RATIO, PROPORTION & RATES OF CHANGE

Chapter 4: Real-Life Graphs

Part 5: Speed-Time Graphs

(Curves)

Teach Us Ma+hs

Starter

Video

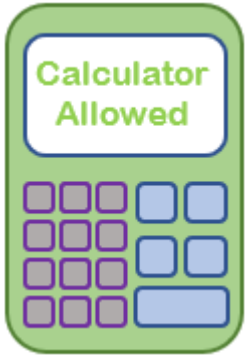
Worksheet – I'm giving it a try!

Worksheet – I'm building my confidence!

Worksheet – I'm ready for anything!

Extension

Homework



Answer 4 questions to make a straight line vertically, horizontally or diagonally.

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Adam and Bob share sweets in the ratio 2 : 9. If Bob gets 35 more sweets than Adam, how many did they share?	Simplify $\frac{x^2 - 36}{x^2 + 8x + 12}$	I invest £3300 in an account that earns 9% compound interest per year. How much is it worth after 4 years?	Solve the simultaneous equations $3x + 9y = 75$ $3x - 7y = -21$
Expand $(x + 6)(x - 2)(x + 5)$	Evaluate $125^{-2/3}$	y is inversely proportional to the square root of x. When y = 6, x = 169. Find an equation for y in terms of x.	A jumper has been reduced in a sale by 35% to £38. How much did it cost originally?
Calculate the nth term of the sequence 2, 5, 12, 23, 38	The mean of 10 numbers is 6. The mean of 15 numbers is 10. What is the mean of all 25 numbers?	Rationalise $\frac{8}{\sqrt{5}}$	Solve $x^2 - 12x + 32 = 0$
Write 0.198198198... as a fraction in it's simplest form.	Simplify $\sqrt{32}$	Make x the subject: $y = \frac{x + b}{4v + x}$	Calculate the area of a sector with $\theta = 26°$ and r = 11cm.

Answers

Answers

55	$\frac{x - 6}{x + 2}$	£4658.22	$x = 7$ $y = 6$
$x^3 + 9x^2 + 8x - 60$	$\frac{1}{25}$	$y = 78 / \sqrt{x}$	£58.46
nth term = $2n^2 - 3n + 3$	8.4	$\frac{8\sqrt{5}}{5}$	$x = 8$ $x = 4$
22/111	$4\sqrt{2}$	$x = \frac{b - 4vy}{y - 1}$	$27.45cm^2$

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Back to the start!

Speed – Time Graphs (Curves)

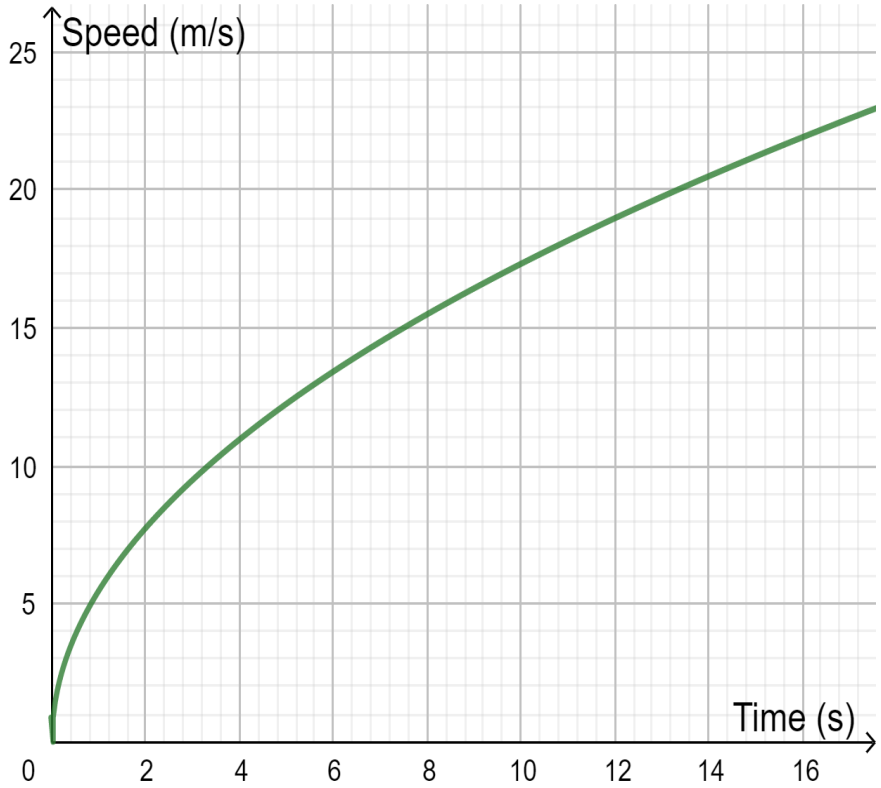
Here is a speed – time graph for a car.
It shows the first 16 seconds of its journey.
(a) Work out the average acceleration of the car between 4 and 12 seconds.

