AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.6.2 ELECTROMAGNETIC WAVES (PACK 1)

SCORE	PERCENTAGE
/297	%

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Q1.

(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]

Q2.

(a) glass vase

1

(b) transmit

1

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

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allow T-shirt reflects (white / all) light

1

(d) changes from red to black

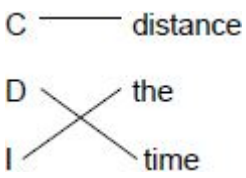
it appears black
it is darker is insufficient

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]

Q3.

(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

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or

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

1

[5]

Q4.

(a) an idea used to explain observations and data

1

(b) different models may be appropriate in different situations

allow one particular model may not be able to explain all observations

1

(c) new (experimental) evidence / data

1

evidence cannot be explained using an existing model
or
predictions made using old model are shown to be incorrect

allow old model based on data now shown to be incorrect

1

new model explains new evidence
or
predictions made with new model are shown to be correct

1

a suitable example given
e.g. nuclear model of the atom replacing the plum pudding model

allow tectonic plates replacing static land masses

big bang theory replacing other theories for the creation of the universe

allow heliocentric model of solar system replacing geocentric model

1

(d) velocity / speed is slower in shallow water

1

so edge of wave (front) entering shallow water slows down

1

but the part of the wave (front) in deeper water continues at a higher speed (leading to a change in direction of the wave fronts)

allow one part of the wave (front) changes speed before other parts

allow an answer in terms of wave (front) travelling from shallow to deep water

1

(e) every point on the wave (front) enters / hits the shallow water at the same time

1

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and so every point slows down at the same time

allow changes speed for slows down

allow an answer in terms of wave (front) travelling from shallow to deep water

1

[11]

Q5.

(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

(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]

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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 λ

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]

Q7.

(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

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λ = 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 • 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]

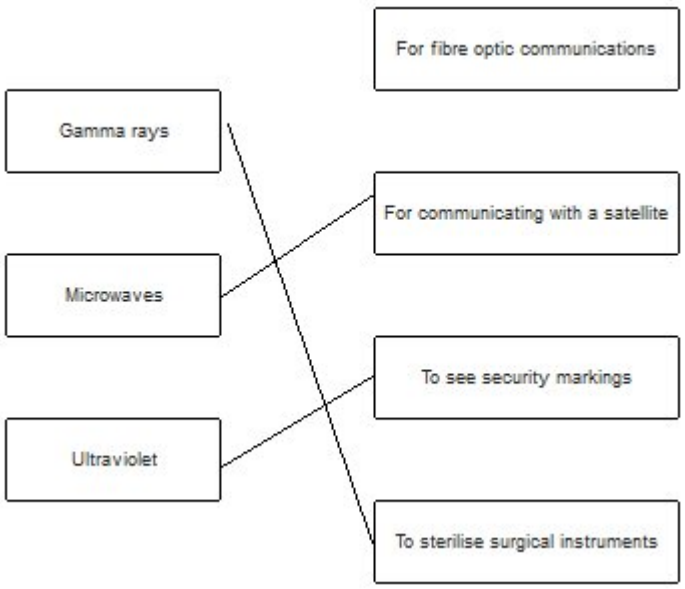
Q8.

(a) radio

1

(b)

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*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]

Q9.

(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

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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]

Q10.

(a) **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

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

6

(b) velocity / speed of the light decreases

allow velocity / speed of the light changes

1

[7]

Q11.

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

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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]

Q12.

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(a) any **one** from:

- (visible) light
- UV / ultra violet
- X-ray
- gamma / γ-ray

1

(b) less than

1

less than

1

the same as

1

[4]

Q13.

(a) **use of infrared:**
remote controls
fibre optic (communications)

1

use of microwaves:
mobile/cell phones

accept mobiles

accept phone signals

satellite (communications/TV)
wi-fi
Bluetooth

1

(b) any **two** from

- same speed
  or
  travel at the speed of light (in a vacuum)
- transverse

  accept a full description of a transverse wave
- transfer energy (from one place to another)
- can be reflected
- can be refracted
- can be diffracted
- can be absorbed / transmitted
- can travel through a vacuum/space
- can be polarised

  travels in straight lines is insufficient

2

[4]

Q14.

