

Mark schemes

- 1** (a) K 1
- (b) Decreases 1
- (c) use a metre rule / 30 cm ruler to measure across 10 (projected) waves
accept any practical number of waves number for 10 1
- and then divide by 10 1
- (d) 1.2 cm = 0.012 m 1
- $18.5 \times 0.012 = 0.22(2)$ (m / s) 1
- allow 0.22(2) with no working shown for 2 marks*
- typical walking speed = 1.5m / s
accept any value e.g. in the range 0.7 to 2.0 m / s 1
- so the water waves are slower (than a typical walking speed)
this cannot score on its own 1
- [8]**
- 2** (a) in a longitudinal wave the oscillations / vibrations are parallel to the direction of energy transfer.
accept wave travel for energy transfer throughout 1
- in a transverse wave the oscillations / vibrations are perpendicular to the direction of energy transfer. 1
- (b) accept any sensible suggestion eg a vibrating drum skin does not move the air away to create a vacuum (around the drum) 1

(c) Level 3 (5–6 marks):

A detailed explanation linking variations in current to the pressure variations of a sound wave, with a logical sequence.

Level 2 (3–4 marks):

A number of relevant points made, but not precisely. A link between the loudspeaker and a sound wave is made.

Level 1 (1–2 marks):

Some relevant points but fragmented with no logical structure.

0 marks:

No relevant content.

Indicative content

the current in the electrical circuit is varying

the current passes through the coil

the coil experiences a force (inwards or outwards)

reversing the current reverses the force

the size of the current affects the size of the force

the varying current causes the coil to vibrate

the (vibrating) coil causes the cone to vibrate

the vibrating cone causes the air molecules to move

the movement of the air molecules produces the pressure variations in the air needed for a sound wave

the air molecules bunch together forming compressions and spread apart forming rarefactions

6

[9]

3

(a) pitch

1

loudness

1

(b) (i) as length (of prongs) decreases frequency / pitch increases

*accept converse**accept negative correlation**ignore inversely proportional*

1

(ii) 8.3 (cm)

accept 8.3 ± 0.1 cm

1

- (iii) (8.3 cm is) between 7.8 (cm) and 8.7 (cm)
ecf from part (ii)

1

(so f must be) between 384 (Hz) and 480 (Hz)

1

$410 \text{ (Hz)} \leq f \leq 450 \text{ (Hz)}$

if only the estimated frequency given, accept for 1 mark an answer within the range

1

- (c) (i) electronic

1

- (ii) frequency is (very) high

accept frequency above

20 000 (Hz) or audible range

1

so tuning fork **or** length of prongs would be very small (1.2 mm)

1

- (d) 285.7 (Hz)

accept any correct rounding 286, 290, 300

allow 2 marks for 285

allow 2 marks for correct substitution $0.0035 = 1 / f$

allow 1 mark for $T = 0.0035 \text{ s}$

allow 1 mark for an answer of 2000

3

[13]

4

- (a) (i) 440 (sound) waves produced in one second

accept vibrations / oscillations for waves

1

- (ii) 0.773 (metres)

allow 2 marks for an answer that rounds to 0.773

allow 2 marks for an answer of 0.772

allow 2 marks for an answer of 0.772

allow 1 mark for correct substitution ie $340 = 440 \times \lambda$

3

- (b) (sound is) louder

do not accept the converse

1

as amplitude is larger

waves are taller is insufficient

1

higher pitch / frequency

1

as more waves are seen

reference to wavelengths alone is insufficient

waves are closer together is insufficient

1

[8]

5 (a) (sound waves) which have a frequency higher than the upper limit of hearing for humans

or

a (sound) wave (of frequency) above 20 000 Hz

sound waves that cannot be heard is insufficient

a wave of frequency 20 000 Hz is insufficient

1

(b) 640

an answer of 1280 gains 2 marks

allow 2 marks for the correct substitution

ie 1600×0.40 provided no subsequent step

allow 2 marks for the substitution $\frac{1600 \times 0.80}{2}$

provided no subsequent step

allow 1 mark for the substitution 1600×0.80 provided no subsequent step

allow 1 mark for the identification that time (boat to bed) is 0.4

3

(c) any **one** from:

