Vectors and Velocity

We found speed, our change in distance,

How do we measure our change in displacement (position)?

Vectors

A Vector is: a quantity w/ a direction and a magnitude (how much)
eg, displacement, velocity, acceleration, force.

A Scalar is: a quantity with only a magnitude.
eg, distance, time, mass, energy

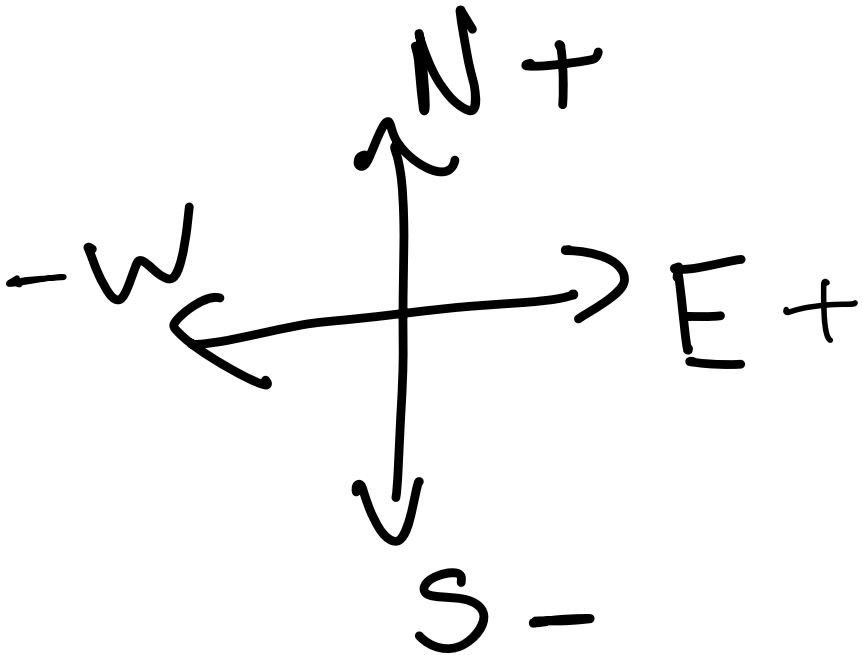
Vectors

Which quantities have we used that are vectors and scalars?

Vectors

With vectors, we need to specify direction.

We've already used 3 methods:



5m W, 6m E, 7m W

$\vec{d} = -5m + 6m - 7m$

$= -6m.$

Change in Displacement

We calculated that a change in distance gave us speed.

A change in displacement (or position) gives us the velocity

Velocity: A change in displacement (position), relative to a starting point, over a time period

$$v = \frac{d}{t} \qquad \vec{v} = \frac{\vec{d}}{t}$$

Velocity

Our formula for velocity is just like the formula for speed, but we need to account for direction.

$$\vec{v} = \frac{\vec{d}}{t}$$

velocity

Our formula for velocity is just like the formula for speed, but we need to account for direction.

$$\overrightarrow{v_{avg}} = \frac{\overrightarrow{\Delta d}}{\Delta t}$$

Velocity

Example: Johnny walked 55m North in 20 seconds. What was his average velocity?

$\vec{d} = 55\text{m N}$

$t = 20\text{s}$

$\vec{v} = \frac{\vec{d}}{t} = \frac{+55\text{m}}{20\text{s}}$

$= 2.75\text{ m/s}$

$= 2.8\text{ m/s N}$

Velocity

Example: Johnny walked 55m North and then 20 m South. The entire journey took 30 seconds. What was his average velocity?

$\vec{d} = +55\text{m} - 20\text{m}$

$= +35\text{m}$

$t = 30\text{s}$

$\vec{v} = \frac{\vec{d}}{t} = \frac{35\text{m}}{30\text{s}}$

$= 1.2\text{ m/s N}$

Velocity

Example: Johnny had an average velocity of 15.0 m/s North for 26.5 seconds. What was his final displacement.

