Solutions by
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GCSE (9-1) Grade 8/9

Area under a curve

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name.
- Answer **all** questions.

Answer the questions in the spaces provided
  – there may be more space than you need.

- **Show all your working out**

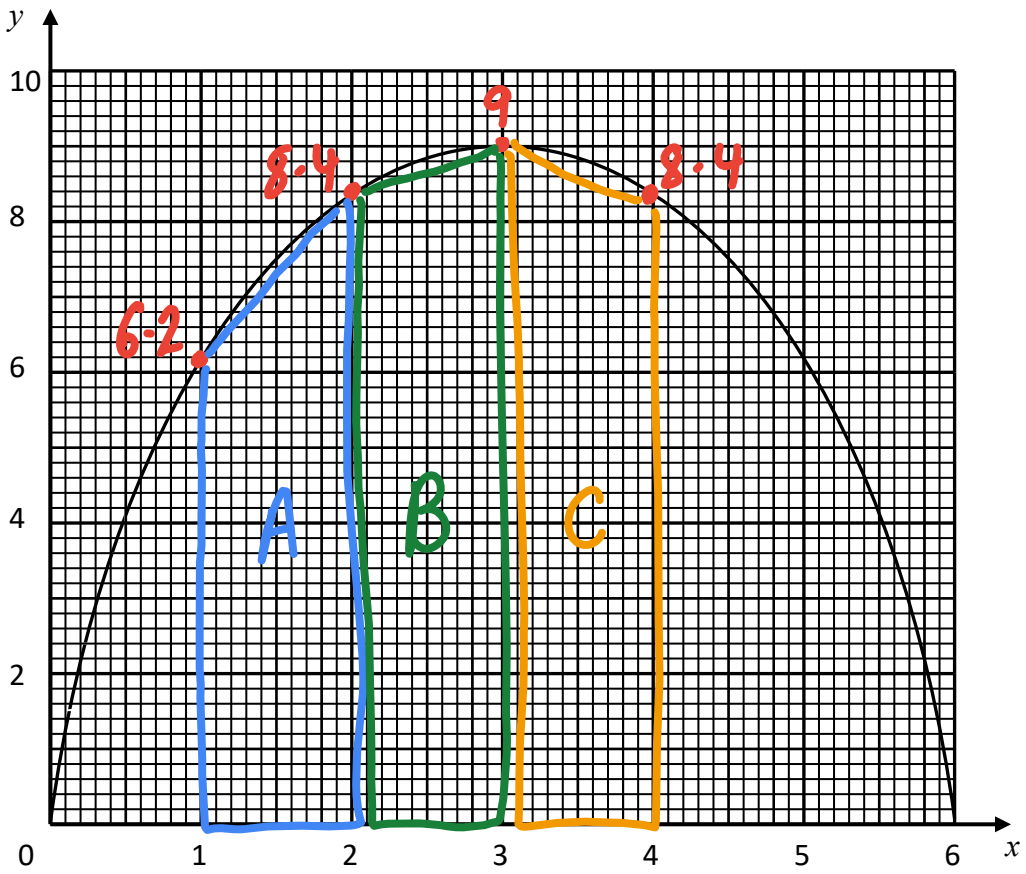
Information

- The total mark for this paper is 73.
- The marks for **each** question are shown in brackets.
  – use this as a guide as to how much time to spend on each question.
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed

Advice

- Read each question carefully before you start to answer it
- Attempt every question
- Check your answers if you have time at the end

1. The diagram shows the graph of $y = 6x - x^2$



(a) Use 3 equal strips on the graph to estimate the area under the curve between $x = 1$ and $x = 4$

$A = \frac{1}{2}(6.2 + 8.4) \times 1 = 7.3$

$B = \frac{1}{2}(8.4 + 9) \times 1 = 8.7$

$C = \frac{1}{2}(9 + 8.4) \times 1 = 8.7$

$7.3 + 8.7 + 8.7 = 24.7$

24.7

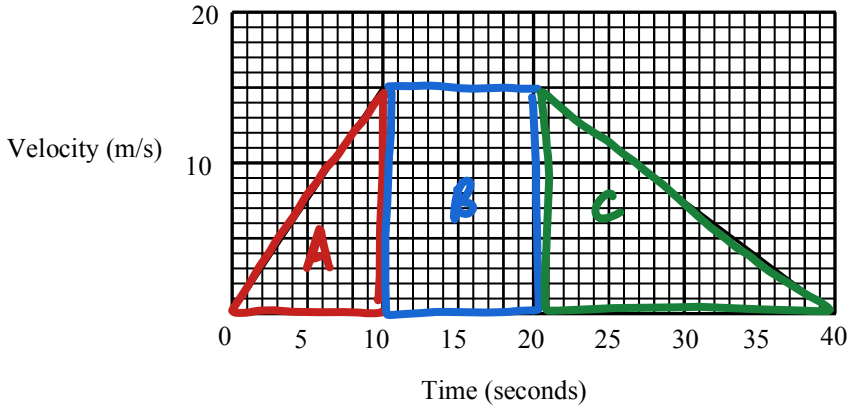
(3 marks)

(b) Is the answer to part (a) an over-estimate or an under-estimate? Justify your answer.