(a) electromagnetic

accept e.m.

1

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(b) (i) 2.2 (arbitrary units)

allow an answer between 2.1 and 2.3

1

(ii) the thicker the tissue the lower the intensity

accept more intensity is needed to pass through thicker tissue

1

the relationship is not linear

accept the line is not straight

*allow for **1** mark*

it still goes through with thicker tissue

or

intensity does not reach zero

or

at 5 cm X rays still pass through

1

(iii) Both variables are continuous

1

(c) (they are) absorbed

accept (they are) stopped

1

(d) With a charge-coupled device (CCD).

1

(e) (i) X-rays are ionising

1

(ii) stand behind a (protective) screen

accept leave the room

accept wear a lead apron

1

[9]

Q15.

(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)

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

$$\frac{0.04}{25 \times 10^{-6}}$$

or

$$\frac{0.08}{50 \times 10^{-6}}$$

*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]

Q16.

(a) the image would decrease in size

1

the image would change (from virtual) to real

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accept that the image (of bulb M) can be projected on to a screen

1

the image would change (from non-inverted) to inverted

1

(b) a ray through the centre of the lens

rays should be drawn with a ruler

ignore arrows

1

a ray parallel to the principal axis and passing through the principal focus to the right of lens

accept solid or dashed lines

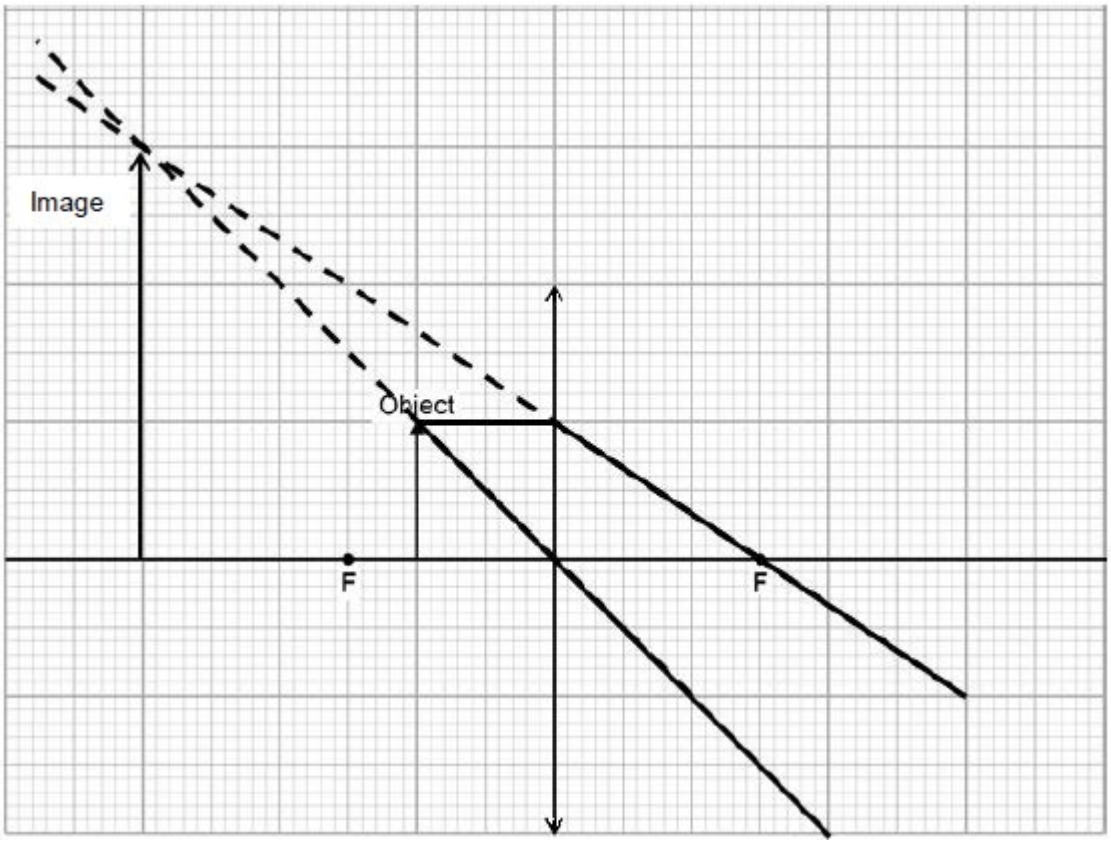
accept a ray drawn as if from the principal focus to the left of the lens, emerging parallel to the principal axis

