



SCAN ME

# Velocity-Time Graphs



SCAN ME

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TOPIC

CHECK YOUR  
ANSWERS

1 A cyclist travels along a straight horizontal path between points  $A$  and  $B$ .

In a model of the motion of the cyclist, at time  $t = 0$  the cyclist starts from rest at point  $A$  and accelerates uniformly for 5 seconds until they reach a speed of  $10 \text{ ms}^{-1}$

For the next 30 seconds the cyclist travels at a constant speed of  $10 \text{ ms}^{-1}$  before decelerating uniformly for 2.5 seconds, coming to rest at point  $B$ .

Using the model

(a) Sketch a speed-time graph for the motion of the cyclist between points  $A$  and  $B$ . (1)

(b) Find the acceleration of the cyclist during the first 5 seconds. (1)

(c) Find the deceleration of the cyclist during the final 2.5 seconds. (1)

(d) Find the total distance travelled by the cyclist. (2)

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(Total for Question 1 is 5 marks)





3

In a model of the motion of the car, at time  $t = 0$  the car starts from rest at point  $C$  and moves with constant acceleration  $2.5 \text{ ms}^{-2}$  until it reaches a speed of  $18 \text{ ms}^{-1}$

The car then moves at a constant speed of  $18 \text{ ms}^{-1}$  before it moves with a constant deceleration for 4 seconds as it comes to rest at point  $D$ .

The total time for the journey between  $C$  and  $D$  is 40 seconds.

(a) For this model of the motion of the car between  $C$  and  $D$ ,

- (i) state the time for which the car is accelerating **(1)**
- (ii) state the value of the constant deceleration **(1)**
- (iii) sketch a speed-time graph **(1)**

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(b) Find the distance between points  $C$  and  $D$ . (2)

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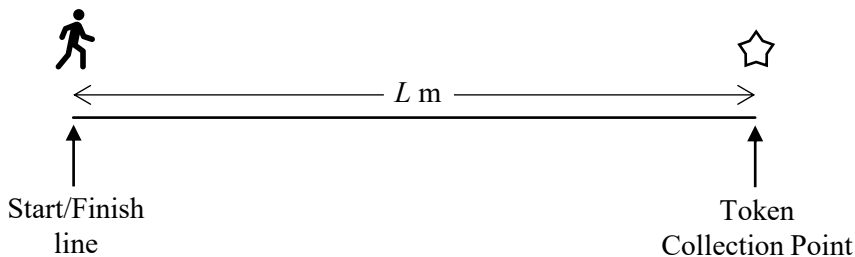
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**(Total for Question 3 is 5 marks)**





- 6 In a gameshow a contestant must run across a straight horizontal bridge of length  $L$  metres. Once they reach the other side, they must collect a token, then run back to the start/finish line.



In the model of the motion, the contestant starts from rest at the start/finish line at time  $t = 0$  then accelerates at a constant rate for 3 seconds, until they reach a velocity of  $6 \text{ ms}^{-1}$

They then maintain a constant velocity of  $6 \text{ ms}^{-1}$  for 12 seconds before decelerating at a constant rate for 3 seconds until they come to rest at the token collection point.

It takes them 5 seconds to find the token, and then they accelerates back towards the start/finish line at a constant rate for 4 seconds until they reach a velocity of  $-6 \text{ ms}^{-1}$

They then maintain at a constant velocity of until they cross the start/finish line at time  $T$  seconds.

Figure 1 shows the velocity time graph for a model of the motion of a contestant on a gameshow.