Underestimate as the area is actually bigger

(1 mark)

2. The velocity-time graph shows the velocity of a car for the first 40 seconds.



Work out the total distance travelled in the first 40 seconds

$A = \frac{10 \times 15}{2} = 75$

$B = 10 \times 15 = 150$

$C = \frac{15 \times 20}{2} = 150$

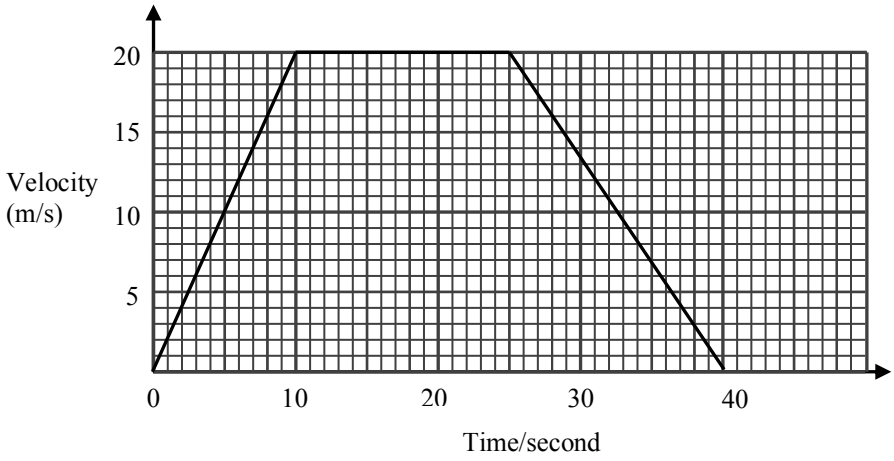
$75 + 150 + 150 = 375$

375m

(2 marks)

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3. This graph shows a journey of a car.

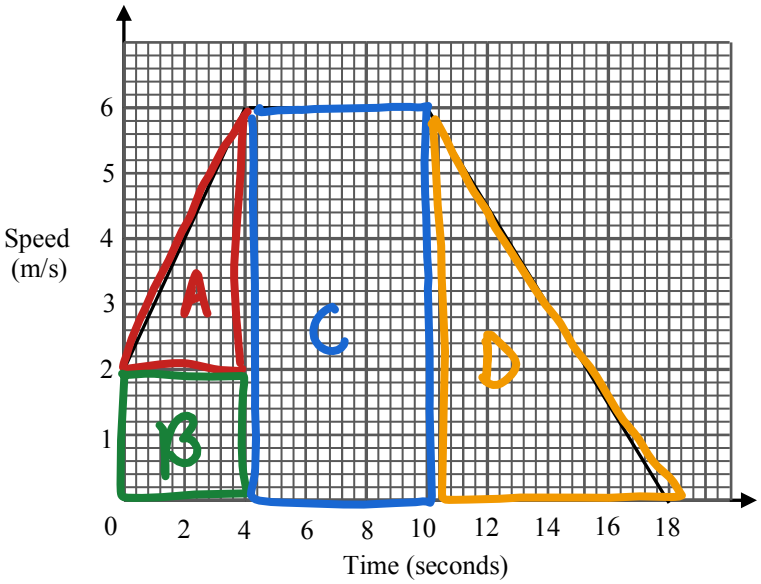


Work out the total distance travelled in the first 40 seconds

Same as above.

(2 marks)

4. The diagram shows the speed-time graph for the last 18 seconds of Sandeep's cycle journey.



(a) Work out distance travelled in the first 4 seconds.

$A = \frac{4 \times 4}{2} = 8$

$B = 4 \times 2 = 8$

$8 + 8 = 16\text{m}$

(2 marks)

(b) Hence, or otherwise, work out distance travelled in the last 18 seconds.

