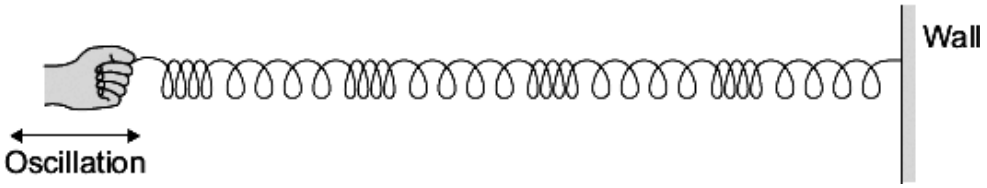
Higher Waves Mini Assessment

33 minutes

33 marks

Q1. **Diagram 1** shows a longitudinal wave being produced in a stretched spring.

Diagram 1



(a) A longitudinal wave has areas of compression and areas of rarefaction.

Mark with the letter **C**, **one** area of compression shown in **Diagram 1.**

(1)

(b) **Diagram 2** shows the apparatus a teacher uses to demonstrate that sound can be reflected.

Diagram 2

(i) Using a ruler, draw on **Diagram 2** to show how sound from the loudspeaker is reflected by the sheet of metal to the sound sensor.

(2)

(ii) The teacher replaced the sheet of metal with a sheet of glass.

When he did this, the reading on the sound level meter went down.

Suggest why.

.....

.....

(1)

(iii) The teacher changed the output from the loudspeaker to increase the amplitude of the sound wave produced.

What effect, if any, does this increase of amplitude have on the loudness of the sound?

Draw a ring around the correct answer.

makes the sound quieter	**does not change the loudness of the sound**	**makes the sound louder**

(1)

(iv) The loudspeaker produces a sound wave at a frequency of 850 Hz. The wavelength of the sound wave is 0.4 m.

Calculate the speed of the sound wave.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

Speed = ... m/s

(2)

(c) Music concerts are sometimes performed in sports halls. The concerts can be spoilt because of the sound reflected from the floor and walls.

What word is used to describe a reflected sound?

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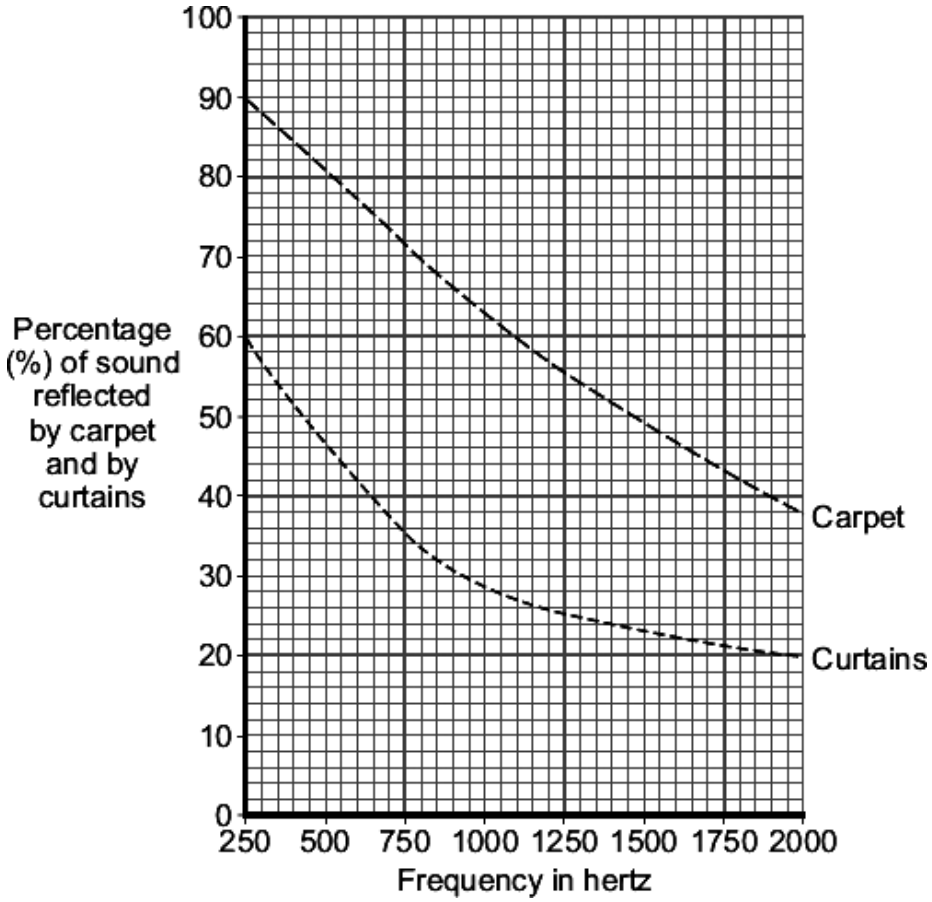
(1)