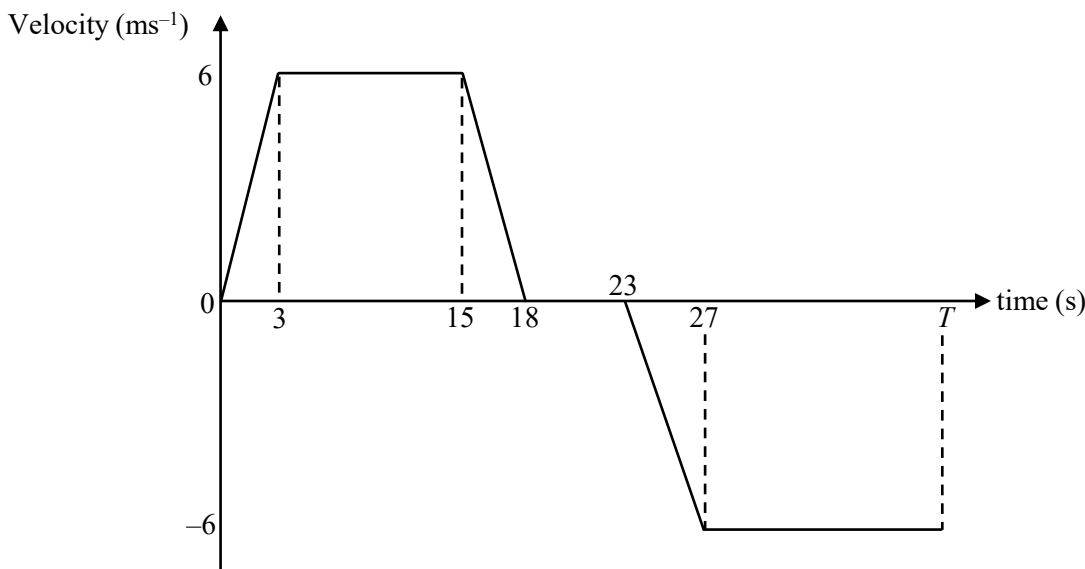


Figure 1





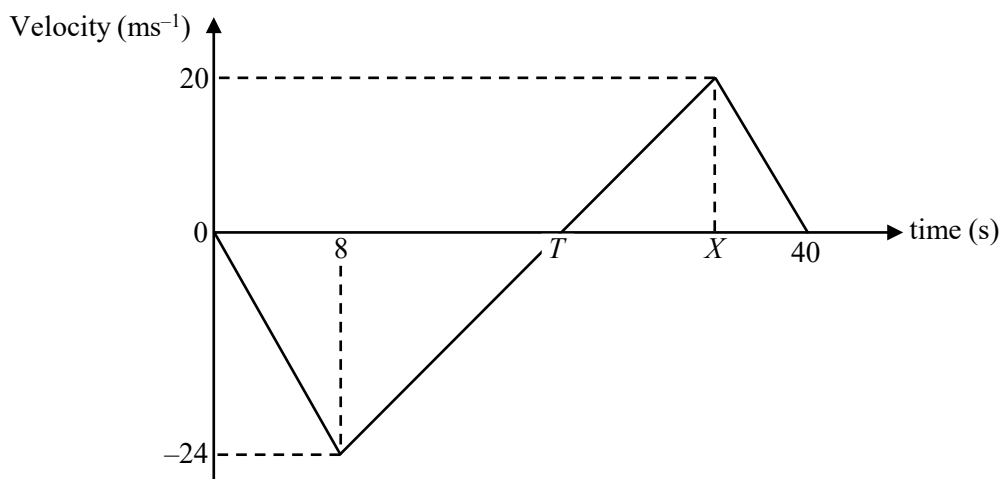


Figure 1

Figure 1 shows a sketch of the velocity-time graph for a model of the motion of a particle travelling in a straight line for 40 seconds.

In a model of the motion, the particle

- moves with uniform acceleration  $A \text{ ms}^{-2}$  between  $t = 0$  and  $t = 8$
- moves with uniform acceleration  $B \text{ ms}^{-2}$  between  $t = 8$  and  $t = X$
- moves with uniform acceleration  $C \text{ ms}^{-2}$  between  $t = X$  and  $t = 40$

(a) Find the value of  $A$  (1)

(b) State the maximum **speed** of the particle during the 40 second journey. (1)

The velocity of the particle is  $0 \text{ ms}^{-1}$  when  $t = 0$ ,  $t = T$  and  $t = 40$ .

The total distance travelled by the particle during the 40 second journey is 446 metres.

(c) Find the value of  $T$  (3)

(d) Find the average velocity for the 40 second journey. (3)

(e) Find the value of  $B$  (1)

(f) Find the value of  $X$  (2)

(g) Find the value of  $C$  (1)



Lined area for writing answers.



(Total for Question 7 is 12 marks)



