Topic 6 Waves

Name: _____

Class: _____

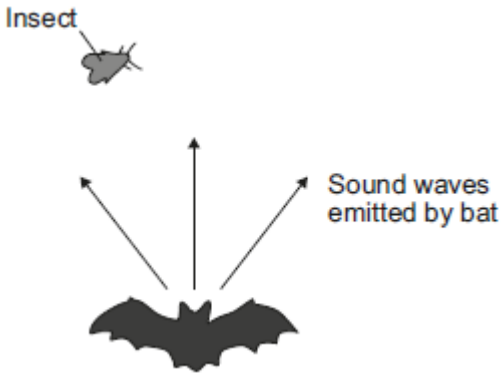
Date: _____

Time: **41 minutes**

Marks: **41 marks**

Comments:

Q1. Bats use the reflection of high pitched sound waves to determine the position of objects.
The image below shows a bat and an insect flying in front of the bat.



(a) What determines the pitch of a sound wave?

Tick (✔) **one** box.

	Tick (✔)
amplitude	
frequency	
speed	

(1)

(b) State the name given to reflected sound waves.

.....

(1)

(c) The bat emits a sound wave with a frequency of 25.0 kHz and a wavelength of 0.0136 metres.

Calculate the speed of this sound wave.

.....

.....

.....

Speed = ... m/s

(2)

(d) Sound waves are longitudinal. Describe a longitudinal sound wave.

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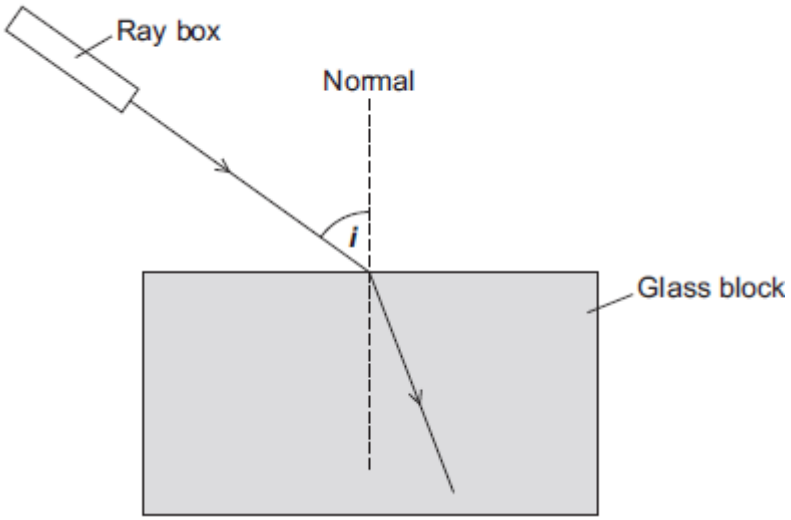
(2)
(Total 6 marks)

Q2.(a) **Figure 1** shows a ray of light entering a glass block.

Figure 1



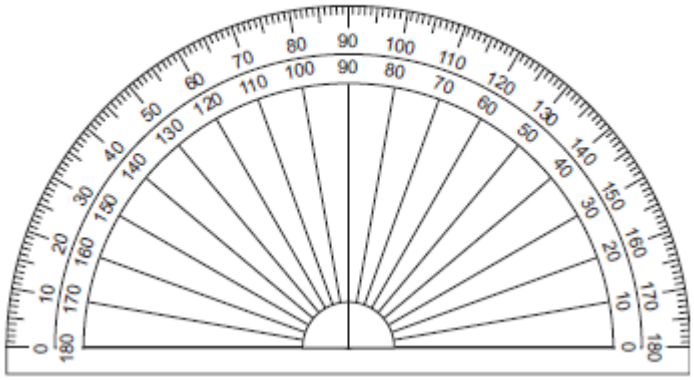
(i) The angle of incidence in **Figure 1** is labelled with the letter ***i***.

On **Figure 1**, use the letter ***r*** to label the angle of refraction.

(1)

(ii) **Figure 2** shows the protractor used to measure angles ***i*** and ***r***.

Figure 2



What is the resolution of the protractor?

Tick (✓) **one** box.

1 degree ☐ 5 degrees ☐ 10 degrees ☐

(1)

(iii) The table shows calculated values for angle ***i*** and angle ***r*** from an investigation.

Calculated values
sin ***i*** = 0.80
sin ***r*** = 0.50

Use the values from the table to calculate the refractive index of the glass.

.....

.....

.....

