

- 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) *any evidence of:* momentum = mass × velocity (words, symbols or numbers)  
appropriate re-arrangement mass as 0.05kg  
*each gains 1 mark*

**but** 800

*gains 4 marks*

4

- (b) (i) *any reference to* friction with air/air resistance  
*gains 1 mark*

**but** *idea that* friction with air/air resistance is high (at high speed)  
*gains 2 marks*

2

- (ii) *any evidence of:* k.e.  $\propto v^2$  **or** k.e. =  $\frac{1}{2} mv^2$   
final k.e.  
initial k.e.  
either initial or final k.e. correctly calculated (i.e. 16000; 10240)  
*each gains 1 mark*

**but** (0.8)<sup>2</sup>  
*gains 3 marks*

**but** 64%(credit 0.64)  
*gains 4 marks (also credit e.c.f)*

4

[10]

M3. (a) (i) 3 1

(ii) 30 000 **or** 10 000 × their (a)(i) correctly calculated 1

(iii) any **two** from:

- frequency is above 20 000 (Hz)  
*accept the frequency is 30 000*
- frequency is above the upper limit of audible range
- upper limit of audible range equals 20 000 (Hz)  
*ignore reference to lower limit*
- it is ultrasound/ultrasonic

2

(b) (i) wave (partially) reflected 1

at crack to produce **A** and end of bolt to produce **B**  
*accept at both ends of the crack* 1

(ii) 0.075 (m) allow **2** marks for time = 0.0000125  
*allow 1 mark for time = 0.000025*  
*answers 0.15 **or** 0.015 **or** 0.09 gain 2 marks*  
*answers 0.18 **or** 0.03 gain 1 mark*  
*the unit is not required but if given must be consistent with numerical answer for the available marks* 3

[9]

- M4.** (a) (i) same frequency / period / pitch / wavelength  
*ignore references to amplitude* 1
- (ii) differences in waveform / shape / quality  
*accept the diagrams are not identical* 1
- (b) (i) 20 000 Hz / hertz  
or 20 kHz / kilohertz  
*in both cases, if the **symbol** rather than the name is used, it must be correct in every detail* 1
- (ii) material(s) / substance(s) (through which sound travels) 1
- (iii) is absorbed  
*accept (some) sound (energy) is transformed / transferred as heat / thermal energy* 1
- is transmitted  
*accept is refracted  
accept changes speed  
accept changes velocity  
do **not** accept is diffracted  
do **not** accept is diffused  
do **not** accept is dissipated* 1

[6]