**GRAYS TUITION CENTRE – Online Tutoring**

**WEEK: 19**

**Week Beginning: (27/07/20)**

**Subject: MATHS**

**Year: 7**

## Lesson Objective:

- To be able to expand our knowledge on velocity-time graphs
- To re-visit the concepts of gradients

## Class Worksheets

- Pages 1 to 9 from the Learning Pack – see below

## Homework

- Pages 10, 11 & 12 from the Learning Pack – see below

## Additional Notes

- All lesson worksheets and **homework for next week (due Week 20)** worksheets can be found below
- Week 18 homework will be marked in lesson hence make sure it is fully complete

**Please print 2 a page or open this document during the lesson to save paper!**


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# Velocity-Time Graphs – Key things to remember:

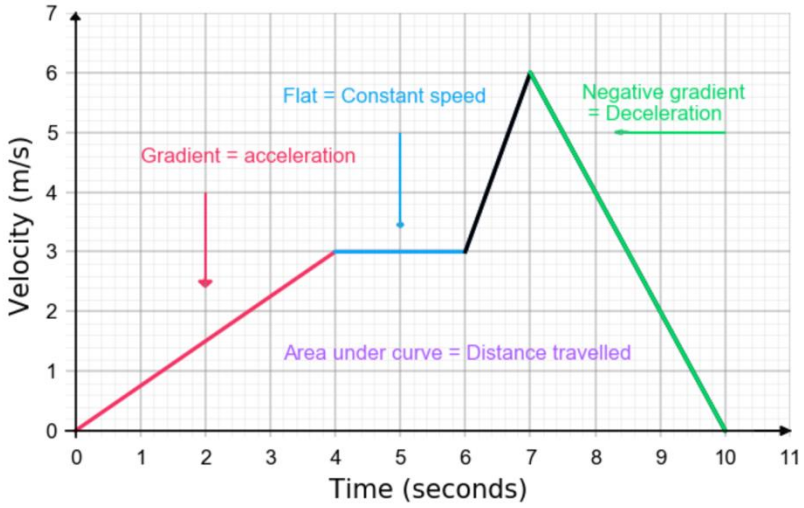
With speed on the $y$-axis and time on the $x$-axis, a speed-time graph tells us how someone/something's speed has changed over a period of time.

**1) The gradient of the line = Acceleration**

**2) Negative gradient = Deceleration**

**3) Flat section means steady velocity (NOT STOPPED)**

**4) Area under the graph = Distance travelled**





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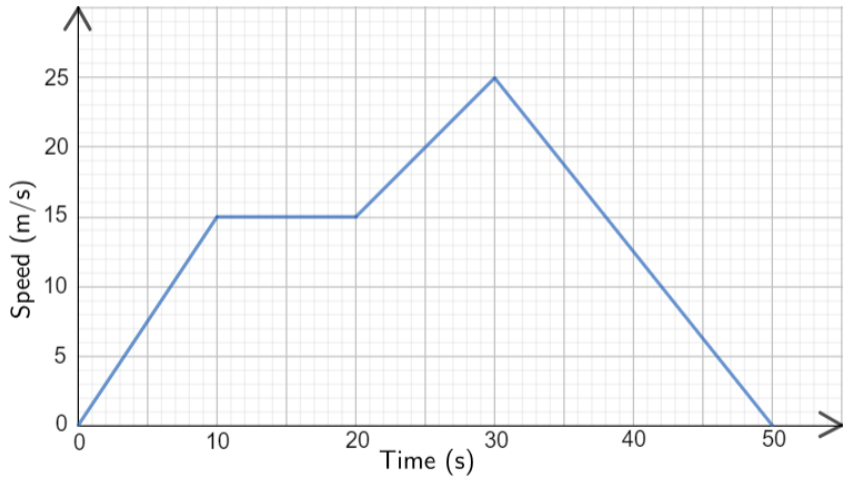
## Example 1 – Acceleration and Distance travelled

The speed-time graph below describes a $50$-second car journey.

Work out the total distance travelled by the car and work out the maximum acceleration of the car during the $50$ seconds.

**[4 marks]**




Lets analyse the graph:

A) The car **accelerated** from $0$ to $15$ m/s over the first $10$ seconds (because the line is straight, the acceleration is **constant**).