- pre-natal scanning / imaging
- imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles

accept heart

*do **not** allow brain **or** lungs (either of these negates a correct answer)*

- Doppler scanning blood flow

1

(d) advantage

any **one** from:

- (images are) high quality or detailed or high resolution
clearer / better image is sufficient
- (scan) produces a slice through the body
- image can be viewed from any direction
allow images are (always) 3D / 360°
- an image can be made of any part (inside the body)
allow whole body can be scanned
- easier to diagnose **or** see a problem (on the image)

1

disadvantage

any **one** from:

- (the X-rays used **or** scans) are ionising
allow a description of what ionising is
- mutate cells **or** cause mutations **or** increase chances of mutations

allow for cells:

DNA / genes / chromosomes / nucleus / tissue

- turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells
- kill cells
damage cells is insufficient
- shielding is needed
can be dangerous (to human health) unqualified, is insufficient

1

[7]

6

(a) (i) 20

1

20 000

*either order**accept ringed answers in box*

1

- (ii) (frequency) above human range
accept pitch for frequency

or

(frequency) above 20 000 (Hz)

*do **not** accept outside human range**allow ecf from incorrect value in **(a)(i)***

1

- (iii) any **one** from:

- pre-natal scanning
accept any other appropriate scanning use
*do **not** accept pregnancy testing*
- removal / destruction of kidney / gall stones
- repair of damaged tissue / muscle
accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation
accept physiotherapy
accept curing prostate cancer or killing prostate cancer cells
- removing plaque from teeth
cleaning teeth is insufficient

1

(b) 7.5×10^{-4} (m) $1.5 \times 10^3 = 2.0 \times 10^6 \times \lambda$ gains 1 mark

2

(c) for reflected waves

must be clear whether referring to emitted or detected / reflected waves

if not specified assume it refers to reflected wave

any **two** from:

- frequency decreased
- wavelength increased
- intensity has decreased

allow amplitude / energy has decreased

allow the beam is weaker

2

[8]

7

(a) the oscillation / vibration (causing the wave)

a movement causes the wave is insufficient

1

for a transverse wave is perpendicular to the direction of energy transfer

accept direction of wave travel

1

and for a longitudinal wave is parallel to the direction of energy transfer

accept direction of wave travel

if no marks awarded allow 1 mark for correctly linking perpendicular with transverse and parallel with longitudinal

the marks may be scored by the drawing of two correctly labelled diagrams

1

(b) for radio waves:

accept converse for each mark

are transverse

1

travel at speed of light / higher speed

1

have greater frequencies

1

can travel through vacuum

accept sound waves are not electromagnetic for 1 mark

1

[7]

8

(a) (i) perpendicular

accept correct description 1

1

(ii) light off – no / slow rotation

1

light on – fast(er) rotation

accept starts rotating

ignore references to energy transfers

1

- (b) one ray drawn from wrist watch and reflected by mirror

accept solid or dashed lines

1

two rays drawn from wrist watch and reflected by mirror with $i = r$ for both rays

judge angles by eye

1

one ray traced back behind mirror

accept solid or dashed lines

1

image in correct position

judged by eye

accept image marked where two reflected rays traced back cross behind the mirror

1

- (c) cannot be formed on a screen

accept image formed behind the mirror

or

rays of light seem to come from it but do not pass through it

1

[8]

9

- (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#), and apply a 'best-fit' approach to the marking.

0 marks

No relevant / correct content.

Level 1 (1-2 marks)

There is a basic description of either wave

OR

What happens to either wave when they enter the body. However there is little other detail.

Level 2 (3-4 marks)

There is either:

A clear description of BOTH waves

OR

A clear description as to what happens to BOTH waves inside the body

OR

A clear description of ONE of the waves with clear detail as to what happens to either wave inside the body.

