

- M1.** (a) distance is a scalar and displacement is a vector  
**or**  
distance has magnitude only, displacement has magnitude and direction 1
- (b) 37.5 km  
*accept any value between 37.0 and 38.0 inclusive* 1
- 062° or N62°E  
*accept 62° to the right of the vertical* 1
- accept an angle in the range 60° – 64°*  
*accept the angle correctly measured and marked on the diagram*
- (c) train changes direction so velocity changes 1
- acceleration is the rate of change of velocity 1
- (d) number of squares below line = 17  
*accept any number between 16 and 18 inclusive* 1
- each square represents 500 m 1
- distance = number of squares × value of each square correctly calculated – 8500 m 1

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- M2.(a)** (i) 9.5  
*accept  $\pm 1$  mm* 1
- 10.5 1
- (ii) 9.5  
*ecf from (a)(i)* 1
- (iii) 190  
*20  $\times$  (a)(ii) ecf* 1
- (iv) medium  
*ecf from (a)(iii)* 1
- (b) (i) any **two** from:
- position of ball before release
  - same angle **or** height of runway
  - same ball
  - same strip of grass
- 2
- (ii) long  
**or**  
longer than in part (a)  
**or**  
uneven  
*do not allow reference to speed* 1

- (c) (i) as humidity increases mean distance decreases  
*accept speed for distance*

1

- (ii)  $71 \times 180 = 12780$   
 $79 \times 162 = 12798$   
 $87 \times 147 = 12789$

*all three calculations correct with a valid conclusion gains 3 marks*

**or**

find k from  $R = k / d$

*all three calculations correct gains 2 marks*

**or**

$$87 / 71 \times 147 = 180.1 \sim 180$$

$$87 / 79 \times 147 = 161.9 \sim 162$$

*two calculations correct with a valid conclusion gains 2 marks*

conclusion based on calculation

*one correct calculation of k gains 1 mark*

3

- (iii) only three readings **or** small range for humidity  
*accept not enough readings*  
*accept data from Internet could be unreliable*  
*ignore reference to repeats*

1

- (d) distance is a scalar **or** has no direction **or** has magnitude only  
*allow measurements from diagram of distance and displacement*

1

displacement is a vector **or** has direction

1

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**M3.** (a) acceleration =  $\frac{\text{change in speed/velocity}}{\text{time taken}}$

**or**  $\frac{10}{4}$

*gains 1 mark  
do not penalise if both of these present  
but 'change in' omitted from formula*

**but**  
2.5

*gains 2 marks*

unit m/s<sup>2</sup> **or** metres per second squared

**or** metres per second per second

**or** ms<sup>-2</sup>  
*for 1 mark*

3

(b) *evidence* of using area under graph or distance average speed × time  
**or**

$10 \times 4 \times \frac{1}{2}$

*gains 1 mark*

**but**  
20

*gains 2 marks*

*units metres / m<sup>-2</sup>*  
*for 1 mark*

3

(c) force = mass × acceleration **or** 75 × 25  
*gains 1 mark*

**but**  
1875

*gains 2 marks*

*\*NB Correct unit to be credited even if numerical answer wrong or absent.*

2

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