B) The line is flat, meaning the car's speed did not change for $10$ seconds – meaning it was moving at a **constant speed**.

C) The car accelerated up to $25$ m/s over the next $10$ seconds,

D) Finally it spent the last $20$ seconds **decelerating** back down to $0$ m/s.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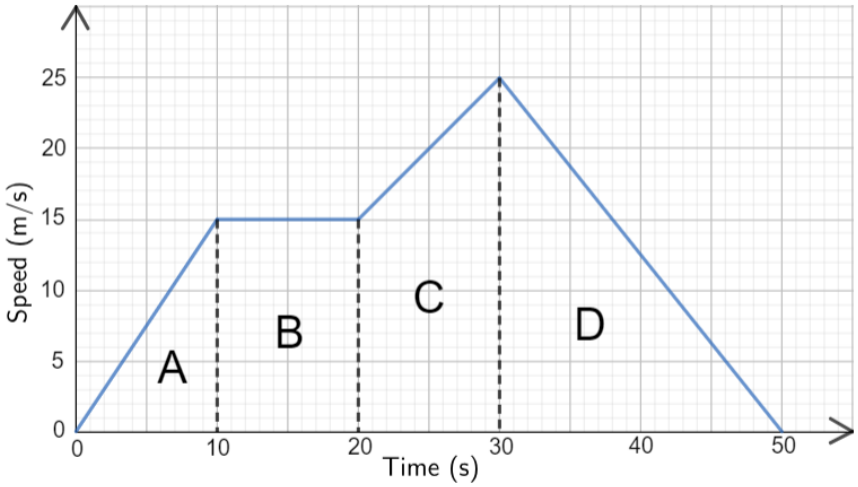


## Work out the total distance travelled by the car:

**Area under the graph = Distance travelled**

To work out the area under this graph, we will break it into $4$ shapes: $A$, $B$, $C$, and $D$ – two triangles, a rectangle, and a trapezium are all shapes that we can work out the area of. So, we get

$$\mathrm{A} = \frac{1}{2} \times 10 \times 15 = 75 \text{ m}$$

$$\mathrm{B} = 10 \times 15 = 150 \text{ m}$$

$$C = \frac{1}{2}(15 + 25) \times 10 = 200 \text{ m}$$

$$D = \frac{1}{2} \times 20 \times 25 = 250 \text{ m}$$

**Total distance travelled**:

$$75 + 150 + 200 + 250 = 675 \text{ m}$$

## Work out the maximum acceleration:

**The gradient of the line = Acceleration**

First lets find the gradient of the each section.

**Section $\mathrm{A}$** :

$$\text{acceleration between 0s and 10s} = \text{gradient} = \frac{15 - 0}{10 - 0} = 1.5 \text{ m/s}^2$$

**Section $\mathrm{B}$**

This section is flat, meaning meaning the acceleration will be $0$

**Section $\mathrm{C}$**

$$\text{acceleration between 20s and 30s} = \text{gradient} = \frac{25 - 15}{30 - 20} = 1 \text{ m/s}^2$$

**Section $\mathrm{D}$**

$$\text{acceleration between 30s and 50s} = \text{gradient} = \frac{0 - 25}{50 - 30} = \frac{-25}{20} = -1.25 \text{ m/s}^2$$