$$\vec{v} \times t = \vec{d}$$

Velocity

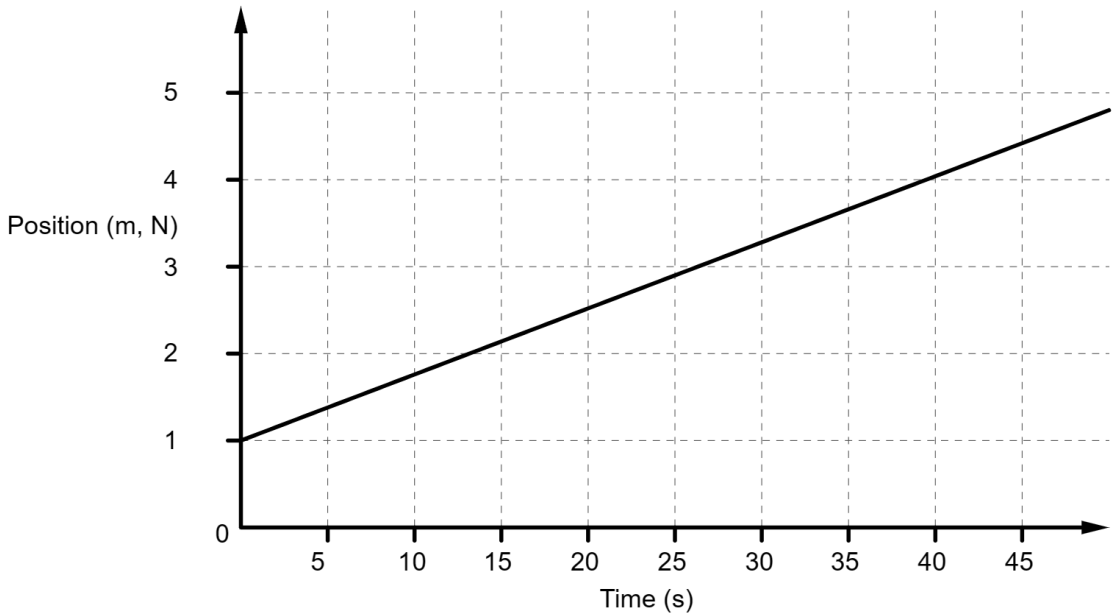
Example: Johnny started at a position of 16 m North. He maintained an average velocity of 4.0 m/s South for 26 seconds. What is his final position?

