

Name:

Exam Style Questions

## Rates of Change



Corbettmaths

Equipment needed: Ruler, Pencil, Calculator and Pen

### Guidance

1. Read each question carefully before you begin answering it.
2. Check your answers seem right.
3. Always show your workings

Video Tutorial

[www.corbettmaths.com/contents](http://www.corbettmaths.com/contents)

Videos 390a, 390b

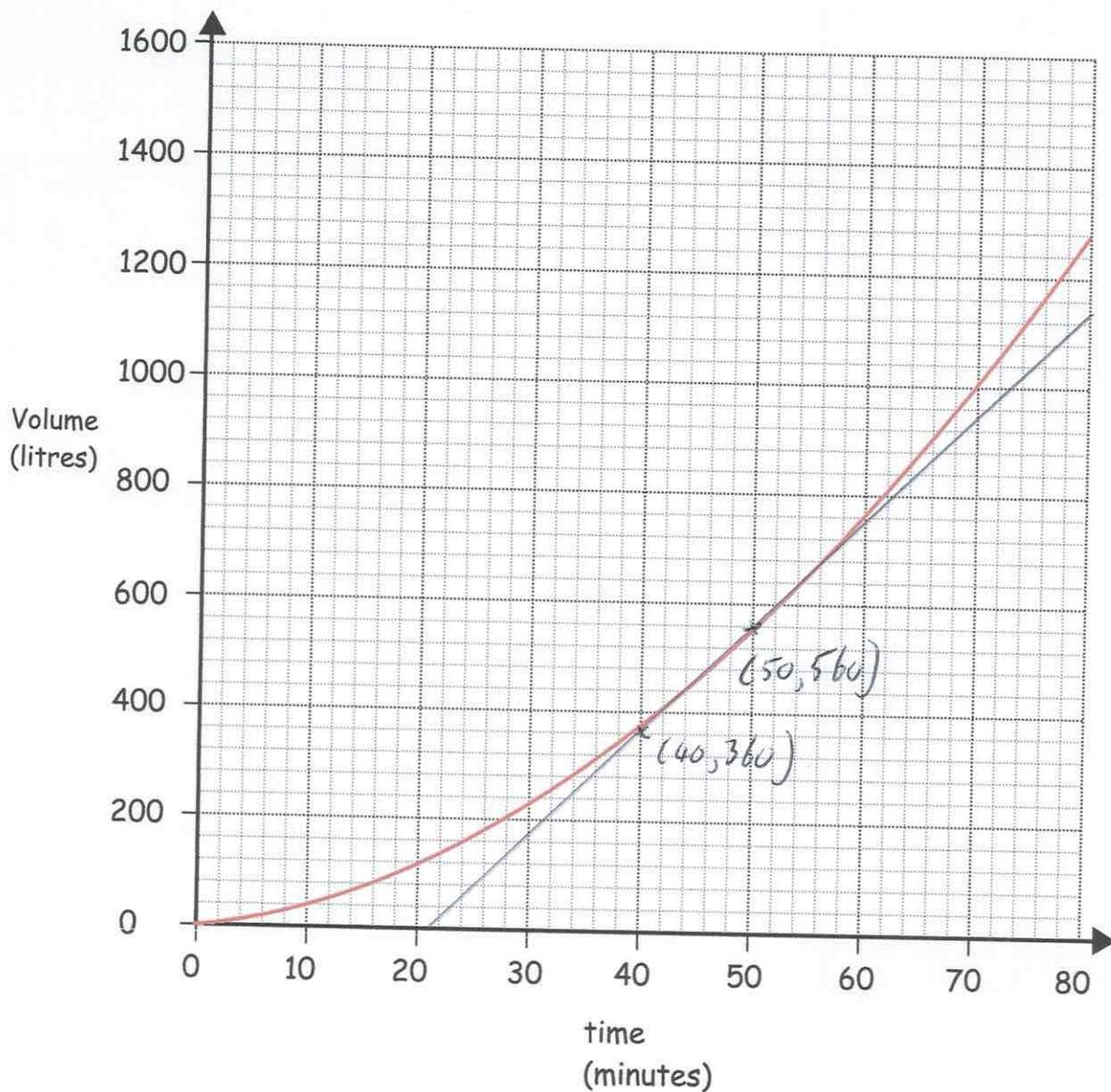


Answers and Video Solutions



\*Please note answers may vary due to possible tangents drawn

- 1 A family are filling a large paddling pool.  
The graph shows the volume, in litres, of the water in the paddling pool as it is being filled.



- (a) Calculate an estimate for the gradient of the graph when the time is equal to 50 minutes.