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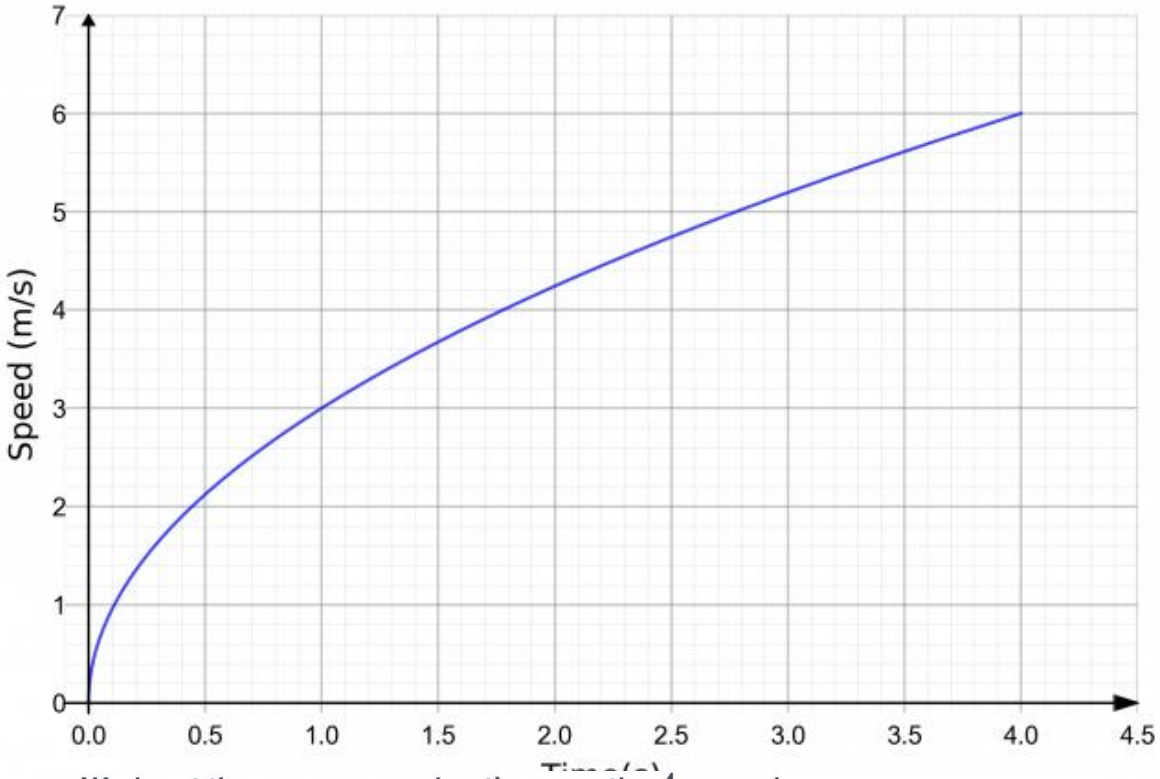
# Average Gradient

Below is a speed-time graph of the first 4 seconds of someone running a race

Work out the average acceleration over the 4 seconds and work out the instantaneous acceleration 2 seconds in

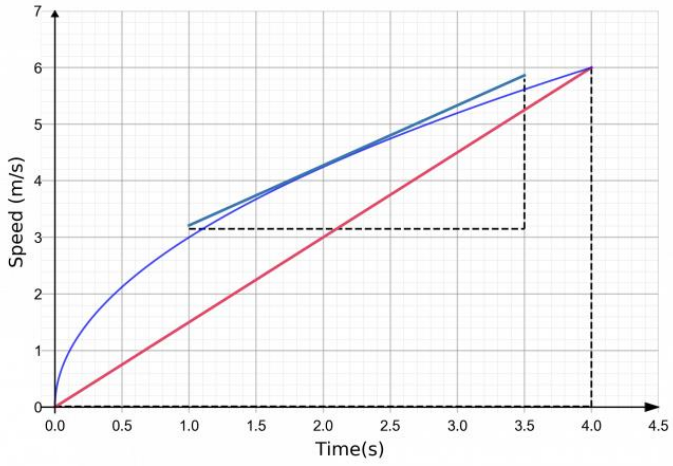



## Work out the average acceleration over the $4$ seconds

To work out the **average acceleration** over the $4$ seconds, we will draw a line from where the graph is at $0$ s to where the graph is at $4$ s and find the gradient of it.

So, we get that average acceleration to be,

$$\text{gradient} = \frac{6-0}{4-0} = 1.5 \text{ m/s}^2$$




## work out the instantaneous acceleration $2$ seconds in

To so this we will draw a **tangent** to the line after $2$ seconds and work out the gradient of that. This is shown above.

