AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.6.1 WAVES IN AIR, FLUIDS AND SOLIDS (PACK 1)

SCORE	PERCENTAGE
/293	%

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Q1.

(a) increased

1

(b) (count) how many waves pass a point

1

in one second

this is dependent on the first mark point being awarded

1

or

(count) number of waves that pass a point in a given time

allow a specific time for a given time

or

(count) number of waves that are produced in a given time (1)

and divide by that time in seconds

this is dependent on the first mark point being awarded

allow an answer in terms of measuring the frequency of the vibrating bar

(c) $\text{period} = \frac{1}{5}$

1

period = 0.2

1

seconds / s

1

[6]

Q2.

(a) Regrettably, this part of the question assessed content that we had stipulated would only be assessed on the Higher tier. All students were awarded full marks for this part of the question.

1

(b) 0.4

1

(c) wave speed = frequency × wavelength

allow $v = f\lambda$

1

(d) 7200 = 0.4 × wavelength

1

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$$\text{wavelength} = \frac{7200}{0.4}$$

1

wavelength = 18 000 (m)

*allow up to full marks for ecf using their answer to part **(b)***

a method shown as
7200 × 2.5 = 18 000
*scores **0** marks*

1

*an answer 18 000 scores **3** marks*

(e) Regrettably, this part of the question assessed content that we had stipulated would only be assessed on the Higher tier. All students were awarded full marks for this part of the question.

2

[8]

Q3.

(a) P-waves are longitudinal and
S-waves are transverse

1

(b) 0.4

1

(c) wave speed = frequency × wavelength

allow $v = f\lambda$

1

(d) 7200 = 0.4 × wavelength

1

$$\text{wavelength} = \frac{7200}{0.4}$$

1

wavelength = 18 000 (m)

*allow up to full marks for ecf using their answer to part **(b)***

a method shown as
7200 × 2.5 = 18 000
*scores **0** marks*

1

*an answer 18 000 scores **3** marks*

(e) because S-waves cannot travel through a liquid

1

and S-waves do not travel through the (outer) core

*allow some (seismic) waves cannot travel through a liquid and do not go through the core for **1** mark*

1

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(f) magnetic field around the coil changes
or
the magnetic field (lines) cut by the coil
allow the generator effect

1

(g) because the magnet changes direction

1

(h) stationary

1

(i) any **two** from:

- stronger magnetic field
  allow stronger magnet
  allow heavier magnet
  bigger magnet is insufficient
- more turns on the coil
  bigger coil is insufficient
  *do **not** accept more coils of wire*
- turns pushed closer together
- spring with a lower spring constant
  allow less stiff spring
  allow weaker spring
  *do **not** accept add an iron core*

2

[13]

Q4.

(a) **A**

1

(b) 2 (%)

1

(c) black
correct order only

1

reflects

1

transmits

1

(d) green

1

(e) without a darkened laboratory would not be able to see reflected light
allow would see all squares all of the time

1

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(f) so same 'amount' of light is incident on each square

a fair test is insufficient
control variable is insufficient

1

(g) two bars drawn at the correct height

*allow **1** mark for 1 correct bar*

2

both bars correctly labelled

1

(h) orange

reason only scores if orange chosen

1

can be seen from the furthest away

allow it reflects the most light

1

(i) repeatable

1

[14]

Q5.

(a) random

human error is insufficient

1

(b) accept any practical suggestion that could cause a range of values
e.g. misjudging the centre of the ray
e.g. not replacing mirror / ray box in the same position

measuring the angle incorrectly is insufficient
moving the mirror / ray box is insufficient

1

(c) range = 10
or
mean of 51 calculated

1

5(°)

*an answer of 5(°) scores **2** marks*

1

(d) within experimental accuracy the angle of incidence and the angle of reflection are the same

allow the angle of incidence is nearly the same as the angle of reflection

or
the angle of reflection is usually different to the angle of incidence

allow only a few of the values are the same / similar
allow the idea of a range of values

1

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relevant use of data
e.g.
at 20° / 30° / 40° there is at least one measurement of angle of reflection that is exactly the same
or
at 50° there are big differences

allow 50° includes anomalous results

an answer in terms of calculated mean(s) may score both marks
e.g.
mean calculated for one or more angle of reflection (1)
conclusion correctly stating angle i = / ≠ angle r (1)

1

(e) results could be collected for angles (of incidence) not yet measured

allow a stated angle of incidence e.g. 10° or 60°

changing the mirror is insufficient
ignore repeat the measurements

1

(f) replace the mirror with an irregular reflecting surface

allow use an irregular reflecting surface
replace mirror with paper is insufficient
*do **not** accept use a glass block*

1

[8]

Q6.