$$m = \frac{560 - 360}{50 - 40} = \frac{200}{10} = 20$$

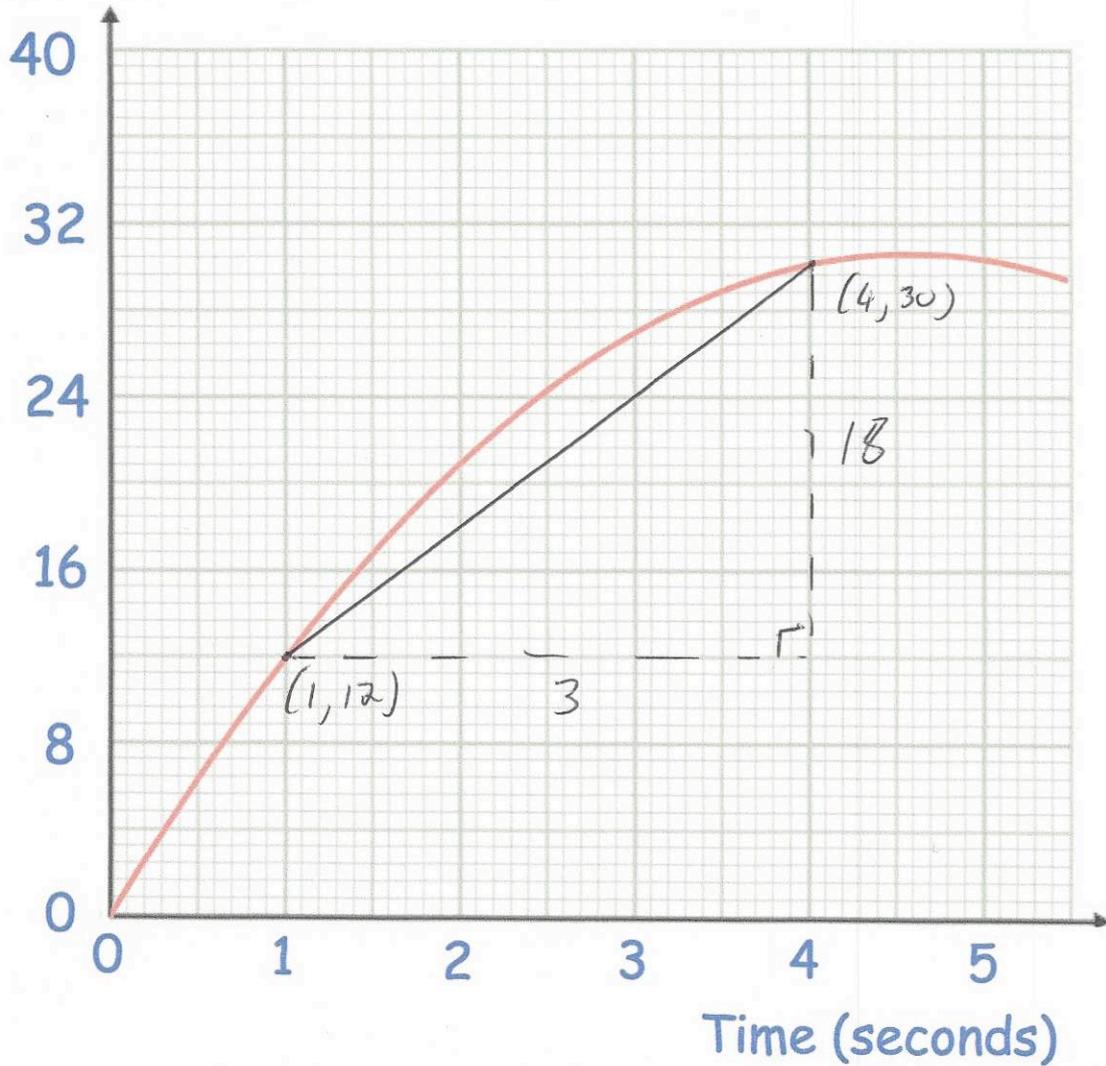
- (b) Describe fully what the gradient in part (a) represents.

The rate of increase of volume of water in the pool at 50 minutes. 20 litres per minute.

(1)

2. A rocket is fired upwards as part of a science experiment. The graph shows the height of the rocket above the ground.

Height (metres)



Work out the average speed between 1 and 4 seconds.

$$\frac{\text{rise}}{\text{run}} = \frac{18}{3} = 6 \text{ m/s}$$

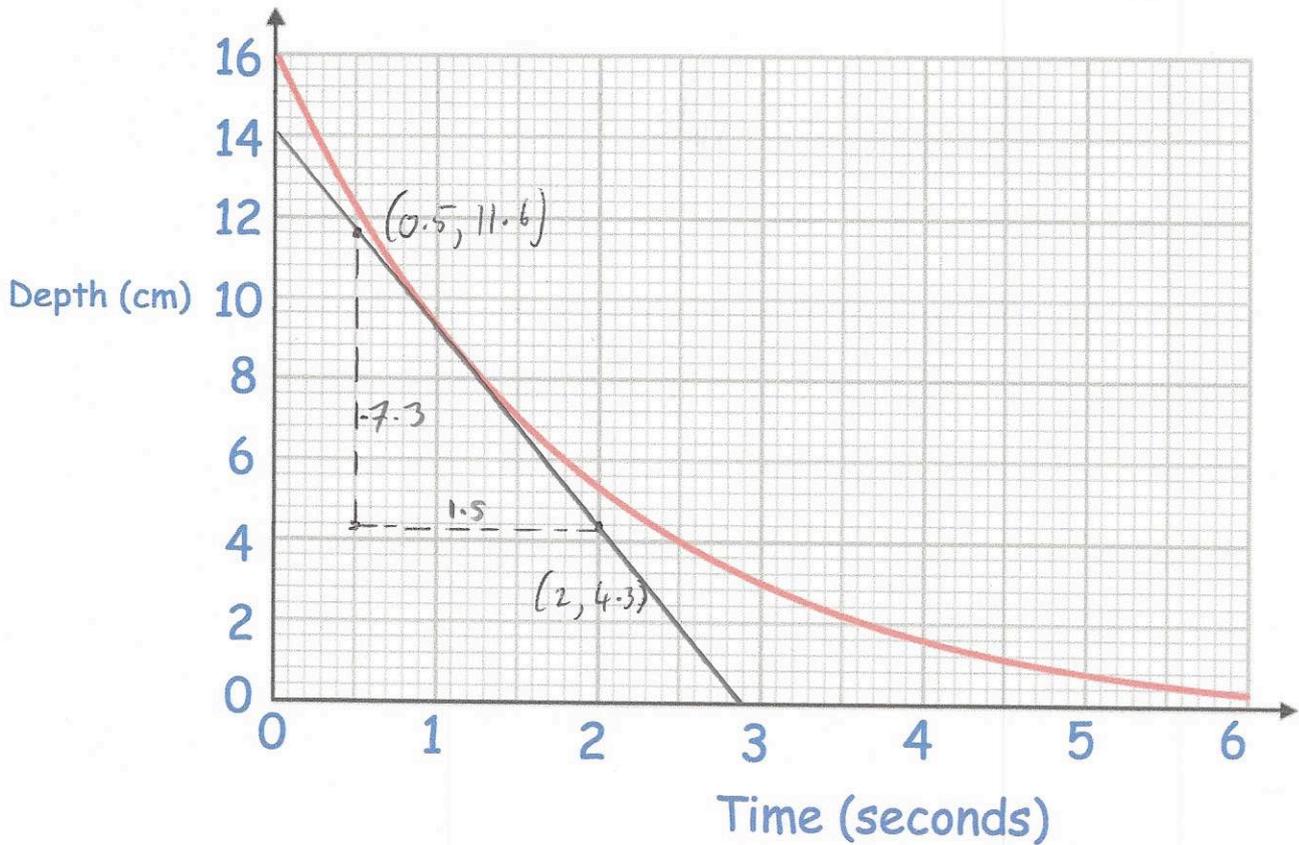
.....6.....m/s  
(3)