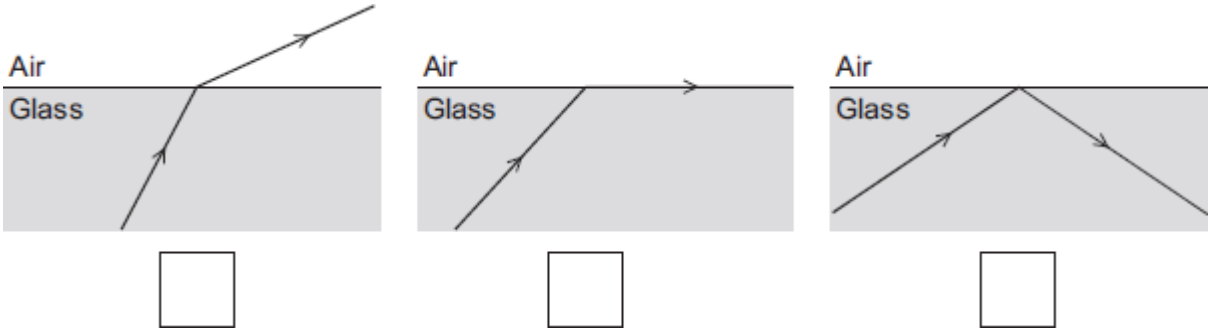
Refractive index = ...

(2)

(b) The diagrams below show a ray of light moving through glass.

Which diagram correctly shows what happens when the ray of light strikes the surface of the glass at the critical angle?

Tick (✓) **one** box.

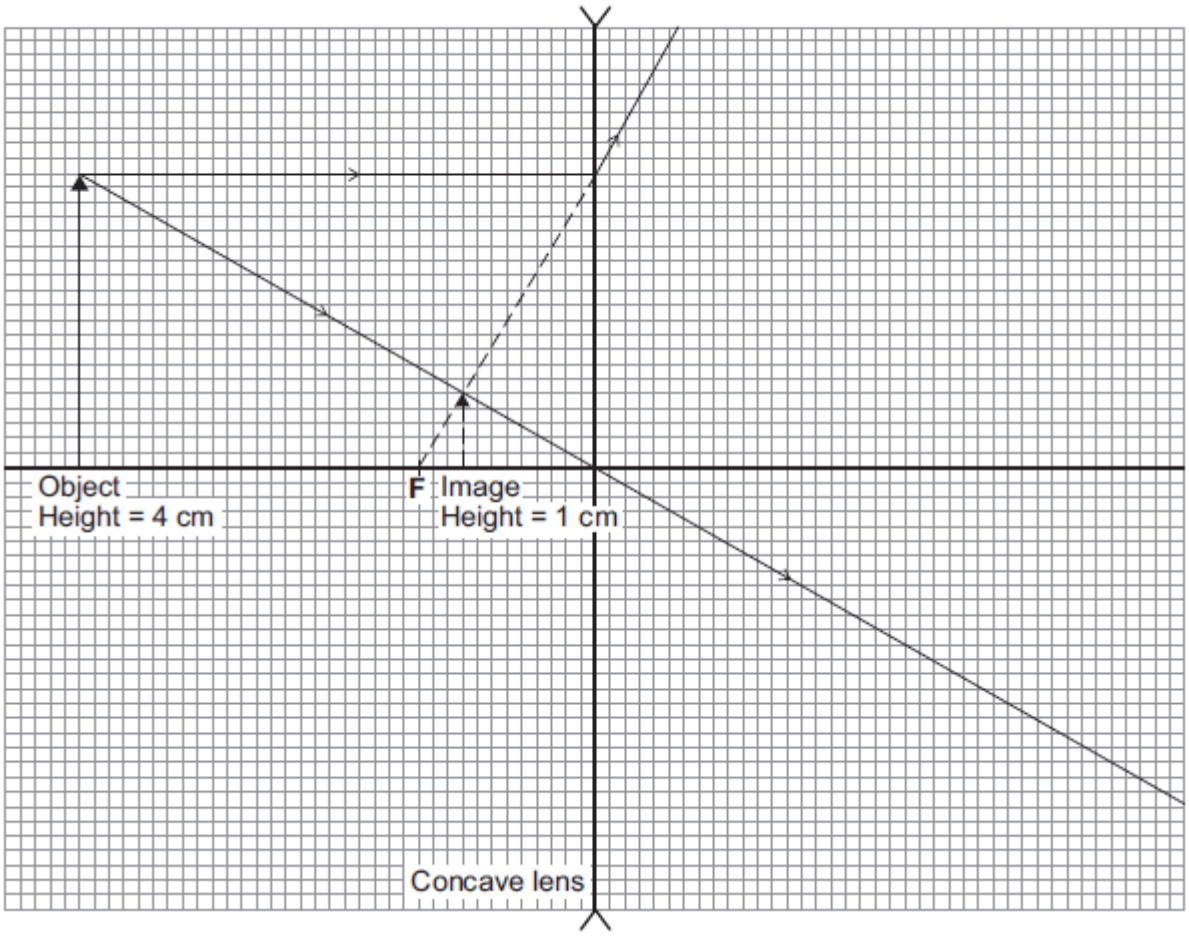


(1)

(c) A concave (diverging) lens is fitted into a door to make a security spyhole.