(a) sound

1

(b) (visible) light

1

(c) cooking food

1

(d) 1.2 gigahertz

1

(e) 300 000 × 1000 = 300 000 000 m/s

1

(f) wave speed = frequency × wavelength

allow $v = f\lambda$

1

(g) 300 000 000 = 1200 000 000 × λ

*an answer of 0.25 scores **3** marks*

1

$$\lambda = \frac{300\,000\,000}{1\,200\,000\,000}$$

*allow ecf from **(e)***

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1

λ = 0.25 (m)

1

[10]

Q7.

(a) **K**

1

(b) **L** and **M**

1

(c) the oscillation should be perpendicular to the direction of the stretched spring

allow up and down

1

(d) timing less than five echoes

1

(e) 3 (.0)

1

(f) 750 (m)

1

(g) speed = $\frac{750}{3}$

*an answer of 250 (m/s) scores **2** marks*

2

speed = 250 (m/s)

allow ecf from parts (e) and (f)

1

(h) any **two** from:

- time more than 5 echoes
- students stand further from the building
- have 2 or more students (independently) measuring the time taken

use a stopwatch with a higher resolution is insufficient

2

[10]

Q8.

(a) arrow drawn vertically downwards from the weight

1

same length as given arrow

1

(b) **C**

*reason only scores if **C** is chosen*

1

smallest force required for the same compression

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steepest gradient is insufficient

1

(c) 1.25

1

(d) $\text{period} = \frac{1}{25}$

*an answer of 0.8 (s) scores **2** marks*

1

period = 0.8 (s)

1

(e) extension = 0.20 m

1

$E_e = 0.5 \times 7.0 \times (0.20)^2$

1

$E_e = 0.14$ (J)

*an answer of 0.14 scores **3** marks*

1

[10]

Q9.

(a) (resultant) force = mass × acceleration

allow F = ma

symbols must be correct

1

(b) (2.7 – 1.5) = 0.75 × a

*an answer of 1.6 scores **3** marks*

1

$a = \frac{1.2}{0.75}$

allow compensation marks for correct use of incorrect resultant force

1

a = 1.6

1

m/s^2

1

(c) transverse

1

the oscillation / vibration is perpendicular to the direction of energy transfer

allow wave travel for energy transfer

1

(d) use springs with a smaller spring constant

allow use weaker springs

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or
use a trolley with greater mass
allow use a heavier trolley
do not accept use a larger trolley
allow add a mass / weight to the trolley

1

(Total 8 marks)

Q10.

(a) gamma rays

1

(b) can travel through the atmosphere

1

(c) explosion of a red super giant
or
a supernova

1

(d) 1.2×10^9 Hz

1

(e) $3.0 \times 10^8 = 1.2 \times 10^9 \times \lambda$
*an answer of 0.25 (m) scores **3** marks*
*allow ecf from **(d)***

1

$$\lambda = \frac{3.0 \times 10^8}{1.2 \times 10^9}$$

1

$\lambda = 0.25$ (m)

1

(g) same as the radio wave

1

(f) expansion due to fusion energy

1

in equilibrium with gravitational collapse
*forces acting inwards equal forces acting outwards gains **1** mark*

1

(h)

Level 2: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3-4
Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1-2
No relevant content	0
Indicative content	

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• Sun goes from main sequence to red giant • then from red giant to white dwarf • when the Sun changes to a red giant the surface temperature will decrease • and the relative luminosity will increase • when changing from a red giant to a white dwarf the surface temperature increases • and the relative luminosity decreases	

4

[14]

Q11.

(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 × 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]

Q12.

(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

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(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]

Q13.

(a) frequency

1

(b) echo(es)

1

(c) 340 (m/s)

*allow **1** mark for correct substitution ie 25 000 × 0.0136 provided no subsequent step*

or

*allow **1** mark for a correct calculation showing an incorrect value from conversion to hertz × 0.0136*

*an answer of 0.34 gains **1** mark*

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2

(d) (a wave where the) oscillations are parallel to the direction of energy transfer

both marking points may appear as labels on a diagram

accept vibrations for oscillations
accept in same direction as for parallel to
allow direction of wave (motion) for direction of energy transfer

*allow **1** mark for a correct calculation showing an incorrect value from conversion to hertz × 0.0136*

1

causing (areas of) compression and rarefaction

accept correct description in terms of particles

mechanical wave is insufficient
needs a medium to travel through is insufficient

1

[6]

Q14.

(a) X marked in the centre of the sign



Check position by eye

1

(b) concentrated

1

(c) 0.5 (s)

*allow **1** mark for correct substitution, ie*

$\frac{1}{2}$

provided no subsequent step

2

(d) make the cables longer

accept pendulum / sign for cables

1

[5]

Q15.

