

Section 1: Displacement and distance

Section test

1. The displacement from O of a particle moving along a straight line is given by

$$x = t^2 - 4t$$

where x is measured in metres.

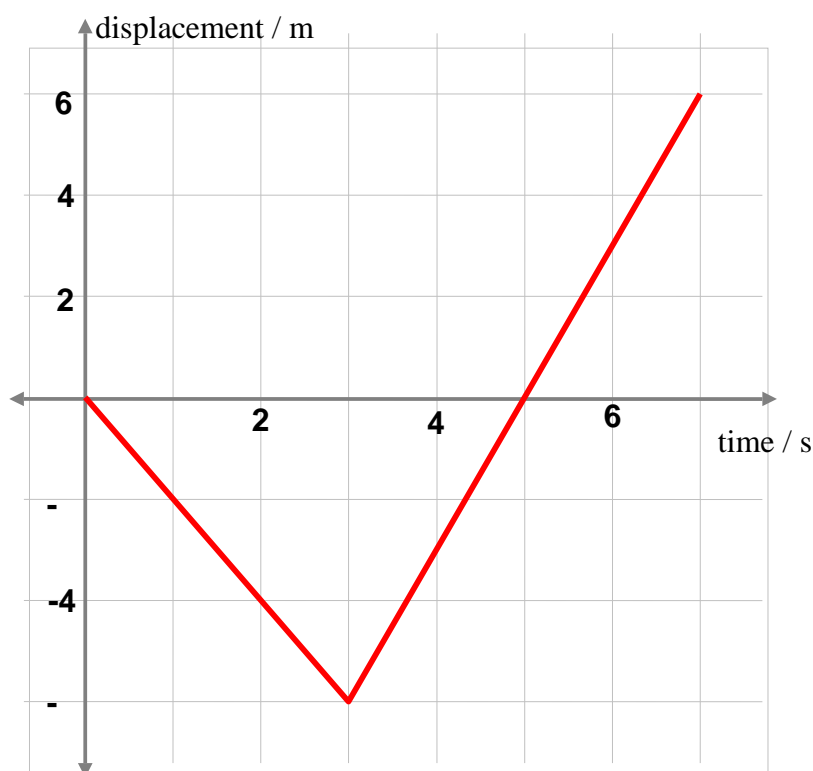
- (i) The displacement of the particle from O is zero at
- | | |
|-------------------------|-------------|
| (a) $t = 4$ | (b) $t = 0$ |
| (c) $t = 0$ and $t = 4$ | (d) $t = 2$ |

(ii) What is the displacement of the particle after 2 seconds?

(iii) Find the distance the particle has travelled after 4 seconds.

(iv) Find the distance the particle has travelled after 6 seconds.

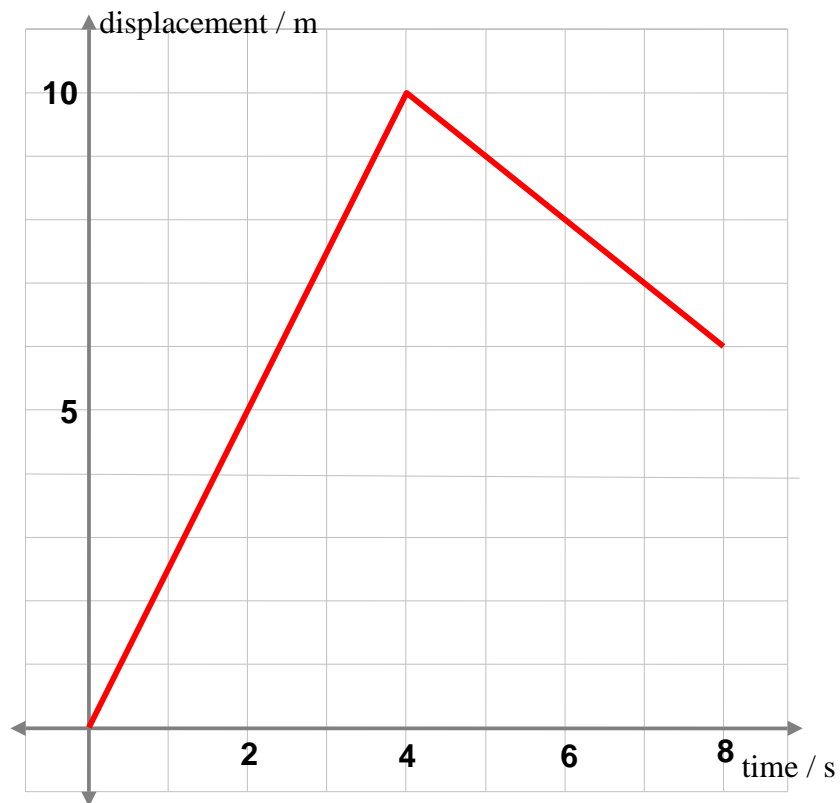
2. The diagram below represents a two-stage journey of a particle moving in a straight line.



- (i) Find the distance travelled by the particle in the 7 seconds.
- (ii) What is the velocity of the particle on the first part of the journey?
- (iii) What is the average velocity of the particle?

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3. The graph below shows the displacement of a particle at time t .



- What is the initial velocity of the particle?
- What is the average velocity of the particle for the whole journey?
- What is the average speed of the particle for the whole journey?

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Solutions to section test

1. (i) When the displacement from O is zero, $t^2 - 4t = 0$

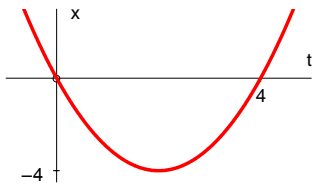
$$t(t - 4) = 0$$

$$t = 0 \text{ or } t = 4$$

(ii) After 2 seconds, $x = 2^2 - 4 \times 2 = 4 - 8 = -4$

So the displacement after 2 seconds is -4 metres.

(iii)



The sketch shows that the particle moves to a maximum displacement of -4 m, and then returns to O .

So the total distance travelled is 8 m.

(iv) Between $t = 0$ and $t = 4$ the particle has travelled 8 m (see above).

After 6 seconds, $x = 6^2 - 4 \times 6 = 36 - 24 = 12$, so displacement is 12 m.

Therefore between $t = 4$ and $t = 6$ the particle travels a further 12 m.

So the total distance travelled after 8 seconds is $8 + 12 = 20$ m.

2. (i) The particle travels 6 m in the negative direction, then reverses direction.

After 7 seconds its position is 6 m in the positive direction.

It therefore travels $6 + 6 + 6 = 18$ m.

(ii) Displacement in first part of the journey = -6 m

Time taken for first part of the journey = 3 seconds

$$\text{Velocity} = \frac{\text{displacement}}{\text{time}} = \frac{-6}{3} = -2 \text{ ms}^{-1}.$$

(iii) Total displacement = 6 m

Time taken for complete journey = 7 seconds

$$\text{Average velocity} = \frac{\text{total displacement}}{\text{time}} = \frac{6}{7} \text{ ms}^{-1}.$$

3. (i) The initial velocity is the gradient of the first part of the graph.

$$\text{Initial velocity} = \frac{10}{4} = 2.5 \text{ ms}^{-1}.$$

(ii) Total displacement = 6 m

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Time of whole journey = 8 seconds

$$\text{Average velocity} = \frac{6}{8} = 0.75 \text{ ms}^{-1}.$$

(iii) Total distance travelled = 10 + 4 = 14

Time of whole journey = 8 seconds

$$\text{Average speed} = \frac{14}{8} = 1.75 \text{ ms}^{-1}.$$