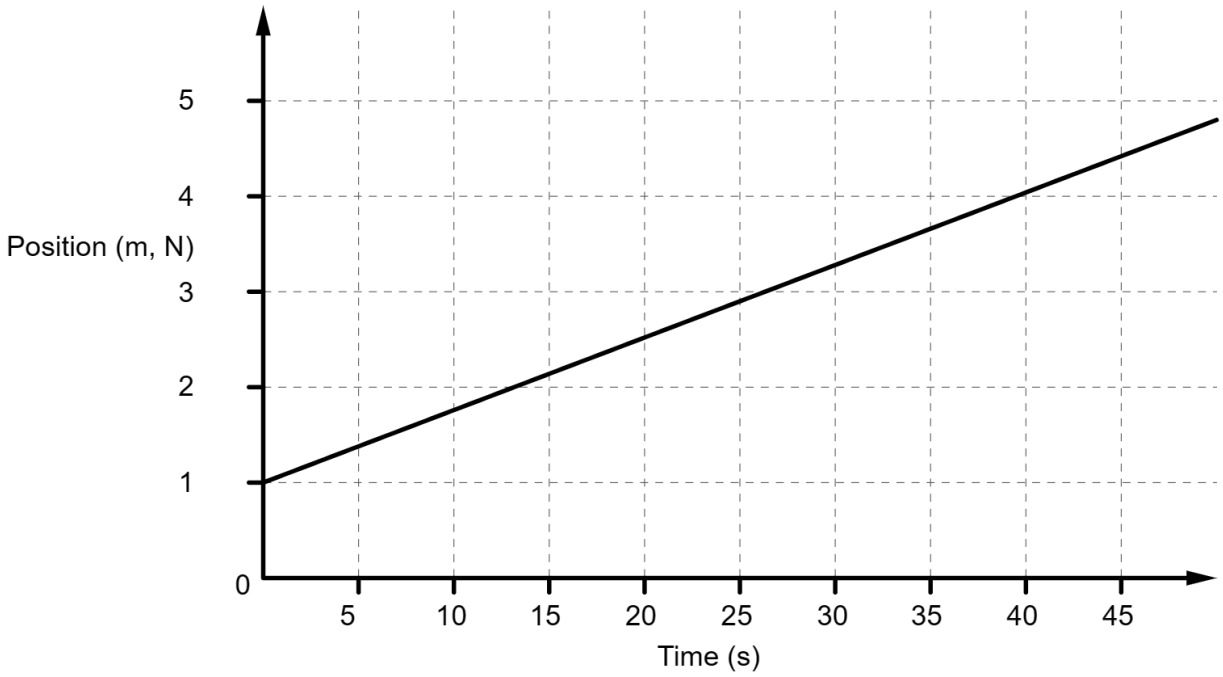
Velocity

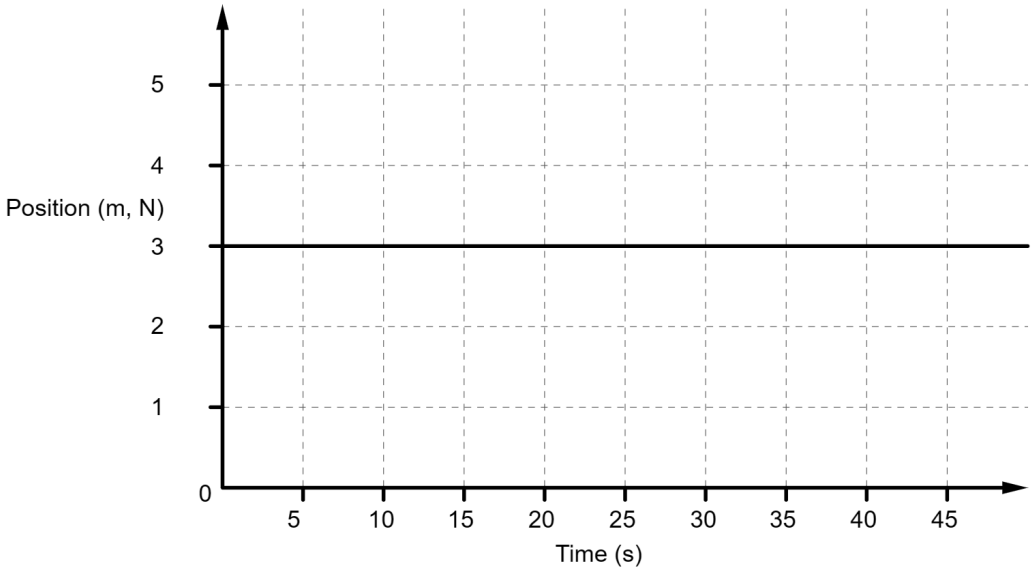
Workbook practice pg 9 (labelled velocity practice).

Graphing Displacement

We’ve seen graphs of distance and speed, but what about graphing displacement?




Position (m, N)
0
1
2
3
4
5
5
10
15
20
25
30
35
40
45
Time (s)


Position (m, N)
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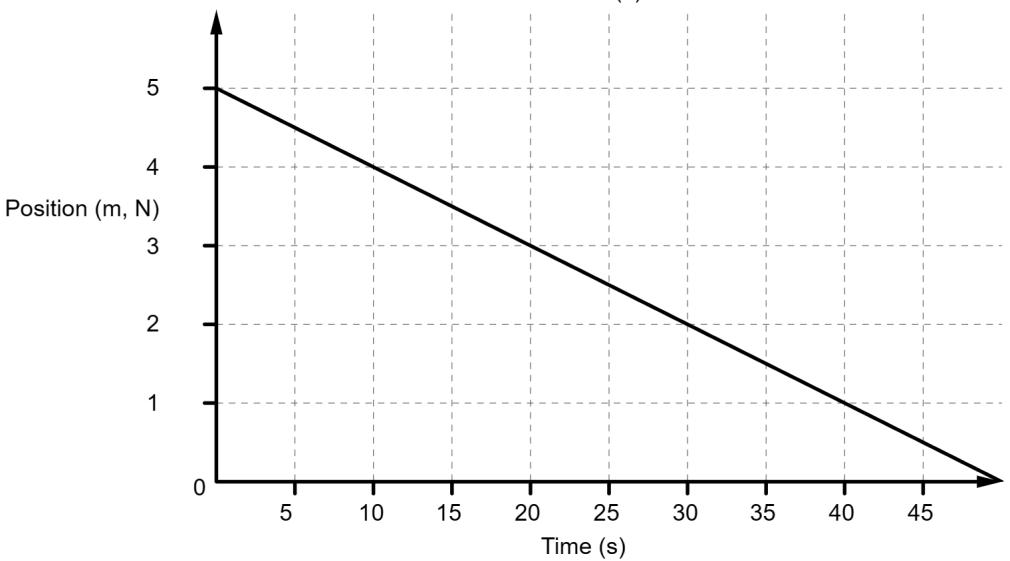
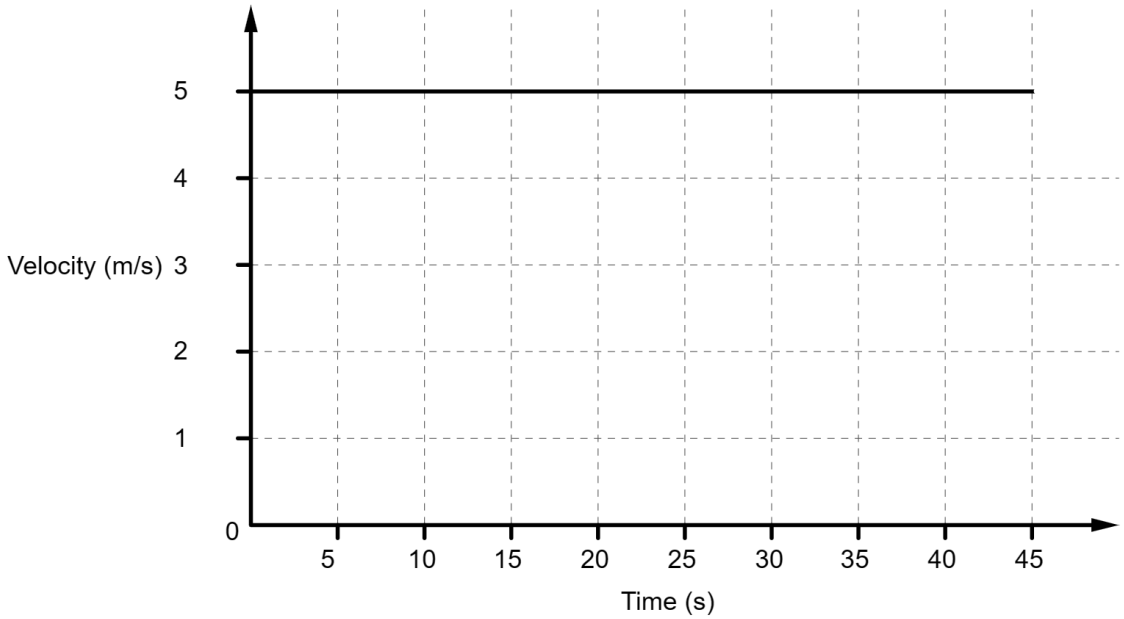
4
5
5
10
15
20
25
30
35
40
45
Time (s)