### Figure 1



9

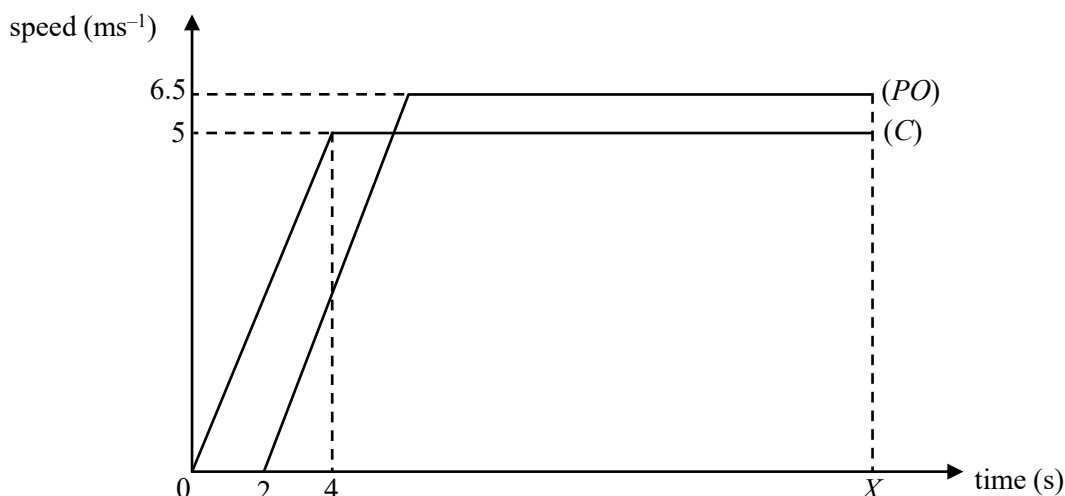


Figure 1

A police officer (*PO*) catches a criminal (*C*). The criminal manages to break free and runs away from the police officer in a straight line along a horizontal road. The police officer chases and eventually catches the criminal.

In a model of their motion, the criminal starts from rest at time  $t = 0$  before travelling with constant acceleration for 4 seconds until they reach a speed of  $5 \text{ ms}^{-1}$ . The criminal maintains a constant speed of  $5 \text{ ms}^{-1}$  until they are caught by the police officer at time  $X$  seconds.

The police officer starts at rest at time  $t = 0$  but remains at rest until time  $t = 2$  when they accelerate with the same acceleration as the criminal until they reach a speed of  $6.5 \text{ ms}^{-1}$ . The police officer maintains a constant speed of  $6.5 \text{ ms}^{-1}$  until they catch the criminal at time  $X$  seconds.

The speed-time graphs shown in Figure 1 describe the model of the motion for the police officer and the criminal.

- Find the value of  $X$ . (5)
- Find the distance travelled by the criminal before they are caught. (2)
- Describe one limitation of the model that could affect your answers to parts (a) and (b). (1)



Lined area for writing answers.



(Total for Question 9 is 8 marks)



10

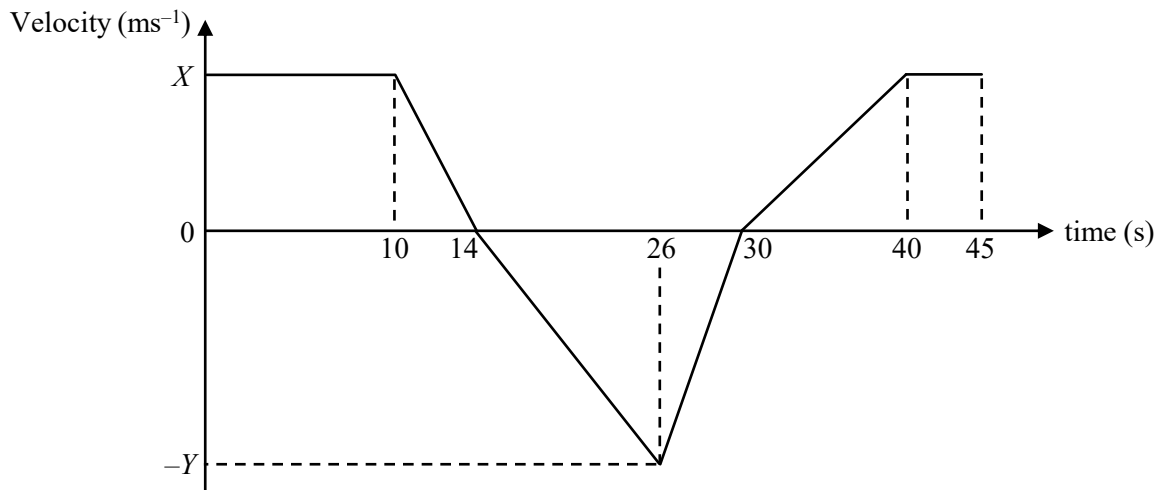


Figure 1

Figure 1 shows a sketch of the velocity-time graph for a model of the motion of a particle travelling in a straight line for 45 seconds.

In a model of the motion, the particle

- moves with constant velocity  $X \text{ ms}^{-1}$ , between the following time intervals.

$$t = 0 \text{ and } t = 10$$

$$t = 40 \text{ and } t = 45$$

- moves with uniform acceleration between the following time intervals

$$t = 10 \text{ and } t = 14$$

$$t = 14 \text{ and } t = 26$$

$$t = 26 \text{ and } t = 30$$

$$t = 30 \text{ and } t = 45$$

The total displacement of the particle when  $t = 30$  is 0 m

The total distance travelled by the particle for the 45 second journey is 289 m

Work out the average velocity for the 45 second journey.

(6)



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**(Total for Question 10 is 6 marks)**