(d) The graph shows how the percentage of sound reflected from the floor and from the walls of a large room can be reduced by carpets and by curtains.



(i) Over which range of frequencies do curtains reduce the percentage of sound reflected the most?

Tick (✓) **two** boxes.

from 250 Hz to 750 Hz ☐

from 750 Hz to 1250 Hz ☐

from 1250 Hz to 1750 Hz ☐

(1)

(ii) The manager of a sports hall plans to use the hall for regular music concerts. He has enough money to buy either carpet or curtains, but not both.

To improve the sound an audience hears, it would be better to hang curtains on the walls rather than laying a carpet over the floor.

Use the data in the graph to explain why.

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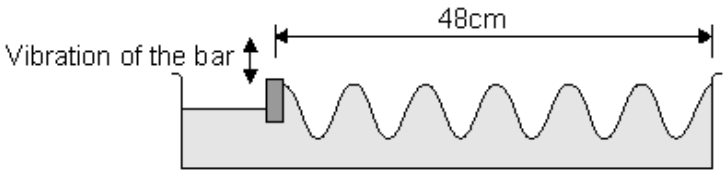
(2)
(Total 11 marks)

Q2. Water waves can be made by vibrating a wooden bar up and down in a tray of water.

The bar moves up and down at a frequency of 5 hertz.



(a) Calculate the speed, in cm/s, of the water waves.

Write down the equation you use and then show clearly how you work out your answer.

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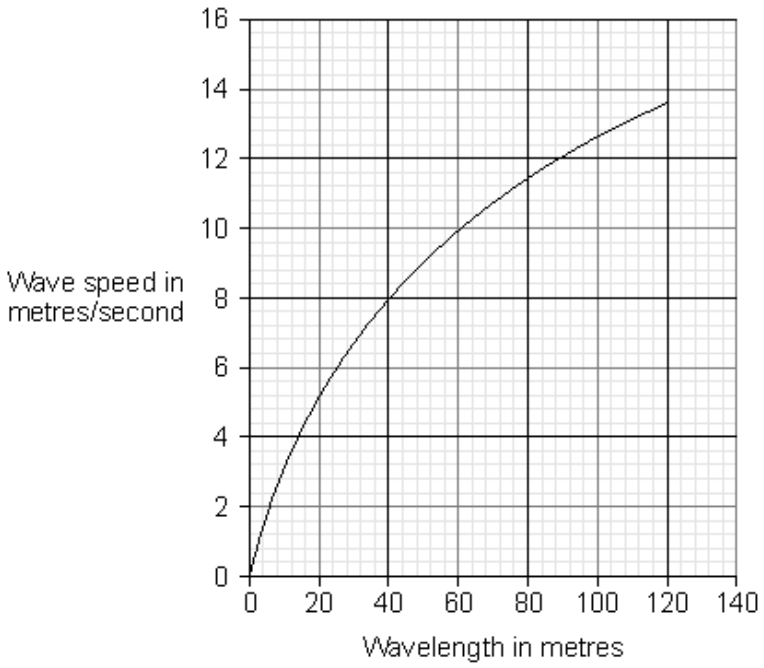
Wave speed = ... cm/s

(3)

(b) The graph shows how the speed of deep ocean waves depends on the wavelength of the waves.



