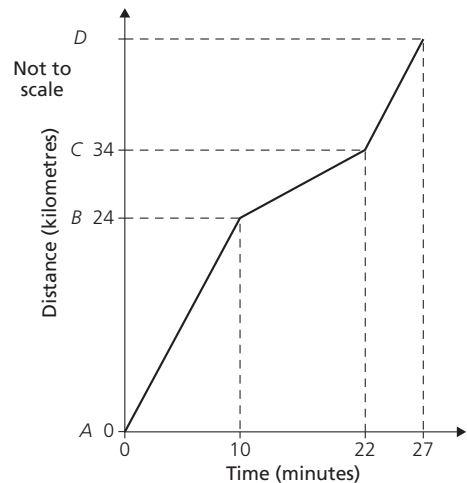
- (a) She came to road works after 10 minutes and left them after 22 minutes. So she spent 12 minutes in the road works.
 (b) (i) In 12 minutes her distance increased from 24 km to 34 km.

So the road works were 10 km long.

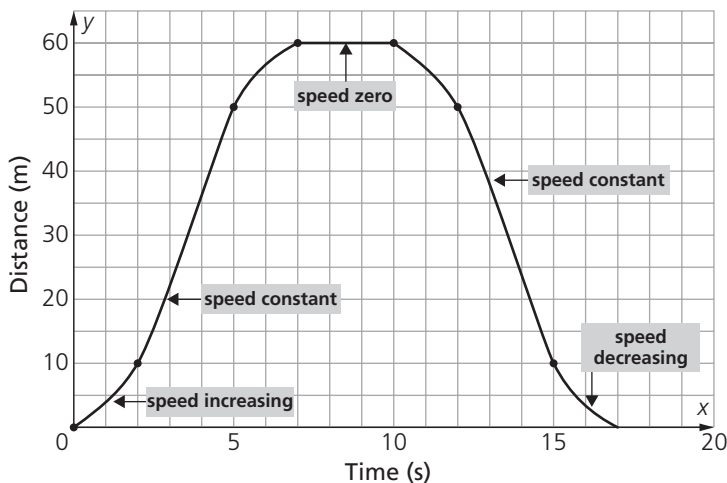
$$\text{Speed} = \frac{10}{12} = 0.833 \text{ km min}^{-1} \text{ (to 3 sf)}$$

- (ii) $0.833 \dots \text{ km min}^{-1} = 0.833 \dots \times 60 \text{ km h}^{-1} = 50 \text{ km h}^{-1}$

- (c) Between *A* and *B* she travelled 24 km in 10 min.
 Between *C* and *D* she travelled 12 km in 5 min (since she was travelling at the same speed as from *A* to *B*).
 Distance to *C* is 34 km so total distance from *A* to *D* is 46 km.



This graph shows the journey of a boy cycling. From the graph you can tell how the boy's speed changes.



What happens to the speed...

Between 0s and 2s the boy is speeding up.

Between 2s and 5s the boy is travelling at a constant speed.

Between 5s and 7s the boy is slowing down.

Between 7s and 10s the boy is stationary.

Between 10s and 12s the boy speeds up.

From 12s to 15s onwards the boy is travelling at a constant speed.

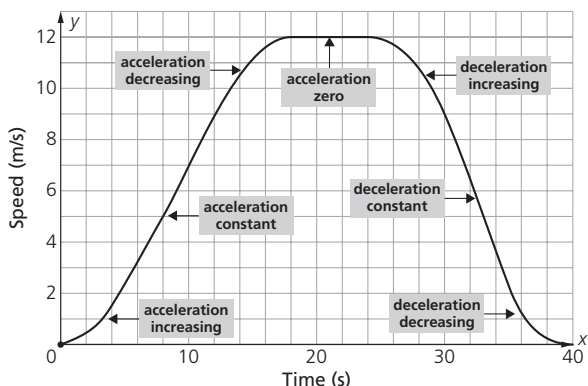
From 15s to 17s the boy is slowing down.

Speed-time graphs

Gradient on a speed-time graph represents acceleration.
 Area under a speed-time graph represents distance travelled.