Then, we get the instantaneous acceleration to be,

$$\text{gradient} = \frac{5.8-3.2}{3.5-1.0} = 1.04 \text{ m/s}^2 \text{ (3 sf)}.$$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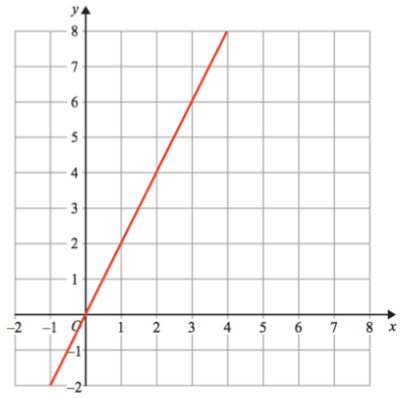
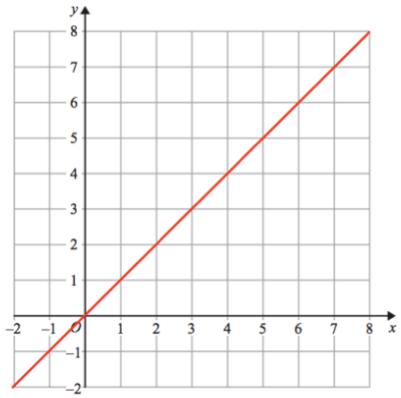
Question 1: Find the gradient of each of these lines

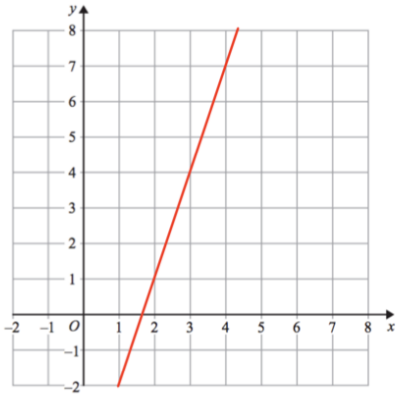
(a)



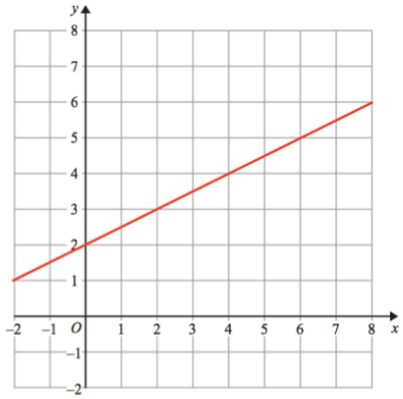
(b)



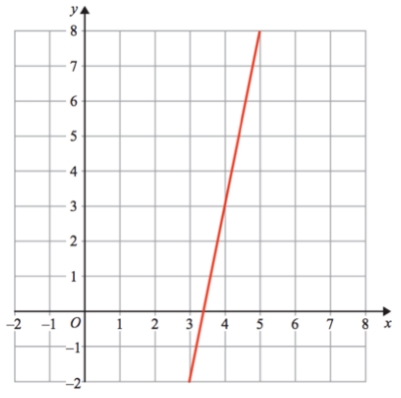
(c)



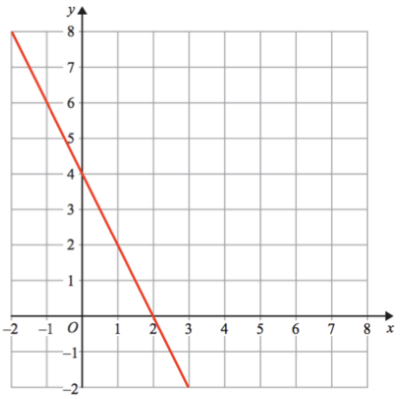
(d)



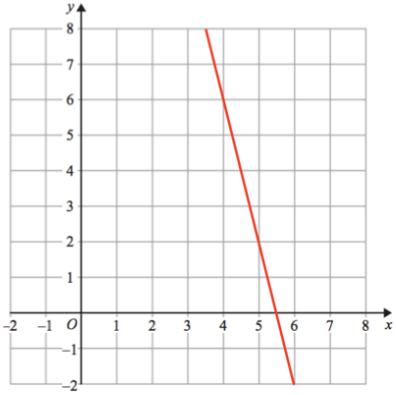
(e)



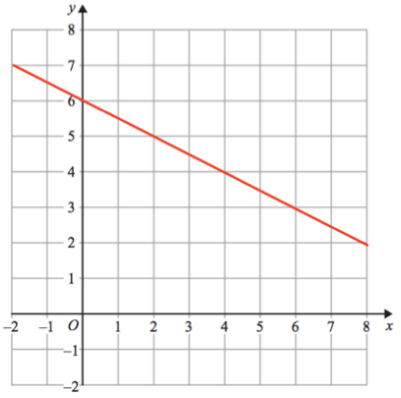
(f)