(b) Work out an estimate of the acceleration of the car at 2 seconds.

(c) By using 4 strips of equal width, work out an estimate for the distance travelled over the first 16 seconds of the journey.

(d) Is your answer to (c) an overestimate or an underestimate of the actual distance travelled? Explain your answer.

(e) Work out the average speed of the car over the first 16 seconds of the journey.



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Watch this video to see how to do the examples.
Remember to pause the video when promoted to copy the notes.

Notes

Speed – Time Graphs (Velocity) (Curves)

Here is a speed – time graph for a car.
It shows the first 16 seconds of its journey.

(a) *Work out the average acceleration of the car between 4 and 12 seconds.*

gradient of line between 2 points = $\frac{\text{change in } y}{\text{change in } x} = \frac{8}{8} = 1\ m/s^2$

(b) *Work out an estimate of the acceleration of the car at 2 seconds.*

instantaneous acceleration = gradient of tangent at that point = $\frac{\text{change in } y}{\text{change in } x} = \frac{12}{6} = 2\ m/s^2$

(c) *By using 4 strips of equal width, work out an estimate for the distance travelled over the first 16 seconds of the journey.*

① $(4 \times 11) \div 2 = 22m$
② $\left(\frac{11 + 15.5}{2}\right) \times 4 = 53m$
③ $\left(\frac{15.5 + 19}{2}\right) \times 4 = 69m$
④ $\left(\frac{19 + 22}{2}\right) \times 4 = 82m$

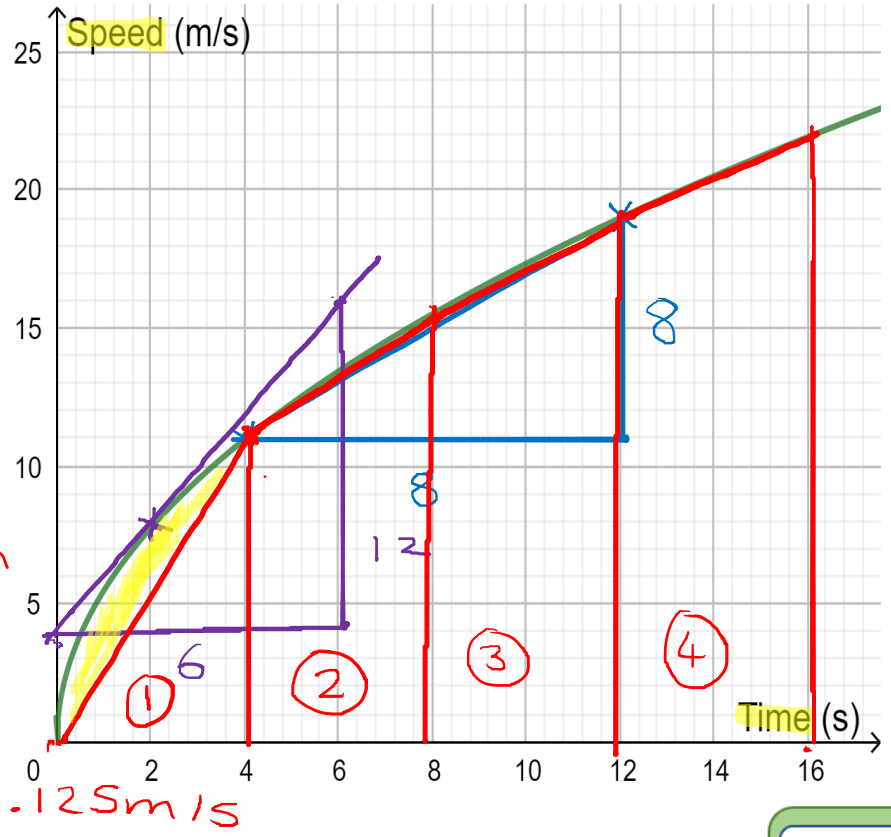
total distance = 226m

(d) *Is your answer to (c) an overestimate or an underestimate of the actual distance travelled?*
Explain your answer.

underestimate the straight lines I drew lie below the curve decreasing the area to be calculated.

