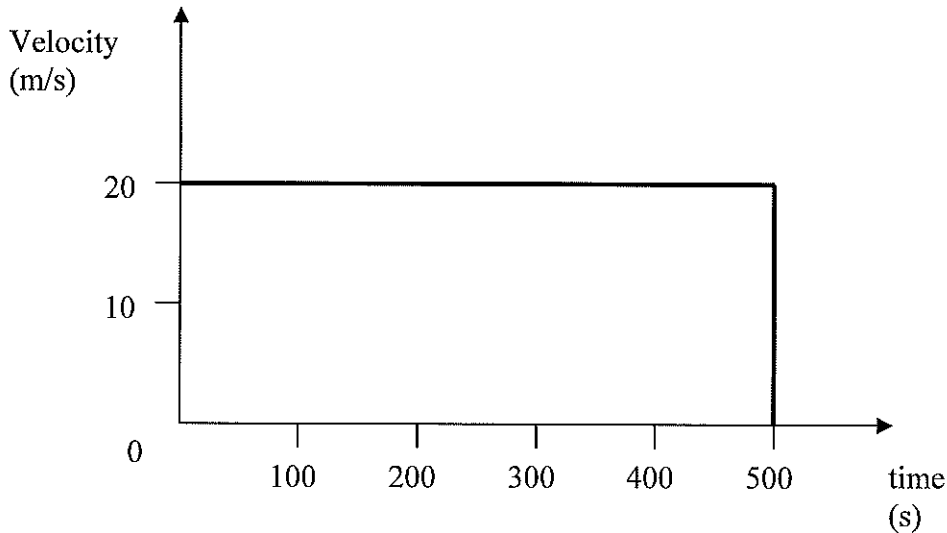


Chapter 6: Calculating the displacement from a velocity time graph (rev A)

Suppose a car were travelling at a velocity of 20 m/s for 500s. The graph would look like this:



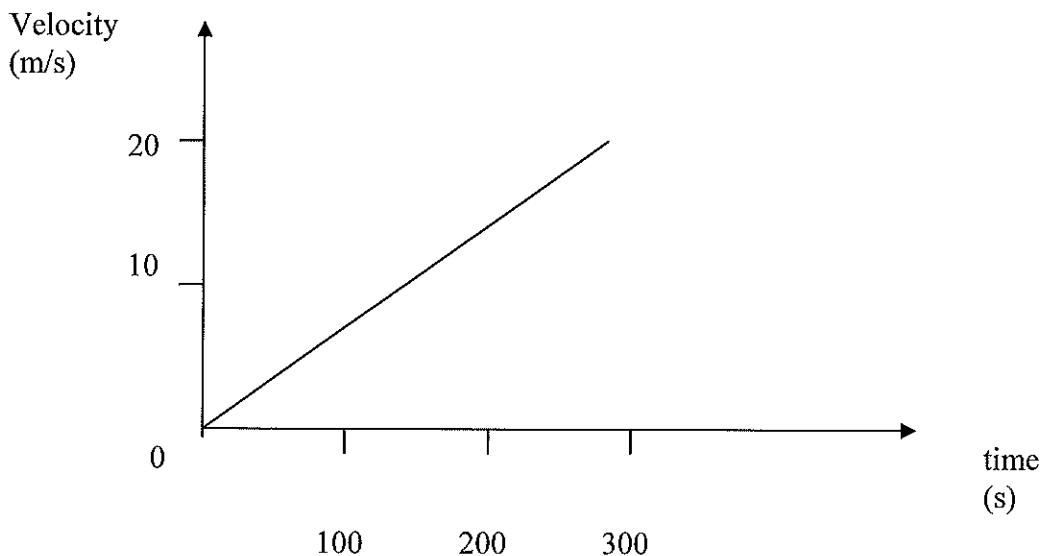
It is easy enough to calculate the final displacement :

$$\begin{aligned}\text{Displacement} &= \text{velocity} \times \text{time} \\ &= +20 \times 500 \\ &= +10,000 \text{ m}\end{aligned}$$

Notice however that the area below the graph (down to the time axis) is also $20 \times 500 = +10,000 \text{ m}$

So displacement = area below the velocity – time graph

Let's try another...



Here a car accelerates from standstill to a velocity of 20 m/s in 300s.

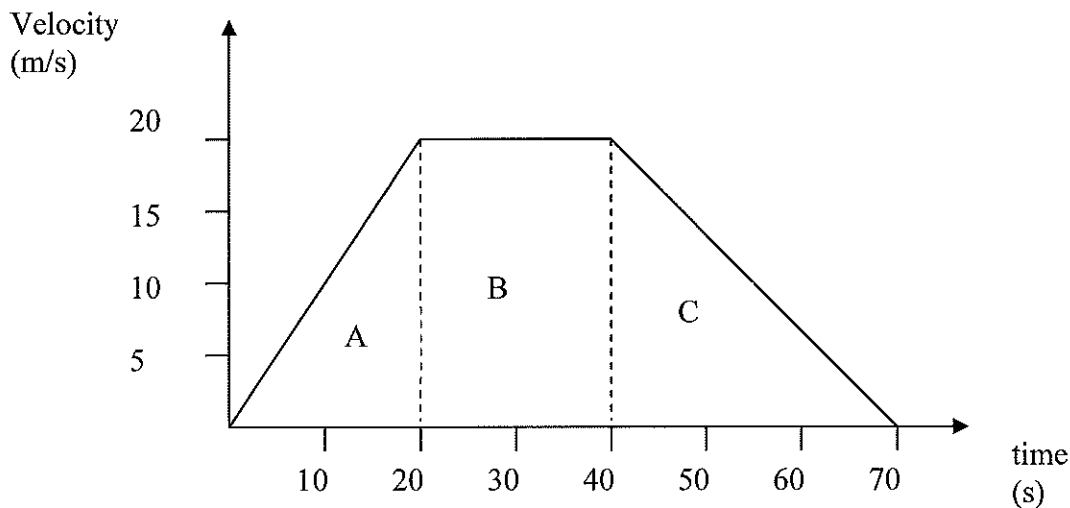
The average velocity is 10 m/s since $(0 + 20) / 2 = 10$

