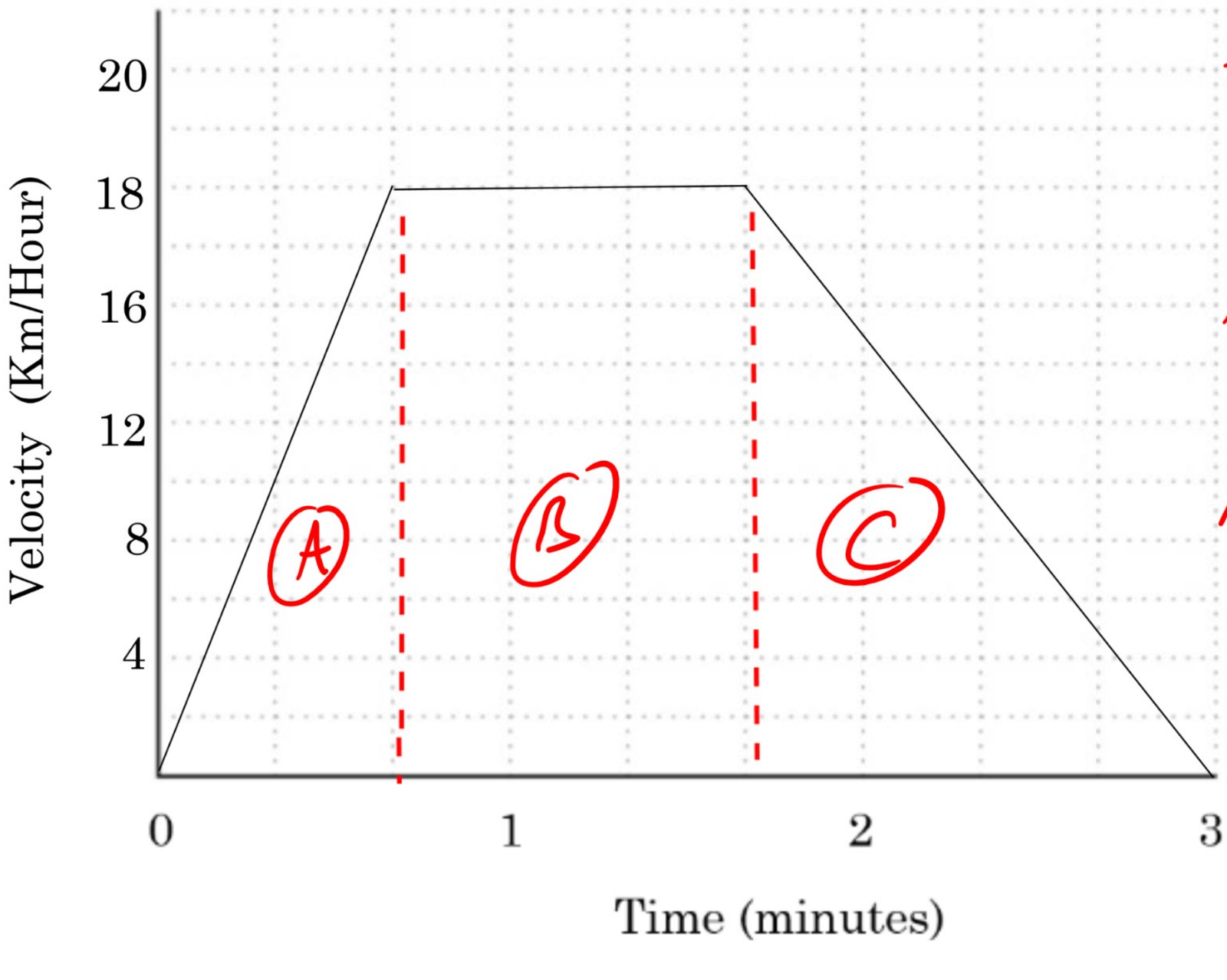
Velocity-Time Graphs Exam Practice

Q1. Ken cycles from his house. The velocity-time graph for part of his journey is shown below:



Area A $= \frac{1}{2} \times \frac{2}{3} \times 18$

$= 6$

Area B $= 1 \times 18$

$= 18$

Area C $= \frac{1}{2} \times \frac{4}{3} \times 18$

$= 12$

a) Work out the total distance which Ken has travelled.

distance = area under V–T graph

= area A + area B + area C

= 6 + 18 + 12

Answer: 36 m

(3 marks)

b) Work out the rate at which Ken decelerates before coming to rest, stating suitable units.

gradient $= \frac{18}{4/3} = 13.5$

Answer: -13.5 m/s²

(2 marks)