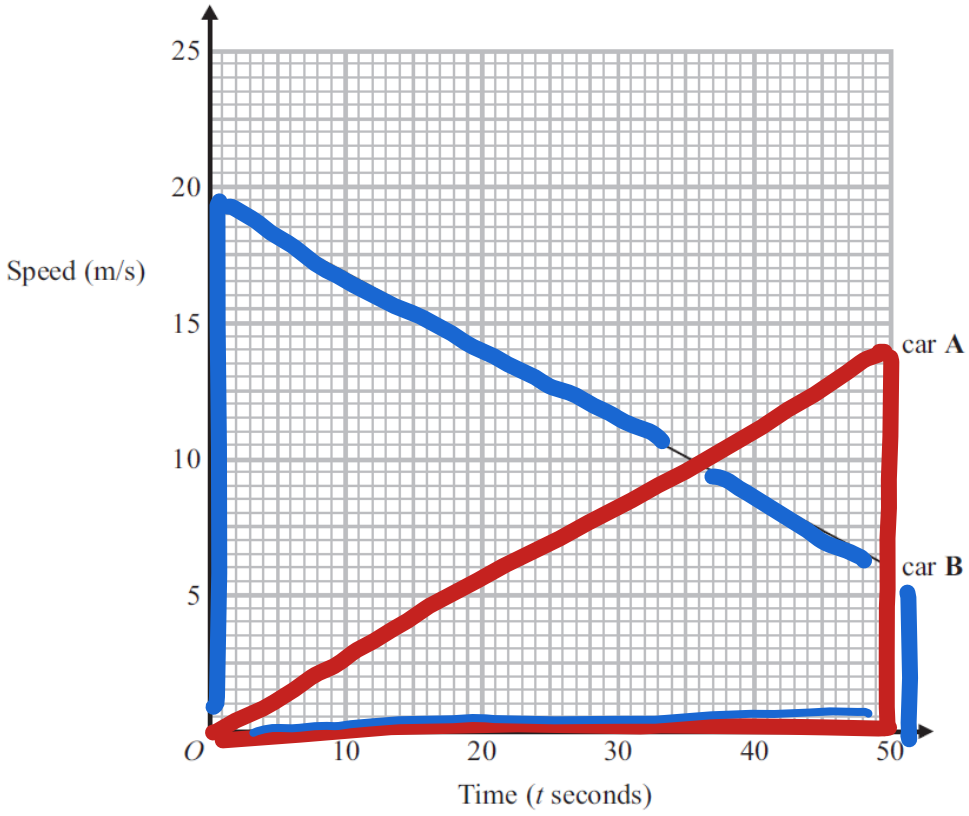
$C = 6 \times 6 = 36$

$D = \frac{8 \times 6}{2} = 24$

$16 + 36 + 24 = 76\text{m}$

(2 marks)

5. The graph shows information about the speeds of two cars.



Which car travelled the furthest?

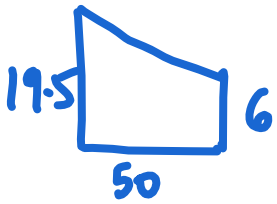
You must show your working.

Car A



$\frac{15 \times 50}{2} = 375\text{ m}$

Car B

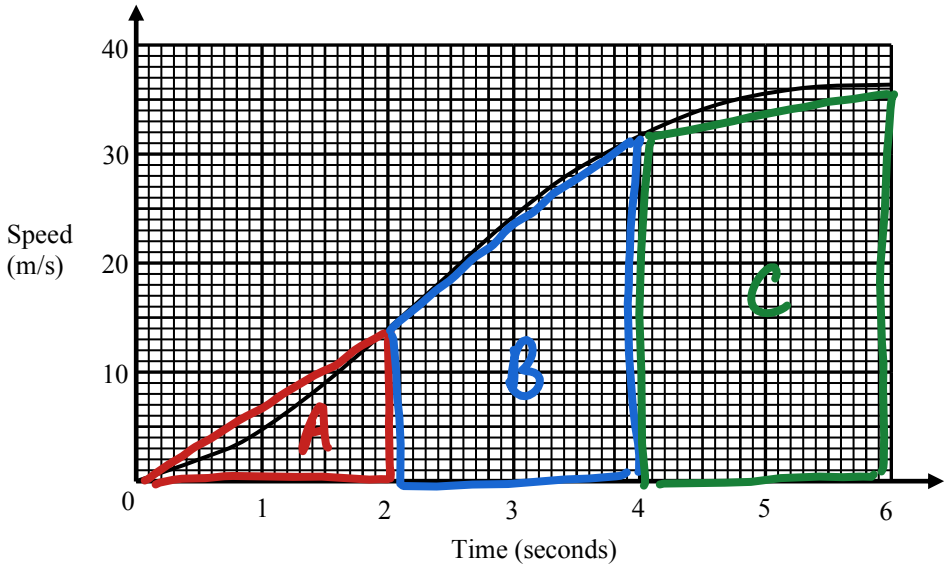


$\frac{1}{2}(6 + 19.5) \times 50 = 637.5\text{m}$

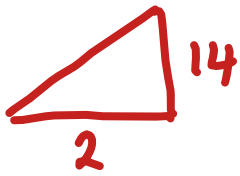
Car B $637.5 > 375$

(4 marks)

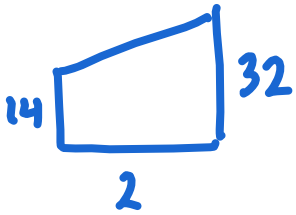
6. The graph shows a car's speed, in m/s, varies in the first 6 seconds after the car moves from rest.



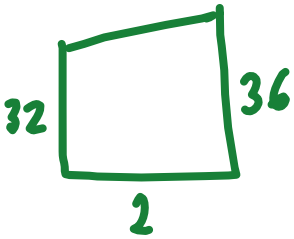
Use 3 equal strips on the graph to estimate the distance travelled in the first 6 seconds.