Position (m, N)
0
1
2
3
4
5
5
10
15
20
25
30
35
40
45
Time (s)

Graphing Velocity

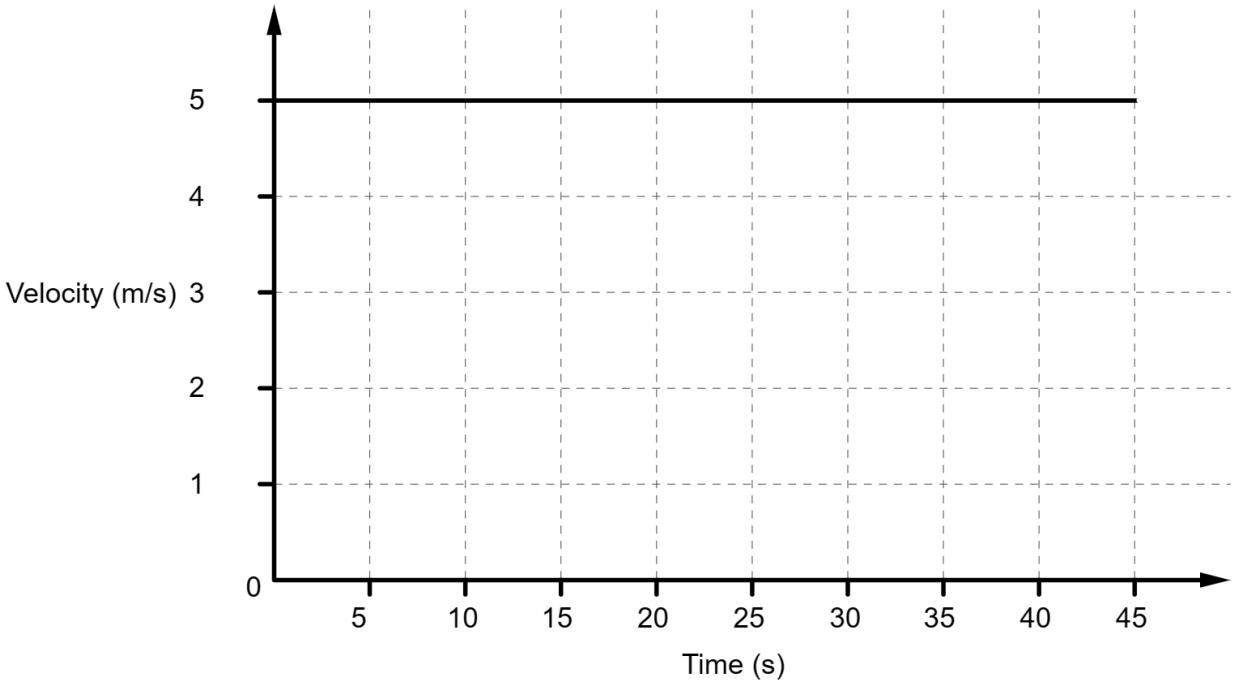
When we graphed speed vs time, the area gave us the distance.