Level 3 (5-6 marks)

There is a detailed description of BOTH of the waves

AND

A detailed description as to what happens to EITHER wave inside the body.

Examples of the points made in the response:**Description of an X-ray**

- X-rays are electromagnetic waves / part of the electromagnetic spectrum
*do **not** allow a description of a property – eg X-rays travel*
- X-rays are (very) high frequency (waves)
through a vacuum / at the speed of light
- X-rays are (very) high energy (waves)
- X-rays have a (very) short wavelength
- Wavelength (of X-rays) is of a similar size to (the diameter of) an atom
- X-rays are a transverse wave
correct description acceptable – oscillations / vibrations are perpendicular (at 90°) to direction of energy transfer
- X-rays are ionising radiation

Description of ultrasound

- ultrasound has a frequency above 20 000 (hertz)
- or**
- ultra sound is above 20 000 hertz
- ultrasound is above / beyond the human (upper) limit (of hearing)
accept ultrasound cannot be heard by humans
 - ultrasound is a longitudinal wave
correct description acceptable – oscillations / vibrations (of particles) are parallel (in same direction) to direction of energy transfer

Statement(s) as to what happens to X-rays inside the human body:

- X-rays are absorbed by bone
- X-rays travel through / are transmitted by tissue / skin

Statement as to what happens to ultrasound inside body:

- ultrasound is (partially) reflected at / when it meets a boundary between two different media
- travel at different speeds through different media

- (b) (because the X-rays) are ionising
accept a description of what ionising is

1

(they will) damage cells
instead of cell, any of these words can be used:
DNA / genes / chromosomes / nucleus

or

mutate cells / cause mutations / increase chances of mutations

or

turn cells cancerous / produce abnormal growths / produce rapidly growing cells
*do **not** accept they can be dangerous (to human health)*
*do **not** accept damage to soft tissue*

or

kill cells

1

- (c) any **one** from:

- removal / destruction of kidney / gall stones
- repair of damaged tissue / muscle
accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation
accept physiotherapy
*accept curing prostate cancer **or** killing prostate cancer cells*
- removing plaque from teeth
cleaning teeth is insufficient

1

[9]

10

- (a) (i) wavelength
accept frequency
accept speed
- (ii) amplitude
accept energy
height is insufficient
- (iii) sound

1

1

1

(b) 0.12

allow 1 mark for correct substitution, ie 8×0.015 provided no subsequent step shown

2

metre per second **or** m/s **or** metre/second

*do **not** accept mps*

units must be consistent with numerical answers

1

[6]**11**

(a) (i) bat(s)

1

(ii) any example in the inclusive range $5 \leftrightarrow 29$ Hz / hertz

appropriate number and unit both required

1

(b) (i) A, C, D

all three required and no other

1

(ii) D, E

both required and no other

1

(c) sound cannot travel through a vacuum / (empty) space / free space

accept there is no medium (for the sound to travel through)

*do **not** accept there is no air (for the sound to travel through)*

1

(because) there is / are nothing / no particles to vibrate

accept because there is / are nothing / no particles between them

and the source (of the sound)

1

[6]**12**(a) any **two** from:

- (sound with frequency) above 20 000 hertz / 20 kHz
- frequencies above (human) audible range
- (sound) cannot be heard by humans

2

- (b) **either**
two appropriate points gain **1** mark each
either both pro / con or one of each

or
one appropriate point (and) appropriate qualification / amplification

examples
other mammals (sufficiently) similar to humans (1)
so results appropriate (1)
unethical to experiment on humans (1)
so it is better to experiment on mice (1)
knowledge / techniques will benefit humans (1)
and also other animals (1)
experiments were justified because ultrasound has proved useful (1)