This graph shows the speed of a toy car. From the graph you can tell how the car's speed changes.

Extended



What happens to the speed

Between 0 s and 17 s the car is speeding up to reach a top speed of 12 m s^{-1} .
 Between 17 s and 25 s the car has a constant speed of 12 m s^{-1} .
 From 25 s onwards the car slows down (decelerates) to come to rest.

What happens to the acceleration

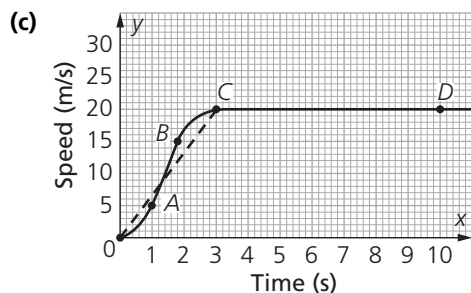
Between 0 s and 2 s the acceleration is increasing.
 Between 2 s and 12 s the acceleration is constant.
 Between 12 s and 17 s the acceleration is decreasing.
 Between 17 s and 25 s the acceleration is zero
 Between 25 s and 30 s the deceleration is increasing.
 From 30 s to 35 s the deceleration is constant.
 From 35 s the deceleration is decreasing.

Exam question

CIE 0580 June '06 Paper 4 Q1

- 1 (a) A train completed a journey of 850 kilometres with an average speed of 80 kilometres per hour. Calculate, giving exact answers, the time taken for this journey in
- hours
 - hours, minutes and seconds.
- (b) Another train took 10 hours 48 minutes to complete the same 850 km journey.
- It departed at 19 20. At what time, on the next day, did this train complete the journey?
 - Calculate the average speed, in kilometres per hour, for the journey.

- (a) (i) $T = \frac{D}{S} = \frac{850}{80} = 10.625$ hours
 (ii) $0.625 \text{ h} = 0.625 \times 60 = 37.5 \text{ min} = 37 \text{ min and } 30 \text{ seconds}$
 So the journey time is 10 h 37 min and 30 sec.
 (b) (i) 10 hours on from 1920 is '2920' which is 0520 the next day. Another 48 minutes brings it to 0608.
 (ii) $48 \text{ min} = \frac{48}{60} = 0.8 \text{ h}$
 So 10 h 48 min is 10.8 h.
 Average speed = $850 \div 10.8 = 78.7 \text{ km h}^{-1}$ (to 3 sf)

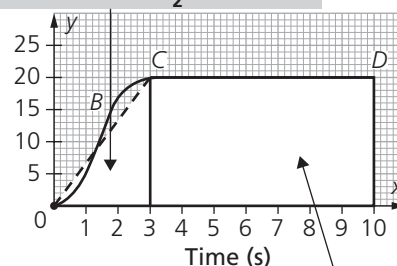


The solid line OABCD on the grid shows the first 10 seconds of a car journey.

- Describe briefly what happens to the speed of the car between B and C.
- Describe briefly what happens to the acceleration of the car between B and C.
- Calculate the acceleration between A and B.
- Using the broken straight line OC, estimate the total distance travelled by the car in the whole 10 seconds.
- Explain briefly why, in this case, using the broken line makes the answer to part (iv) a good estimate of the distance travelled.
- Calculate the average speed of the car during the 10 seconds. Give your answer in kilometres per hour.

- (c) (i) The speed of the car increases from 15 m s^{-1} to 20 m s^{-1} .
 (ii) Between B and C the curve is getting less steep so the acceleration is decreasing.
 (iii) A is the point (1, 5) and B is the point (1.8, 15)
 Gradient = $\frac{15 - 5}{1.8 - 1} = \frac{10}{0.8} = 12.5 \text{ m s}^{-2}$
 (iv) Distance is area under graph:
 Total area is $30 + 140 = 170$
 Total distance travelled = 170 m
 (v) The area of the graph below the dotted line about the same as the area of the graph above the dotted line.
 (vi) The car travelled 170 m in 10 s.
 Average speed = $\frac{170}{10} = 17 \text{ m s}^{-1} = 17 \times 60 \times 60 \text{ m h}^{-1} = 61\,200 \text{ m h}^{-1} = 61.2 \text{ km h}^{-1}$