(e) *Work out the average speed of the car over the first 16 seconds of the journey.*

average speed = $\frac{\text{total dist}}{\text{total time}} = \frac{226}{16} = 14.125\ m/s$



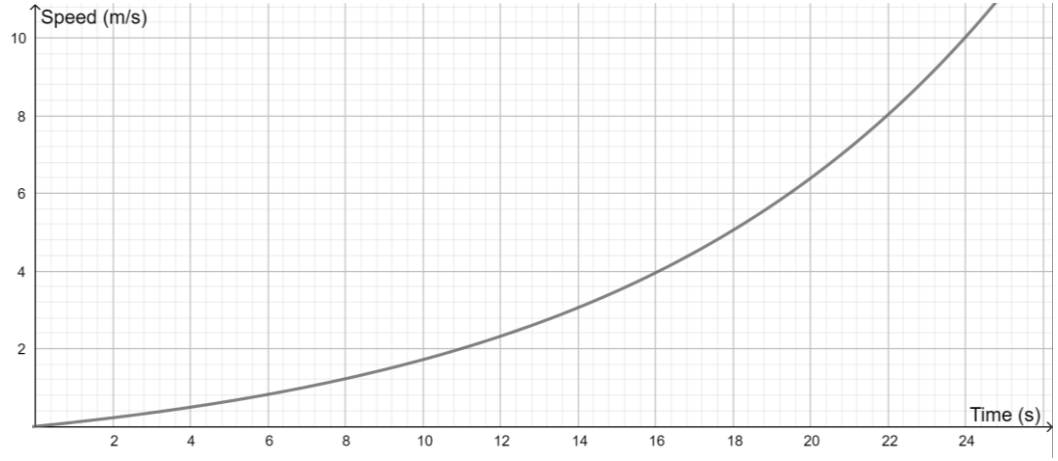
acceleration → gradient
distance → area under the graph.

average 'v' (between 2 points)
instantaneous (tangent)

Calculator Allowed

Back to the start!

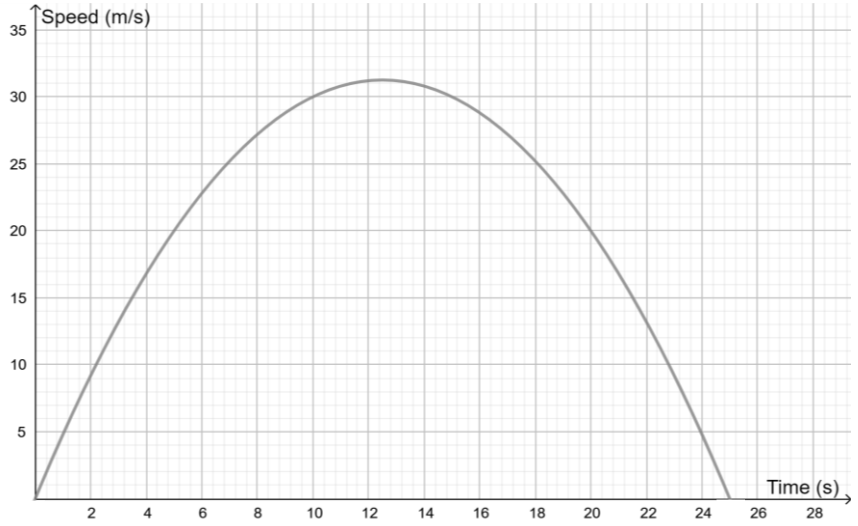
I'm giving it a try!



Here is a speed – time graph for a bus.
It shows the first 24 seconds of its journey.

(a) Work out the average acceleration of the bus between 0 and 10 seconds.

(b) Work out the average acceleration of the bus between 16 and 24 seconds.



Here is a speed – time graph for a car.
It shows the first 25 seconds of its journey.