2

- (c) examples
allow a wide variety of appropriate responses

publish / tell doctors / the public (1)
...their evidence / results / research / data (1)
valid point (1)
appropriate example / qualification / expansion / etc (1)

carry out more research / tests (1)
...to make sure / check reliability (1)
allow just 'stop using them / ultrasonic waves' for 1 mark only
allow using them (only) for industrial purposes for 1 mark only

2

[6]

13

- (a) (i) **J and L**
both required, either order

1

- (ii) **K**

1

- (iii) **L**

1

highest frequency

reason does not score if L not chosen
accept most waves (on screen)
*do **not** accept frequency above 20 000(Hz)*
*do **not** accept cannot hear it*

1

(b) transmitter

detector

computer

all three in correct order

allow 1 mark for one correct

2

[6]

14

(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]

15

- (a) letter C clearly marking a compression
accept C at any point in a compression
if more than one letter C marked
all must be correct 1
- (b) (i) straight continuous line drawn from loudspeaker to metal to sound sensor
judge by eye 1
- angle I = angle R
judge by eye
ignore any arrows on lines 1
- (ii) less sound reflected
accept energy for sound
- or**
- (some) sound passes through the glass
accept (some) sound absorbed by the glass 1
- (iii) makes the sound louder 1
- (iv) $v = f \times \lambda$
 340
allow 1 mark for correct substitution
ie 850×0.4
provided no subsequent step shown 2
- (c) echo 1
- (d) (i) from 250 Hz to 750 Hz 1

- (ii) curtains reduce (percentage of) sound reflected more (than carpet)
accept curtains absorb more sound (than carpet)

1

for all frequencies (shown)

accept for both marks an answer in terms of walls having a larger (surface) area to reflect sound and curtains reducing the amount of reflected sound more (than carpet)

answers less noisy or walls / curtains have a larger area gain 1 mark only

*do **not** accept curtains are cheaper*

1

[11]

16

- (a) 10 600 (Hz)

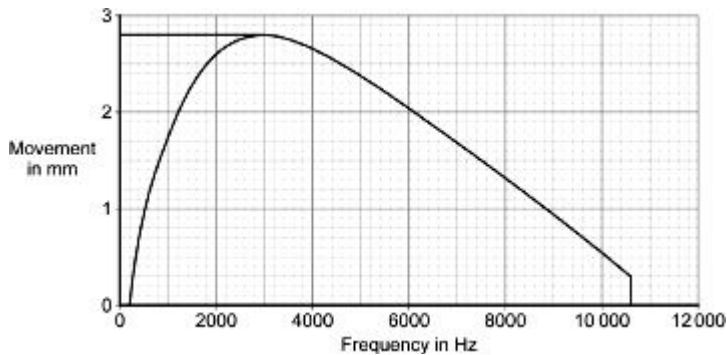
accept 10.6 kHz

1

- (b) 3000 (Hz)

allow 1 mark for a line drawn to show greatest movement (allow only if frequency is between 2800 and 3200)

accept other indication of correctly using the graph



2

- (c) (No)

no marks for just the ticked box

reasons can score even if yes is ticked

(human hearing) range is 20 – 20 000 (Hz)

accept (most) people hear up to 20 000 (Hz) / 20 kHz

1

any **one** from:

- range on graph is within this range
- range on graph starts after 20 Hz
- range on graph is from to 200 – 10 600 (Hz)
- range on graph finishes before 20 000 Hz

1

(d) reliability

this answer only

1

(e) only 1 variable affects dependent variable / size of movement

accept 'results' for 'size of movement'

or

there is only one independent variable

fair test is insufficient

*do **not** accept to control the experiment*

or

to be able to compare (effect of different frequencies)

1

[7]

17

(a) vibrate

*allow move more (vigorously) but **not** just move*

1

dirt / muck / grit / rust / dust etc.