1

image drawn where rays cross

image should be to left of the lens

1



(c) (i) (because the glass in) lens A has a greater refractive index

accept lens A is more powerful

accept lens A has a shorter focal length

1

(ii) when the magnification increases by 1, the image distance increases by 10 cm

*accept for **1** mark it is a linear pattern*

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or

as the image distance increases, the magnification increases

*do **not** accept directly proportional*

2

(iii) diagram showing the surfaces of a convex lens C having greater curvature than lens B

the size of the lens drawn is not important

1

[10]

Q17.

(a) B

must be in correct order

1

A

1

D

1

(b) (i) mass increases as refractive index increases

accept weight / density increases as refractive index increases

1

(ii) thinner

accept thin

1

heavier

accept heavy

1

(iii) maximum one advantage and one disadvantage of each design

water-filled

advantages:

- lenses are light
- wide range of focal length
- allows fine adjustment
- allows lenses to be altered independently.

1

disadvantages:

- unattractive
- lens might burst
- lens might leak
- uncomfortable.

1

sliding lenses

advantages:

- hard-wearing
- look like conventional glasses

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- easy to adjust
- allows lenses to be altered independently.

1

disadvantages:
- heavy
- might slide out of position
- might get dirt between the lenses.

1

(c) any two from:
the image is
- blurred
- coloured
- inverted
- diminished.

accept not focussed

1
1

[12]

Q18.

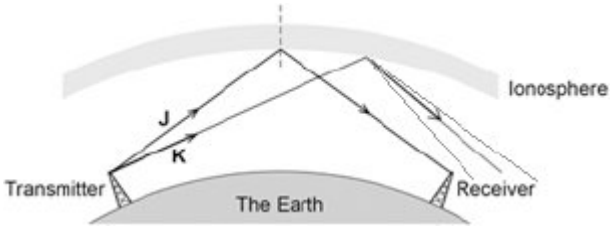
(a) (i) reflection of wave **K** at or within the ionosphere

allow dashed lines

1

angle i = angle r

'judge by eye'



tolerance for the reflected ray is between the first e and last r
ignore arrows
a reflected ray to the receiver doesn't score 2nd mark
additional rays shown don't score 2nd mark

1

(ii) normal

1

(b) (i) microwave

1

(ii) refraction

1

(c) All electromagnetic waves are transverse.

1

All electromagnetic waves have the same speed in a vacuum.

1

[7]

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Q19.

(a) (i) microwave

1

(ii) refraction

1

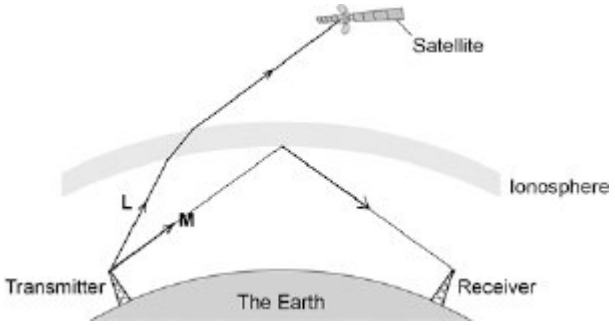
(b) (i) wave M continues as a straight line to the ionosphere and shown reflected