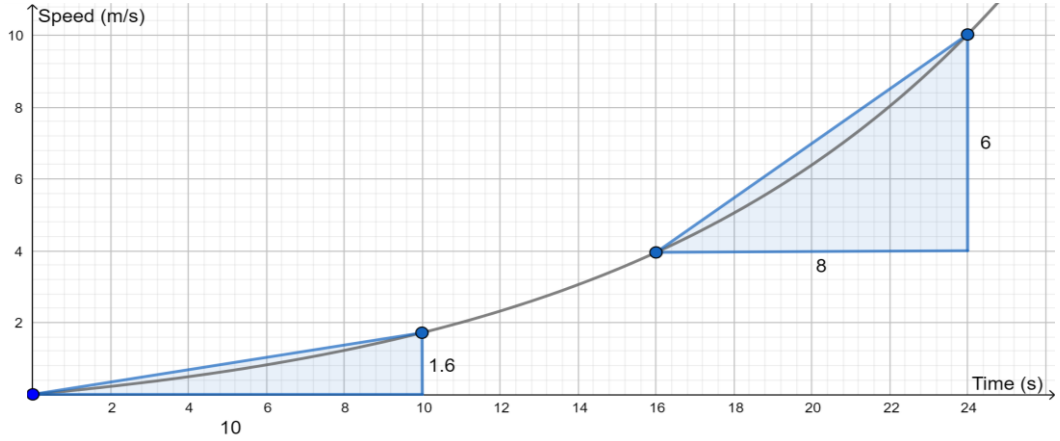
(a) Work out the average acceleration of the car between 0 and 10 seconds.

(b) Work out the average acceleration of the car between 18 and 24 seconds.

Answers

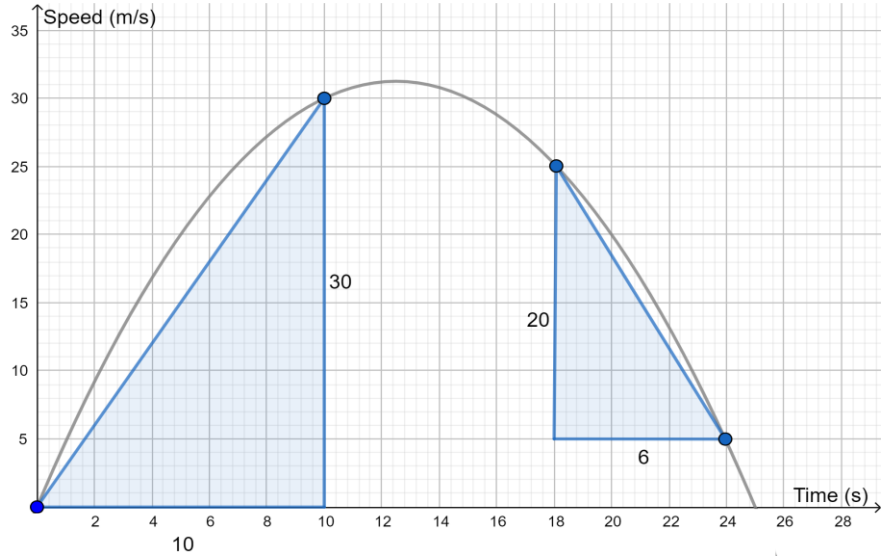
Answers

I'm giving it a try!



(a) $1.6 \div 10 = 0.16 m/s^2$

(b) $6 \div 8 = 0.75 m/s^2$



(a) $30 \div 10 = 3 m/s^2$

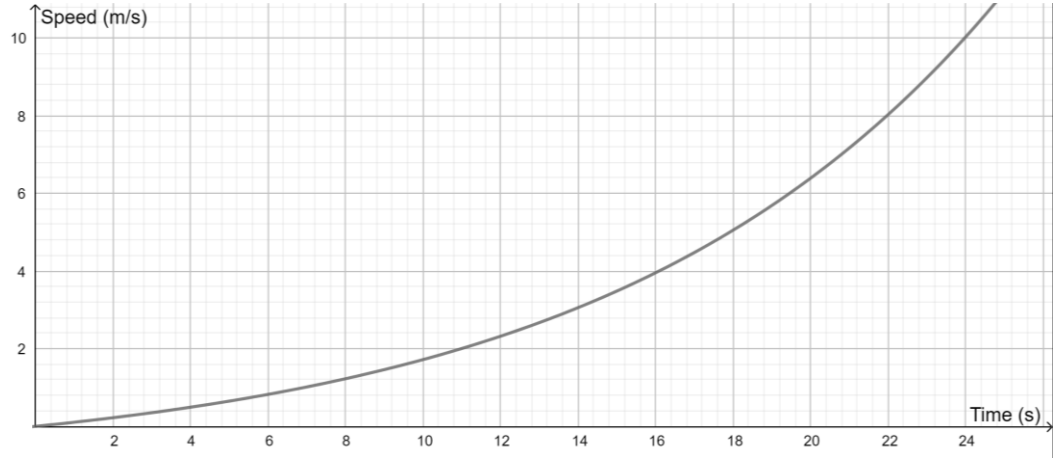
(b) $-20 \div 6 = -3.\dot{3} m/s^2$ ($= 3.\dot{3} m/s^2$ deceleration)

Now that you have marked your work, take time to reflect on how confident you are feeling…

My Reflections…

Back to the start!