So the displacement at a time of 300s will be given by:

$$\begin{aligned}\text{Displacement} &= \text{average velocity} \times \text{time} \\ &= +(10 \times 300) \\ &= \underline{\underline{+3,000 \text{ m}}}\end{aligned}$$

$$\begin{aligned}\text{Using the area: area of a triangle} &= \frac{1}{2} \times b \times h \\ &= \frac{1}{2} \times 300 \times 20 \\ &= \underline{\underline{+3,000 \text{ m}}} \quad (\text{the same})\end{aligned}$$

Now a slightly harder example:



The car accelerates to 20 m/s, then stays at a constant velocity until 40s, when it starts decelerating to standstill.

Find the displacement at:

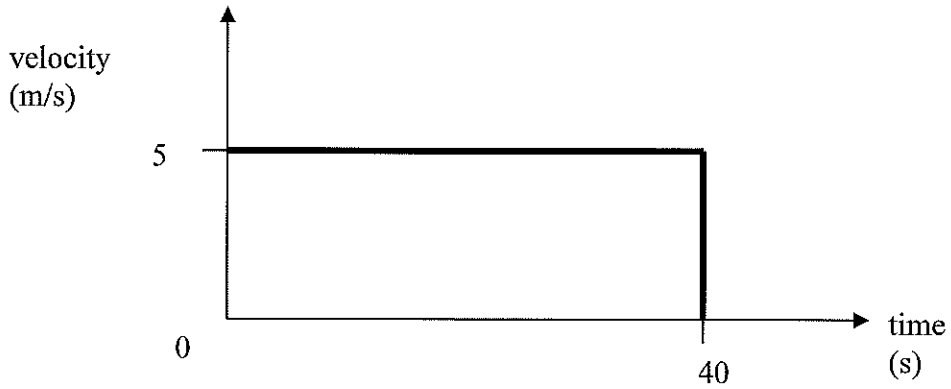
- a) 20s
- b) 40s
- c) 70s

Answers

- a) Displacement at a time of 20s = Area A = $\frac{1}{2} \times b \times h = \frac{1}{2} \times 20 \times 20 = \underline{\underline{200 \text{ m}}}$
- b) Displacement at a time of 40s = Area A + Area B = $200 + (20 \times 20) = \underline{\underline{600 \text{ m}}}$
- c) Displacement at a time of 70s = (Area A + Area B) + Area C
= $600 + (\frac{1}{2} \times 30 \times 20)$
= $\underline{\underline{900 \text{ m}}}$

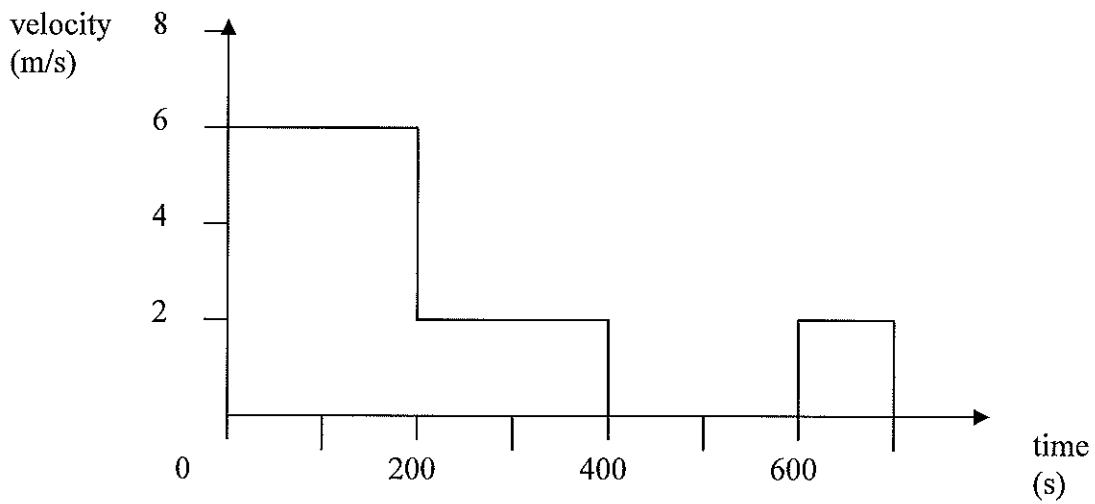
Questions

1. Calculate (using the area) the final displacement



2. Calculate the displacement at :

- a) 200s
- b) 400s
- c) 700s



3. Calculate the displacement at :

- a) 15s
- b) 20s
- c) 30s