Use the graph to predict a speed for waves with a wavelength of 140 m.

Show clearly how you have used the graph to work out your answer.

Speed of waves = ... m/s

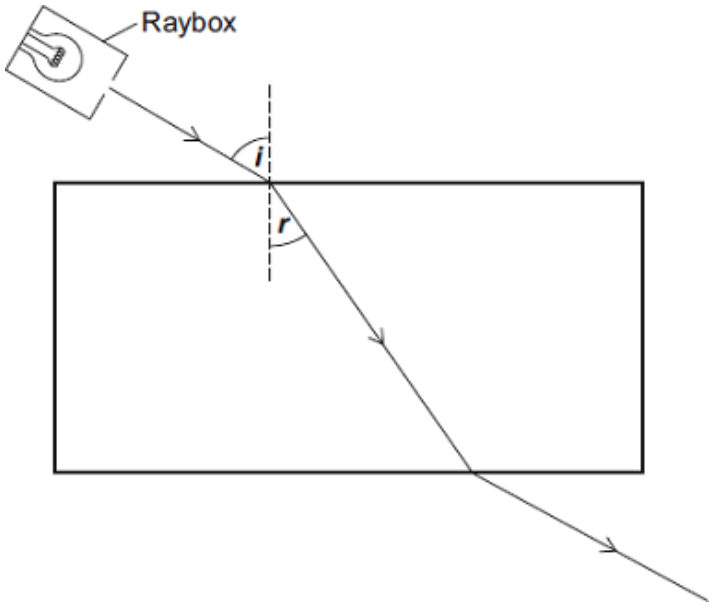
(2)

(Total 5 marks)

Q3. A student investigated the refraction of light as it passes into and out of a clear plastic block.

Diagram 1 shows the apparatus the student used.

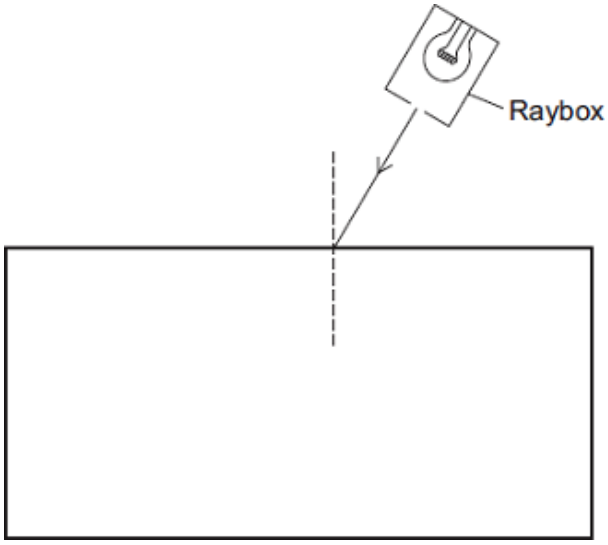
Diagram 1



(a) **Diagram 2** shows the same apparatus.

Use a ruler to draw on **Diagram 2** the path of the light ray.