\* Answers may vary slightly due to tangents

3

Water is being emptied out of a bath.

The graph shows the depth of the water for the first 6 seconds.



Use the graph to work out an estimate of the rate of decrease of depth at 1 second.

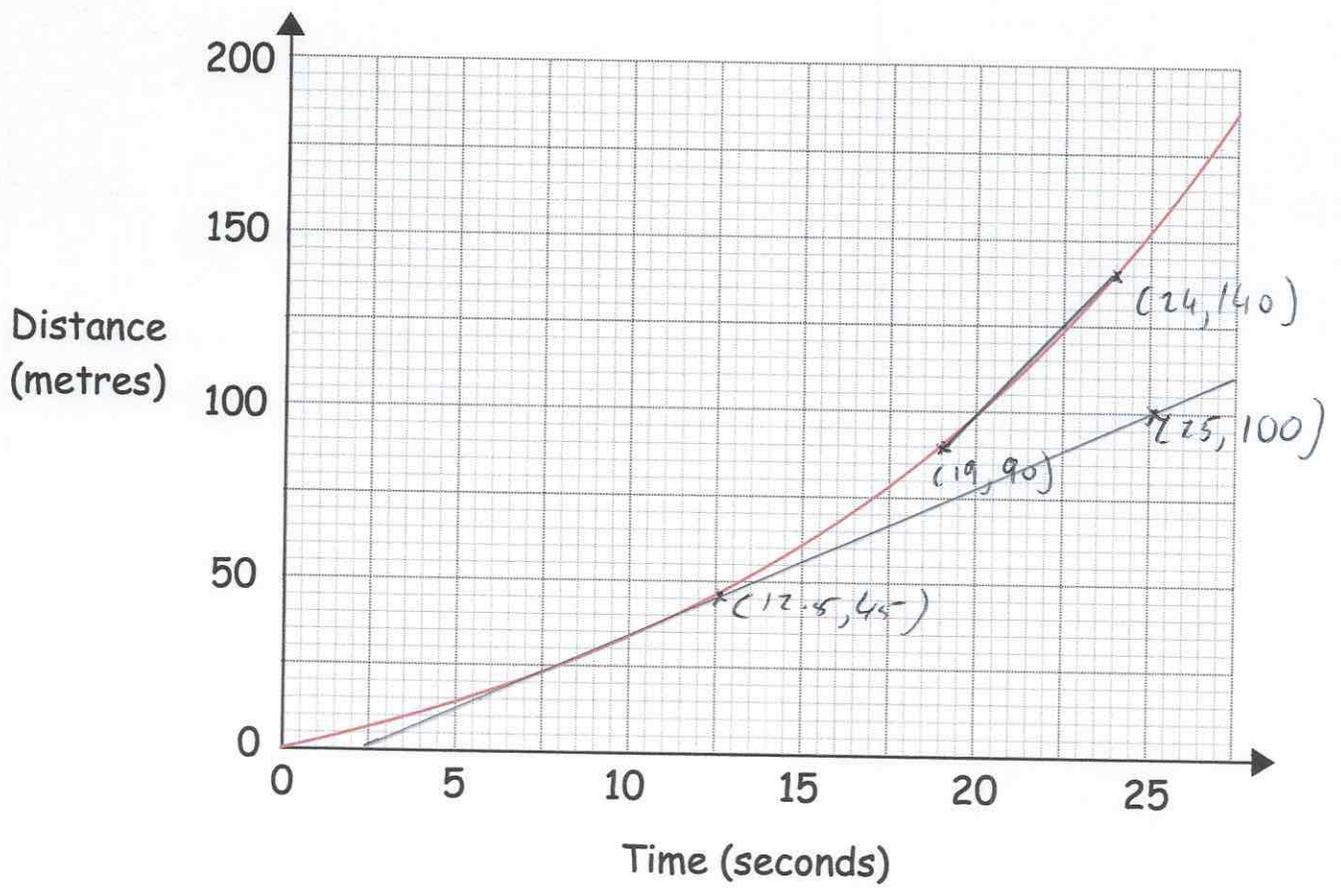
$$\text{gradient} = \frac{\text{rise}}{\text{run}} = \frac{-7.3}{1.5} = -4.86$$

$$\text{rate of decrease} = 4.86$$

$$\dots\dots\dots 4.86 \text{ cm/s}$$

(3)