Figure 3 shows how this lens produces an image.

Figure 3



(i) State **one** word to describe the nature of the image in **Figure 3**.

.....

(1)

(ii) Use data from **Figure 3** to calculate the magnification of the image.

.....

.....

.....

Magnification = ...

(2)

(iii) What is another use for a concave lens?

Tick (✓) **one** box.

A magnifying glass	☐
Correcting short sight	☐
To focus an image in a camera	☐

(1)
(Total 9 marks)

Q3.(a) Radio waves, microwaves and visible light are all electromagnetic waves that are used for communication.

(i) Name another electromagnetic wave that is used for communication.

.....

(1)

(ii) Name an electromagnetic wave which is **not** used for communication.

State a use for this electromagnetic wave.

Electromagnetic wave .....

Use .....

.....

(2)

(b) The table below shows the wavelengths for some electromagnetic waves, **A**, **B**, **C** and **D**.

Wave	Wavelength
A	1000 m
B	100 m
C	10 m
D	3 cm

A teacher is going to demonstrate diffraction of waves through a gap. She will carry out the demonstration in a classroom.

The teacher is able to generate waves **A**, **B**, **C** and **D**.

Which wave, **A**, **B**, **C** or **D**, would she use? ☐

Explain your answer.

.....

.....

.....

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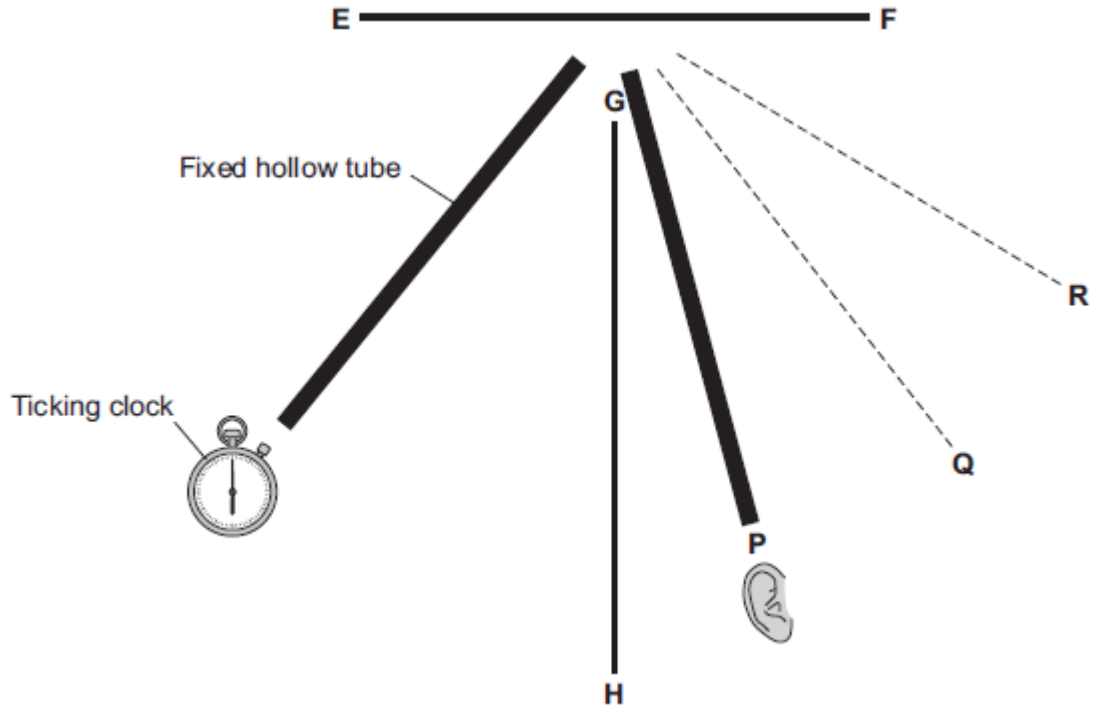
.....

.....

