Mark schemes

Q1.

(a) C

1

(b) B

1

(c)

$$\text{period} = \frac{1}{5000}$$

1

period = 0.0002 (s)

1

(d) any named electromagnetic wave

allow electromagnetic (wave)

1

(e) F

1

(f)

$$\text{wavelength} = \frac{330}{750}$$

1

= 0.44 (m)

1

(g) **Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

method of making sound

eg cymbals, wooden blocks, starting pistol

measuring distance

- measuring distance between sound source and detector eg distance to wall, distance along track, distance between microphones
- use of measuring instrument eg tape measure, trundle wheel, metre rule

measuring time

- timing started when sound made and timing stopped when sound heard
- use of measuring instrument eg stopwatch, oscilloscope, data logger

extra detail

- dividing time by 2 or multiply distance by 2 for echo method
- use of equation speed = $\frac{\text{distance}}{\text{time}}$

(h) increases

1

[13]

Q2.

(a) 1 (°)

1

(b) **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

Some indicative content could be indicated within a labelled diagram

- place a glass block on a piece of paper
- draw around the glass block
- use the ray box to shine a ray of light through the glass block
- mark the ray of light entering the glass block
- mark the ray of light emerging from the glass block
- join the points to show the path of the complete ray through the block
- and draw a normal line at 90 degrees to the surface
- use a protractor to measure the angle of incidence
- use a protractor to measure the angle of refraction
- use a ray box to shine a ray of light at a range of different angles (of incidence)
- increase the angle of incidence in 10 degree intervals
- from an angle of incidence of 10 degrees to an angle of incidence of 60 degrees

Methods involving mirrors and reflection score zero

(c) points plotted correctly

allow tolerance of ± half a small square

1

curve drawn passing through points

allow a line starting at the origin

1

(d) the line curves

allow the line is not straight

*allow line does not pass through the origin if consistent with their answer to question **(c)***

1

(e) normal drawn

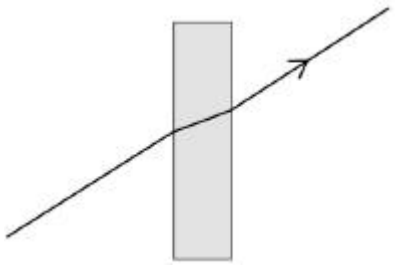
1

ray reflected so i = r

judge by eye

1

(f)



1

[13]

Q3.

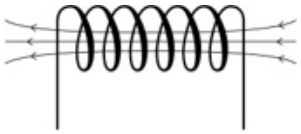
(a) direction (of the magnetic field)

1

(b) increase the current in the wire

1

(c)



1

(d) **D A B C**

*allow **1** mark for D B A C*

2

(e) decrease the distance between the electromagnet and the iron arm

1

(f) $\text{period} = \frac{1}{6.25}$

1

period = 0.16 (s)

1

(g) **B**

1

[9]

Q4.

(a) wavelength = Q

1

(b) $\text{amplitude} = \frac{R}{2}$

1

(c) radio waves

1

(d) s = 300 000 000 × 0.000009

1

s = 2700 (m)

1

(e) satellite communications
or
cooking /heating food

allow WiFi

1

[6]

Q5.

(a) wavelength

1

frequency

1

this order only

(b) parallel

1

(c) 8000 Hz

1

(d) period = $\frac{1}{8000}$

allow ecf from part ***(c)***

1

0.000125 (s)

1

(e) $\lambda = \frac{330}{6600}$

1

λ = 0.050

allow 0.05

1

m

1

(e) distance travelled = speed × time

or

s = *vt*

allow any correct rearrangement

1

(f) 13.2 = 330 × *t*

1

$t = \frac{3600}{120}$

1

t = 0.040 (s)

allow 0.040 (s)

1

(g) loudspeaker **B** is closer to the technician (than speaker **A**)

*'it' means speaker **B***

1

so the sound would take more time to travel (to the technician)

1

so the sound from each speaker arrives at the technician at the same time

1

[16]

Q6.

(a) **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

Some indicative content could be indicated within a labelled diagram

- place a glass block on a piece of paper
- draw around the glass block
- use the ray box to shine a ray of light through the glass block
- mark the ray of light entering the glass block
- mark the ray of light emerging from the glass block
- join the points to show the path of the complete ray through the block
- and draw a normal line at 90 degrees to the surface
- use a protractor to measure the angle of incidence
- use a protractor to measure the angle of refraction
- use a ray box to shine a ray of light at a range of different angles (of incidence)
- increase the angle of incidence in 10 degree intervals
- from an angle of incidence of 10 degrees to an angle of incidence of 80 degrees

Methods involving mirrors and reflection score zero

(b) angle of incidence in degrees / ° on *x*-axis **and** angle of refraction in degrees / ° on *y*-axis

1

all points plotted correctly

*allow **1** mark if 3 or 4 points plotted correctly*

allow tolerance of half a small square

2

curved line of best fit

allow line of best fit from their incorrectly plotted points

1

(c) normal drawn at 90° at the point where the incident ray strikes the mirror

1

straight line drawn with a ruler **and** angle of incidence = angle of reflection

ignore any arrows

1

(d) (the protractor drawn on the paper means you) do not have to move the mirror (to measure the angles)

allow do not have to mark the position of the rays of light

allow protractor does not need to be repositioned

1

(so) more likely to record the correct angle of incidence and/or reflection

allow reducing random error

allow more accurate

1

ray in method A does not diverge

allow the ray in method A is thin(ner)

1

(making it) easier to judge the centre (position) of the ray

allow more accurate if not already awarded

allow converse answers in terms of method B being worse than method A

1

[16]