accept reflection at or within the ionosphere

1

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

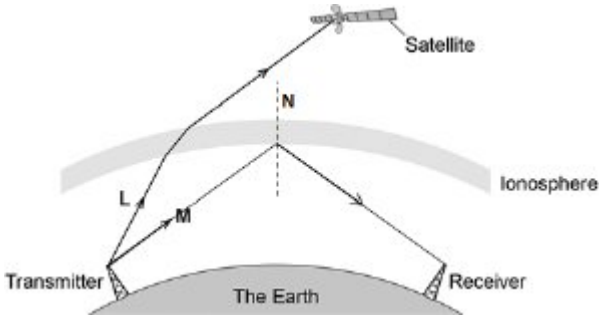
if more than 2 rays shown 1 mark maximum



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
- transfer energy

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- can travel through a vacuum

  *an answer travel at the same speed though a vacuum scores **2** marks*

- can be polarised

- show interference.

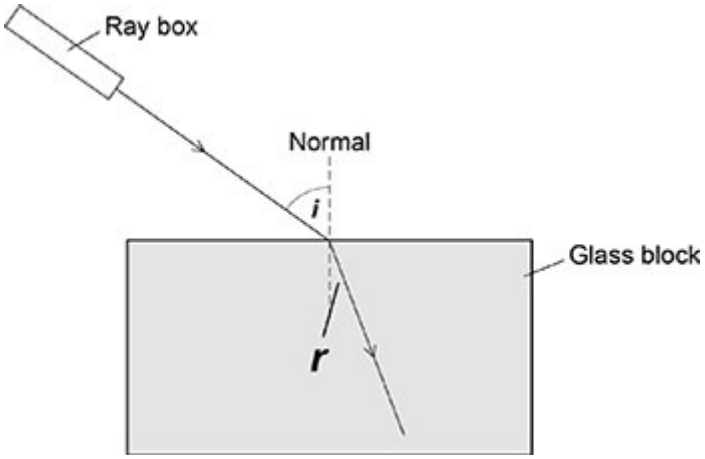
  travel in straight lines is insufficient

2

[7]

Q20.

(a) (i)



1

(ii) 1 degree

1

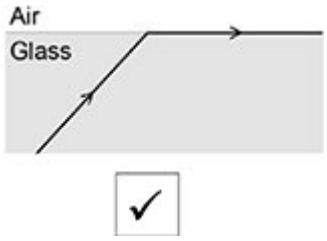
(iii) 1.6

*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

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(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]

Q21.

(a) 20,000

accept 20 kilo

or

20 k

***or** 20 001*

1

an atom

1

(b) 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 in the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks
no relevant content

Level 1 (1−2 marks)
At least one relevant statement is given for either type of wave

Level 2 (3−4 marks)
either
a use, risk and precaution is given for one type of wave
or
A medical use is given for both types of wave
plus
a risk or precaution for one type of wave

Level 3 (5−6 marks)
At least one medical use is given for both types of wave linked to the risks and any precautions necessary

Examples of the points made in the response

<u>Medical use of X-rays</u>
Any one from:
- Detecting bone fractures
- Detecting dental problems
- Killing cancer cells
- CT scanning.

Ignore details about how X-rays / ultrasound work

accept any specific use of X-rays, eg

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- *detecting heart / lung disorders (with chest X-rays)*
- *mammograms / breast cancer detection*
- *detecting stones / bowel disease (with abdominal X-rays)*

Risks with X-rays

X-rays pose a risk / danger / hazard

accept are harmful

X-rays cause ionisation / damage to cells
or
mutate cells / cause mutations / increase chances of mutations
or
turn cells cancerous / produce abnormal growths / produce rapidly growing cells
or
kill cells

accept a description of what ionising is

instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus

accept (may) cause cancer

Operator precautions with X-rays

The X-ray operator should go behind a (metal / glass) screen / leave the room when making an X-ray / wear a lead lined apron

accept appropriate precautions for the patient e.g. limit the total exposure / dose (in one year)

wear a radiation badge is insufficient

Medical use of ultrasound

Any one from:
- Pre-natal scanning
- Imaging (a named body part).
- removal / destruction of kidney / gall stones
- removing plaque from teeth

  cleaning teeth is insufficient
- 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*

