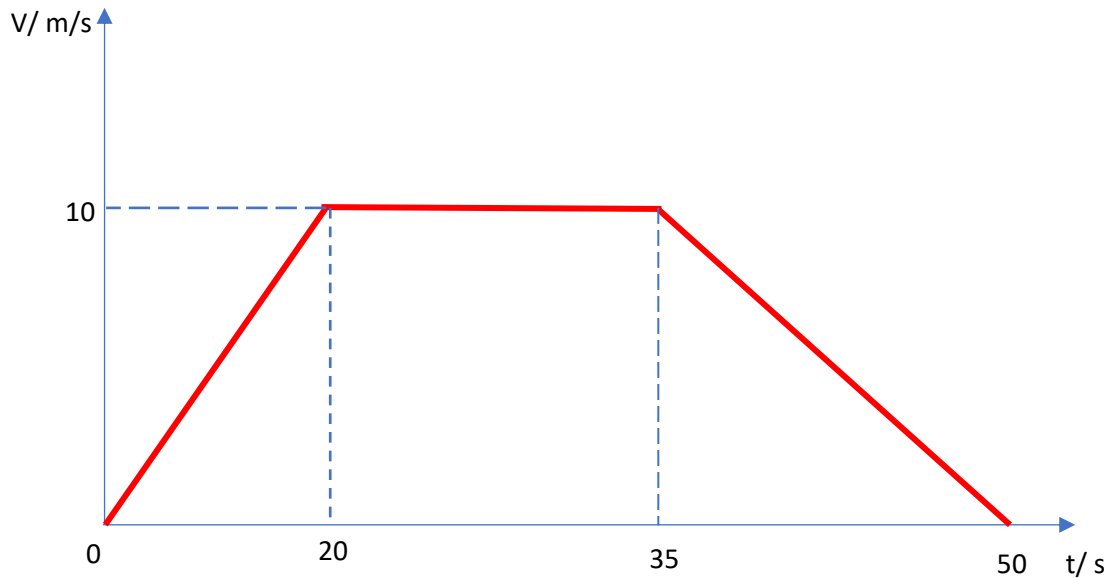


## Velocity - Time Graph

1. The diagram shows **Velocity-Time graph** of a car moving along a straight road.
  - a. Find the acceleration in the **first 20 s**.
  - b. Find the acceleration in the **last 15s**.
  - c. Find a **total distance** travelled



- a) The line on the Velocity - Time graph represents acceleration of the object. The acceleration can be found by calculating the gradient of the line.

$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

In the first 20 seconds of car's movement:

$$y_2 - y_1 = 10 - 0 = 10$$

$$x_2 - x_1 = 20 - 0 = 20$$

$$\text{Acceleration} = \text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{10}{20} = 0.5 \text{ m/s}^2$$

- b) In the last 15 seconds of car's movement:

$$y_2 - y_1 = 0 - 10 = -10$$

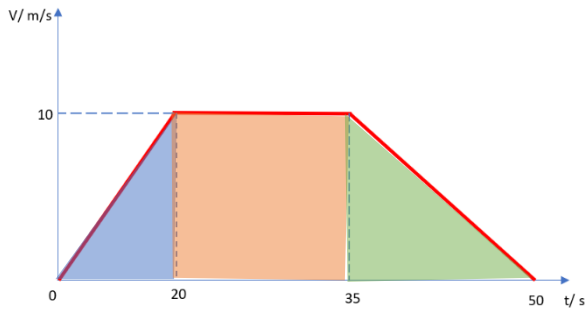
$$x_2 - x_1 = 50 - 35 = 15$$

$$\text{Acceleration} = \text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-10}{15} = -0.67 \text{ m/s}^2$$




## Velocity - Time Graph

c) Total distance can be calculated by finding the total area under the graph.

To find the area we can:



(i) divided the area into smaller areas:

2 triangles:  and   
1 rectangle: 

$$\text{Area of triangle} = \frac{a \times b}{2}$$

$$\text{Area of rectangle} = a \times b$$

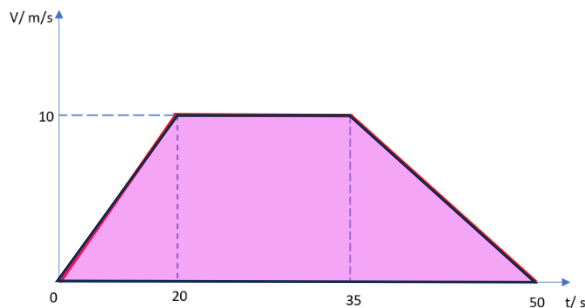
$$\text{Area } \triangle = \frac{20 \times 10}{2} = 100$$


$$\text{Area } \square = 15 \times 10 = 150$$

$$\text{Area } \triangle = \frac{15 \times 10}{2} = 75$$

**Distance travelled** = Total area:  $100 + 150 + 75 = 325$

**Distance travelled** = 325 m



(ii) or we can calculate the area of trapezium: 

