Mark schemes

1.

(a) **B**

1

(b) a control

1

(c) record the initial temperature of the two thermometers in each flask

allow initial temperature is a control variable

or

ensure initial temperature is the same in both flasks

1

switch the infrared heater on and start the stop clock (at the same time)

allow switch on the power supply for switch on the heater

1

after five minutes record the (final) temperature from both flasks

allow calculate the temperature increase / change after five minutes

1

see / check if the temperature inside the flasks had increased by different amounts

1

(d) 27 (°C)

allow 27 (°C) identified on the table

allow test 3

1

(e) ignore (the result)

allow repeat (the result)

1

(f) (33/3 =) 11

1

(g) the black flask absorbed the most infrared during the five minutes

1

[10]

2.

Level 3 (5–6 marks):
A detailed and coherent plan covering all the major steps is provided. The steps in the method are logically ordered. The method would lead to the production of valid results.

A source of inaccuracy is provided.

Level 2 (3–4 marks):
The bulk of a method is described with mostly relevant detail. The method may not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):
Simple statements are made. The response may lack a logical structure and would not lead to the production of valid results.

0 marks:
No relevant content.

Indicative content

place a glass block on a piece of paper

draw around the glass block and then remove from the paper

draw a line at 90° to one side of the block (the normal)

use a protractor to measure and then draw a line at an angle of 20° to the normal

replace the glass block

using a ray box and slit point the ray of light down the drawn line

mark the ray of light emerging from the block

remove the block and draw in the refracted ray

measure the angle of refraction with a protractor

repeat the procedure for a range of values of the angle of incidence

possible source of inaccuracy

the width of the light ray

which makes it difficult to judge where the centre of the ray is

[6]

3.

(a) magnification = $\frac{\text{image height}}{\text{object height}}$

1

dividing by an object height of 1 cm gives the same (numerical) value

1

(b) accept anything practical that would work eg:

use a taller object

use a (travelling) microscope

attach a scale to the screen and use a magnifying glass

1

(c) both points plotted correctly

1

correct line of best fit drawn

a curve passing through all points (within ½ square), judge by eye

1

(d) values of 1.4 and 0.6 extracted from the graph

1

2.33 times bigger

accept any number between 2.3 and 2.5 inclusive

1

(e) by dividing the distance between the lens and the image by the distance between the lens and the object

1

at least one correct calculation and comparison eg 100÷25 = 4 which is the same as the measured magnification

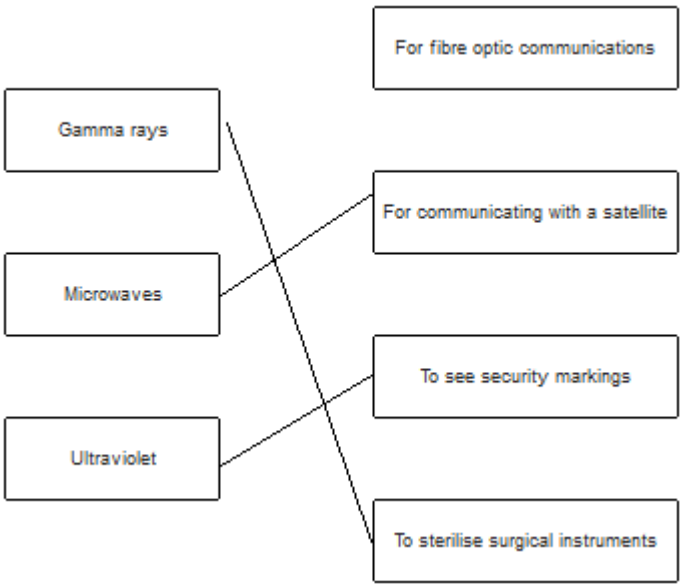
1

[9]

4. (a) radio

1

(b)



*award **1** mark for each correct line*

if more than one line is drawn from any em wave then none of those lines gain credit

3

(c) ionising

1

[5]

5. (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]

6. (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

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)

7. (a) transverse

1

(b) the water at point **X** moves up and down

1

(c) $v = 2.0 \times 0.032$

1

$v = 0.064$ (m/s)

1

m/s

1

(d) energy

1

(e) **D**

1

(f) **B**

1

[8]