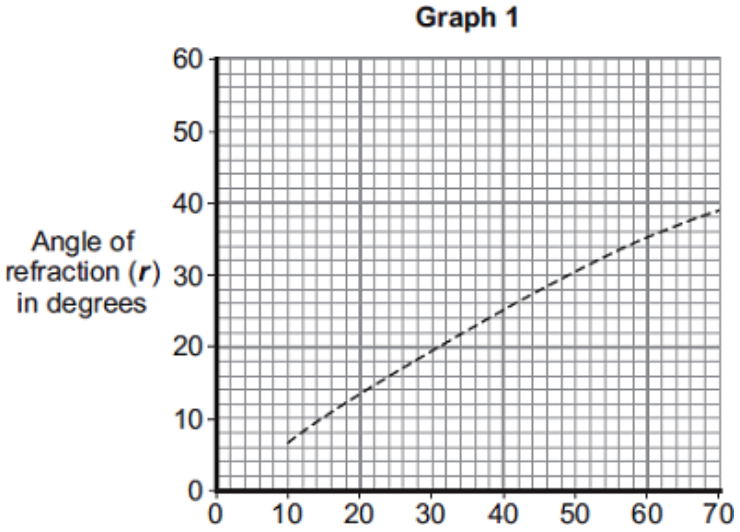
Diagram 2



(2)

(b) The student measured the angle of refraction (***r***) for different angles of incidence (***i***) for light entering the plastic block.

The results are shown in **Graph 1**.



(i) What **two** conclusions can be made about the relationship between the angle of incidence and the angle of refraction from **Graph 1**?

1 .....

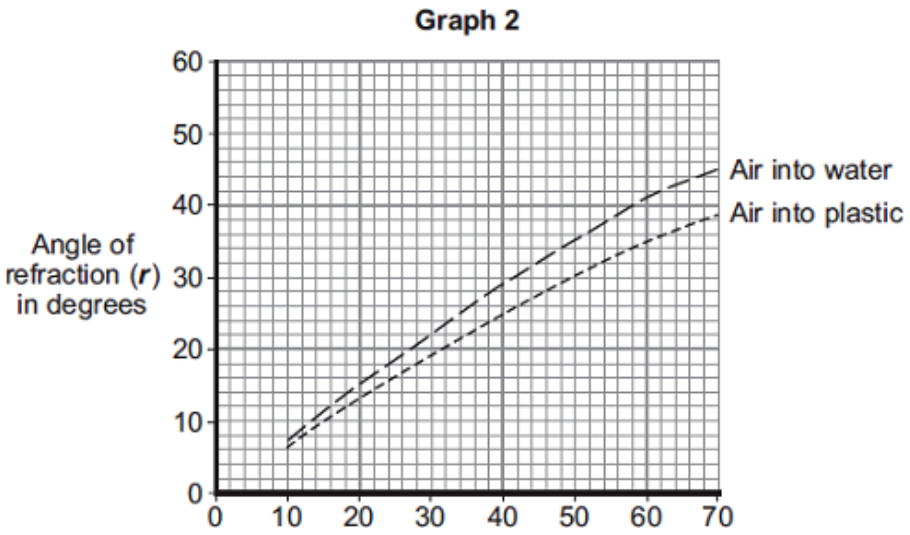
.....

2 .....

.....

(2)

(ii) **Graph 2** shows the student's results for light passing from air into plastic. The graph also shows the results for light passing from air into water.



How does the refraction of light passing from air into water compare to the refraction of light passing from air into plastic?

.....

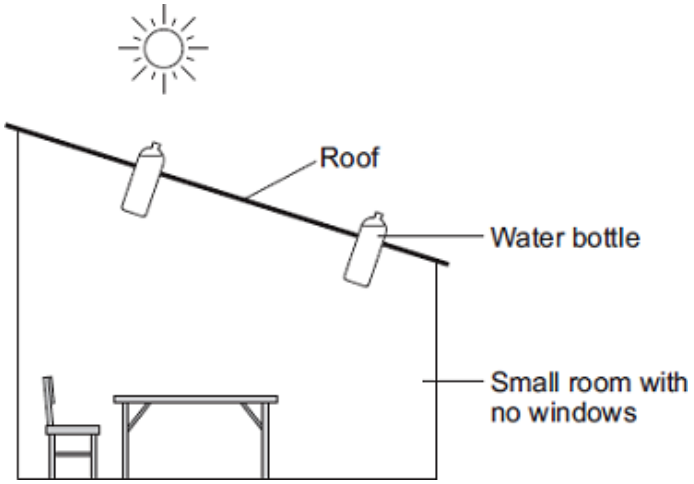
.....