(3)

(c) In another demonstration, a teacher used a loud ticking clock as a source of sound, two hollow tubes and two smooth surfaces, **EF** and **GH**.

The figure below shows one of the hollow tubes fixed in position with a ticking clock at one end.



A student placed his ear at one end of the other hollow tube in position **P**. He moved this hollow tube, in turn, to positions **Q** and **R**.

(i) At which position, **P**, **Q** or **R**, did he hear the loudest sound? ☐

(1)

(ii) Explain your answer to part **(i)**.

.....

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.....

.....

.....

.....

(3)

(iii) Suggest why smooth surface **GH** in the figure above was needed.

.....

.....

(1)

(iv) The frequency of a sound wave is 15 Hz.

The speed of sound is 330 m / s.

Calculate the wavelength of the sound wave.

.....

.....

Wavelength = ... m

(2)

(v) Give a reason why it would **not** be possible to do the demonstration in the figure above using sound waves with a frequency of 15 Hz.

.....

.....

(1)

(Total 14 marks)

Q4. Waves may be either longitudinal or transverse.

(a) Describe the difference between a longitudinal and a transverse wave.

.....

.....

.....

.....

(2)

(b) Describe **one** piece of evidence that shows when a sound wave travels through the air it is the wave and not the air itself that travels.

.....

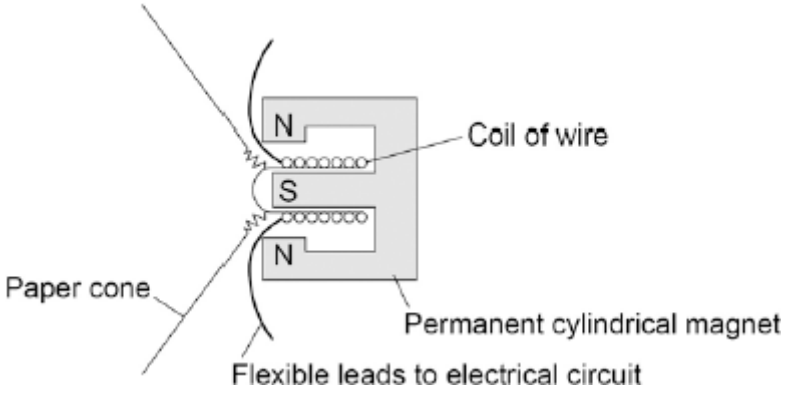
.....

.....

(1)

(c) The figure below shows the parts of a moving-coil loudspeaker.

A coil of wire is positioned in the gap between the north and south poles of the cylindrical magnet.



Explain how the loudspeaker converts current in an electrical circuit to a sound wave.

.....

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.....

.....

.....

.....

.....

.....

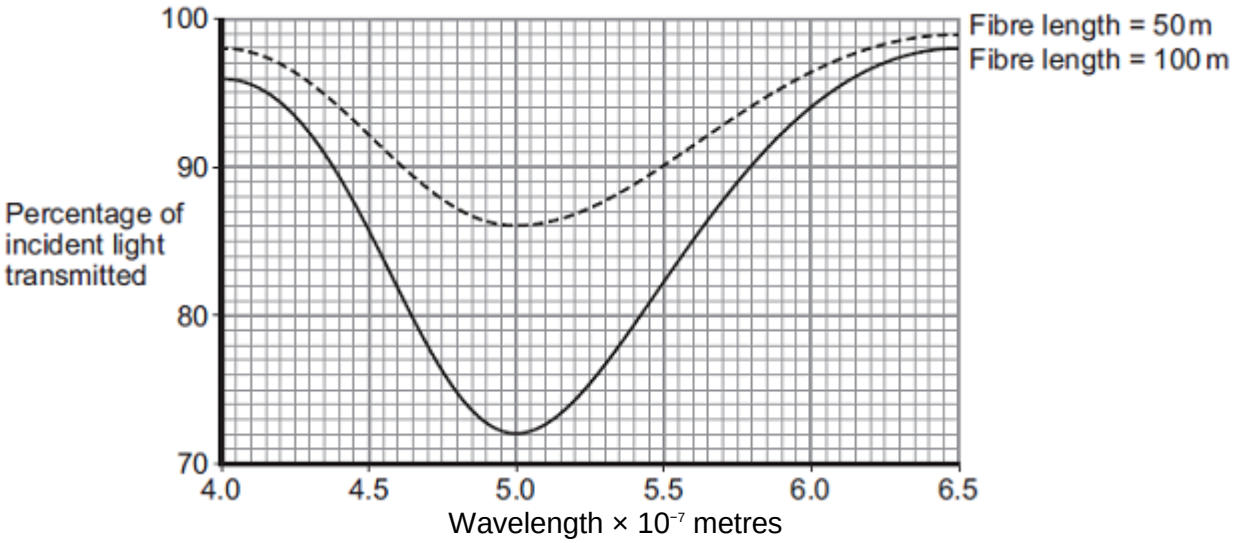
.....