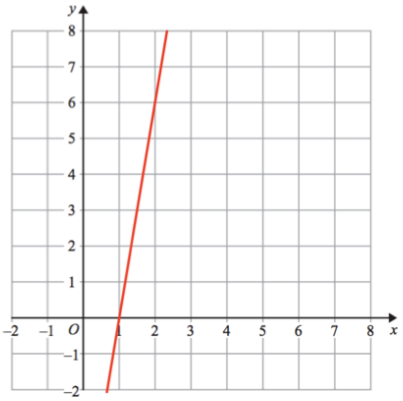
(g)



(h)



(i)

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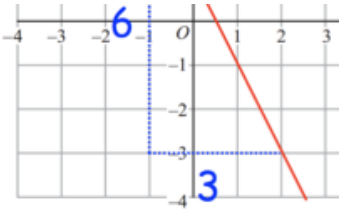
Question 1: Alisha says that the gradient of the line is 2.
Explain her mistake.




Question 2: Find the gradient of the line passing through the points (4a, −a) and (6a, 5a)

Question 3: The line passing through (5, −2) and (8, c) has a gradient of 3.
Find c.

Question 4: The line passing through (−8, −9) and (−2, h) has a gradient of 4.
Find h.

Question 5: The line passing through (3, −4) and (m, 10) has a gradient of 2.
Find m.

Question 6: The line passing through (−2, 5) and (2, n) has a gradient of −½
Find n.

Question 7: The line passing through (1, p) and (5, 1) has a gradient of 0.75
Find p.

Question 8: Find the equation of the line shown

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Question 1: Write down the gradient of each of these lines.

(a) $y = 3x + 1$ (b) $y = 2x - 5$ (c) $y = 7x + 4$ (d) $y = 10x + 5$

(e) $y = x - 2$ (f) $y = 6x$ (g) $y = -4x + 3$ (h) $y = -3x - 7$

(i) $y = \frac{1}{2}x + 3$ (j) $y = -\frac{4}{5}x - 9$

Question 2: Write down where each of these lines cross the y-axis (y-intercept)

(a) $y = 2x + 3$ (b) $y = 7x + 1$ (c) $y = 3x - 2$ (d) $y = x - 5$

(e) $y = 2x$ (f) $y = -4x + 6$ (g) $y = -5x - 3$ (h) $y = -3x$

(i) $y = \frac{4}{3}x + \frac{2}{5}$ (j) $y = -\frac{2}{3}x - \frac{1}{2}$


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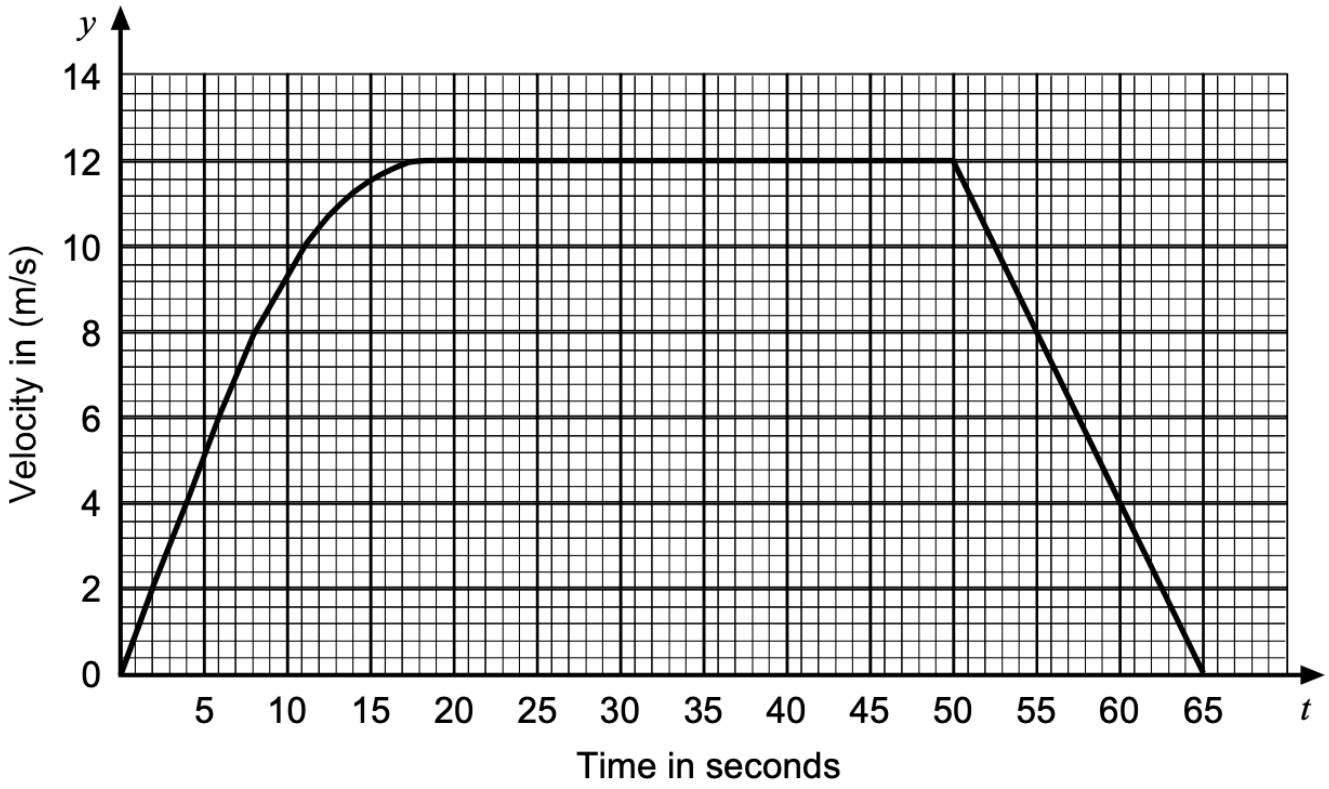
1. A car travels between two sets of traffic lights.
The diagram represents the velocity/time graph of the car.