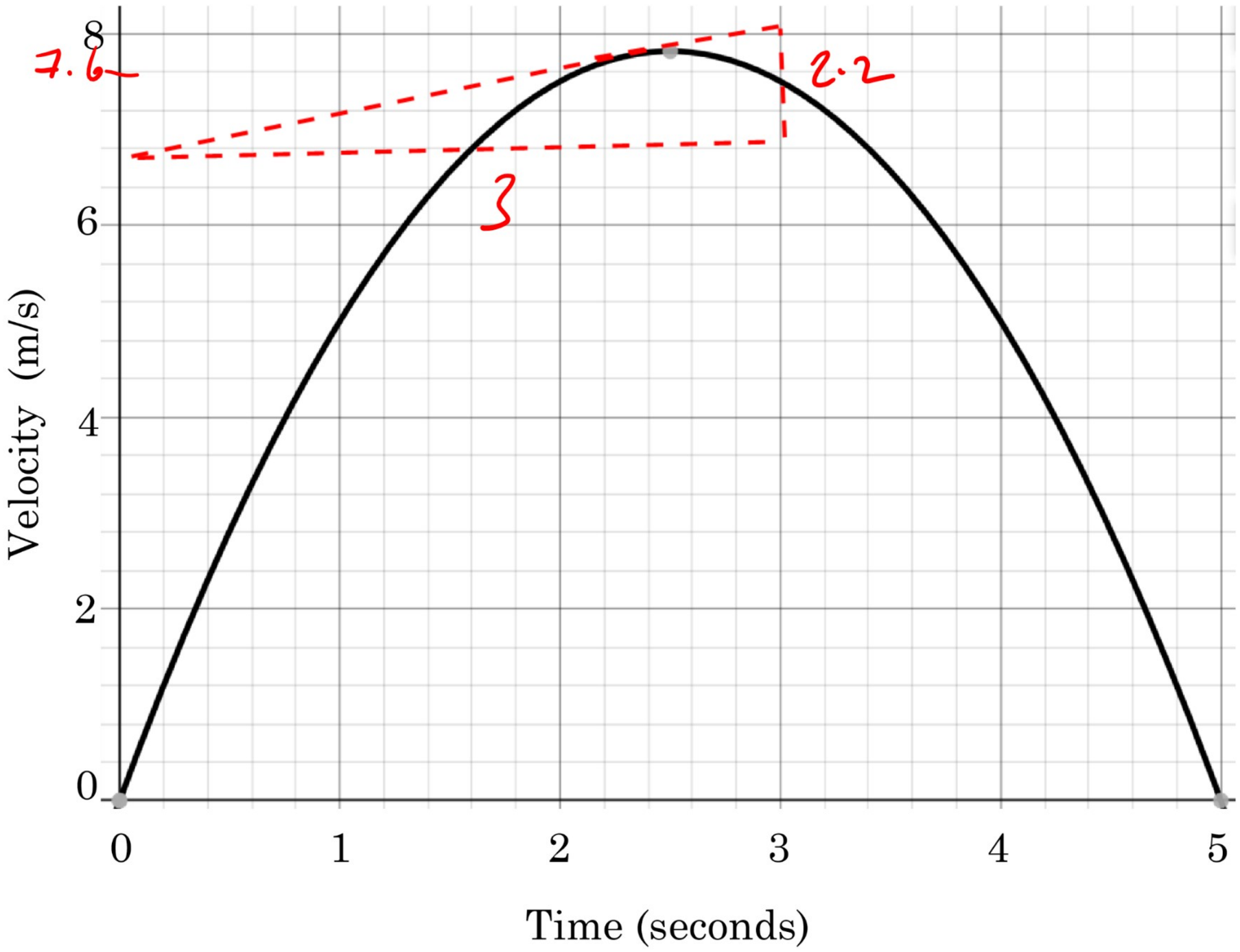
c) Explain why the graph shown above is unlikely to be a completely realistic representation of his journey.

A human is not capable of accelerating at a constant rate exactly, so the lines in would be curves in reality.

Answer: _____

(1 mark)

Q2. Below is the velocity-time graph of the journey of a particle.



a) Estimate the acceleration of the particle at a time of 2.4 seconds.

gradient of tangent to curve at $t = 2.4$

is $\frac{2.2}{3} \approx 0.73$

Answer: $0.73\ m/s^2$

(2 marks)

b) (i) How many seconds have passed until the particle changes direction?

direction changes when the velocity goes from positive to negative, at $t = 2.5$ seconds

Answer: 2.5 seconds

(1 mark)