.....

(6)
(Total 9 marks)

Q5. Different wavelengths of light can be used to transmit information along optical fibres.

The graph below shows how the percentage of incident light transmitted through a fibre varies with the wavelength of light and the length of the fibre.



Compare the percentages of incident light transmitted through the two different fibres over the range of wavelengths shown.

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.....

.....

.....

.....

.....

.....

.....

.....

(Total 3 marks)

M1.(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*

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

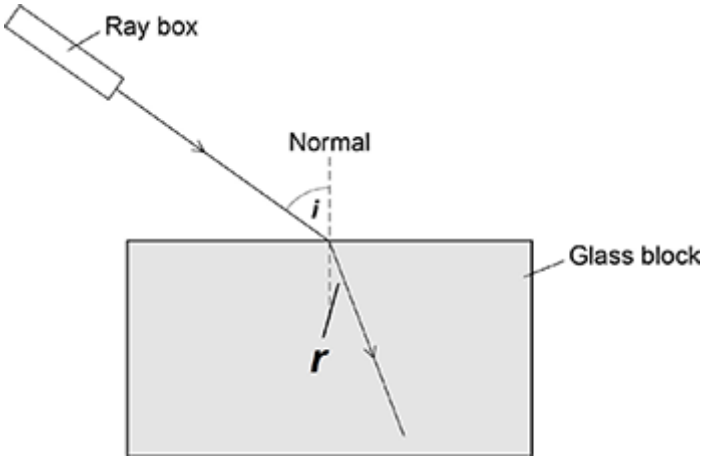
accept correct description in terms of particles

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

1

[6]

M2.(a) (i)



1

(ii) 1 degree

1

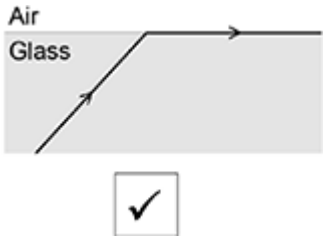
(iii) 1.6

*allow **1** mark for correct substitution, ie 0.80 / 0.5 provided no subsequent step shown*

working showing 1.59(9…..) scores zero

2

(b) 2nd diagram ticked



1

(c) (i) any **one** correct description:

- upright
- virtual
- diminished.

treat multiple words as a list

1

(ii) 0.25

*allow **1** mark for correct substitution, ie 1 / 4 or 5 / 20 provided no subsequent step shown*

ignore any unit

2

(iii) Correcting short sight

1

[9]

M3.(a) (i) infrared / *IR*

1

(ii) *UV / X-rays / gamma rays*

1

appropriate use corresponding with given wave:

dependent on first marking point

- UV: security marking ***or*** *tanning*
- X-rays: medical imaging ***or*** *checking baggage*
- gamma rays: sterilising surgical instruments ***or*** killing harmful bacteria in food

accept any sensible alternative uses

1

(b) D

1

gap must be comparable to wavelength

accept converse

1

can create gap of that size in classroom

dependent on first marking point

1

(c) (i) Q

1

(ii) sound waves reflected

accept 'it' for sound waves

ignore bounce

1

at EF

1

angle of incidence equal to angle of reflection

1

(iii) stop sound going direct from clock to ear

1

(iv) 22 (m)

*allow **1** mark for correct substitution, ie*
*330 = 15 × λ scores **1** mark*

2

(v) outside audible range

1

[14]

M4.(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]

M5.(for both fibres) increasing the wavelength of light decreases and then increases the percentage / amount of light transmitted

*accept for **1** mark:*
(for both fibres) increasing the wavelength (of light) to 5 (x 10^{-7} metres), decreases the (percentage) transmission

1

(for both fibres) the minimum transmission happens at 5 (x 10^{-7} metres)
or
maximum transmission occurs at 6.5 (x 10^{-7} metres)

*accept for a further **1** mark:*

(for both fibres) increasing the <u>wavelength</u> of the light from 5 (x 10^{-7} metres) increases the amount of light transmitted

increasing <u>wavelength</u> (of light), decreases the percentage transmitted is insufficient on its own

1

the shorter fibre transmits a greater percentage of light (at the same wavelength)

*accept for **1** mark:*
Any statement that correctly processes data to compare the fibres

1

[3]