# 3.13 Motion: Speed, Velocity and Acceleration: 30-minute Pack

Total Marks

AQA 8464 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

**Answer ALL questions. Show all your working.**

**1** The list below gives typical average speeds for different forms of transport: walking pace = 1.5 m/s; cycling = 5.5 m/s; a car in a built-up area = 13 m/s; a car on a UK motorway = 31 m/s; a train = 55 m/s.

**(a)** A train travels at its typical speed, given above, for a distance of 11 km. Calculate how long this journey takes, in seconds. **(2)**

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**(b)** Amara, a cyclist, rides 220 m in a time of 40 s. Calculate her average speed, and state whether this matches the typical cycling speed given above. **(3)**

.....

**(Total for Question 1 is 5 marks)**

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**2** Zara, a skater, accelerates from 2.0 m/s to 8.0 m/s in a time of 4.0 s. Use acceleration = change in velocity / time taken (a = (v - u) / t) to calculate her acceleration.

**(Total for Question 2 is 3 marks)**


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**3** Nia, a cyclist, decelerates from 6.0 m/s to rest at a constant rate of 1.2 $m/s^2$. Use a = (v - u) / t to calculate how long it takes her to stop.

**(Total for Question 3 is 4 marks)**

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**4** Distance and displacement both describe how far an object has moved, but they are not always equal in value.

**(a)** State what is meant by distance travelled. **(1)**

**(b)** State what is meant by displacement. **(1)**

**(c)** Priya cycles 800 m due north from her house to a park, travelling in a straight line. She then cycles back home along the same straight route. Calculate (i) the total distance she travels, and (ii) her overall displacement for the whole journey. **(2)**

**(Total for Question 4 is 4 marks)**


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**5** Higher tier only. Ibrahim, a skateboarder, has an initial velocity of 2.0 m/s and accelerates at a constant 1.5 $m/s^2$ over a distance of 6.0 m. The equation sheet gives $v^2 = u^2 + 2 a s$. Calculate his final velocity, v.

**(Total for Question 5 is 4 marks)**

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**6** Higher tier only. Freya rides an electric scooter at 24 m/s. She decelerates uniformly at 3.0 $m/s^2$ until she comes to rest. Use $v^2 = u^2 + 2 a s$ (with the deceleration taken as negative) to calculate the distance she travels while decelerating.

**(Total for Question 6 is 4 marks)**


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# Mark scheme · 3.13 Motion: Speed, Velocity and Acceleration: 30-minute Pack

## Question 1

(a) converts 11 km to 11000 m and substitutes: time = 11000 / 55 **M1**

(a) 200 s cao **A1**

**(a) Answer: 200 s**

(b) substitutes: speed = 220 / 40 **M1**

(b) 5.5 m/s cao **A1**

(b) yes, this exactly matches the typical cycling speed of 5.5 m/s given above, oe **B1**

**(b) Answer: 5.5 m/s; this matches the typical cycling speed given above.**

## Question 2

change in velocity = 8.0 - 2.0 = 6.0 (m/s) **M1**

substitutes: a = 6.0 / 4.0 **dM1**

1.5 $m/s^2$ cao **A1**

**Answer: 1.5 $m/s^2$**

## Question 3

rearranges to make t the subject: t = (v - u) / a, oe **M1**

correct substitution with consistent signs, e.g. t = (0 - 6.0) / (-1.2), oe using magnitudes t = 6.0 / 1.2 **dM1**

5.0 cao **A1**

correct unit of time: s (seconds) **B1**

**Answer: 5.0 s**

## Question 4

(a) the total length of the path travelled by an object, regardless of direction, oe **B1**

**(a) Answer: The total length of the path travelled, regardless of direction.**

(b) the straight-line distance from an object's starting point to its finishing point, in a stated direction (a vector), oe **B1**

**(b) Answer: The straight-line distance from the start point to the finish point, in a stated direction.**

(c) distance = 1600 m (oe 800 + 800) **B1**

(c) displacement = 0 m (oe zero, since she returns to her starting point) **B1**

**(c) Answer: Distance = 1600 m; displacement = 0 m**

## Question 5

substitutes correctly: $v^2 = (2.0)^2 + 2 \times 1.5 \times 6.0$ **M1**

$v^2 = 22\ (m/s)^2$ (4 + 18) **A1**

takes the square root of their $v^2$ value **dM1**

v = 4.7 m/s (2 s.f.), awrt 4.7 **A1**

**Answer: 4.7 m/s (2 s.f.)**

## Question 6

rearranges $v^2 = u^2 + 2as$ to make s the subject: $s = (v^2 - u^2) / (2a)$, oe **M1**

correct substitution with deceleration taken as negative: $s = (0^2 - 24^2) / (2 \times (-3.0))$ **dM1**

s = 96 m cao **A1**

obtains a positive distance despite the negative acceleration used, showing correct understanding of the sign convention **B1**

**Answer: 96 m**


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