(1)

(c) In some countries people are too poor to pay for electricity. Some people living in small houses with no natural light are using bottles filled with water instead of light bulbs.

The bottles are fitted into small holes in the roof of the house. Sunlight refracts as it passes into and out of the bottle, causing light to spread into the room. This simple device gives about the same amount of light as a 50 W light bulb.

Diagram 3



(i) Suggest **one** way this simple device can help improve the lives of the people using it.

.....

.....

(1)

(ii) The increasing use of energy resources to generate electricity within developed countries has ethical implications.

Suggest **one** ethical implication.

.....

.....

(1)
(Total 7 marks)

Q4. (a) Water waves are transverse waves. Sound waves are longitudinal waves.

(i) Explain the difference between a transverse wave and a longitudinal wave.

You may include labelled diagrams in your answer.

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.....

.....

(3)

(ii) Name **one** type of wave that may be either transverse or longitudinal.

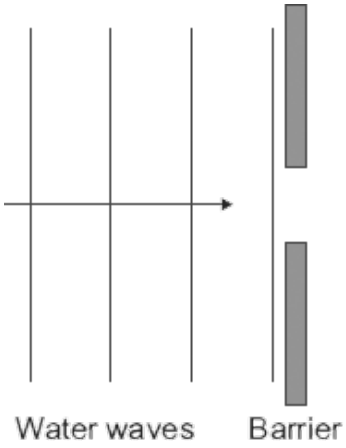
.....

(1)

(b) The diagram shows water waves in a ripple tank moving towards a gap in a barrier.

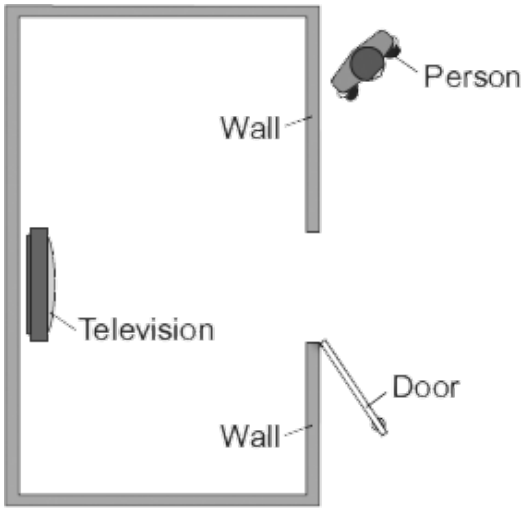
The water waves diffract as they pass through the gap.

Complete the diagram to show the diffracted water waves.



(1)

(c) A television is switched on inside a room. A person outside the room can hear the television, but only when the door is open.



When the door is open, the person can hear the sound but cannot see the television.

Explain why.

.....

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.....

.....

(2)
(Total 7 marks)

Q5. All radio waves travel at 300 000 000 m/s in air.

(i) Give the equation that links the frequency, speed and wavelength of a wave.

.....

(1)

(ii) Calculate the wavelength, in metres, of a radio wave which is broadcast at a frequency of 909 kHz. Show clearly how you work out your answer.

.....

.....

.....