What is the area under a velocity-time graph?

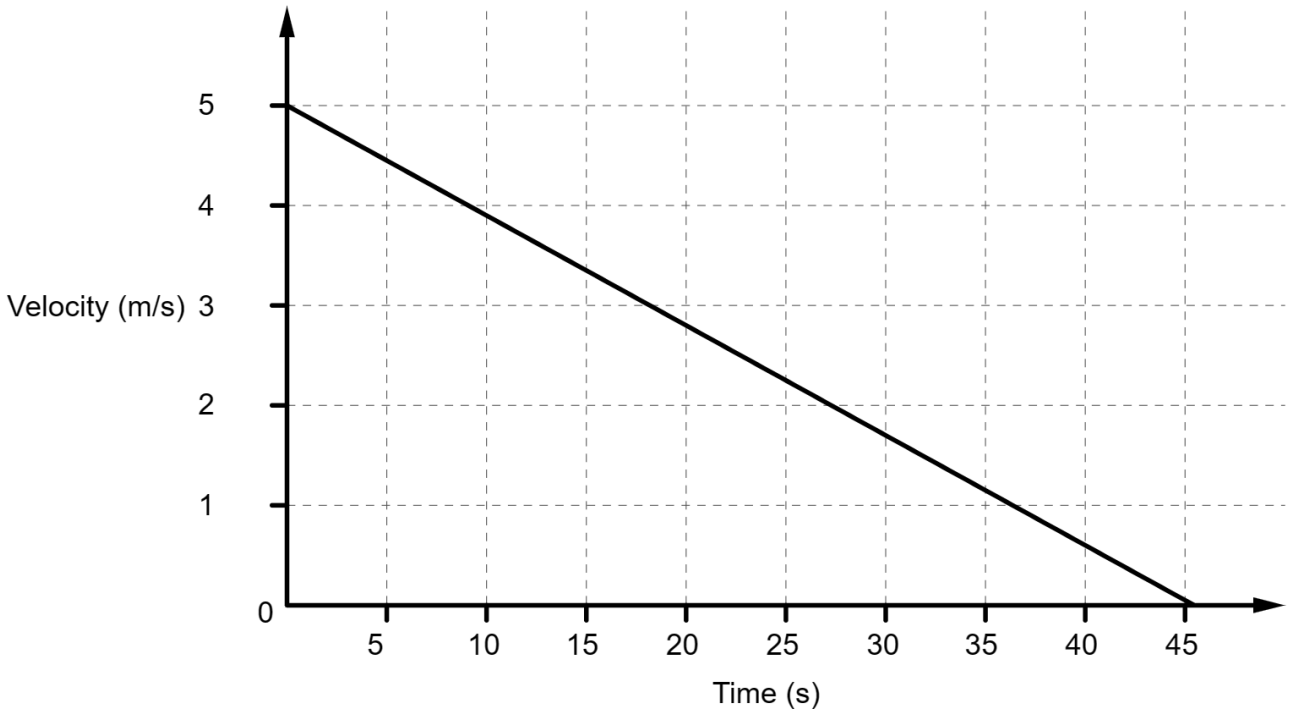


Graphing Velocity

What is the position after 45 s?