Risks with ultrasound

Ultrasound poses no risk / danger / hazard (to the user / patient)

accept ultrasound is safer than using X-rays

Ultrasound is not ionising
or
Ultrasound does not damage (human) cells

Precautions with ultrasound

The operator needs to take no precautions when making an ultrasound scan

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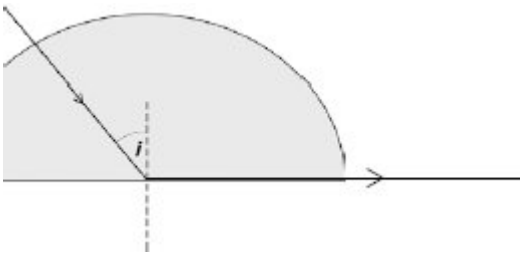
this can be assumed if it is stated that ultrasound is harmless or it is safer than using x-rays or it is non-ionising

6

[8]

Q22.

(a) (i) line drawn at 90 degrees to the normal:



ignore (partial) reflection of the ray

1

(ii) 1.5

award both marks for an answer that rounds to 1.5
*award **1** mark for correct substitution ie 1 / sin 41*
***or** 1 / 0.656(059)*

2

(b) 26

*award **3** marks for an answer that rounds to 26*
*award **2** marks for*

$$1.3 = \frac{0.57(3576)}{\sin r}$$

or

$r = \sin^{-1}(0.57(3576) / 1.3)$

*award **1** mark for correct substitution.ie* $1.3 = \frac{\sin 35}{\sin r}$

or

sin 35° shown correctly, ie 0.57(3576), or used correctly in the calculation
an answer of 0.44 scores 2 marks
an answer of 26.9 scores 0

3

[6]

Q23.

(a) refraction

1

(b) towards the normal

1

(c) (i) convex

1

(ii) principal focus

accept focal point

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1

(d) parallel on left

1

refracted towards the normal at first surface

1

refraction away from normal at second surface

1

passes through or heads towards principal focus

1

(e) refractive index

accept material from which it is made

1

(radius of) curvature (of the sides)

accept shape / radius
*do **not** accept power of lens*
ignore thickness / length

1

[10]

Q24.

(a) (i) frequency

1

wavelength

1

(ii) 10^{-15} to 10^{4}

1

(b) 2.0×10^{5}

correct substitution of
*3.0×10^{8} / 1500 gains **1** mark*

2

Hz

1

(c) (i) (skin) burns

1

(ii) skin cancer / blindness

1

(d) (i) any **one** from:

- (detecting) bone fractures
- (detecting) dental problems
- treating cancer

1

(ii) any **one** from:

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- affect photographic film
- absorbed by bone
- transmitted by soft tissue
- kill (cancer) cells

*answer must link to answer given in **(d)(i)***

1

(iii) 9 / 36 = 0.25
0.5 / 2 = 0.25
4 / 16 = 0.25

accept:

36 / 9 = 4

2 / 0.5 = 4

16 / 4 = 4

2

conclusion based on calculation

*two calculations correct with a valid conclusion scores **2** marks*

*one correct calculation of k scores **1** mark*

1

[13]

Q25.

(a) wavelength correctly shown

1

(b) (i) increased

1

decreased

1

(ii) 17-18 inclusive

1

evidence of measurement divided by 3 or mean of 3 separate measurements

1

mm

accept cm if consistent with answer

1

(c) (i) red shift

1

(ii) moving away

1

(iii) the furthest galaxies show the biggest red shift

1

(meaning that) the furthest galaxies are moving fastest

1

(so the) Universe is expanding

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1

(extrapolating backwards this suggests that) the Universe started from an initial point

1

(iv) cosmic microwave background radiation

allow CMBR

1

[13]

Q26.