A 

$\frac{1}{2} \times 2 \times 14 = 14$

B 

$\frac{1}{2}(14+32) \times 2 = 46$

C 

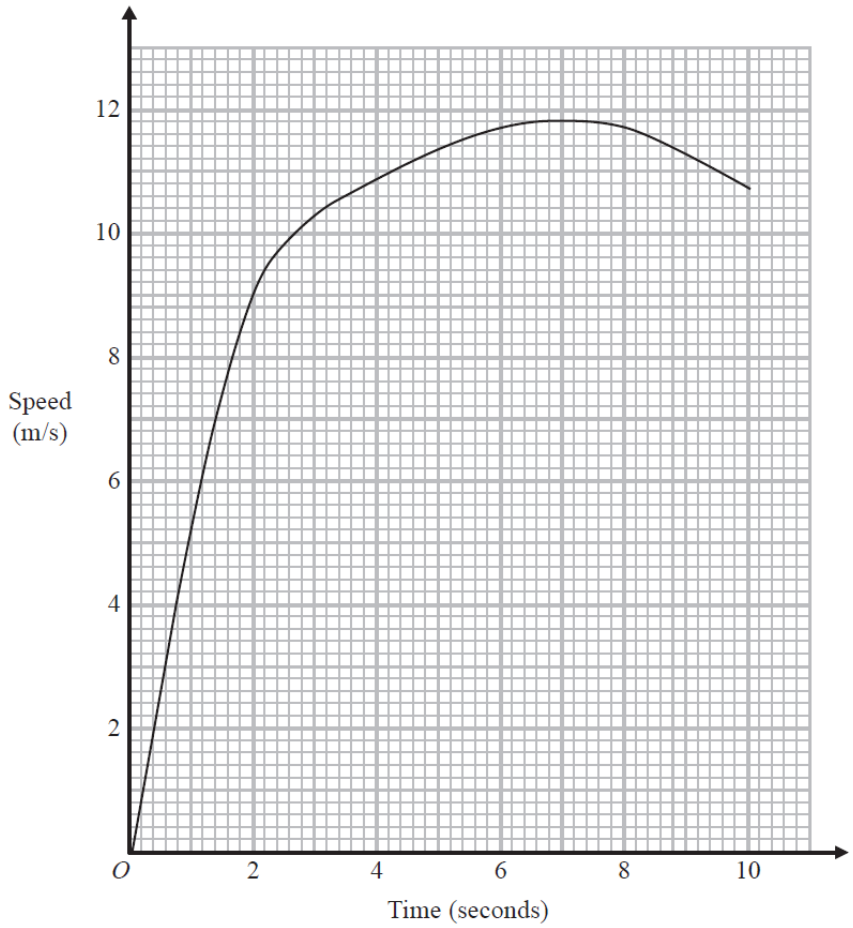
$\frac{1}{2}(32+36) \times 2 = 68$

$14 + 46 + 68 =$ 128m

(3 marks)

7. Usain runs in a race.

The graph shows his speed, in metres per second (m/s), during the first 10 seconds of the race.



(a) Use 4 equal strips on the graph to estimate the total distance travelled in the first 10 seconds.

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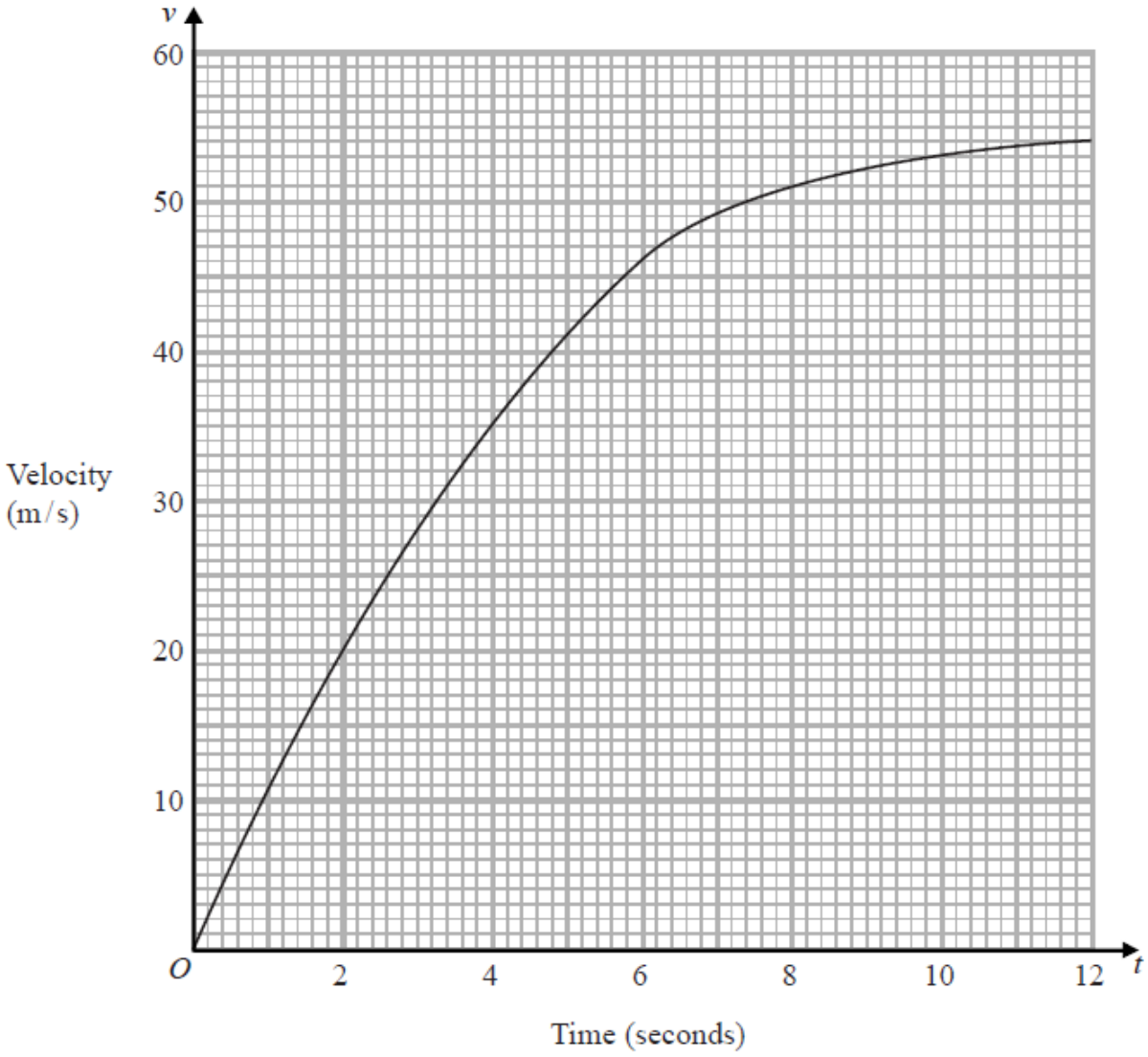
(3 marks)