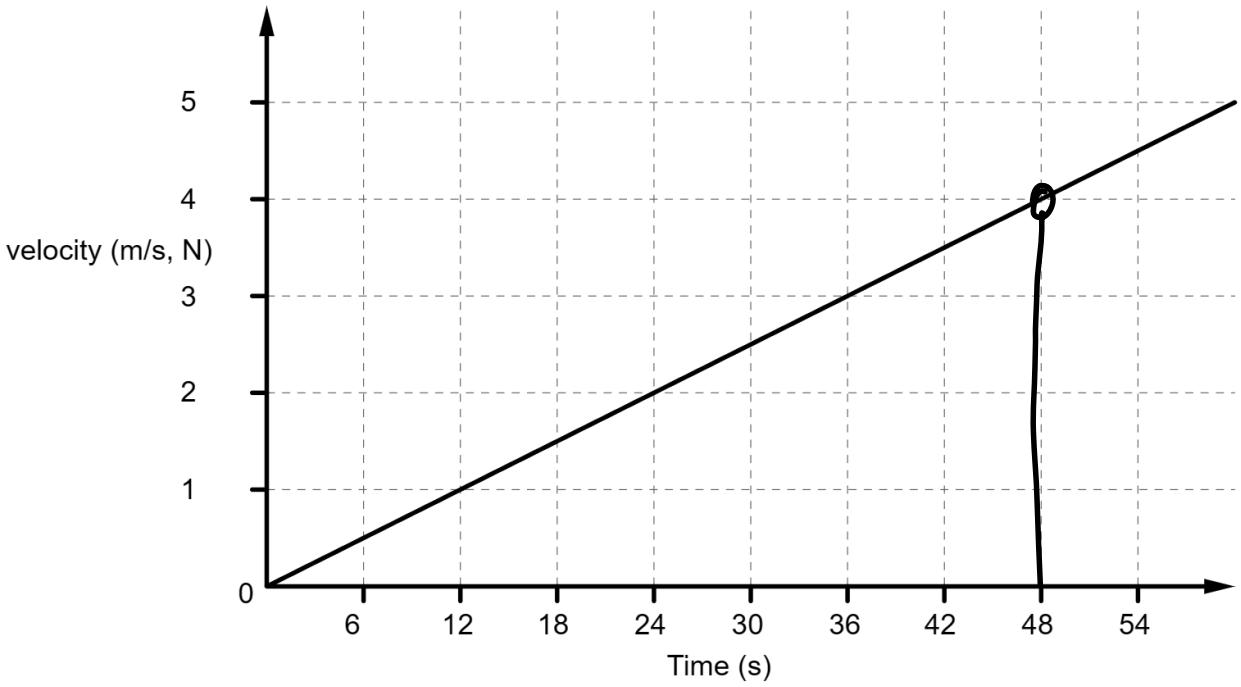


Graphing Velocity



Graphing Velocity

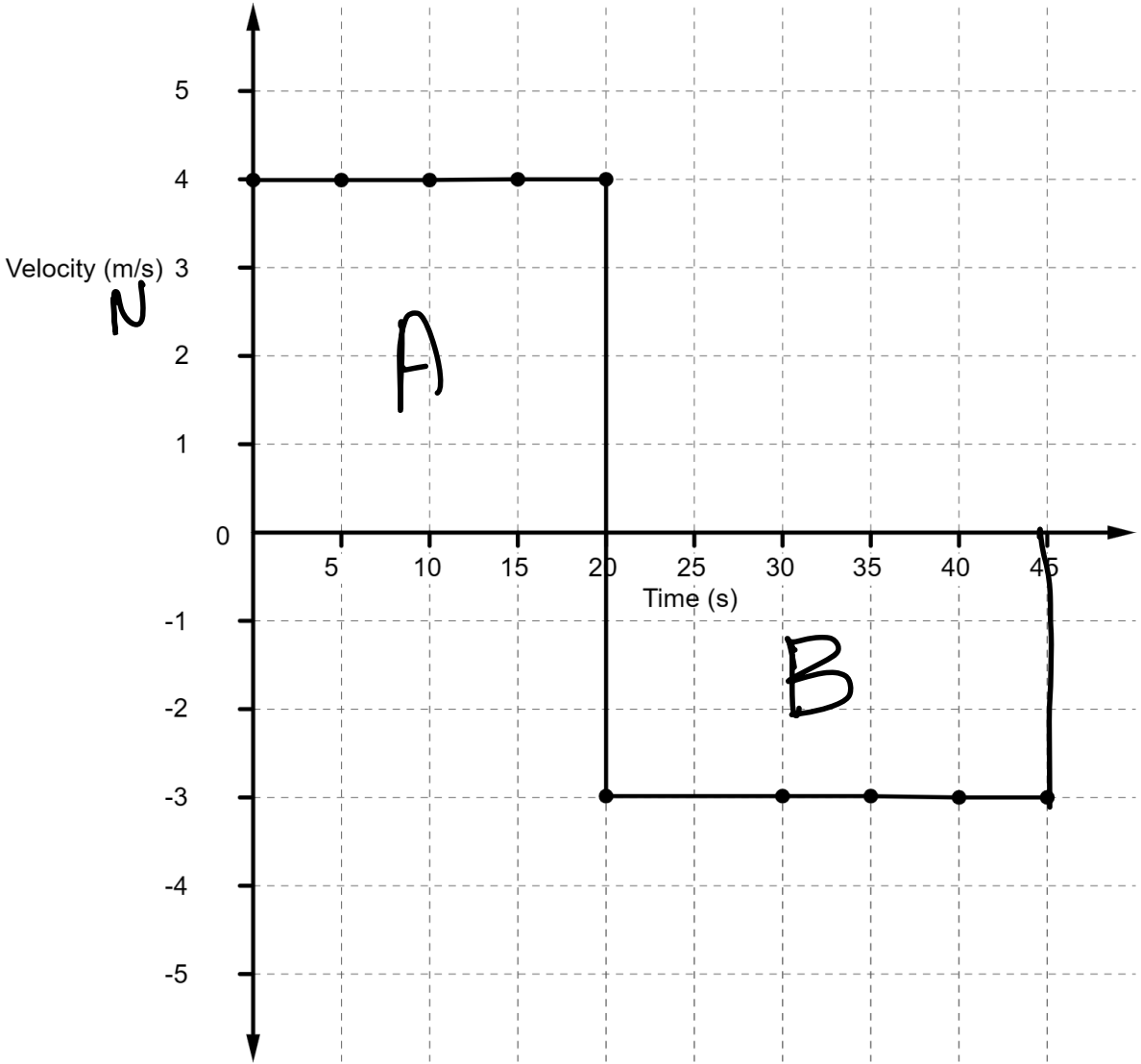
What is the position after 48 s?