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(a) 20 000 Hz

1

(b) 400 (m)

*allow **1** mark for correct*
substitution ie 1600 × 0.25
provided no subsequent steps shown
*an answer of 200 (m) gains **1** mark*

2

(c) twice

1

(d) From pulse 1 to pulse 3 the distance (to the sea floor) decreased

accept the sea got shallower
or
the submarine went deeper for the distance decreased

1

then (after pulse 3) the distance (to the sea floor) increased

accept the sea got deeper
or
the submarine rose for the distance increased
*An answer of the distance decreased then increased gains **1** mark*

1

[6]

Q16.

(a) ultrasound is not ionising

allow ultrasound does not harm the (unborn) baby

1

but X-rays are ionising

1

so X-rays increase the health risk to the (unborn) baby

accept specific examples of health risks, eg cancer, stunted growth, impaired brain function etc
X-rays are dangerous is insufficient

1

(b) ultrasound/waves are partially <u>reflected</u>

(when they meet a boundary) (between two different media / substances / tissues)

must be clear that not all of the wave is reflected

1

the time taken is measured (and is used to determine distances)

1

(c) 1600 (m/s)

*800 (m/s) gains **2** marks*
*160 000 (m/s) gains **2** marks*

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*0.0016 (m/s) gains **2** marks*

*allow **2** marks for*

$$\frac{0.04}{25\times10^{-6}}$$

or

$$\frac{0.08}{50\times10^{-6}}$$

*80 000 (m/s) gains **1** mark*

*0.0008 (m/s) gains **1** mark*

*allow **1** mark for*

$$\frac{0.04}{25}$$

or

$$\frac{0.08}{50}$$

*allow **1** mark for evidence of doubling the distance or halving the time*

3

(d) (i) they are absorbed by bone

allow stopped for absorbed

X-rays are reflected negates this mark

1

they are transmitted by soft tissue

allow pass through for transmitted

allow flesh / muscle / fat

accept less (optically) dense material for soft tissue

1

(the transmitted) X-rays are detected

1

(ii) short

accept small

1

[12]

Q17.

(a) high frequency sound (waves)

1

with a frequency above limit of human hearing
or with a frequency greater than 20 000 Hz

above limit of human hearing

***or** greater than 20 000 Hz gains maximum **1** mark*

1

(b) $5(.0) \times 10^{-4}$ (m)
or
0.0005 (m)

*$1500 = 3 \times 10^{6}\ \lambda$ gains **2** marks*

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*answer of 500 gains **2** marks*
*1500 = 3.0 λ gains **1** mark*

3

(c) it will run off the surface of the skin
or
water is not a gel
accept water would evaporate

1

(d) The width of the coupling agent

1

The width of the water

1

(e) (i) A

1

(ii) E

1

(f) (i) **K**
reflection from skin
maximum 5 marks if no mention of reflection

1

very little reflection, so small peak

1

L
reflection from front of kidney

1

large amount of reflection, so large peak

1

M
reflection from back of kidney

1

smaller peak due to absorption of ultrasound in kidney
or
smaller peak as further from source
or
front of the kidney already reflected a lot, so there is now less to be reflected
reflection from a boundary gains 1 mark if no other mark given

1

(ii) 0.06 (m)
or
$6(.0) \times 10^{-2}$
*0.12 (m) gains **2** marks*
*distance = $1500 \times 8 \times 10^{-5} \times 0.5$ gains **2** marks*
*distance = $1500 \times 8 \times 10^{-5}$ gains **1** mark*

3

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[19]

Q18.

(a) (i) microwave

1

(ii) refraction

1

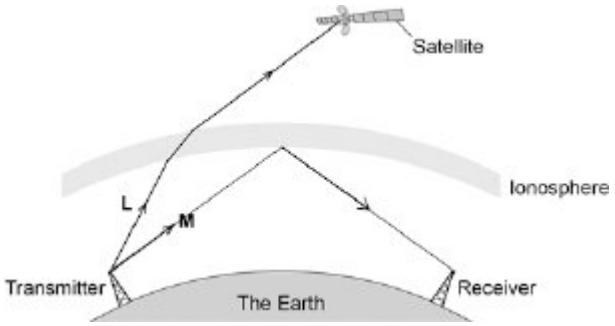
(b) (i) wave M continues as a straight line to the ionosphere and shown reflected

accept reflection at or within the ionosphere

1

correctly reflected wave shown as a straight line reaching the top of the receiver