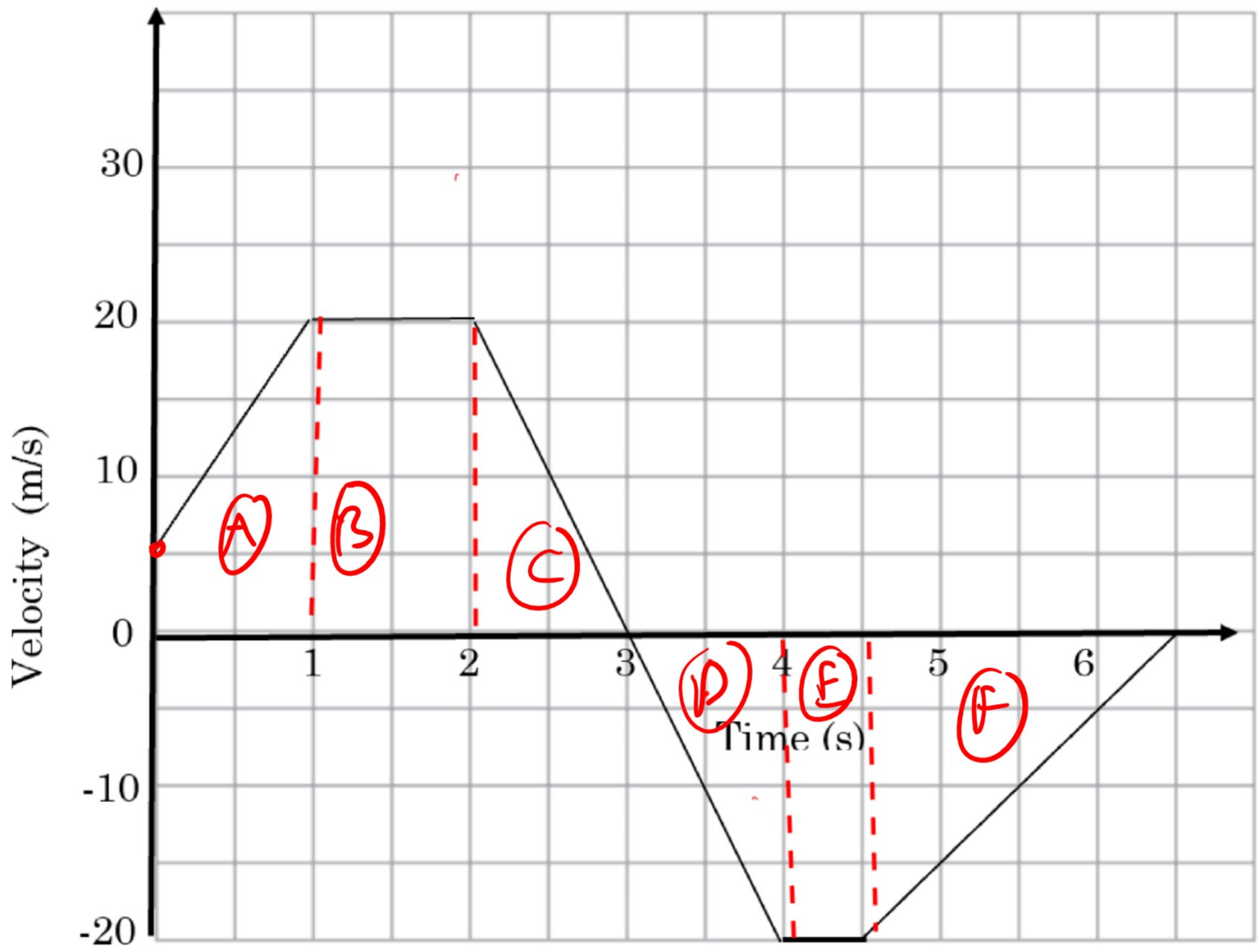
(ii) What is the average acceleration of the particle up until this time?

$\frac{7.6}{2.5} = 3.04$

Answer: $3.04\ m/s^2$

(2 marks)

Q3. The graph below shows the velocity-time graph of a particle which is travelling along a straight line.