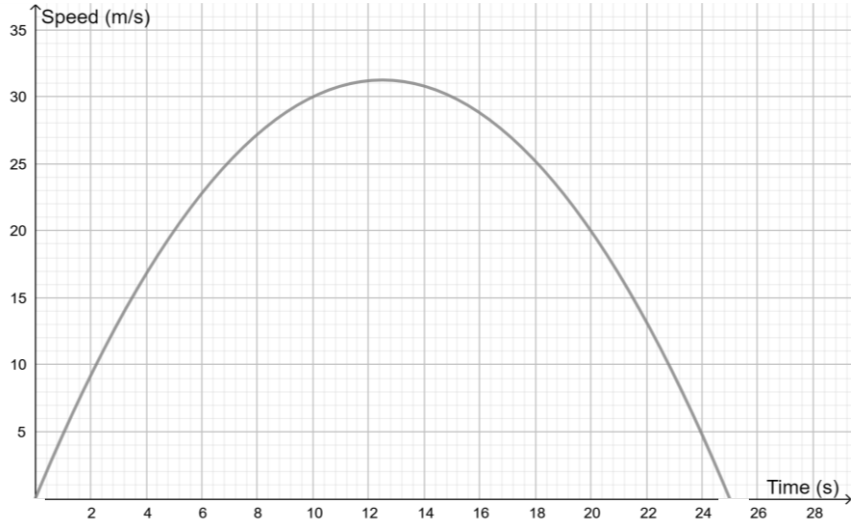
I'm building my confidence!



Here is a speed – time graph for a bus.
It shows the first 24 seconds of its journey.

(a) Work out an estimate of the acceleration of the bus at 10 seconds.

(b) Work out an estimate of the acceleration of the bus at 20 seconds.



Here is a speed – time graph for a car.
It shows the first 25 seconds of its journey.

(a) Work out an estimate of the acceleration of the car at 6 seconds.

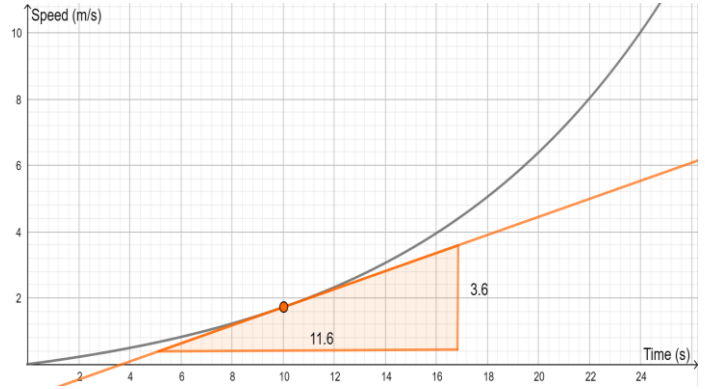
(b) Work out an estimate of the acceleration of the car at 20 seconds.

Teach Us Maths

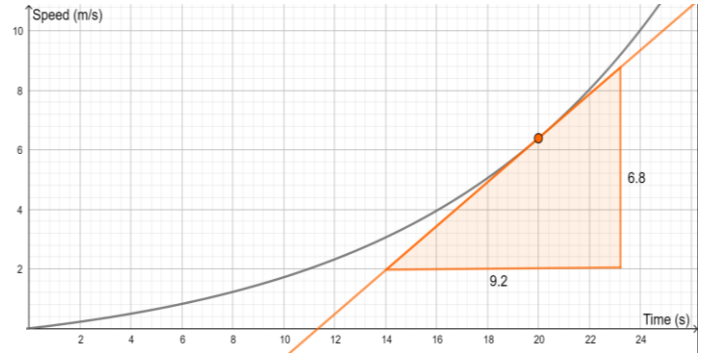
Answers

Answers

I'm building my confidence!