$$A = \vec{d} = \frac{b \times h}{2}$$

$$= \frac{48s \times 4m/s}{2}$$

$$= 96m\ N$$



Challenge

What is the distance travelled?

The displacement?

$A = 20s \times 4\,m/s$

$= 80m\,N$

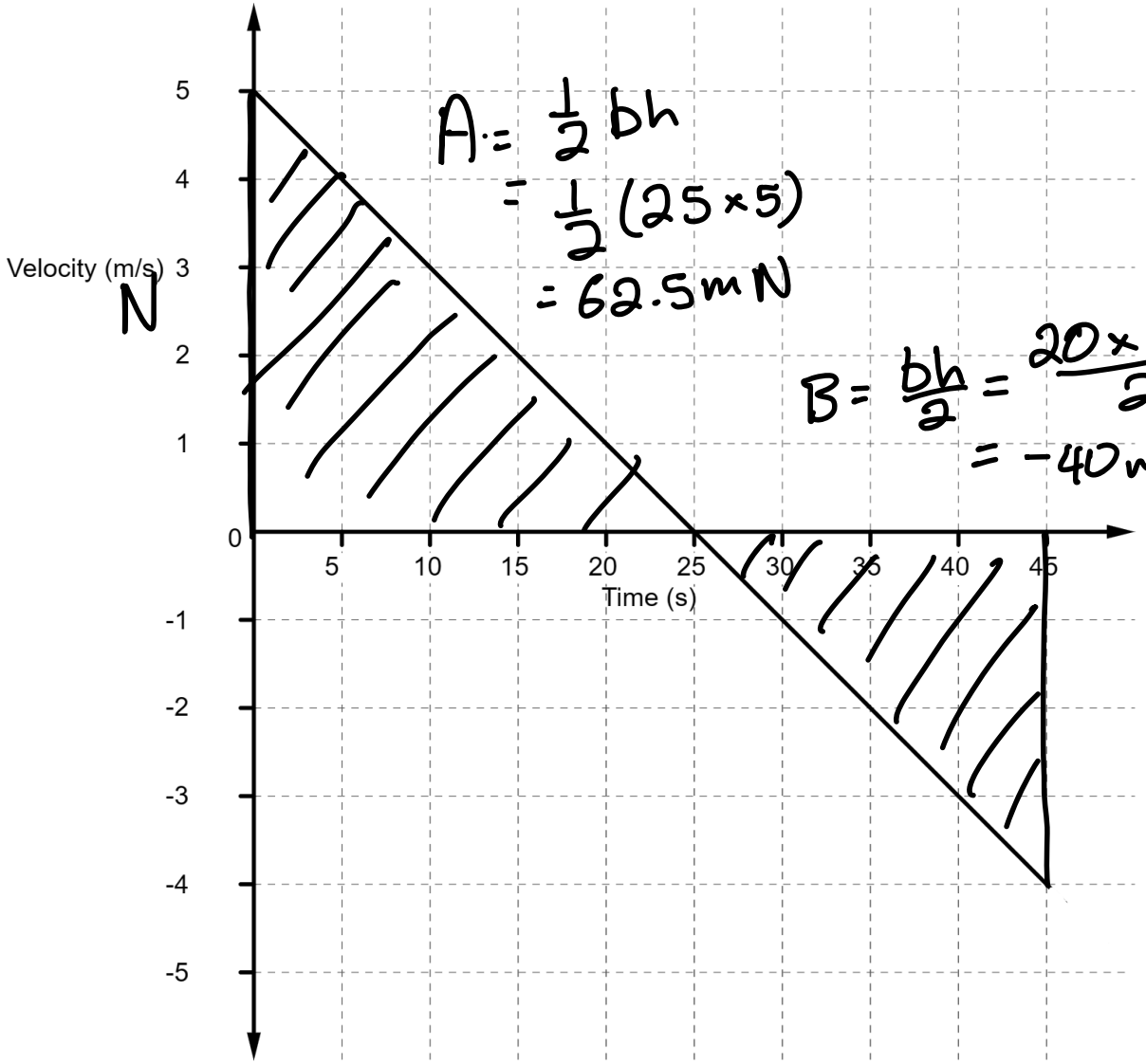
$B = 25s \times -3\,m/s$

$= -75m = 75m\,S$

$d = 155m$

$\vec{d} = 5m\,N$

Challenge



What is the distance travelled?

