

# Velocity time graphs

All answers to calculations should be to 2 significant figures.

1. What does the gradient of a velocity time graph represent?

Acceleration of the object

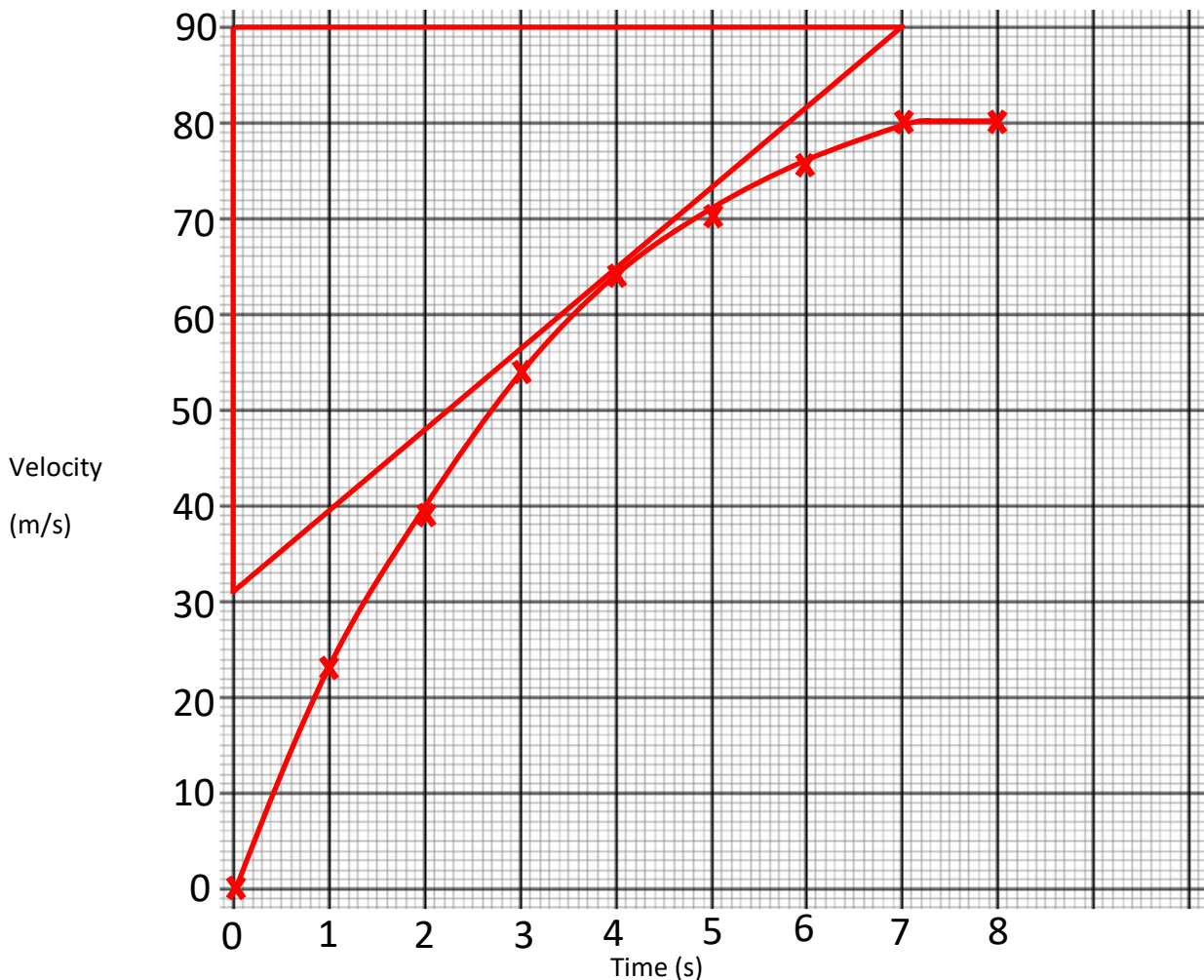
2. What does the area under the graph line of a velocity time graph represent?

Distance travelled

3. Nicola used a motion sensor and data logger to collect the time and velocity of a toy car rolling down wooden ramp, which is written in the table below.

| Time(s)        | 0 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
|----------------|---|----|----|----|----|----|----|----|----|
| Velocity (m/s) | 0 | 23 | 39 | 54 | 64 | 70 | 75 | 80 | 80 |