(b) Is the answer to part (a) an over-estimate or an under-estimate? Justify your answer.

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(1 mark)

8. The graph shows information about the velocity, v m/s, of a parachutist t seconds after leaving a plane.



(a) Use 4 equal strips on the graph to estimate the total distance travelled in the first 12 seconds.

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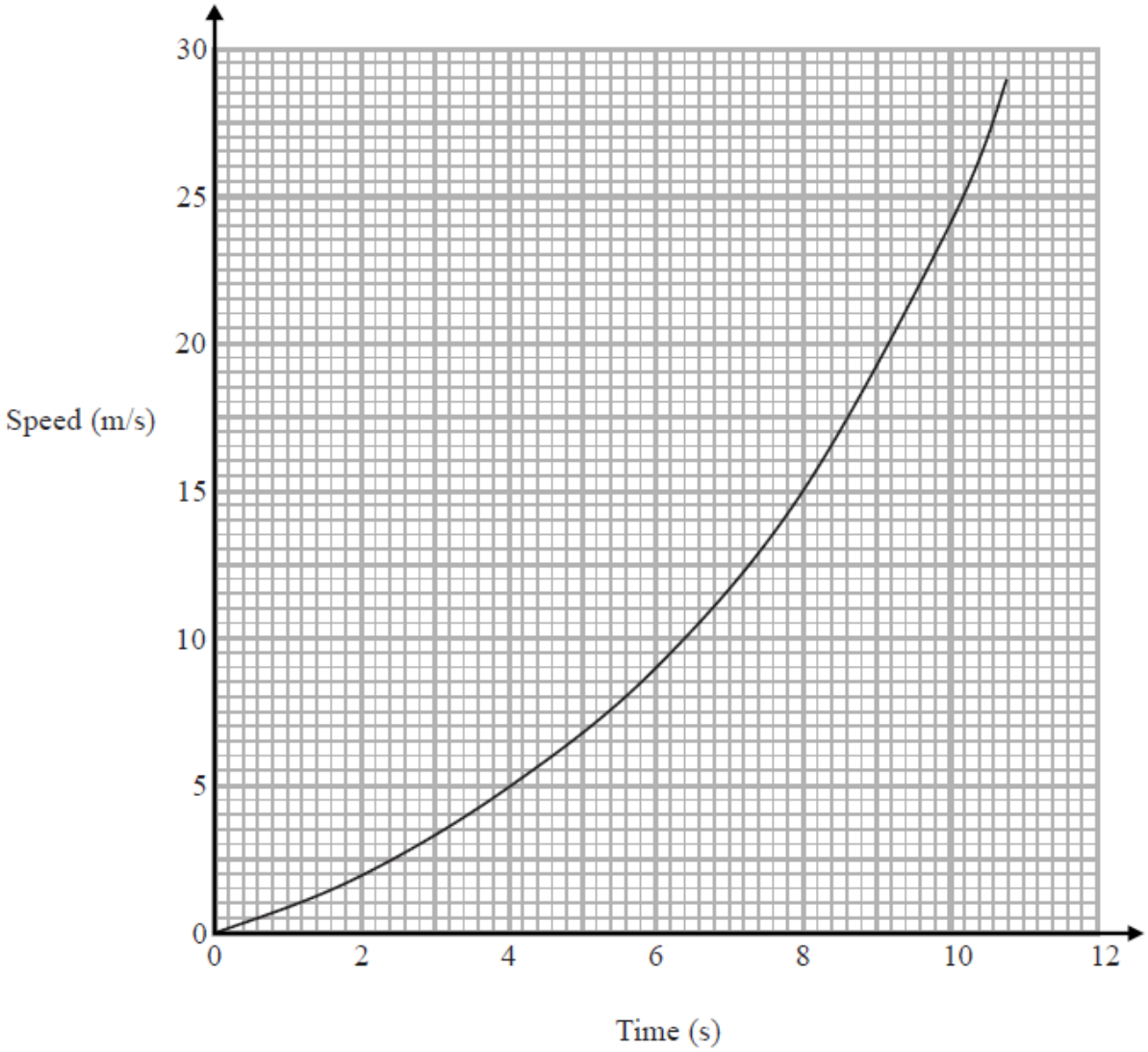
(3 marks)

(b) Is the answer to part (a) an over-estimate or an under-estimate? Justify your answer.