*do **not** accept bacteria*

1

(b) any **one** medical use eg

ignore incorrect biological detail

- scanning unborn babies
- destroying (kidney) stones

1

(c) (i) 2

1

(ii) C

1

[5]

- 18** (a) microphone 1
- (c) (i) vertical line from any maxima or minima to axis
*do **not** penalise minor errors but*
*do **not** allow unless intention is clear* 1
- (ii) loudness / volume / intensity / energy
*do **not** accept noise* 1
- (c) 17
this answer only 1
- (d) the greater the distance, the smaller the amplitude
accept volume / intensity / energy / loudness for amplitude
or
 there is a (strong) negative correlation between distance and amplitude
or
 there is an inverse square relationship between distance and amplitude
*do **not** accept distance and amplitude are inversely proportional* 1
- (e) 20 Hz
either order 1
- 20,000 Hz
accept 20 kHz provided unit has been clearly changed 1
- [7]**
- 19** (a) sound / mechanical / longitudinal (wave) 1
- any **one** from:
- above 20 000 hertz / 20kHz
 - above (human) audible range
 - cannot be heard by humans
- 1

(b) **either**

particles / molecules / fluid vibrate(s) (1)

(and) knock particles of dirt off the jewellery (1)

or

by the process of cavitation (1)

accept 'formation and collapse of tiny bubbles'

which breaks up / releases dirt from the surface (1)

2

(c) **either both pro****or both con****or one of each****either**two appropriate points gain **1** mark each**or**

one appropriate point (and) appropriate qualification / amplification

*examples**other mammals (sufficiently) similar to humans (1)**so results appropriate (1)**unethical to experiment on humans (1)**so it is better to experiment on mice (1)**knowledge / techniques will benefit humans (1)**and also other animals (1)**experiments were justified because ultrasound has proved useful (1)*

2

[6]**20**

(a) 20000

accept any unambiguous indication

1

(b) kilohertz

*credit misspellings**credit '1000 hertz' or '1000 Hz'**accept 1000 oscillations/beats/waves per second*

1

- (c) (i) cleaning (e.g. something delicate such as a watch)
or quality control/ flaw detection
credit any appropriate extra Specification response
e.g. sonar 1
- (ii) pre-natal (scanning)
do not credit just 'scanning'/medical scanning/ scanning a baby
credit any appropriate extra Specification response
e.g. destruction of (kidney) stones or cleaning teeth 1
- (d) 8 (μ s) 1
- (e) distance (1)
 between the boundary and the detector (1)
accept 'between the boundary and the source'
accept any correct use of speed = distance/time 2
- (f) examples
 publish/tell doctors/the public (1) ... their evidence/results/research/data (1)
 carry out more research/tests (1) ... to make sure/check reliability (1)
allow a wide variety of appropriate responses
valid point (1) appropriate example/qualification/expansion/etc. (1)
allow just 'stop using them/ultrasonic waves' (1)
allow using them (only) for industrial purposes (1) 2

[9]

21

- (a) (i)
correct order essential
 (A =) a microphone 1
 (B =) an oscilloscope
or cathode ray oscilloscope or CRO 1
- (ii) the amplitude
accept any unambiguous indication 1

(iii) quieter / softer

*do **not** accept less (which could refer to the amplitude, frequency or wavelength)*

1

(b) sound cannot travel through a vacuum / (empty) space / free space

accept there is no medium for the sound to travel through

1

(because) there is / are nothing / no particles to vibrate

accept (because) there is / are nothing / no particles between them and the source (of the sound)

1

[6]**22**

(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]

23

(a) (i) 25 (%)

*do **not** accept ¼*

1

(ii) increases

1

(b) tick (✓) in top and bottom box

both required

1

(c) SHINY surfaces are good reflectors of infra-red radiation

accept white for shiny

or black surfaces are POOR reflectors of infra-red radiation

accept bad for poor

accept insertion of 'not' before 'good' in statement

or black surfaces are good EMITTERS of infra-red radiation

or black surfaces are good ABSORBERS of infra red radiation

1

[4]

24

(a) (mechanical) vibration(s)

***not** just 'particles knocking into each other'*

not reference to 'sound particles'