8. (a) convex

1

(b) In Exampro, the measurement of 0.8 cm or 2.0 cm will depend on the printing of the exported diagram and should therefore be checked by the teacher/student using this mark scheme.

image height = 0.8 (cm)
and
object height = 2 (.0 cm)

*both correct for **1** mark*

1

(c) magnification = $\frac{\text{magnification} = \underline{0.8\ (\text{cm})}}{2\ (.0\ \text{cm})}$

*allow their measured object and image heights from question **(b)***

1

magnification = 0.4(0)

1

(d) inverted

1

real

1

(e) black

this order only

1

green

1

[8]

9. (a) R

1

(b) S

1

(c) $T = \frac{1}{0.20}$

1

T = 5(.0 s)

1

(d) The wavelength decreases

1

(e) Time taken by the wave to travel the length of the tray

1

(f) Depth of water

1

(g) as the depth increases, the speed increases

allow positive correlation (between speed and depth)

1

(h) 0.49 (m/s)

1

[9]

10. (a) Microwaves

1

Radio waves

1

(b) normal

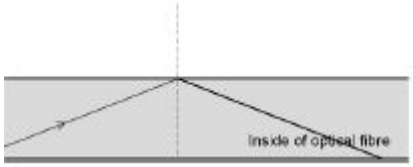
1

(c) reflected ray drawn to the right of the normal

ignore arrows

1

correct ray of light drawn using a ruler with i = r



1

(d) they need to be flexible

ignore bendy / ductile / malleable / elastic

1

(e) transmitted

1

absorbed

1

absorbed

1

[9]

11. (a) D

1

(b) Any **one** from:

- mutation (of genes/DNA/chromosomes)

  allow can damage OR destroy genes/DNA/chromosomes

  ignore damage/destroy cells/tissues/organs

  ignore mutates cells

- cancer/tumour

- cell death

  allow kills cells

1

(c) the risk of harm is lower from the X-ray

1

by a factor of 60

1

(d) 0.0060 sieverts

1

(e) $\frac{0.1}{2.5} \times 100$

1

4 (%)

*allow 0.04 for **1** mark*

1

[7]

12. (a) B

1

(b) electrical heating

1

(c) orange

allow a correct answer indicated in the box provided the answer space is blank

1

(d) becomes (more) red

allow changes from mainly orange to mainly red

1

(e) the independent

allow a correct answer indicated in the box provided the answer space is blank

1

(f) pour (hot) water into the (hollow metal) cube

1

point the IR detector at each / a side and take a reading

allow point the IR detector at the cube and take a reading

allow IR detector touching the surface and take a reading

allow take the temperature for take a reading

1

keep the detector the same distance from each surface

1

(g) 0.1°C

1

(h) one bar drawn to 68.0 (°C)

ignore the position of the bars on the x-axis

1

one bar drawn to 28.0 (°C)

1

tallest bar labelled Matt black and shortest bar labelled Shiny silver

1

(i) any **one** from:

- (matt) black is the best emitter
- shiny silver is the worst emitter

allow matt white and shiny black are (almost) the same at emitting

allow black is a good emitter

allow silver is a poor emitter

allow an answer in terms of highest / lowest temperature

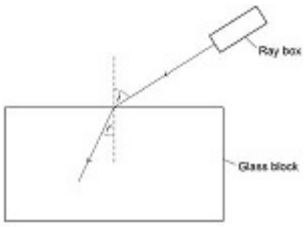
ignore any reference to absorption / reflection

1

[13]

13. (a) correct angle labelled

answer must indicate the angle, the letter r on it's own is insufficient



1

(b) 58 (degrees)

allow 57 to 59 inclusive

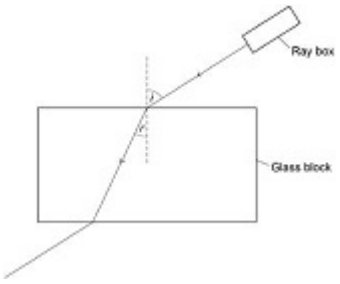
1

(c) ray continues in a straight line to the edge of the block

1

ray refracts away from the normal

1



both rays in the air should be parallel

judge by eye

1

(d) random

allow a correct answer indicated in the box provided the answer space is blank

1

(e) 25

1

(f) less than

allow a correct answer indicated in the box provided the answer space is blank

1

(g) there is no data/results outside of that range

allow that is all the student measured

1

(h) light would not pass through an opaque block
or
light will pass through a transparent block

an answer which does not refer to either transparent or opaque should be taken as referring to transparent