Wavelength = ... metres

(2)
(Total 3 marks)

M1. (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]

M2. (a) 40 (cm/s)

correct answer

an answer 0.4 m/s gains full credit

if answer is incorrect

*allow **1** mark for correct wavelength λ = 8 cm*

or

*allow **2** marks for correct substitution into the correct equation, ie. V = 5 × 8*

or

*allow **2** marks for clearly stated wrong wavelength correctly substituted into correct equation and correctly calculated, ie*

λ = 16 cm/s

V = 5 × 16

= 80

3

(b) line extended following pattern

1

14 m/s

accept their numerical value, if not 14, provided the first mark has been awarded

1

[5]

M3. (a) refracted into the block, angle r < i

1

refracted correctly out of block, two rays in air parallel

judge by eye

*if first mark not scored allow **1** mark for correct refraction shown as ray leaves the block*

1

(b) (i) the angle of refraction is (always) less than the angle of incidence

1

the angle of refraction increases as the angle of incidence increases

*accept angle i and angle r are **not** directly proportional*

accept there is positive correlation

1

(ii) (for the same angle of incidence) the angle of refraction in plastic is less than the angle of refraction in water

accept (for the same angle of incidence) plastic refracts light more than water
accept it is less

1

(c) (i) accept any sensible suggestion to do with being able to see inside (during daylight hours)
eg able to (see to) work / cook inside

accept to see what they are doing lights up the room is insufficient
ignore no need to pay for electricity

1

(ii) accept any ethical suggestion, eg

- fair access to energy for all
- unequal use of energy resources
- consequences for the future of decisions made now
- damage to global environment affects all

damage to the environment is insufficient

1

[7]

M4. (a) (i) the oscillation / vibration (causing the wave)

a movement causes the wave is insufficient

1

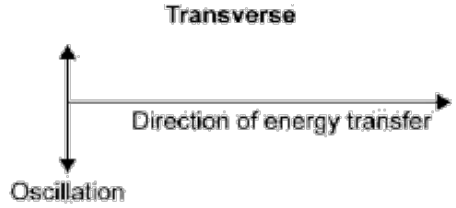
for a transverse wave is perpendicular to the direction of energy transfer

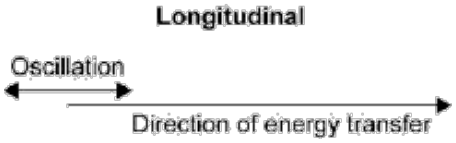
*answers given in terms of direction of wave travel and not energy transfer for both types of wave, score **1** mark for these **two** mark points*

1

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

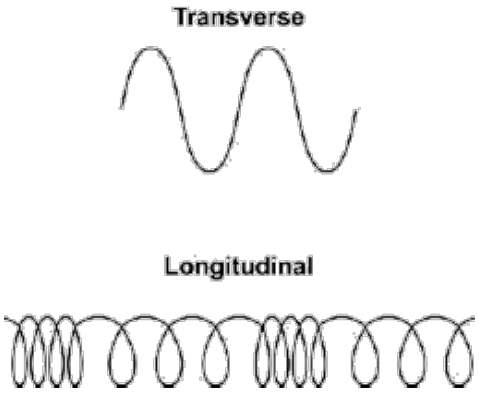
the marks may be scored by the drawing of two correctly labelled diagrams ie





two labelled diagrams showing the general form of a transverse and longitudinal wave gain 1 mark if no other mark has been awarded

eg



1

(ii) mechanical wave

accept specific examples, eg waves on a spring / slinky / seismic / earthquake waves

accept water waves

*do **not** accept shock waves*

1

(b) semicircular waves drawn

judged by eye

do not need to be full semicircles

ignore any rays

1

(c) sound (waves) will diffract (towards the person)

1

or

light (waves) do not diffract (towards the person)

(because) width of door way similar to / less than wavelength of sound (waves)

or

(because) width of doorway much greater than wavelength of light (waves)

*a general statement that waves (only) <u>diffract</u> when the width of a gap is similar to the wavelength of the waves can be awarded **1** mark*

1

[7]

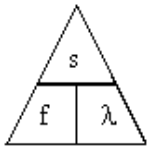
M5. (i) speed = frequency × wavelength

accept the equation rearranged

*accept v **or** s = f × λ*

do not allow w for wavelength

do not accept



unless subsequent calculation correct

1

(ii) 330 (m)

allow 1 mark for

$$\lambda = \frac{300\,000\,000}{909\,000}$$

***or** 300 000 000 = 909 000 × λ*

***or** answer of 330000(m) **or** 330033(m)*

2

[3]

E1. (a) About three-quarters of students could correctly identify a region of compression in the spring.

