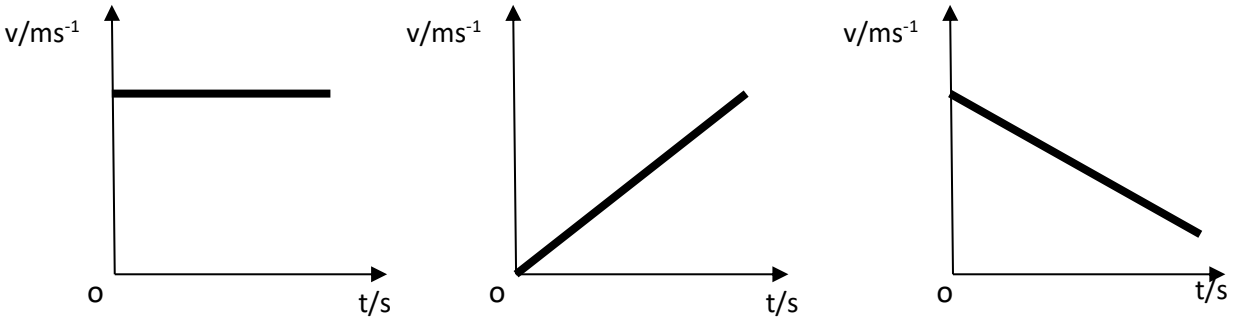
Graphs

N4

Speed – Time Graphs

A speed-time graph is a useful way of describing the motion of an object.
Since speed is a scalar quantity, a speed-time graph considers motion in one direction only.

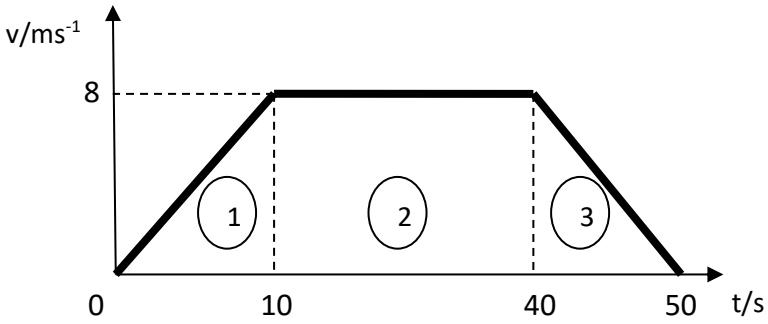
The graphs below illustrate the 3 types of motion you will study.



constant speed | **increasing speed (constant acceleration)** | **decreasing speed (constant deceleration)**

The steeper the line (larger gradient) the greater the acceleration

Example: The motion of a car over 50 s is described in the speed-time graph below.



a) Calculate the acceleration of the car during the first 10 s.
b) Calculate the distance travelled by the car for the entire 50 s.

Solution

a) a = ?
v = 8 ms^{-1}
u = 0 (at rest)
t = 10 s

$a = \frac{v - u}{t}$

$a = \frac{8 - 0}{10}$

$a = 0.8\ ms^{-2}$

b) **To calculate the distance travelled we cannot use d = vt as the speed is not constant throughout the journey.**
The distance travelled = area under the speed-time graph
Area 1 = ½ (10 x 8) = 40 (area of right angled triangle)
Area 2 = 30 x 8 = 240 (area of rectangle)
Area 3 = ½ (10 x 8) = 40 (area of right angled triangle)

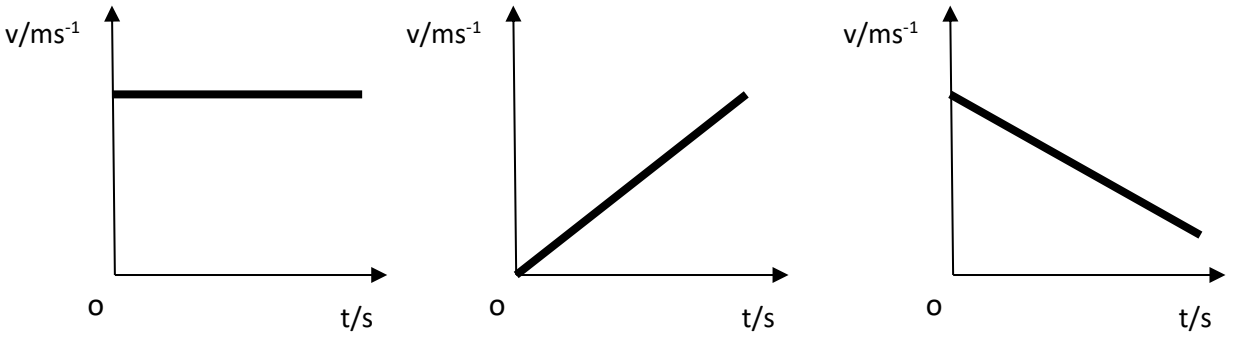
Total area = 40 + 240 + 40 = 320 so distance travelled = 320m

N5

Velocity – Time Graphs

A velocity-time graph is a useful way of describing the motion of an object.
Since velocity is a vector quantity, a velocity-time graph can consider motion in two directions.

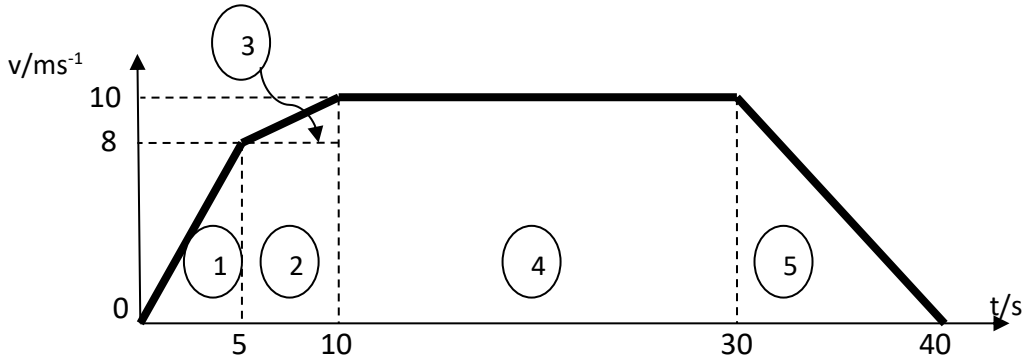
The graphs below illustrate the 3 types of motion you will study.



constant velocity | **increasing velocity (constant acceleration)** | **decreasing velocity (constant deceleration)**

The steeper the line (larger gradient) the greater the acceleration

Example: The motion of a car over 40 s is described in the velocity-time graph below.



a) During which stage of the journey is the acceleration of the car the greatest?
b) Calculate the deceleration of the car between 30 and 40 s.
c) Calculate the displacement of the car for the entire 40 s.

Solution

a) Between 0 and 5 s. **(the gradient of the line is greater than 5 s to 10 s)**

b) a = ?
v = 0
u = 10ms^{-1}
t = 10s

$a = \frac{v - u}{t}$

$a = \frac{0 - 10}{5}$

$a = -2\ ms^{-2}$ deceleration = $2ms^{-2}$

c) Displacement = area under the velocity-time graph

Area 1 = ½ (5 x 8) = 20
Area 2 = 5 x 8 = 40
Area 3 = ½ (5 x 2) = 5
Area 4 = 20 x 10 = 200
Area 5 = ½ (10 x 10) = 50

Total area = 20 + 40 + 5 + 200 + 50 = 315 so the displacement = 315 m