1

(b) K

1

(c) (i) reflected by the material from loudspeaker to microphone X

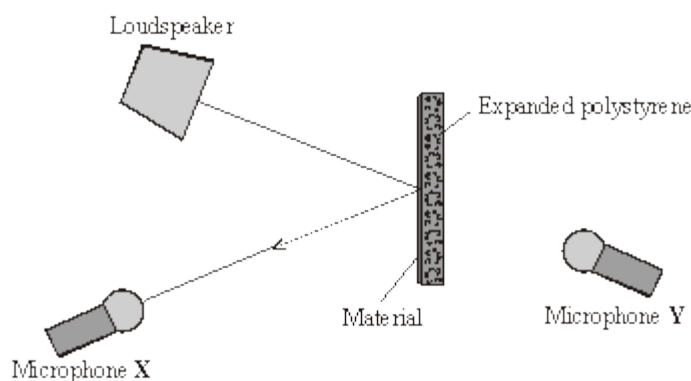
1

shown by straight lines with angle of incidence = angle of reflection
(by eye) **and** at least one arrow in the correct direction

*do not credit if the direction is contradicted by any incorrect arrow /
may be shown by waves / wavefronts in the direction of straight
lines*

ignore any sound to Y or which 'misses' the material

example



1

(ii) any **one** from:

- so (the student) can compare results
- so only one (independent) variable
- to get reliable / accurate results
- because (the expanded) polystyrene absorbs some of the sound
do not credit just 'so it's a fair test'

1

(iii) **[A]** wood

1

[B] either 0.25 or 1/4 or 25 % or 15/60 or 1 : 3*do not credit 1 : 4*

1

(d) practical suggestion

1

appropriate reason / explanation

example line / panel the walls with wood / plasterboard / increase the thickness of the plaster (on the walls) (1)

(this) will absorb / reflect (back) (most / some of) the sound (1)

credit legal suggestions for attempting to limit the noise made by the neighbours

example ask the neighbours to make less noise (1)

by limiting the time(s) music played (1)

do **not** credit reference to 'sound particles' for second mark

1

[9]

25

(a) (i) **A, C and D***any order but all three required and no others*

1

(ii) **D and E***either order but both required and no others*

1

(b) (i) 20000 (Hz) to 20 (Hz)

*accept '19980 (Hz)'***or** vice-versa

1

(ii) frequency (of dog whistle) too high (for humans to hear) / frequency above 20000 Hz

*accept 'it is ultrasound'**accept 'sound from the whistle is ultrasonic'*

1

(c) (i) substance

1

reflection

correct order essential

1

(ii) detector

1

[7]

26

(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 crackPulse **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]

27

(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]

28

(a) sound with a frequency above audible

do not accept answer in terms of λ

do not accept sound which cannot be heard unless obvious from context

accept above 20 kHz

1

(b) (i) to show detail **or** to give a clear image/picture

*accept the generators **or** transducers can be small*

accept so the beam does not spread out/beam in focus

***not** 'good picture'*

1

(ii) (much) smaller wavelength

allow higher frequency/pitch

1

(iii) no damage to living cells (provided low power)

accept the converse

*accept no damage to baby **or** not dangerous to baby*

1

(iv) any **two** forms

sex

stage of development

or specific examples

abnormalities

general health

potential problems (at birth)

accept specific examples e.g. umbilical cord around neck

size of head

accept multiple births

2

[6]

29

(a) stop

accept any indication

cannot travel

2

(b) middle box ticked

*accept a tick next to the statement even if not in the box
do **not** accept two ticks*

1

(c) (i) B

highest frequency

accept most waves (in box)

accept 'squashed together'

*do **not** accept 'squashed'*

accept 'close (together)'

accept shortest wavelength

2

(ii) D

largest amplitude

*accept tallest **or** highest wave**do **not** accept biggest wave**do **not** accept 'high' wave*