The car leaves the first set of traffic lights.

(a)Use the graph to find the velocity of the car after 15 seconds.

..... (1)

(b)Calculate an estimate for the acceleration of the car, in $m/s^2$, after 10 seconds.

..... (2)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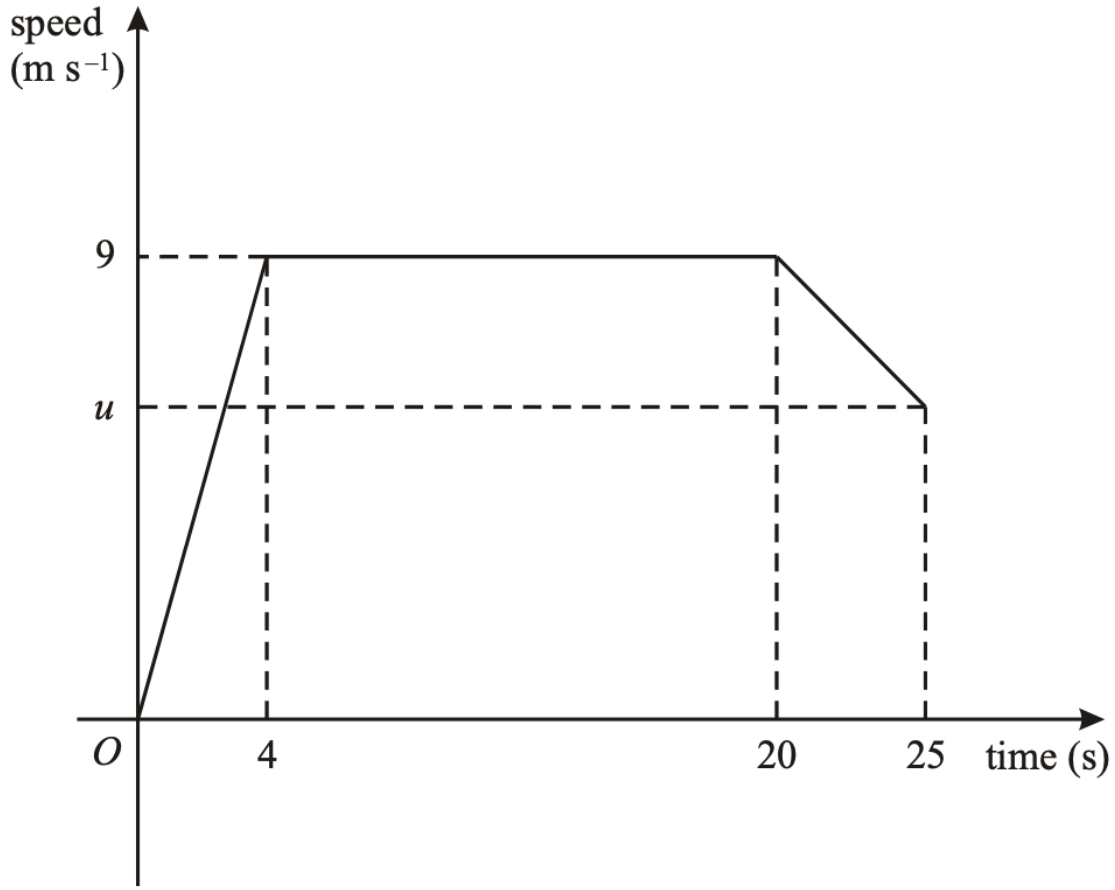
3. A sprinter runs a race of 200 m.
Her total time for running the race is 25 s.
Below is a sketch of the speed-time graph for the motion of the sprinter.