4. This graph shows the distance travelled by a runner.



- (a) Work out an estimate of the speed of the runner at 10 seconds.

$$m = \frac{100 - 45}{25 - 12.5}$$

$$= \frac{55}{12.5}$$

$$= 4.4$$

..... 4.4 ..... m/s  
(3)

- (b) Work out the average speed of the runner between 19 and 24 seconds.

$$m = \frac{140 - 90}{24 - 19}$$

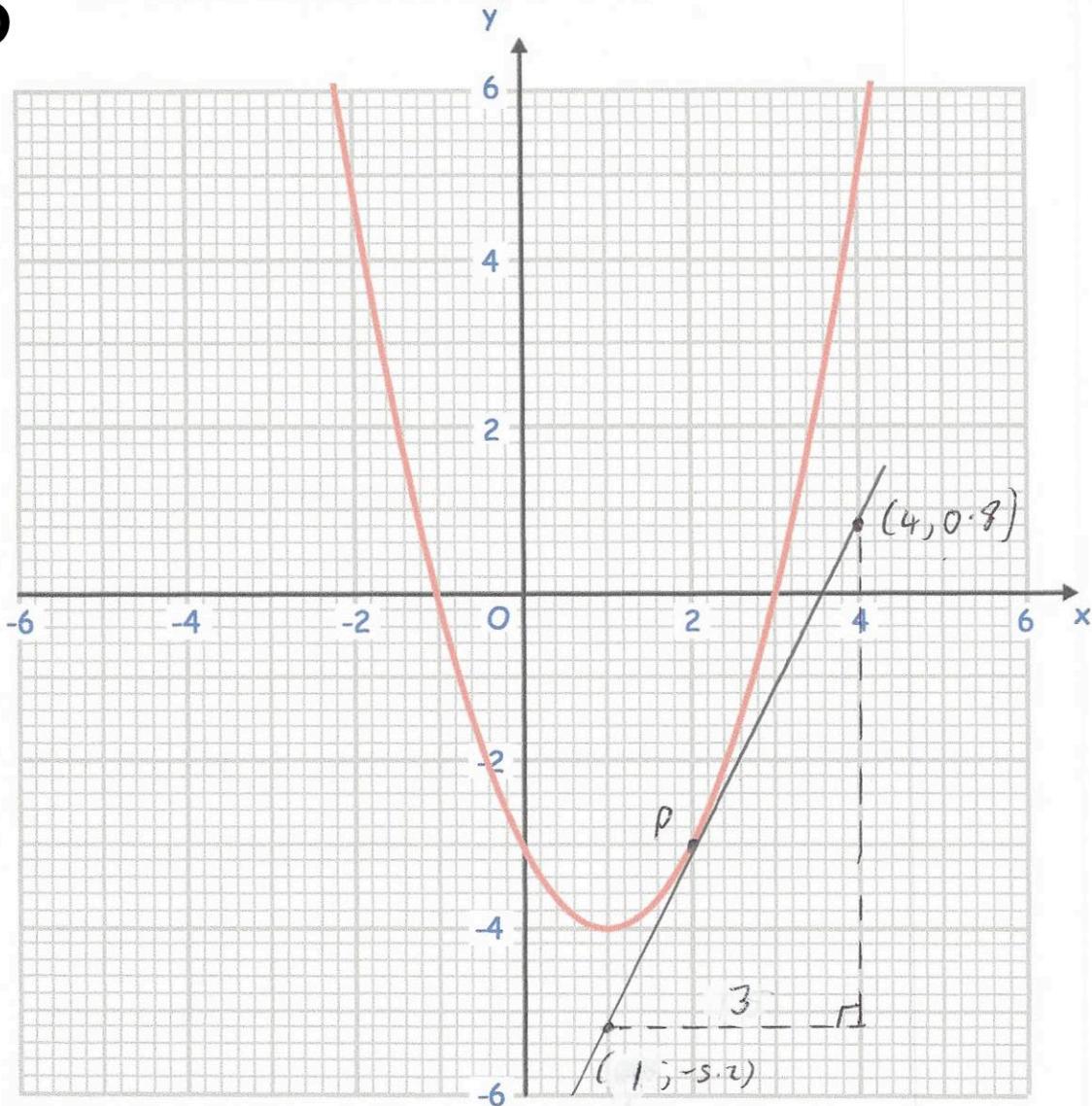
$$= \frac{50}{5}$$

$$= 10 \text{ m/s}$$

..... 10 ..... m/s  
(3)

5

The diagram shows part of the graph of  $y = x^2 - 2x - 3$



P is a point on the graph of  $y = x^2 - 2x - 3$  where  $x = 2$

Calculate an estimate for the gradient of the graph at the point P.