(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)

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

2

(v) outside audible range

1

[14]

Q27.

(a) (i) short sight
accept myopia

1

(ii) diverging

1

(b) light

1

(c) Marks awarded for this answer will be determined by the quality of communication as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1–2 marks)
There is a basic description of one advantage ***or*** disadvantage of using **either** of the methods

Level 2 (3–4 marks)
There is a *description* of some advantages **and / or** disadvantages of using **both** methods
or
a full, detailed description of the advantages and disadvantages of using **either** of the methods.

Level 3 (5–6 marks)
There is a *clear description* of the advantages and disadvantages of using **both** methods.

examples of the points made in the response
extra information

laser surgery

advantages:

- *appearance*
- *permanent effect*
- no glasses which need changing

disadvantages:

- risks associated with surgery
- large cost
- not able to drive etc straightaway

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- (still) might need glasses for reading

wearing glasses

advantages:

- able to function straightaway
- any problems easy to sort out

disadvantages:

- *easily broken*
- *easily lost*
- need changing
- overall cost might be greater if several changes in vision
- might eventually need two pairs of glasses

6

(d) move lens

1

closer to film

1

[11]

Q28.

(a) decreases

correct order only

1

increases

1

(b) (i) intensity (of transmitted light) depends on thickness
or
to enable a valid comparison
or
it is a control variable

accept absorption depends on thickness
it would affect the results is insufficient
fair test is insufficient

1

(ii) transmits the least light
or
absorbs the most light

accept very little light is transmitted
*do **not** accept transmits none of the light*
*do **not** accept absorbs all of the light*
any reference to heat negates this mark

1

[4]

Q29.

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(a) long

1

(b) lens A

1

it is a concave / diverging lens

this mark is only gained if lens A is stated

any reference to lens material or mass of lens negates this mark

allow it will focus light onto the retina

1

(c) The refractive index of the lens material

1

(d) 4

ignore any signs

*allow **1** mark for correct substitution, ie* $\frac{1}{0.25}$ *provided no subsequent step*

2

(e) Cauterising open blood vessels

1

(f) 5

*allow **1** mark for correct substitution, ie* $\frac{70}{14}$ *provided no subsequent step*

2

[9]

Q30.

(a) transmits

correct order

1

absorbs

1

(b) light

*allow ultra violet **or** UV **or** infrared **or** IR **or** gamma*

1

(c) 20

*allow **1** mark for correct working, ie* $\frac{60}{3}$ *provided no subsequent step*

2

(d) Killing cancer cells

1

[6]

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Q31.

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

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

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- 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]

Q32.

(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 wavelength of the light from 5 (x 10^{-7} metres) increases the amount of light transmitted

increasing wavelength (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]

Q33.

(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 energy transfer

accept direction of wave travel

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:

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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]

Q34.

(a) (i) magnified

1

upright

1

(ii) v = −6(cm)

*max **2** marks if no minus sign*
*6(cm) gains **2** marks*
1/v = 1/12 − 1/4 = −1/6
*gains **2** marks*
1/12 = 1/4 + 1/v
*gains **1** mark*
−5.99(cm)
*using decimals gains **3** marks*

3

(b) it is <u>virtual</u>

1

[6]

Q35.

(a) (i) (visible) light

accept visible

1

(ii) microwaves

1

(b) J

1

(c) (i) B

1

(ii) shorter than

1

(d) (i) To find out if using a mobile phone is harmful to health

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1

(ii) any **two** from:

- (X has a) low(er) SAR value
  "it" refers to mobile phone
  accept has a low(er) rate

- (maximum) energy absorbed (by the head) is less
  accept energy emitted (by phone) is less
  accept radiation for energy

- (if mobiles are harmful) less likely to cause harm
  accept will not cause harm
  accept it is safer

2

[8]

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