1

(i) The angles of incidence tested

1

[11]

14. (a) focal length

this answer only

1

(b) one correct line drawn from the top of the object, passing through the lens and crossing or meeting given line

ignore any arrow drawn on the line

if two lines are drawn, both must be correct

1

inverted image drawn at the correct position and length

arrowhead required

1

(c) similarity
(both are) diminished

1

difference
concave is <u>virtual</u> and convex is <u>real</u>
or
concave is upright and convex is inverted

allow smaller for diminished

a comparison must be made
ignore reference to positions of images

1

(d)

*an answer of 1.5 (mm) scores **3** marks*

$$6.0 = \frac{9.0}{\text{object height}}$$

1

$$\text{object height} = \frac{9.0}{6.0}$$

1

object height = 1.5 (mm)

*provided working can be seen, an attempt to convert 9.0 mm to cm or m with all other steps correct scores **2** marks*

1

[8]

15. (a) metre rule

allow metre ruler

allow tape measure

do not accept ruler

do not accept metre stick

1

(b) (wave) speed = frequency × wavelength

allow $v = f\lambda$

1

(c)

*an answer of 44 (m/s) scores **3** marks*

80 cm = 0.8 m

1

v = 55 × 0.8

this mark may be awarded if wavelength is incorrectly or not converted

1

v = 44 (m/s)

allow correct calculation using an incorrectly or not converted wavelength

*an answer of 4400 (m/s) scores **2** marks*

1

(d) move the (wooden) bridge

1

to the right

dependent on 1st mp being scored

1

OR

change the mass/weight (on the string) scores **1** mark

add more masses/weights (to the string) scores both marks

(e) **Level 2**: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

Level 1: The design/plan 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

add or take away masses from the string (ignore any stated values)

adjust frequency using the signal generator and/or move the wooden bridge

observe a steady / stationary pattern measure the wavelength

calculate wave speed from frequency and wavelength

a Level 1 answer should include a way of changing tension a complete Level 2 answer would include either changing frequency and/or moving the bridge

[11]

16. (a) B

1

(b) upright

1

virtual

1

(c) image height = 9.5(mm)

allow any value between 9 and 10 inclusive

allow 5 (squares)

1

object height = 24(mm)

allow 12 (squares)

1

$$\text{magnification} = \frac{9.5}{24}$$

or

$$\frac{\text{their image height}}{\text{their object height}}$$

1

magnification = 0.4

allow an answer that rounds to 0.4 provided both object height and image height are correct

or

$$\frac{\text{their image height}}{\text{their object height}}$$

ignore any units

correctly calculated

1

*an answer of 0.4 scores **4** marks*

(d) decrease

1

[8]

17. (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]

18. (a) glass vase

1

(b) transmit

1

(c) the T-shirt reflects all wavelengths / colours of light (equally)

allow T-shirt reflects (white / all) light

1

(d) changes from red to black

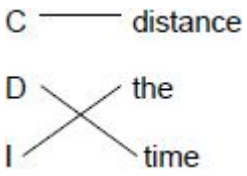
it appears black
it is darker is insufficient

1

as the cap absorbs (all) the (blue) light
or
as the cap does not reflect the (blue) light

1

(e)



all 3 lines correct

*allow **1** mark for 1 line correct*

if more than one line drawn from a variable all of those lines do not score

2

(f) the (infrared) heater

allow infrared (radiation)

*do **not** accept answers where burning yourself is given as the hazard*

1

(g) answer must be a comparison, e.g. the matt / black surface is the better absorber (of infrared radiation)

matt black is a good absorber is insufficient

1

[9]

19. (a) C

1

(b) radio waves have a longer wavelength than ultraviolet

1

(c) (risk of) skin cancer

cancer is insufficient

or

(prematurely) ageing skin

skin damage is insufficient

ignore kills skin cells

1

(d) risk is higher (for X-ray of uds than X-ray of chest)

1

by a factor of 50

or

risk calculated for each type of X-ray
chest X-ray = 1:200 000 (1)
uds = 1:4000 (1)

1

[5]

20. (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

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

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]

21. (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)***

1

λ = 0.25 (m)

1

[10]