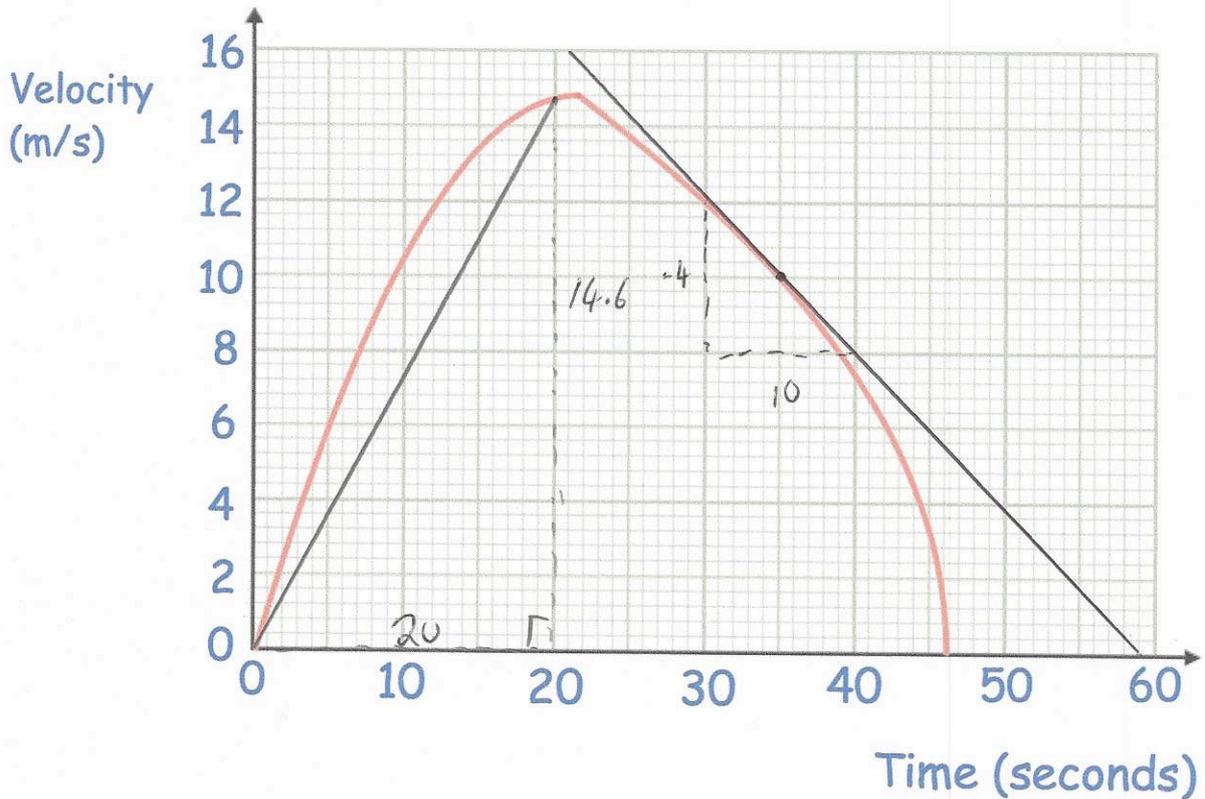
$$\text{gradient} = \frac{\text{rise}}{\text{run}} = \frac{6}{3} = 2$$

2

(3)

# 6

Below is the velocity-time graph of a car journey



- (a) Work out the average acceleration over the first 20 seconds of the journey. State the units of this acceleration.

$$\frac{\text{rise}}{\text{run}} = \frac{14.6}{20} = 0.73$$

$$0.73 \text{ m/s}^2$$

(4)

- (b) Use the graph to calculate an estimate for the deceleration of the car when  $t = 35$  seconds. State the units of this acceleration.

$$\frac{\text{rise}}{\text{run}} = \frac{-4}{10} = -0.4$$

acceleration = -0.4

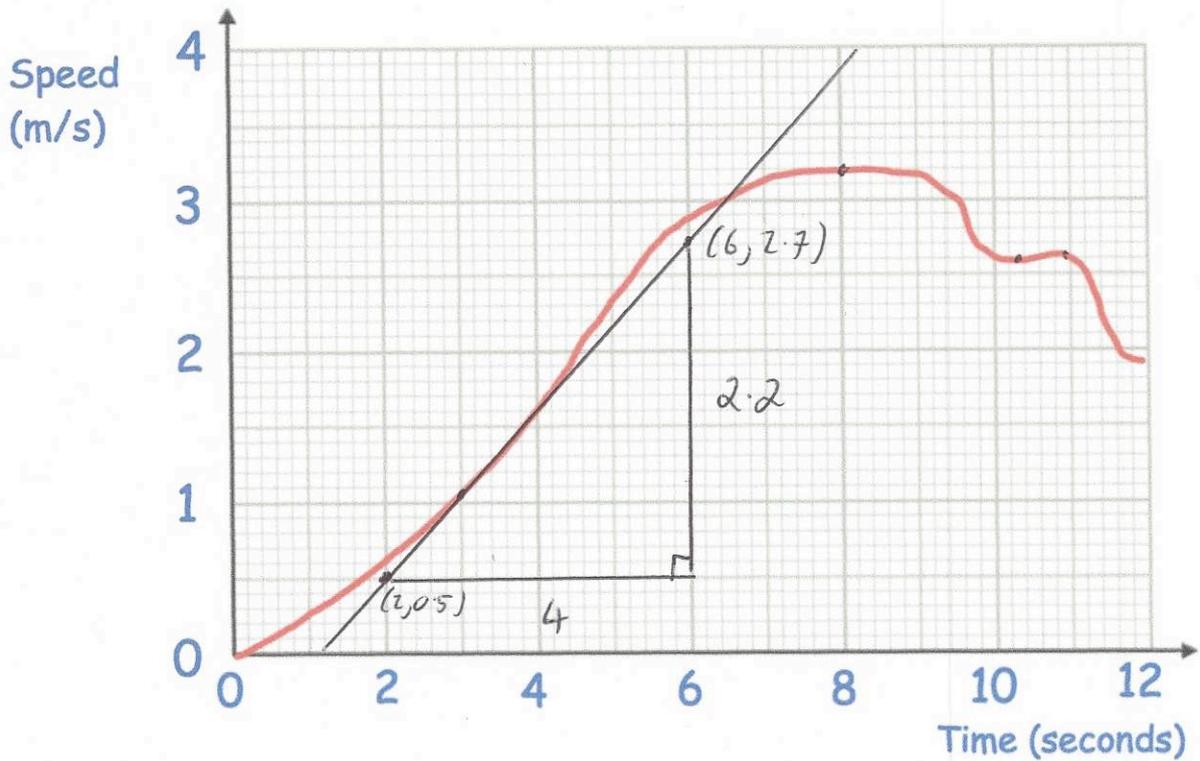
deceleration = 0.4

$$0.4 \text{ m/s}^2$$

(4)

7

Some students carry out an experiment.  
They record the speed of a toy car during 12 seconds.