.....

(1 mark)

9. The graph shows information about the velocity, v m/s, of a parachutist t seconds after leaving a plane.



(a) Use 3 equal strips on the graph to estimate the total distance travelled in the first 9 seconds.

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(3 marks)

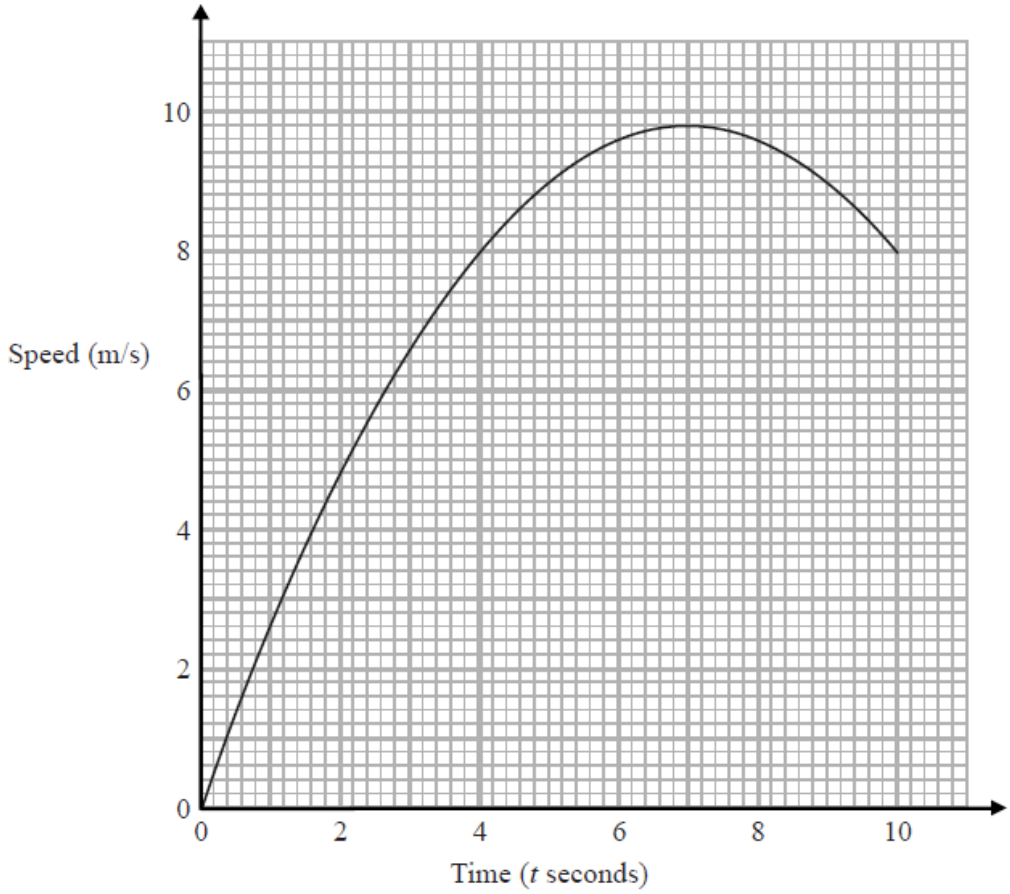
(b) Is the answer to part (a) an over-estimate or an under-estimate? Justify your answer.

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(1 mark)

10. Karol runs in a race.

The graph shows her speed, in metres per second, t seconds after the start of the race.



(a) Use 3 equal strips on the graph to estimate the total distance travelled in the first 9 seconds.

