

Section 1: Displacement and distance

Solutions to Exercise level 1

1. (i) Total displacement is the final displacement
Total displacement = -20 m.

Total distance travelled = $40 + 40 + 20 = 100$ m.
- (ii) Total displacement = 0
Total distance travelled = $2 + 2 + 0.5 + 0.5 = 5$ km.
2. (i) 3 m
- (ii) 8 m
(this is the displacement relative to the starting position since $y = 11$)
- (iii) $t = 1.6$ s
- (iv) $t = 1.3$ s
- (v) This can only be approximated using the graph. At $t = 2.8$, the displacement is approximately -3 m.
- (vi) This can only be approximated using the graph. The maximum value of y is approximately 11.5 m. The total distance travelled is therefore approximately $8.5 + 11.5 = 20$ m
3. (a) (i) 2 m, 5 m
(ii) 3 m
(iii) 3 m
(iv) velocity = 0.5 ms⁻¹, speed = 0.5 m s⁻¹
(v) Average velocity = 0.5 m s⁻¹
(vi) Average speed = 0.5 m s⁻¹
- (b) (i) 140 km, 0 km
(ii) -140 km
(iii) 140 km
(iv) velocity = -168 km h⁻¹, speed = 168 km h⁻¹
(v) Average velocity = -168 km h⁻¹
(vi) Average speed = 168 km h⁻¹
- (c) (i) 0 m, -6 m
(ii) -6 m

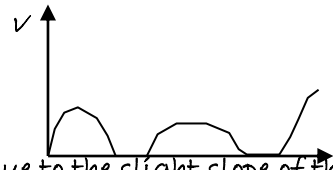
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- (iii) 18 m
- (iv) OA: velocity = 6 m s^{-1} , speed = 6 m s^{-1}
 AB: velocity = 0 m s^{-1} , speed = 0 m s^{-1}
 BC: velocity = -6 m s^{-1} , speed = 6 m s^{-1}
- (v) Average velocity = -1 m s^{-1}
- (vi) Average speed = 3 m s^{-1}

- (d) (i) 5 km, 5 km
- (ii) 0 km
- (iii) 60 km
- (iv) OA: velocity = -30 km h^{-1} , speed = 30 km h^{-1}
 AB: velocity = 6 km h^{-1} , speed = 6 km h^{-1}
- (v) Average velocity = 0 km h^{-1}
- (vi) Average speed = 10 km h^{-1}

4. (i) The apple moves with constant negative acceleration (due to gravity), until it is instantaneously at rest. It then moves with constant positive acceleration.
 This is graph (a).

- (ii) The car will move with variable speed and variable acceleration, stopping at intervals.
 This is not represented by any of the graphs.
 The graph might look like this:



- (iii) The ball will very gradually increase its speed due to the slight slope of the bowling lane. The acceleration is constant as it is due to gravity.
 This is graph (c).
- (iv) The parachutist will initially have constant acceleration due to gravity. When the parachute opens, there will initially be negative acceleration, after which the speed will be approximately constant.
 This is graph (b).

5. (i) 50 km

- (ii) From Newcastle to Haltwhistle:
 Time take = 45 minutes = 0.75 hours
 Average speed = $\frac{\text{distance}}{\text{time}} = \frac{50}{0.75} = 66.7 \text{ km h}^{-1}$.

From Carlisle to Newcastle:

$$\text{Time taken} = 1 \text{ hr } 20 \text{ minutes} = \frac{4}{3} \text{ hours}$$

$$\text{Average speed} = \frac{\text{distance}}{\text{time}} = \frac{100}{4/3} = 75 \text{ km h}^{-1}.$$

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(iii) Total distance travelled for whole journey = 200 km

Total time taken = 4 hours 50 minutes = $4\frac{5}{6}$ hours

$$\begin{aligned}\text{Average speed} &= \frac{\text{total distance travelled}}{\text{time taken}} \\ &= \frac{200}{4\frac{5}{6}} \\ &= 41.4 \text{ kmh}^{-1}\end{aligned}$$

6. Total distance travelled = $500 + 150 = 650$ metres.

$$\text{Average speed} = \frac{\text{total distance}}{\text{time}} = \frac{650}{250} = 2.6 \text{ ms}^{-1}.$$

Taking east as the positive direction:

Total displacement = $500 - 150 = 350$ metres.

$$\text{Average velocity} = \frac{\text{total distance}}{\text{time}} = \frac{350}{250} = 1.4 \text{ ms}^{-1}.$$