(a) Calculate the acceleration of the toy car at 3 seconds.

$$\frac{\text{rise}}{\text{run}} = \frac{2.2}{4} = 0.55$$

.....0.55.....m/s<sup>2</sup>  
(3)

(b) Write down a time when the toy car was not accelerating.

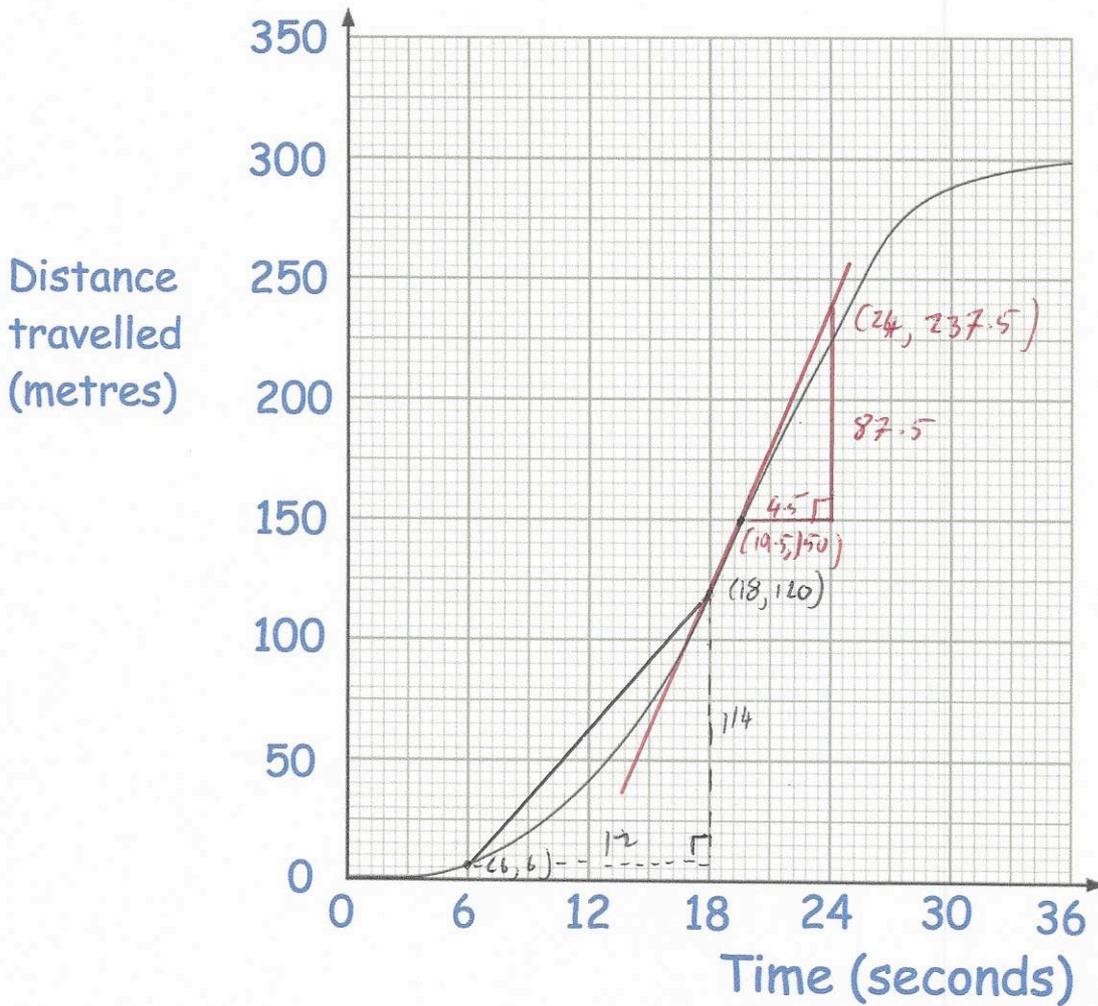
.....8.....seconds  
(1)

or 10.3 or 10.9

(approximations)

# 8

The graph shows the distance travelled by a train over 36 seconds.



(a) Work out the average speed of the train between 6 and 18 seconds.

$$\frac{\text{rise}}{\text{run}} = \frac{114}{12} = 9.5$$

9.5  
.....m/s  
(3)

(b) Estimate the highest speed reached by the train on the journey.  
Give your answer in kilometres per hour.