2

[7]**30**

(a) glass

1

air

must be in correct order

1

closer the particles faster the speed

*answer must show a comparison***or**

particles in glass closest in air furthest apart

*accept the denser the material the faster the sound travels***or**

sound travels faster in solids than gases

incorrect explanation negates credit

1

(b) (i) grasshopper

(ii) ultrasound

accept ultrasonic

1

(c) all of reflected pulse closer than given in original diagram

accept a cluster of pulses ignore a reflected pulse in original position any pulse drawn to right of original negates credit

1

reflected pulse smaller than emitted but greater than 1 square high

accept cluster of pulses provided one part fulfils height criteria

2

[7]

- 31** (a) number of complete vibrations per second
for 1 mark 1
- (b) (i) correct trace (more waves), *ignore amplitude*
for 1 mark 1
- (ii) correct trace (higher amplitude), *ignore frequency*
for 1 mark 1
- (c) (i) higher
for 1 mark 1
- (ii) quieter
for 1 mark 1
- [5]**

- 32** (a) vibrates (owtte)
for one mark 1
- (b) (i) higher
for one mark 1
- (ii) louder
for one mark 1
- (c) (i) ultrasonic (ultrasound)
for one mark 1
- (ii) different frequency / wavelength / pitch
gains 1 mark
- but**
high frequency / pitch, higher frequency /pitch (lower frequency / pitch *wrong*)
gains 2 marks 2

[6]

33

(a) 4

1

(b) 3

1

(c) 3

correct answer with no working = 2
allow 1 mark for $f = \text{number} \div \text{time}$
or correct working i.e., $12 \div 4$
N.B. correct answer from incorrectly
recalled relationship / substitution = 0

2

Hz / hertz

accept HZ, hz, hZ
allow waves / cycles per second
allow wps, w/s, cps, c/s

1

[5]**34**

(a) Quality of written communication:
 Correct use of 2 of the words, angle, critical, normal and reflection

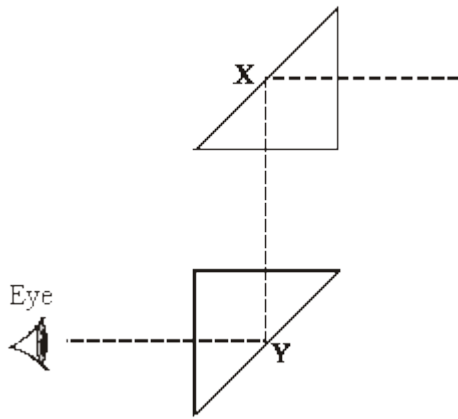
1

any **two** from

- light is reflected / bounces off
- if angle between ray and normal angle of incidence
- is greater than critical angle
- idea that no refraction bending if ray at 90°

2

(b)



1 mark for reflection at **X** if ray would reach the lower prism
 1 mark for subsequent reflection at **Y**
 1 mark for subsequent ray emerging from prism in direction of front of eye
 accept dotted **or** dashed lines
 ignore any arrows

3

[6]

35

(a) (ultrasound) waves reflected
 accept 'bounce off'

1

at boundary / from muscle

1

(b) (i) time

1

(ii) speed of (ultrasound) waves

1

[4]

36

(a) (i) cat

1

(ii) tuna

1

- (b) (i) ultrasound
allow ultrasonic
- (ii) cleaning / quality control / flaw detection / medical scanning /
animal scaring / sonar

1

1

[4]**37****Quality of written communication**

correct use of **three scientific** terms from speed / velocity, reflection,
density, time, boundary

1

any **three** from:

different tissues have different densities

ultrasound travels at different speeds / velocities in different tissues

reflection

accept bouncing back

from tissue boundaries

time taken to return

3

[4]**38**

- (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
- (ii) increase the frequency **or** decrease wavelength
accept higher frequency nothing else added

1

1

[4]**39**

- idea that (in words or on diagram)
 - sound reflects / bounces off cliff
 - returns the way it came / produces an echo
- each for 1 mark*

[2]**40**

D

*gains 1 mark***but E (D + E = 1)***gains 2 marks***[2]**