(a) $3.6 \div 11.6 = 0.31 m/s^2$ (2dp)



(b) $6.8 \div 9.2 = 0.74 m/s^2$ (2dp)

(a) $13 \div 5 = 2.6 m/s^2$

(b) $-27 \div 9 = -3 m/s^2$ ($= 3 m/s^2$ deceleration)

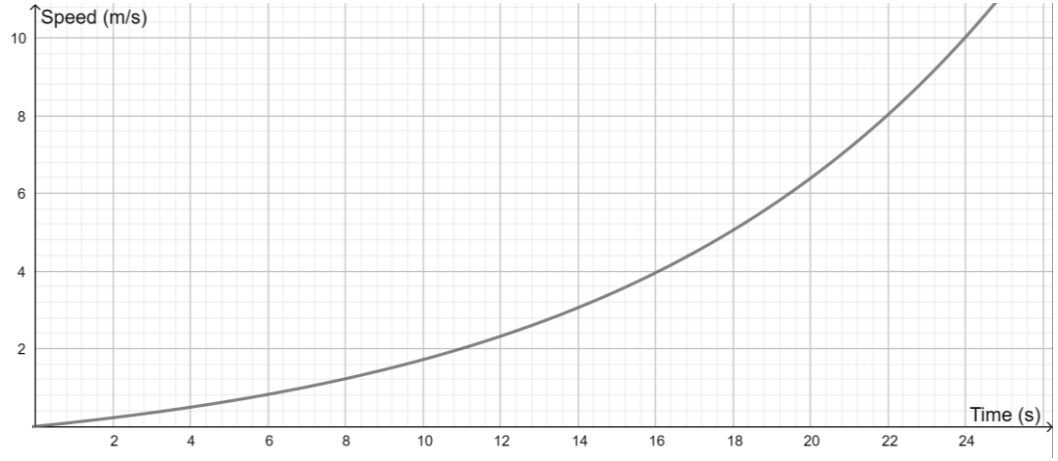
Now that you have marked your work, take time to reflect on how confident you are feeling…

My Reflections…

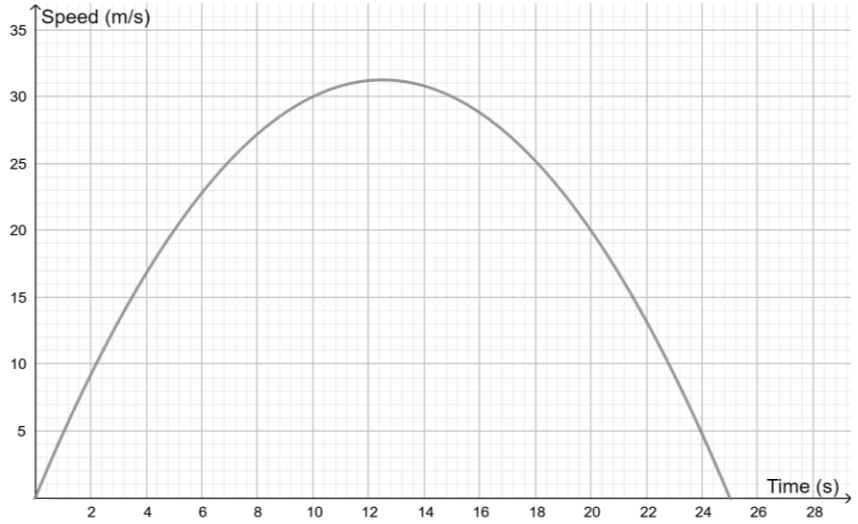
☆☆☆

Back to the start!

I'm ready for anything!



Here is a speed – time graph for a bus.
It shows the first 24 seconds of its journey.
(a) By using 1 strip, work out an estimate for the distance travelled over the first 8 seconds of the journey.
(b) By using 3 strips of equal width, work out an estimate for the distance travelled over the first 24 seconds of the journey.
(c) Is your answer to (b) an overestimate or an underestimate of the actual distance travelled? Explain your answer.
(d) Work out the average speed of the bus over the first 24 seconds of the journey.

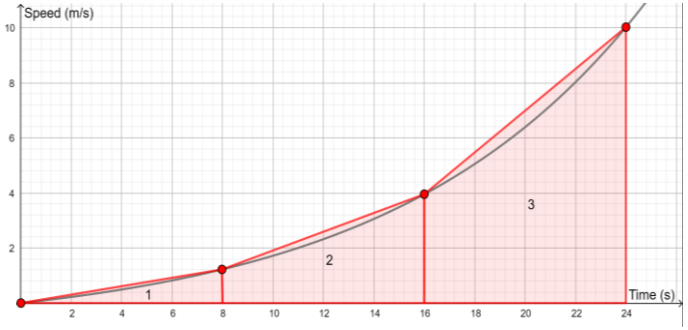


Here is a speed – time graph for a car.
It shows the first 25 seconds of its journey.
(a) By using 1 strip, work out an estimate for the distance travelled over the first 5 seconds of the journey.
(b) By using 5 strips of equal width, work out an estimate for the distance travelled over the first 25 seconds of the journey.
(c) Is your answer to (b) an overestimate or an underestimate of the actual distance travelled? Explain your answer.
(d) Work out the average speed of the car over the first 25 seconds of the journey.