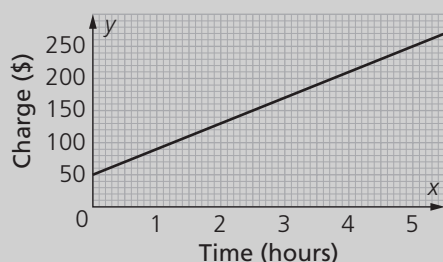
Area of triangle is $\frac{1}{2} \times 3 \times 20 = 30$



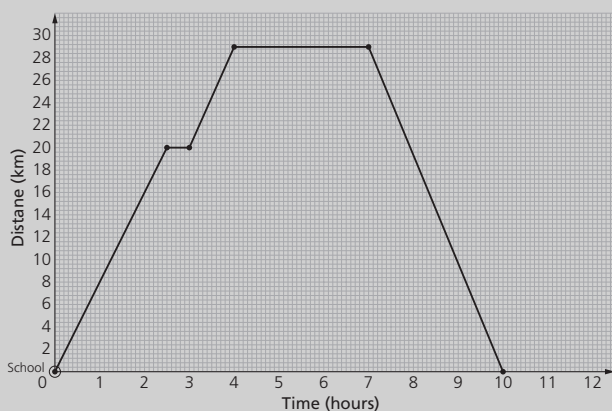
Area of rectangle is $7 \times 20 = 140$

Questions

- The graph below shows the amount an electrician charges for up to five hours' work.
 - What does the electrician charge for being called out?
 - How much does he charge for 2 hours' work?
 - If he charged Mr Bali \$210 then how many hours work did he do?
 - A second electrician had a call out fee of \$60 and an hourly fee of \$35. For how many hours work would the two electricians charge the same amount?

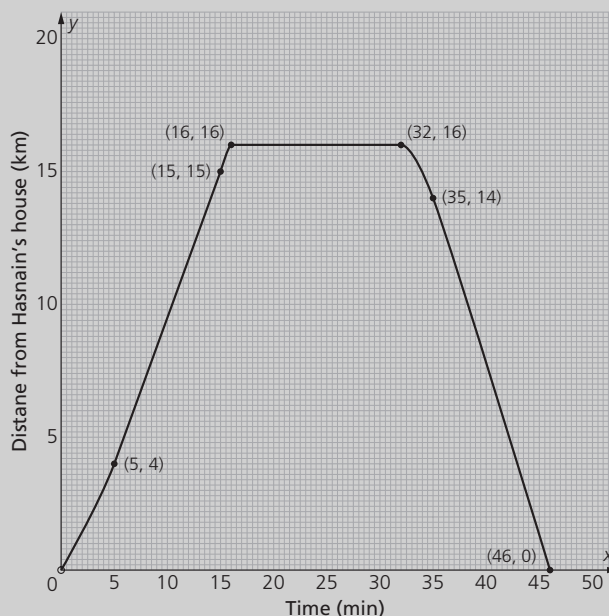


- A coach was hired to take a school team to a football game. The graph shows the distance travelled from the school.
 - How far did the coach travel before stopping?
 - For how long did the coach stop?
 - How much further did the coach travel to the game?
 - How long did the coach wait at the game?
 - How long did the return journey take?
 - What was the average speed of the coach on the return journey?



- Hasnain drove to see a friend. The graph shows his journey to and from his friend's house and the time he spent with his friend.
 - How long it take for Hasnain to reach a constant speed?
 - What was happening to his speed in the first 5 minutes?

- What was the constant speed in km h^{-1} ?
- How long did Hasnain spend at his friend's house?
- What was his constant speed for the last 11 minutes of his journey?



- Awais was on a fast road and the graph shows his journey.
 - How long it take Awais to reach a constant speed?
 - How far did he travel at this constant speed?
 - What was happening to his acceleration in the first minute?
 - By using the dotted lines for the first minute and the last 30 seconds estimate how far Awais travelled.
 - Is this an under-estimate or an over-estimate of the distance that Awais travelled? Give a reason for your answer.