\* steepest gradient.

$$\frac{\text{rise}}{\text{run}} = \frac{87.5}{4.5} = 19.4 \text{ m/s}$$

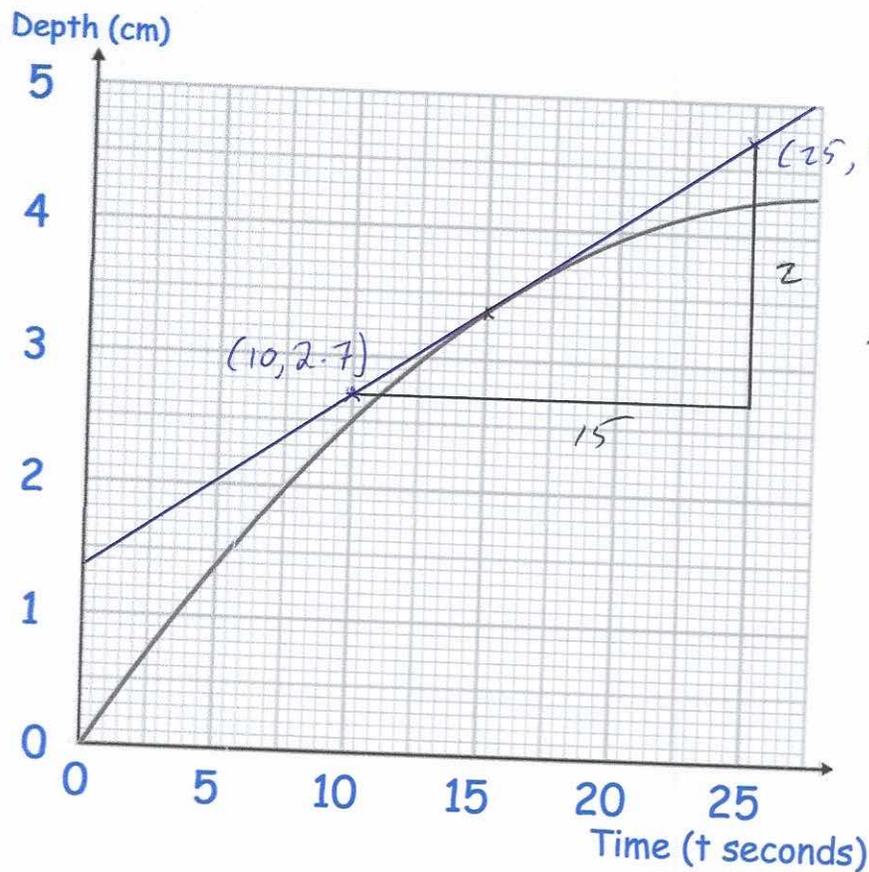
70  
.....km/h  
(4)

$$\begin{aligned} &= 1166.6 \text{ m/min} \\ &= 70000 \text{ m/h} \\ &= 70 \text{ km/h} \end{aligned}$$

9. Jack is filling a container with water.



The graph shows the depth of the water, in centimetres,  $t$  seconds after the start of filling the container.



$$\begin{aligned}
 M &= \frac{\text{rise}}{\text{run}} \\
 &= \frac{z}{15} \\
 &= 0.1333\dots
 \end{aligned}$$

- (a) Calculate an estimate for the gradient of the graph when  $t = 15$  seconds.

$$0.1\dot{3}$$

(3)

- (b) Describe fully what your answer to (a) represents

The rate of increase in depth of water in the container at  $t=15$  :  $0.1\dot{3}$  cm/s

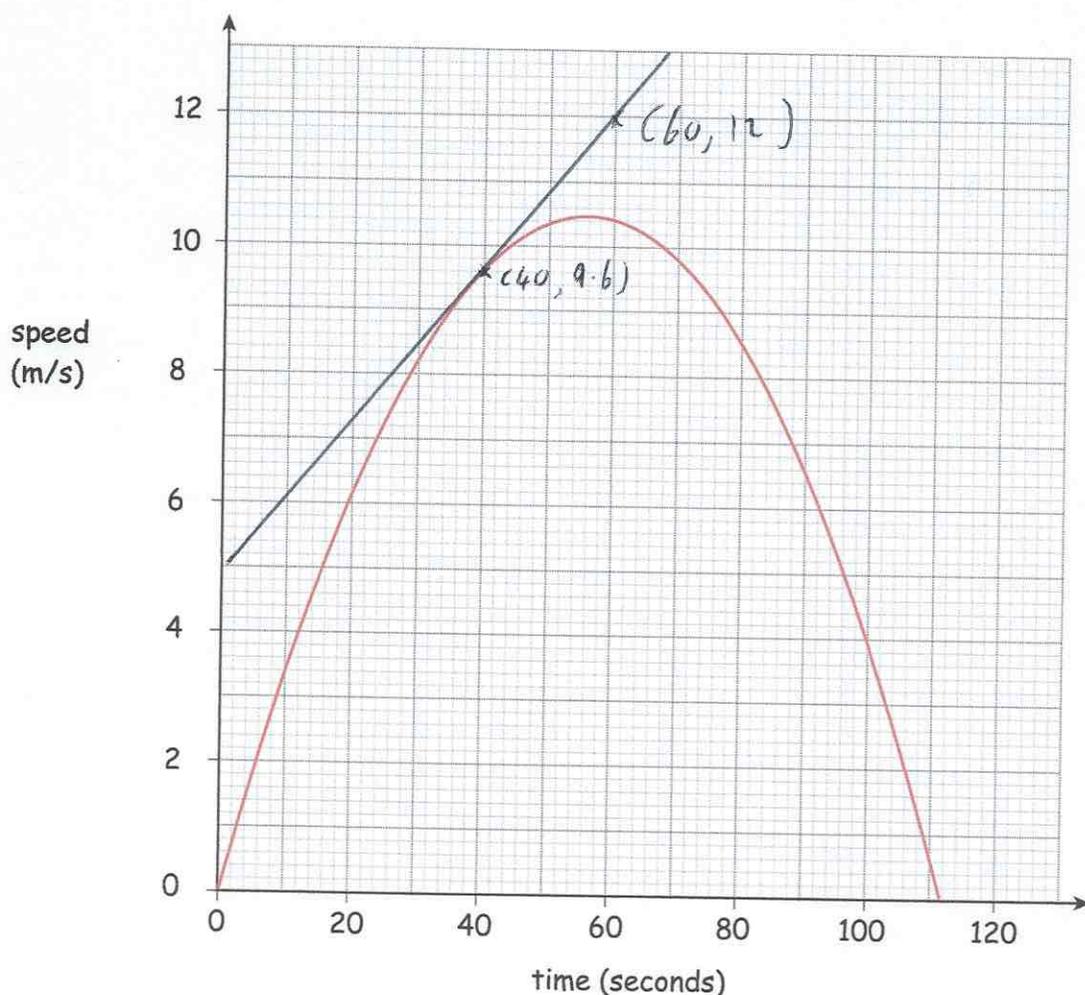
(2)