Calculate:

a) The acceleration in the first 4 seconds of the race

..... (2)

b) The distance covered by the sprinter in the first 20 seconds of the race

c) The value of u

..... (2)

..... (3)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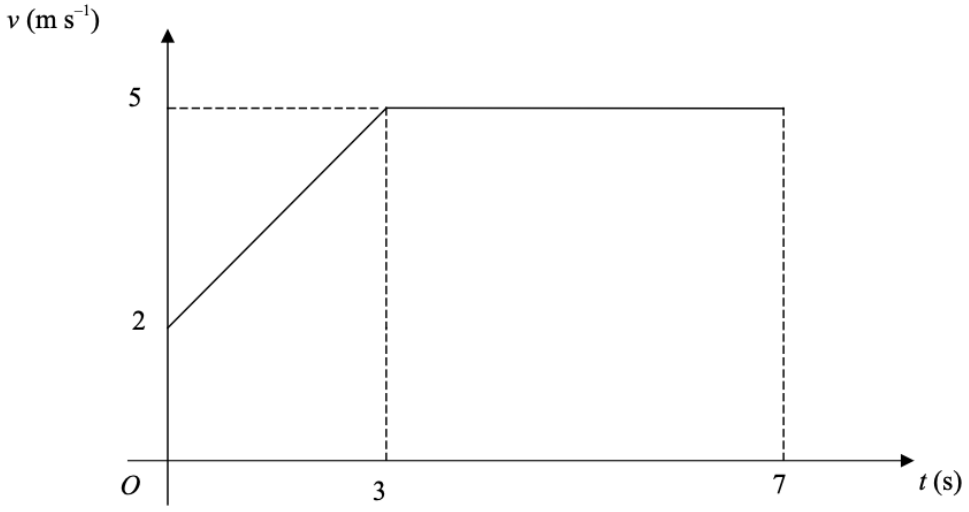
4. Below is a sketch of the speed-time graph of a cyclist moving on a straight road over a 7 second period.




Calculate:

a) The acceleration for the first 3 seconds

..... (2)