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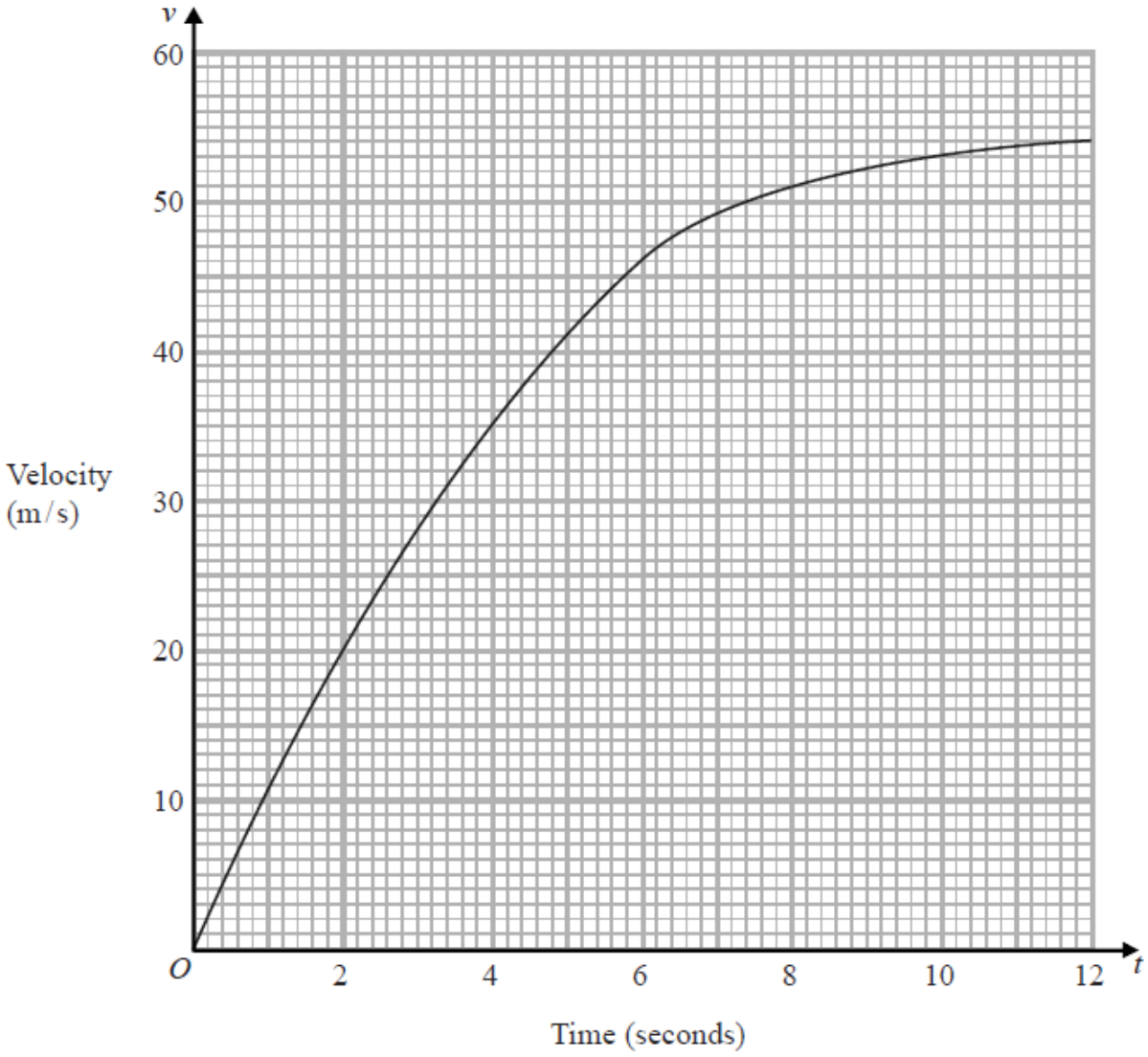
(3 marks)

(b) Is the answer to part (a) an over-estimate or an under-estimate? Justify your answer.

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(1 mark)

11. The graph shows information about the velocity, v m/s, of a parachutist t seconds after leaving a plane.



(*a*) Work out an estimate for the acceleration of the parachutist at $t = 6$

..... m/s^2

(2 marks)

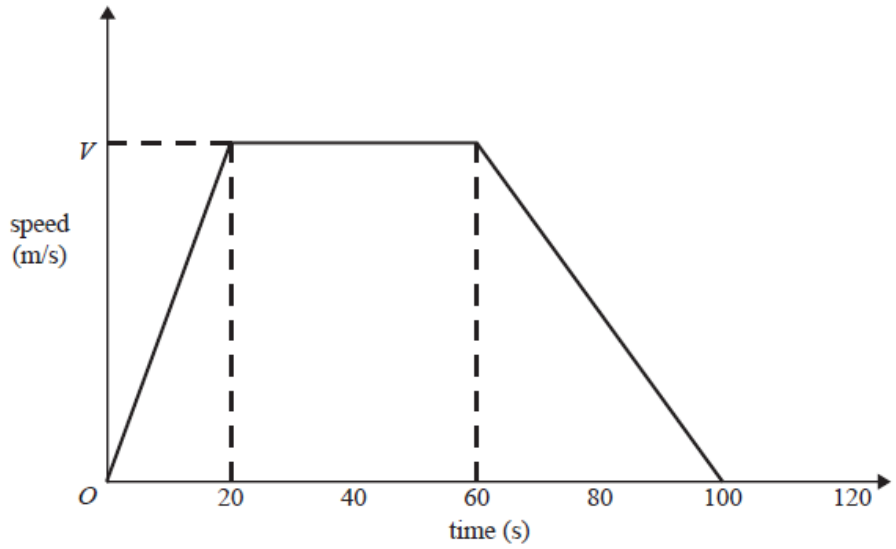
(*b*) Work out an estimate for the distance fallen by the parachutist in the first 12 seconds after leaving the plane.
Use 3 strips of equal width.

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(3 marks)

12. Here is a speed-time graph for a car journey.

The journey took 100 seconds.



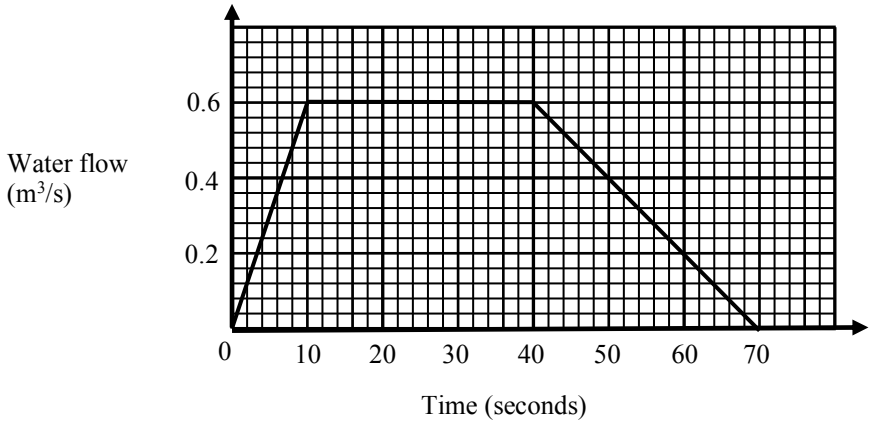
The car travelled 1.75 km in the 100 seconds.