Using the data above, plot the graph on the paper below



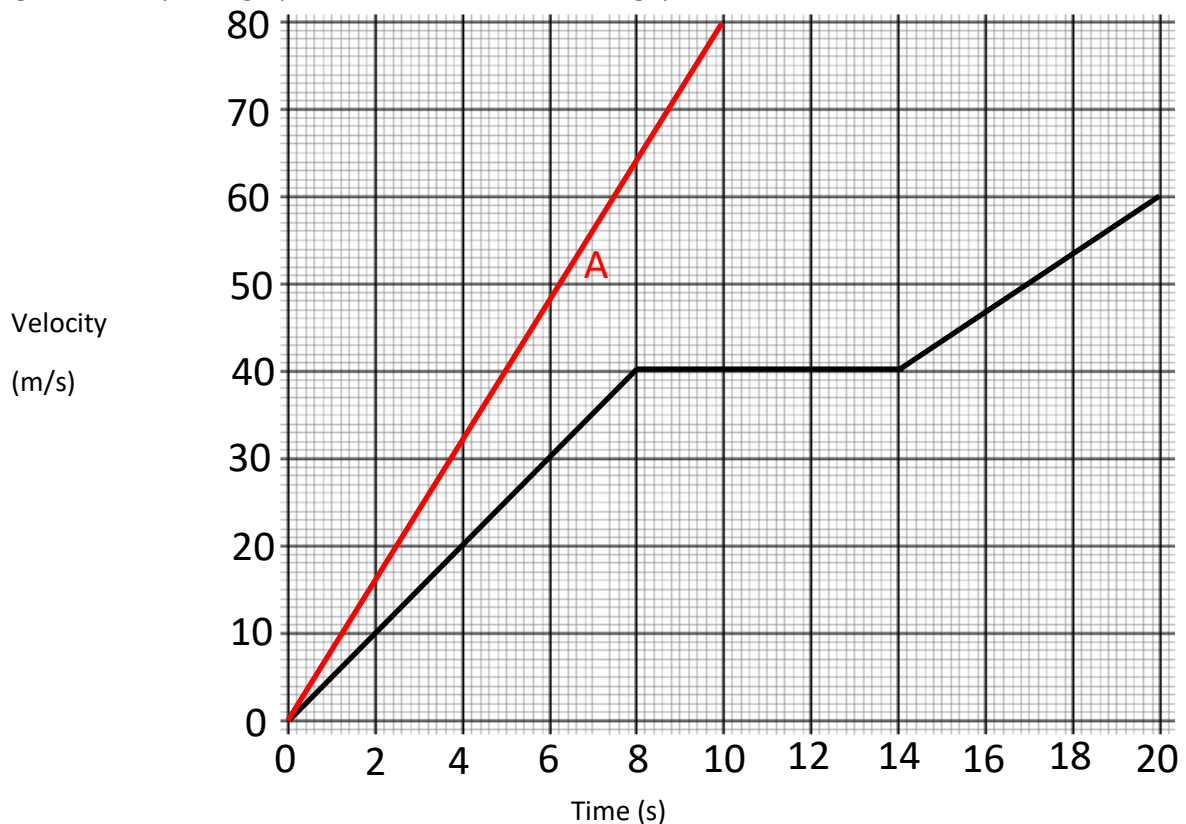
3a. Using the graph above calculate the acceleration of the object at 4 seconds. Remember to show your workings on the graph.

Draw a tangent to the line at 4 seconds, then calculate the gradient.

$$\text{Gradient (acceleration)} = \frac{90 - 31}{7 - 0} = \frac{59}{7} = 8.4\text{m/s}^2$$

Allow an answer of 8.3 to 8.5

4. Using the velocity time graph below answer the following questions.



4a. Calculate the acceleration of the object between 0 to 8 seconds.

Calculate the gradient of the line from 0-8 seconds

$$\text{Gradient (acceleration)} = \frac{40 - 0}{8 - 0} = 5\text{m/s}^2$$

4b. How far does the object move between 0 to 14 seconds

Split the graph into two sections a triangle (0-8 seconds) and a rectangle (8-14 seconds).

Calculate the area of both the triangle and the rectangle. Area under the graph will give the distance travelled.

$$\text{Area of triangle (distance travelled 0 - 8 seconds)} = \frac{1}{2} \times 8 \times 40 = 160 \text{ m}$$

$$\text{Area of rectangle (distance travelled 8 - 14 seconds)} = 6 \times 40 = 240\text{m}$$

The 6 comes from 14 seconds-8 seconds.

Now add the areas to find the total area and total distance from 0 to 14 seconds.

$$160\text{m} + 240\text{m} = 400\text{m}$$

4c. Calculate the average velocity between 14 and 20 seconds

During the 14-20 second time span the minimum velocity is 40m/s and maximum velocity is 60m/s.

So, average velocity is the mean of these two

$$(40+60)/2 = 50\text{m/s}$$

**4d. On the graph above sketch a graph line between 0 to 10 seconds for an object that has a uniform acceleration of  $8\text{m/s}^2$ . Label this line A.**

As the object has uniform acceleration, this means that the line on the velocity time graph will be a straight line. The line will start at 0,0 and end at 80,10. This is because if you multiply the acceleration by the time period of 10 seconds you will obtain a velocity of 80m/s.