(b) (i) There were many excellent responses to this question scoring both marks. However, a significant number of students failed to score both marks because of the careless way in which the lines had been drawn. Examples included angles being nowhere near equal, large gaps between the ray and the reflecting surface and lines starting and finishing large distances from the speaker and the sound sensor.

(ii) Over half of students were able to suggest a suitable reason for the reading on the sound level meter going down.

(iii) About two-thirds of students correctly chose 'makes the sound louder'.

(iv) The calculation of the speed of sound was generally well done with three-quarters of students scoring both marks.

(c) A surprisingly large number of students did not know that a reflected sound is called an echo. Almost a fifth of students did not attempt this question.

(d) (i) Half of the students correctly chose the frequency range from 250 Hz to 750 Hz.

(ii) Only the better students realised that the reason why curtains would be better than carpet is because curtains reflect less sound. Many thought that carpet would be a better choice, in spite of the fact that in the stem of the question they were told that curtains would be better. In some of these cases, it was clear that students thought that reflection of sound was a good thing. In some cases, students thought that because the line for carpet on the graph was higher than the line for curtains, it must therefore be better. Very few students could make a sensible reference to the frequencies shown on the x-axis. Some students thought that curtains and carpet were able to change the frequency in different ways.

E3. (a) Just under half of the students scored both marks on this question showing correctly the refraction into and out of the block.

(b) (i) A large number of students were able to conclude that the angle of refraction increases as the angle of incidence increases. Fewer students were able to give a second correct conclusion.

(ii) When students answered in terms of angle of refraction, they were generally able to identify that “into water” was greater than “into plastic”. However when referring just to refraction, not many students realised that refraction was greater into plastic than into water.

(c) (i) Fewer than one-fifth of students were able to state a practical improvement which the water bottle ‘lights’ would bring. Many answers lacked detail, merely stating ‘it will help them to see’.

(ii) Around one-fifth of students were able to identify an ethical implication. Many answers gave environmental implications. There was evidence that students had not read the question thoroughly, with many answers relating to the water bottles in the roof. Comments such as “they may need the water to drink”, or “they only have access to dirty water” were not uncommon.

E4. (a) (i) A very small proportion of students were able to give a correct and concise answer. Few students confused the two types of wave but many tended to describe properties such as ‘travel through a vacuum’ rather than explain the difference between the two types of wave. Many students lost one mark by talking in terms of the direction of the wave rather than the direction of energy transfer. A number of students gained one mark by simply drawing a representation of the two waves.

(ii) The specification states that ‘mechanical waves may be either transverse or longitudinal’. This answer was given by few students; however, correct examples of mechanical waves such as seismic waves were acceptable. Most students named a part of the electromagnetic spectrum or sound. A significant number of students gave ‘heat waves’.

(b) This was better answered with two-thirds of students scoring the mark. Although not penalised for this, the quality of the completed diagrams left a lot to be desired. Students should, in general, be encouraged to take more care and with this particular diagram to draw the diffracted wavefronts the same distance apart as the incident wavefronts. There was evidence that some students had been taught interference, unfortunately this seems to have led to incorrect diagrams being drawn.

(c) Most students were unable to apply the idea of diffraction, introduced in part (b), to answer part (c). Of those students that correctly stated the sound waves would be diffracted or that the light waves would not be diffracted, few then related the wavelength of the wave to the width of the doorway. Most answers were in terms of refraction, reflection or sound travelling through walls. This was despite being told the sound could only be heard when the door was open.

E5. This question gave a full range of marks and it was quite well answered, although 909 kHz was often not converted to hertz.