Work out the value of V.

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(4 marks)

13. The graph shows the rate at which water is flowing from a pipe.



(a) Work out the area under the graph between $t = 0$ and $t = 70$

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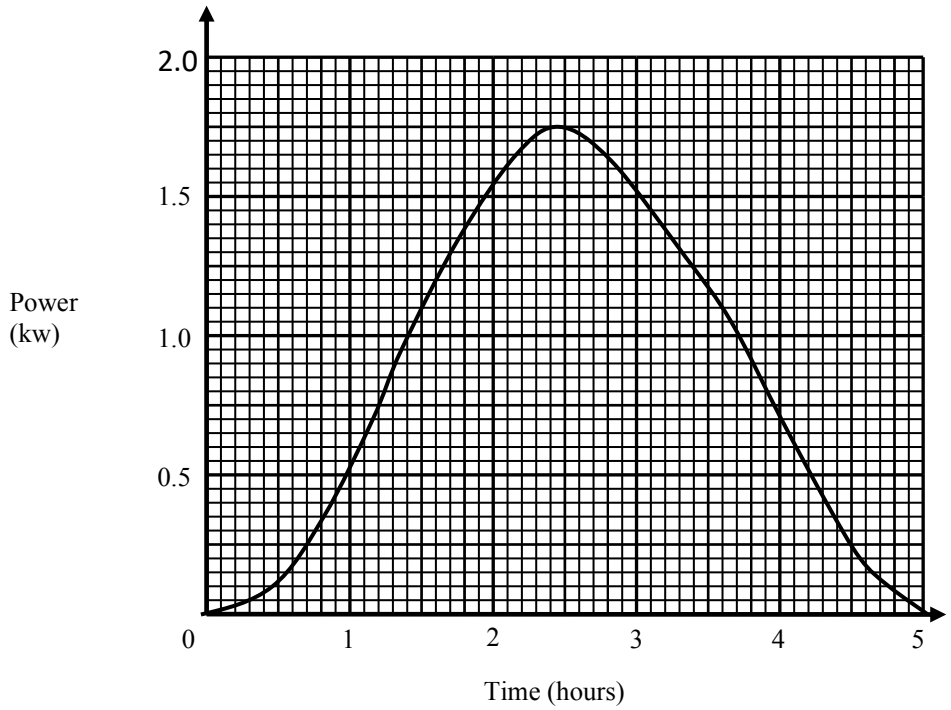
(2 marks)

(b) Give an interpretation to the value found in part (a).

.....

(1 mark)

14. The graph shows the amount of power, in kilowatts, produced by a solar panel over a period of time, in hours.



The area under a power-time graph represents the amount of energy produced.

a) Use 3 equal strips on the graph to estimate the amount of energy produced between $t = 1$ and $t = 4$

.....

(3 marks)

(b) Is the answer to part (a) an over-estimate or an under-estimate? Justify your answer.

.....

(1 mark)

15. An athlete runs along a straight road.

She starts from rest and moves with constant acceleration for 5 seconds, reaching a speed of 8 m/s This speed is then maintained for 50 seconds. She then decelerates at a constant rate until she stops. She has run for a total of 75 seconds.

(a) Sketch a speed-time graph to illustrate the motion of the athlete.

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(3 marks)

(b) Work out the total distance, in m, run by the athlete.

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(2 marks)

16. A girl runs a 450 m to a shop in a time of 90 s. It is assumed that, starting from rest, she moves with constant acceleration for 4 s, reaching a speed of V m s^{-1}. She maintains this speed for 60 s and then moves with constant deceleration for 26 s until she stops.

(a) Sketch a speed-time graph for the motion of the girl during the whole race.

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(3 marks)

(b) Work out the value of V.

.....

(3 marks)

17. A car accelerates uniformly from rest for 20 seconds.

It moves at constant speed v m s^{-1} for the next 40 seconds and then decelerates uniformly for 10 seconds until it comes to rest.

(a) For the motion of the car, sketch a speed-time graph,

.....

(3 marks)

Given that the total distance moved by the car is 880 metres,

(b) find the value of v

.....

(3 marks)

18. A car is travelling along a straight horizontal road.

The car takes 120 s to travel between two sets of traffic lights which are 2145 m apart.
The car starts from rest at the first set of traffic lights and moves with constant acceleration for 30 s until its speed is 22 m s^{-1}.

The car maintains this speed for T seconds.

The car then moves with constant deceleration, coming to rest at the second set of traffic lights.

(a) Sketch a speed-time graph for the motion of the car between the two sets of traffic lights.

.....

(3 marks)

(b) Find the value of T.

.....

(3 marks)

TOTAL FOR PAPER IS 73 MARKS