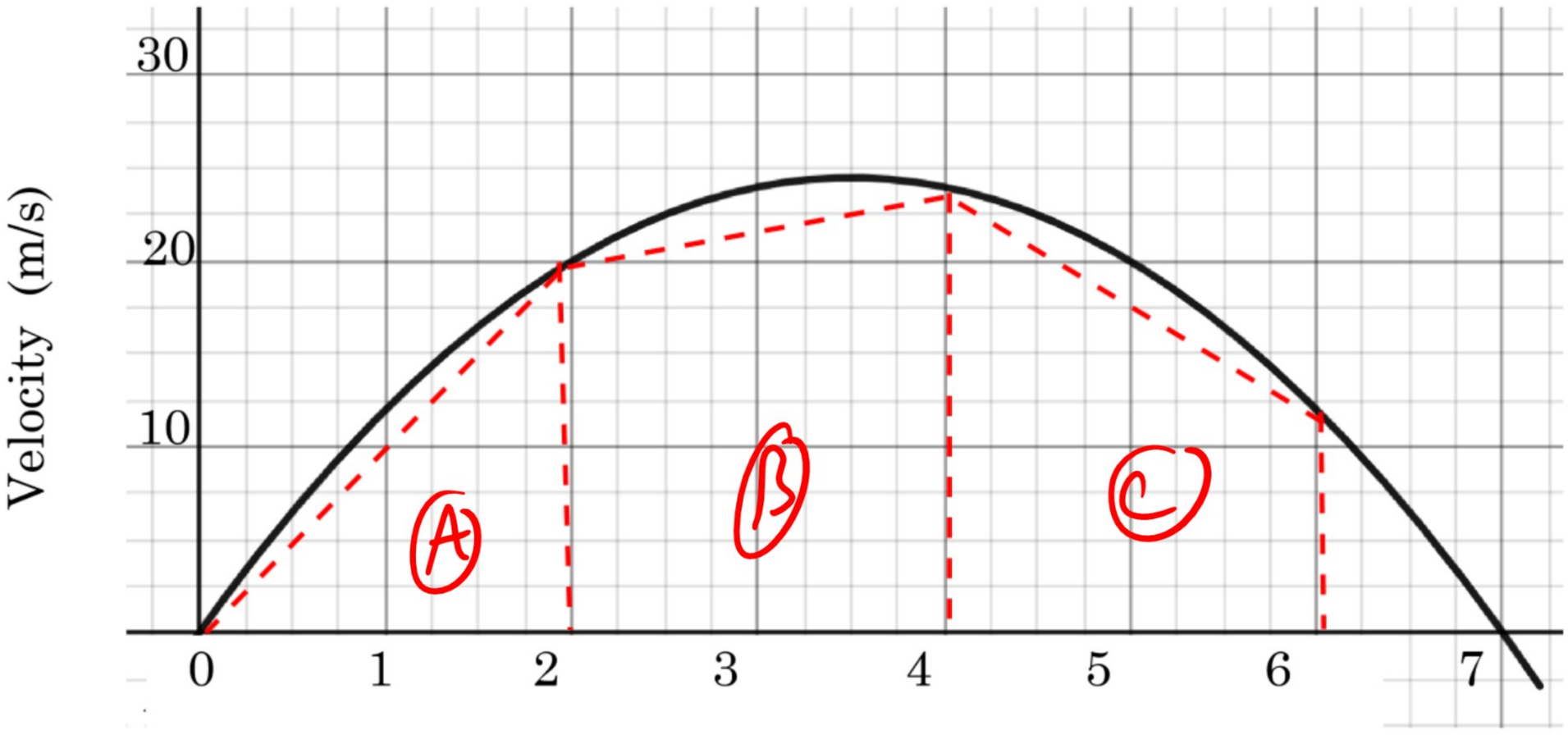
At time time t = 0, the particle is at point P. Find all the times at which the particle is at a distance of 22.5 m from point P.

- Area A = $\frac{1}{2} \times (5+20) \times 1 = 17.5$
  Area B = $1 \times 20 = 20$
  Area C = $\frac{1}{2} \times 1 \times 20 = 10$
  } outward journey
- Area D = $\frac{1}{2} \times 1 \times 20 = 10$
  Area E = $\frac{1}{2} \times 20 = 10$
  Area f = $\frac{1}{2} \times 2.5 \times 20 = 25$
  } returning journey
- we need 5 from area B so $17.5 + 5 = 22.5$, $10 \times t = 5 \Rightarrow t = 0.25$
  So 1.25 seconds going out from P.
- A+B+C = 37.5m, so we need $37.5 - 22.5 = 15$m to P, which we get from: using all of D, and $\frac{1}{2}$ of stage E. ($10 + 5 = 15$m) This takes us 4.25 seconds

Answer: 1.25, 4.25 secs

(4 marks)

Q4. The journey of a particle is modelled using the velocity-time graph shown below.



a) Using 3 equal strips, estimate the distance travelled by the particle in the first 6 seconds.

Area A = $\frac{1}{2} \times 2 \times 20 \Rightarrow$ Area A = 20

Area B = $\frac{1}{2}(20 + 23.75) \times 2 \Rightarrow$ Area B = 43.75

Area C = $\frac{1}{2}(43.75 + 11.25) \times 2 \Rightarrow$ Area C = 55

Answer: 118.75 m

(3 marks)

b) (i) Explain whether your answer to part (a) is an under-estimate or an over-estimate of the actual distance travelled.

- The trapezia and triangle are underneath the V-T curve

$\Rightarrow$ under-estimate

Answer: under-estimate

(2 marks)

(ii) Explain how you could have obtained a more accurate answer to part (a) using the graph.

- Use more strips

Answer: Use more strips.

(2 marks)