Answers

Answers

I'm ready for anything!



(a) $(1.2\times8)\div2=4.8\text{m}$

(b) $\frac{(1.2+4)}{2}\times8=20.8\text{m}$ $\frac{(4+10)}{2}\times8=56\text{m}$

Total distance $= 4.8+20.8+56 = 81.6\text{m}$

(c) Overestimate as the straight lines I have drawn lie above the curve increasing the area I am calculating.

(d) $81.6\div24=3.4\text{m/s}$

(a) $(20\times5)\div2=50\text{m}$

(b) $\frac{(20+30)}{2}\times5=125\text{m}$ $30\times5=150\text{m}$ $\frac{(30+20)}{2}\times5=125\text{m}$

$(20\times5)\div2=50\text{m}$

Total distance $= 50+125+150+125+50 = 500\text{m}$

(c) Underestimate as the straight lines I have drawn lie below the curve decreasing the area I am calculating.

(d) $500\div25=20\text{m/s}$

Now that you have marked your work, take time to reflect on how confident you are feeling…

My Reflections…

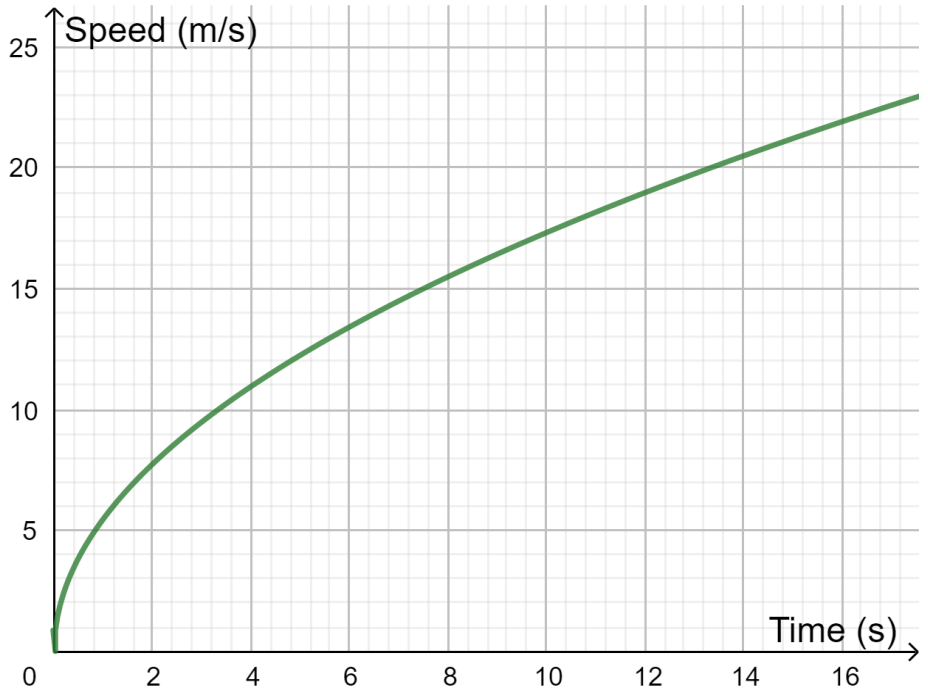
Back to the start!

Extension

Here is a speed-time graph for a car.
It shows the first 16 seconds of its journey.

Calculate the average acceleration of the car over the first 16 seconds of its journey.

Can you find a time at which the cars instantaneous acceleration is equal to its average acceleration?



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Answers

Answers

Here is a speed-time graph for a car.
It shows the first 16 seconds of its journey.

Calculate the average acceleration of the car over the first 16 seconds of its journey.

Can you find a time at which the cars instantaneous acceleration is equal to its average acceleration?

The average acceleration over the first 16 seconds is equal to the instantaneous acceleration at approximately 4 seconds. This is where the chord and tangent are approximately parallel, so the gradients are equal.

Back to the start!

Homework

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Retrieval Homework

1) Solve $x^2 + 3x - 18 = 0$

2) A bag is reduced by 15% to £41. How much did it cost originally?