- (c) Explain why your answer to (a) is only an estimate

It is a hand-drawn tangent - it may not be precise.

(1)

10. The speed-time graph shows information about a tram journey between two stops.



- (a) Work out an estimate of the gradient of the graph at  $t = 40$

$$m = \frac{12 - 9.6}{60 - 40}$$

$$= 0.12$$

0.12

(3)

- (b) Describe fully what your answer to (a) represents

The ~~speed~~ acceleration of the tram at  $t = 40$ ,  
which is  $0.12 \text{ m/s}^2$

(1)

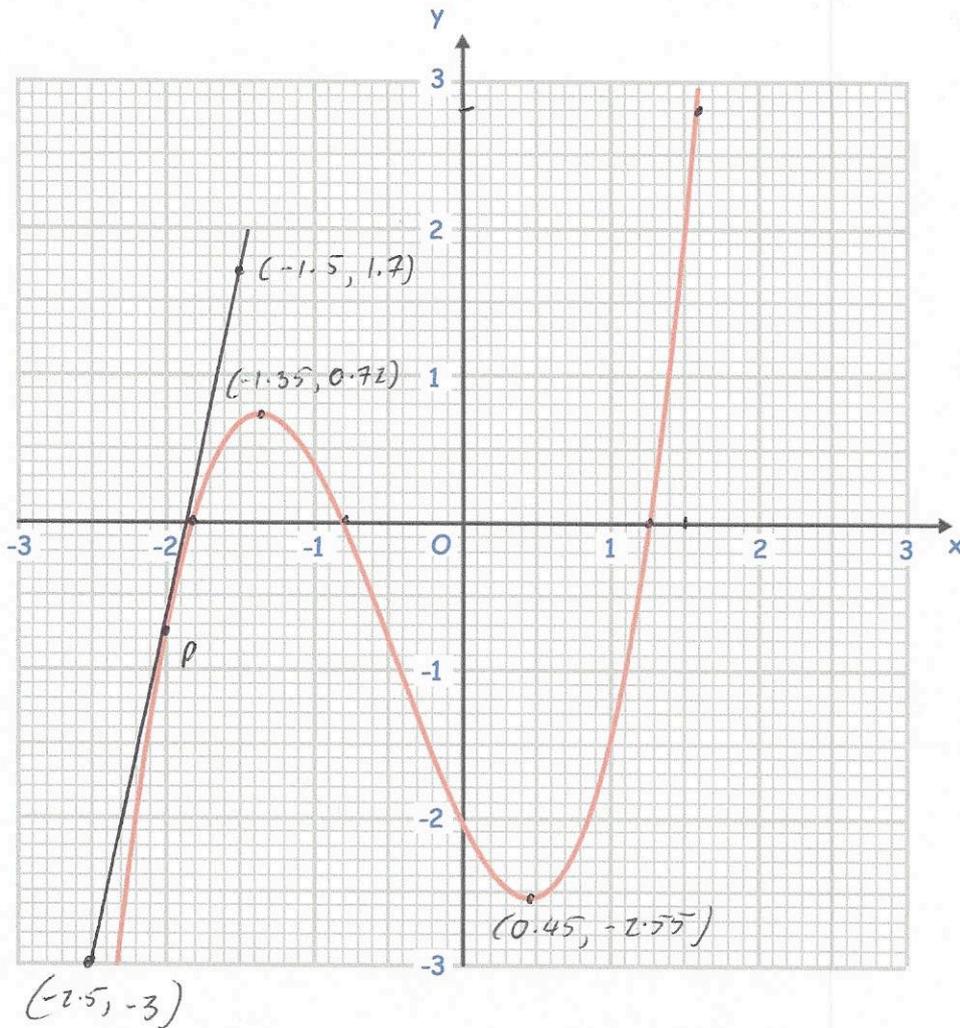
- (c) Describe what the area under the graph represents.

The distance travelled by the tram.  
or the distance between the two stops

(1)

# 11

The graph of  $y = f(x)$  is drawn on the grid.



(a) Write down the coordinates of the two turning points of the graph.

$(-1.35, 0.72)$  and  $(0.45, -2.55)$   
(2)

(b) Write down the estimates for the roots of  $f(x) = 0$

$x = -1.82, -0.8$  &  $1.25$   
(2)

(c) Use the graph to find  $f(1.5)$

2

.....  
(1)

P is a point on the graph of  $y = f(x)$  where  $x = -2$

Calculate an estimate for the gradient of the graph at the point P.

$$\frac{\text{rise}}{\text{run}} = \frac{4.7}{1}$$

4.7

.....  
(3)