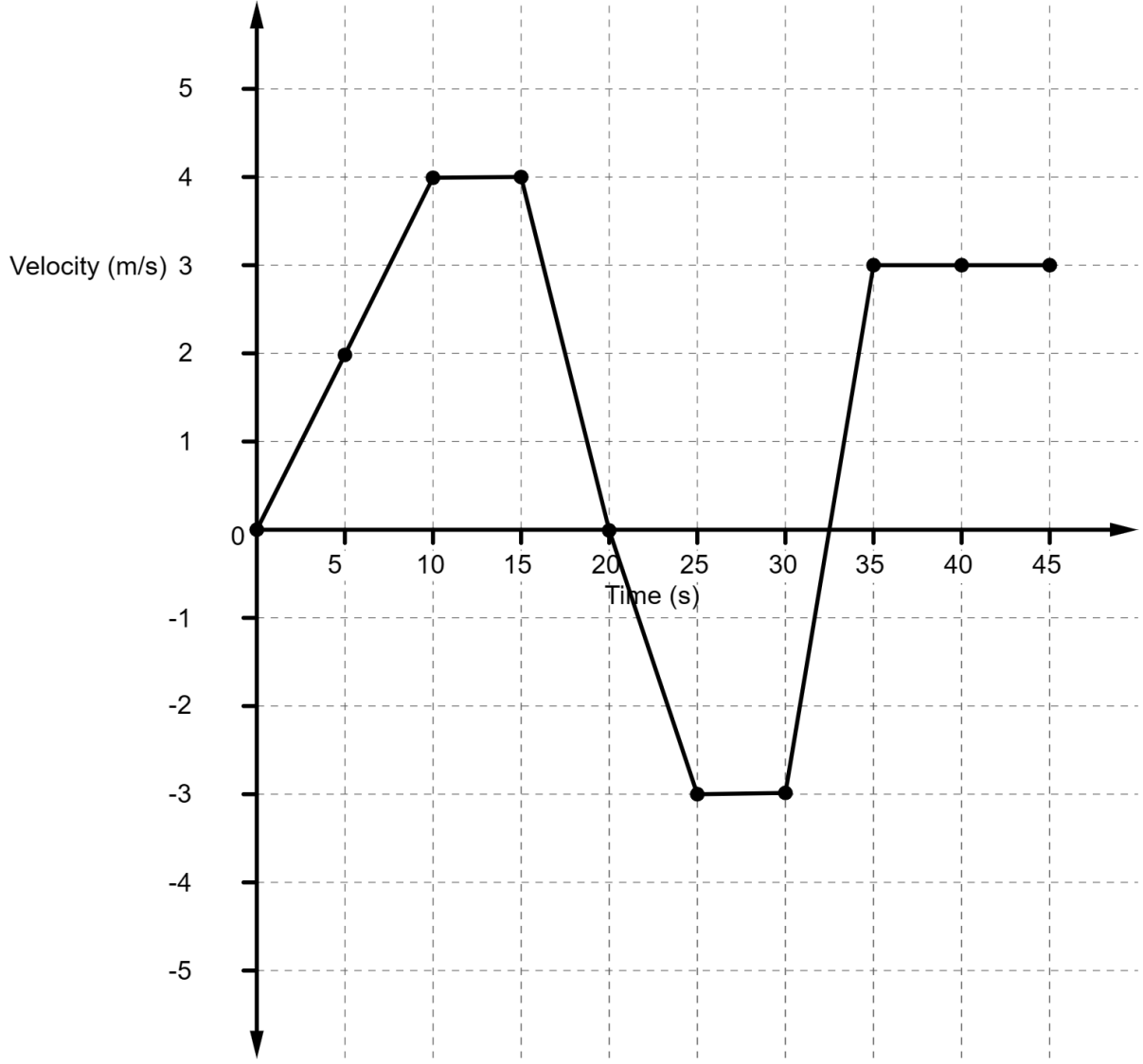
The displacement?

$d = 62.5 + 40$

$= 102.5\text{m}$

$\vec{d} = +62.5 - 40$

$= 22.5\text{m, N.}$



Challenge

What is the distance travelled?

The displacement?