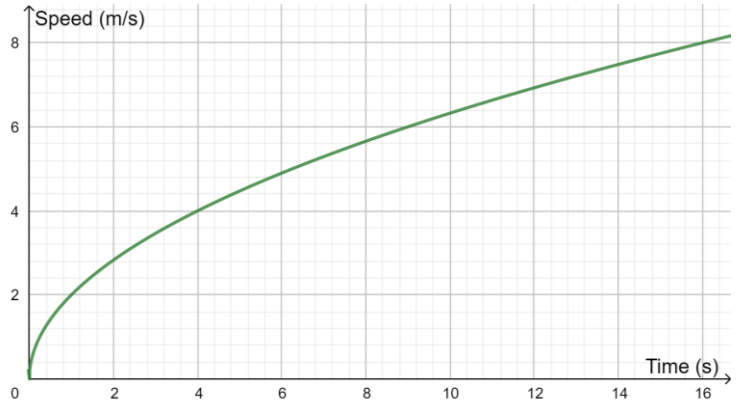
3) Write 0.206206… as a fraction.

4) Simplify $\sqrt{300}$

5) Calculate the n^{th} term of the sequence

9 , 18 , 31 , 48 , 69

Topic Homework



Here is a speed − time graph for a bike.
It shows the first 16 seconds of its journey.
(a) Work out the average acceleration of the bike between 4 and 13 seconds.
(b) Work out an estimate of the acceleration of the bike at 4 seconds.
(c) By using 4 strips of equal width, work out an estimate for the distance travelled over the first 16 seconds of the journey.
(d) Is your answer to (c) an overestimate or an underestimate of the actual distance travelled? Explain your answer.
(e) Work out the average speed of the bike over the first 16 seconds of the journey.

My Reflections…

Answers

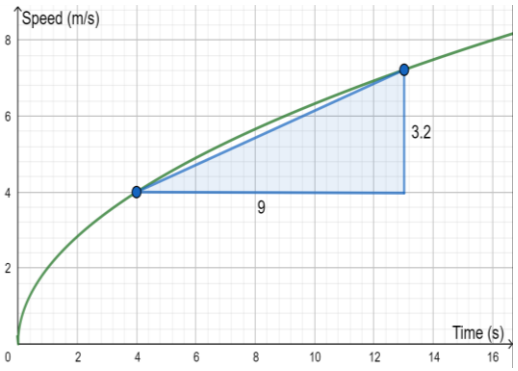
Answers

Homework

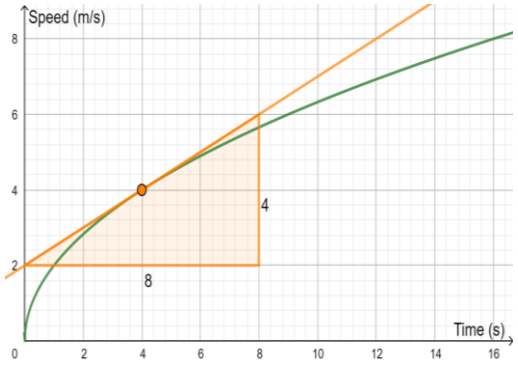
Retrieval Homework

(1) $x = 3, x = -6$ (2) £48.24 (3) $\frac{206}{999}$ (4) $10\sqrt{3}$ (5) $2n^2 + 3n + 4$

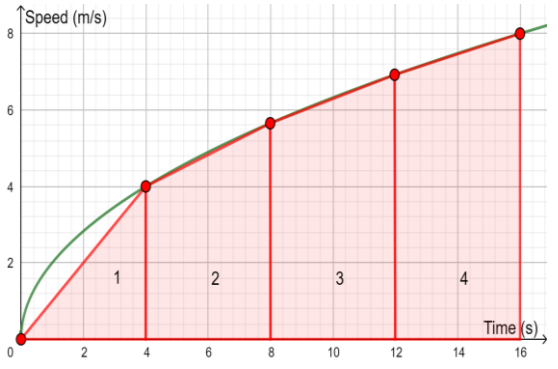
Topic Homework



(a) $3.2 \div 9 = 0.3\dot{5}\text{m/s}^2$



(b) $4 \div 8 = 0.5\text{m/s}^2$



(c) $8+19.2+25+29.8 = 82\text{m}$

(d) Underestimate as the straight lines I have drawn in (c) lie below the curve decreasing the area I am calculating.

(e) $82 \div 16 = 5.125\text{m/s}$

Back to the start!