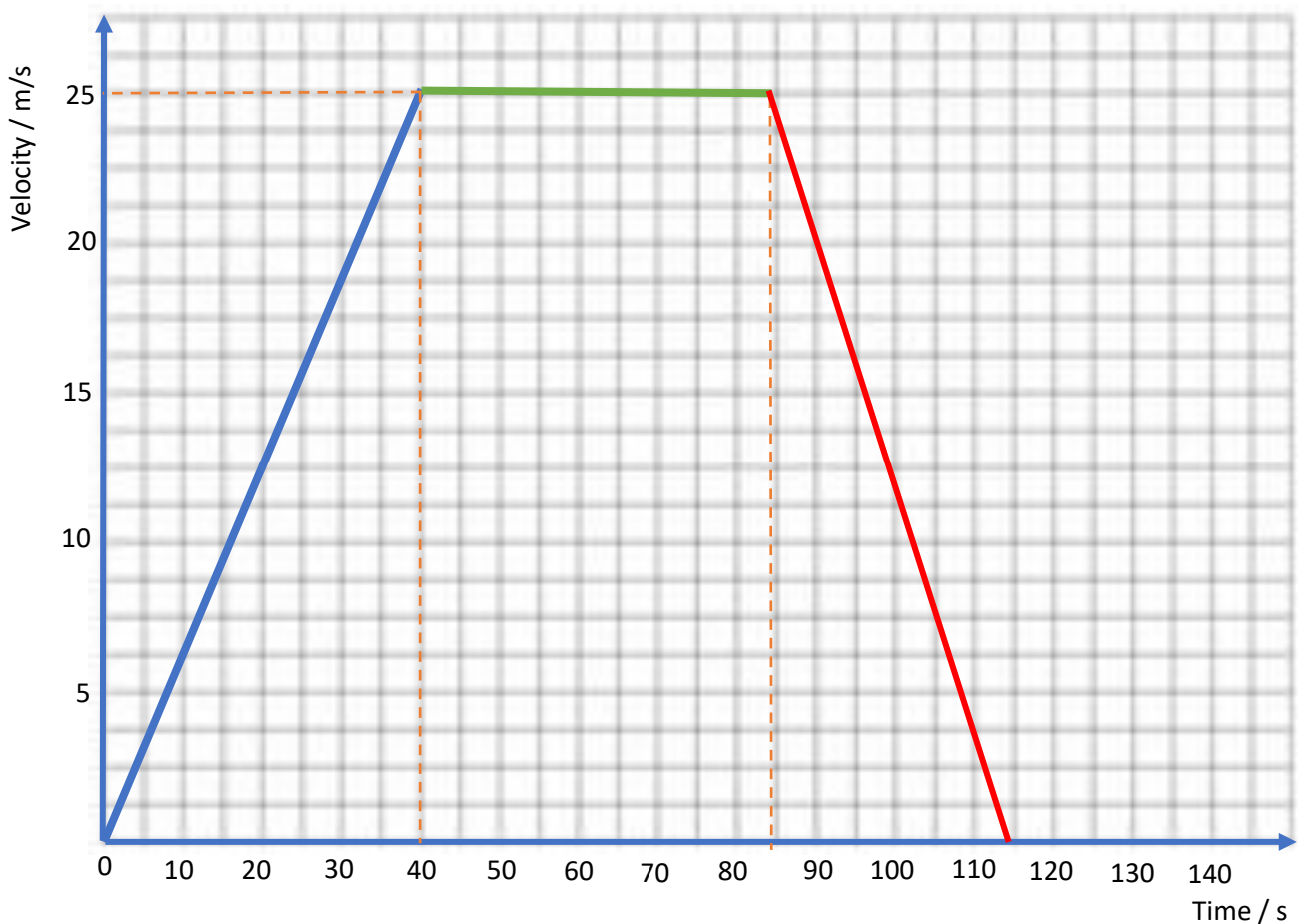
$$\text{Area of trapezium} = \frac{a+b}{2} h$$

$$\text{Area } \text{trapezium} = \frac{15+50}{2} \times 10 = 325$$

**Distance travelled** = 325 m

## Velocity - Time Graph

2. A car starts from **rest** on a straight road. The car uniformly accelerates for **40 seconds**, reaching the **velocity of 25 m/s**. Then the car travels at a **constant speed** of **25 m/s** for **t seconds**. The car finally decelerates at a constant rate coming to **rest** in a further **30 seconds**.
- Find the acceleration in the first **40 s**.
  - Given that the distance travelled in **2 km**. Find the value of **t**
  - Sketch **Velocity-Time graph**.



- a) The line on the Velocity-Time graph represents the acceleration. To calculate the acceleration, we need to calculate the gradient of the class.
- $$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{25 - 0}{40 - 0} = 0.63$$
- therefore, acceleration = 0.63 m/s<sup>2</sup>

## Velocity - Time Graph

b) The total distance = 2 km = 2000m

(i) distance travelled during the first 40 seconds

$$S = ut + \frac{1}{2} at^2 = 0 \times 40 + \frac{1}{2} \times 0.63 \times 40^2 = 504 \text{ m}$$

(ii) acceleration in the last 30 seconds of journey:

$$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 25}{30} = -0.83$$

therefore, acceleration = -0.83 m/s<sup>2</sup>

Therefore, distance travelled during the last 30 seconds

$$S = ut + \frac{1}{2} at^2 = 25 \times 30 + \frac{1}{2} \times (-0.83) \times 30^2 = 376.5 \text{ m}$$

Distance travelled with the constant speed :

$$2000 - 504 - 376.5 = 1,119.5 \text{ m}$$

t - time taken for the traveling that distance with the constant speed of 25 m/s

$$\text{time} = \frac{\text{Distance}}{\text{Speed}} = 1119.5 / 25 = \underline{44.78 \text{ seconds}}$$

c) knowing now all the result we can plot the graph.