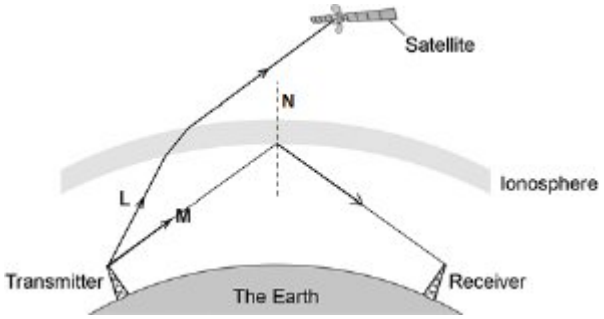
if more than 2 rays shown 1 mark maximum



ignore arrows

1

(ii) normal drawn at point where their **M** meets the ionosphere



1

(c) any **two** from:

- transverse
- same speed (through air)

  *accept speed of light **or** 3 × 10^8 m / s*
- can be reflected
- can be refracted
- can be diffracted
- can be absorbed

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- transfer energy
- can travel through a vacuum

  *an answer travel at the same speed though a vacuum scores **2** marks*
- can be polarised
- show interference.

  travel in straight lines is insufficient

2

[7]

Q19.

(a) 1.25

*accept 1.3 for **2** marks*

*allow **1** mark for correct substitution*

ie $\frac{1}{0.8}$

provided no subsequent step shown

2

(b) (i) increasing the length (of the pendulum) decreases the number of oscillations / swings made (in 20 seconds)

accept increasing the length (of the pendulum) increases the time (of 1 oscillation / swing)

accept increasing the length (of the pendulum) decreases the speed / frequency (of 1 oscillation / swing)

answers must refer to the effect of increasing / decreasing length

ignore references to time being proportional to length

1

changing the mass (of the pendulum bob) does not change the number of oscillations / swings made (in 20 seconds)

accept changing the mass does not change the time / speed / frequency / results

accept weight for mass

1

(ii) any **two** suitable improvements:

- measure (the number of swings) over a wider range of (pendulum) lengths
- measure (the number of swings) over a wider range of (bob) masses
- measure the number of swings made over a greater period of time
- repeat each measurement & calculate mean / average (number of oscillations in 20 seconds)

  accept repeat measurements & discard anomalous measurements

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repeat measurements is insufficient

- measure (the total number of swings &) the fraction of swings made
- start the swings at the same height.

use a computer / datalogger to make measurement (of number of oscillations) is insufficient

measuring time period is insufficient

using a stop clock with greater resolution is insufficient

2

[6]

Q20.

(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 (Hz) ≤ *f* ≤ 450 (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

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*allow **2** marks for 285*
*allow **2** marks for correct substitution 0.0035 = 1 / f*
*allow **1** mark for T = 0.0035 s*
*allow **1** mark for an answer of 2000*

3

[13]

Q21.

(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* $0.77\dot{2}$
*allow **2** marks for an answer of 0.772*
*allow **1** mark for correct substitution ie 340 = 440 × λ*

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]

Q22.

(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* $\frac{1600 \times 0.80}{2}$

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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 <u>any</u> 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 <u>ionising</u>

  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]

Q23.

(a) (i) 20

1

20 000

either order

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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]

Q24.

(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 <u>energy transfer</u>

accept direction of <u>wave travel</u>

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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]

Q25.

(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

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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]

Q26.

(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

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- 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

6

(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*

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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]

Q27.

(a) (i) wavelength

accept frequency

accept speed

1

(ii) amplitude

accept energy

height is insufficient

1

(iii) sound

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]

Q28.

(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

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(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]

Q29.

(a) (i) bat(s)

1

(ii) any example in the inclusive range 5 ↔ 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

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(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]

Q30.

(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]

Q31.

(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 <u>20 000</u> (Hz)
  ignore reference to lower limit
- it is ultrasound/ultrasonic

2

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(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]

Q32.

(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

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(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]

Q33.

(a) 10 600 (Hz)

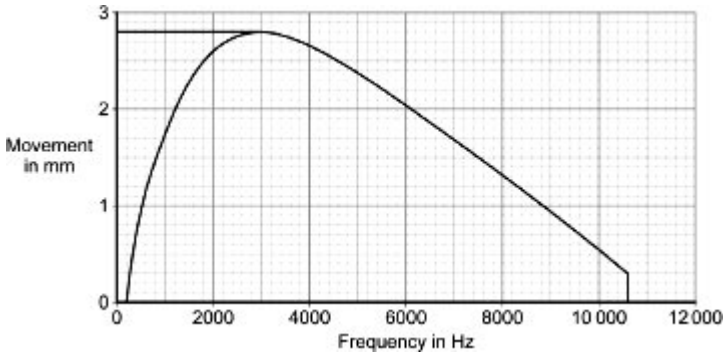
accept 10.6 kHz

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)

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- 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]

Q34.

(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]

Q35.

(a) sound / mechanical / longitudinal (wave)

1

any **one** from:

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

1

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(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)
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[6]

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