

M1. (a) (i)	3	1
	(ii) 30 000 or 10 000 × their (a)(i) correctly calculated	1
	(iii) any two from:	
	<ul style="list-style-type: none"> • frequency is above 20 000 (Hz) <i>accept the frequency is 30 000</i> • frequency is above the upper limit of audible range • upper limit of audible range equals <u>20 000</u> (Hz) <i>ignore reference to lower limit</i> • it is ultrasound/ultrasonic 	2
(b) (i)	wave (partially) <u>reflected</u>	1
	<p>at crack to produce A and end of bolt to produce B <i>accept at both ends of the crack</i></p>	1
	(ii) 0.075 (m) allow 2 marks for time = 0.0000125 <i>allow 1 mark for time = 0.000025</i> <i>answers 0.15 or 0.015 or 0.09 gain 2 marks</i> <i>answers 0.18 or 0.03 gain 1 mark</i> <i>the unit is not required but if given must be consistent with numerical answer for the available marks</i>	3

[9]

M2. (a) changes the sound wave(s)

to a varying **or** changing (electric) potential difference **or** p.d. **or** voltage
or current **or** to an irregular alternating current or a.c. **or** transfers
sound energy to electrical energy (1 mark is vibrations **or** pulses **or** of
sound **or** in air become electrical waves

*do not credit just 'to electricity' **or** 'to a.c'*

2

(b) (i) decrease **or** reduce the amplitude

accept less amplitude nothing else added

1

(ii) increase the frequency **or** decrease
wavelength

accept higher frequency nothing else added

1

[4]

M3. (i) (partly) reflected when they hit a (boundary between two) different media or substance or tissue

accept named substances

*do **not** accept bounce back*

1

time taken for reflected wave (to return) is used to produce the image

1

(ii) any **one** from:

cleaning a delicate mechanism / jewellery

*do **not** accept cleaning*

welding plastics

cutting textiles

mixing emulsion paints

sonar

motion sensors (in burglar alarms)

*do **not** accept burglar alarms*

removing dental plaque

industrial quality control

breaking up kidney stones

treating injuries

1

[3]

- M4.** (a) (ultrasound) waves reflected
accept 'bounce off' 1
- at boundary / from muscle 1
- (b) (i) time 1
- (ii) speed of (ultrasound) waves 1

[4]

M5. (a) any **two** points:

*do **not** credit features which are true of sound in general eg longitudinal waves*

- humans cannot hear ultrasound
- it has a very high frequency / pitch
*do **not** credit just 'has a high frequency / pitch'*
- above the (upper) limit for humans / above 20 000 Hz

2

(b) (i) ultrasound / waves are reflected

*...are bounced is insufficient, but
...echo is acceptable*

1

Pulse **A** indicates / is the crack

Pulse **B** indicates / is the back (of the block or crack)
need to mention both A and B to get this mark

1

(ii) 90 (mm)

accept any answer in the range 88 – 92 (mm)

1

[5]

- M6.** (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]