

- 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

[8]

- 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)²

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]