b) The distance covered by the cyclist over the 7 second period

..... (2)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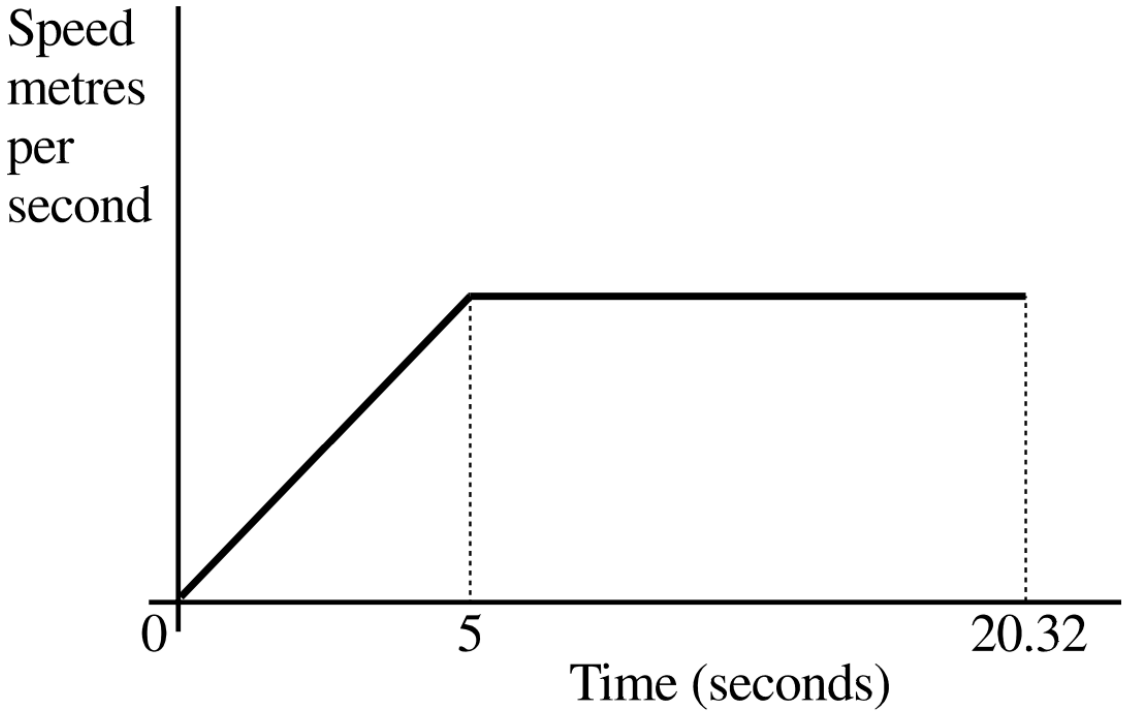
5. A sprinter runs a race of 200 m.
His total time for running the race is 20.32s.
Below is a sketch of the speed-time graph for the motion of the sprinter.




Calculate:

a) The maximum speed of the sprinter during the race

..... (4)

b) The distance covered by the sprinter in the first 5 seconds of the race

..... (2)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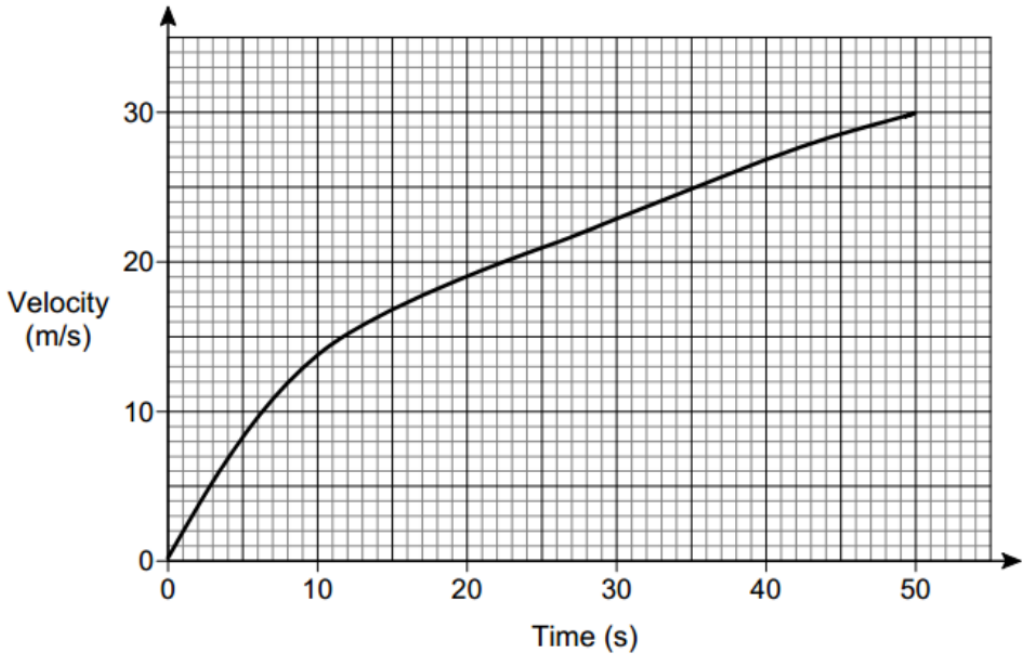
6. Here is the velocity-time graph of a car for 50 seconds.




Work out the average acceleration during the 50 seconds.
Give the units of your answer.

..... (2)

Estimate the time during the 50 seconds when
the instantaneous acceleration = the average acceleration
You must show your working on the graph.

..... (2)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