

## Mark schemes

### 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

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)

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) C ——— distance

D \ / the  
I / \ time

*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
- (b) radio waves have a longer wavelength than ultraviolet
- (c) (risk of) skin cancer  
*cancer is insufficient*  
**or**  
(prematurely) ageing skin  
*skin damage is insufficient*  
*ignore kills skin cells*
- (d) risk is higher (for X-ray of uds than X-ray of chest)

1

1

1

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]

**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

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]

**Q6.**

- (a) sound 1
- (b) (visible) light 1
- (c) cooking food 1
- (d) 1.2 gigahertz 1
- (e)  $300\,000 \times 1000 = 300\,000\,000$  m/s 1
- (f) wave speed = frequency  $\times$  wavelength  
*allow  $v = f \lambda$*  1
- (g)  $300\,000\,000 = 1200\,000\,000 \times \lambda$   
*an answer of 0.25 scores 3 marks* 1
- $$\lambda = \frac{300\,000\,000}{1\,200\,000\,000}$$
- allow ecf from (e)* 1
- $\lambda = 0.25$  (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)  $1.2 \times 10^9$  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

$\lambda = 0.25 \text{ (m)}$

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)

<b>Level 2:</b> Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3-4
<b>Level 1:</b> Facts, events or processes are identified and simply stated but their relevance is not clear.	1-2
<b>No relevant content</b>	0
<b>Indicative content</b> <ul style="list-style-type: none"> <li>• Sun goes from main sequence to red giant</li> <li>• then from red giant to white dwarf</li> <li>• when the Sun changes to a red giant the surface temperature will decrease</li> <li>• and the relative luminosity will increase</li> <li>• when changing from a red giant to a white dwarf the surface temperature increases</li> <li>• and the relative luminosity decreases</li> </ul>	

4

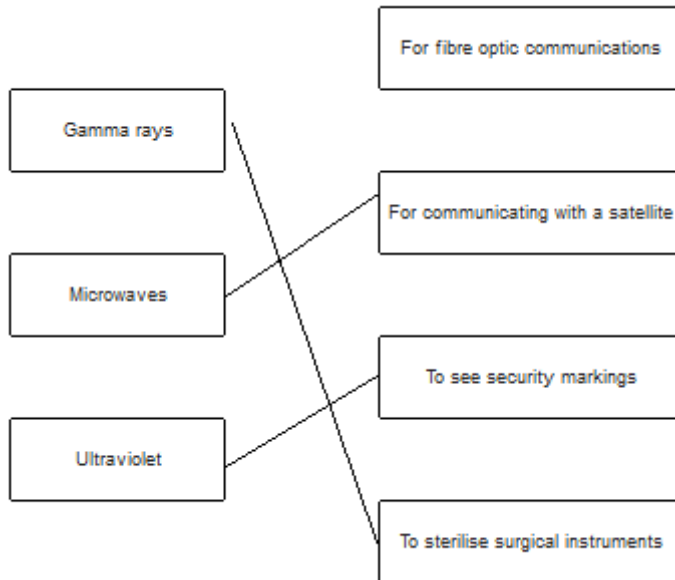
[14]

**Q8.**

(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]

**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

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  $100 \div 25 = 4$  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  $90^\circ$  to one side of the block (the normal)

use a protractor to measure and then draw a line at an angle of  $20^\circ$  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

(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**

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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.

- (a) any **one** from:
- (visible) light
  - UV / ultra violet
  - X-ray
  - gamma /  $\gamma$ -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

- (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 reflected  
(when they meet a boundary) (between two different media / substances / tissues)

*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

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*

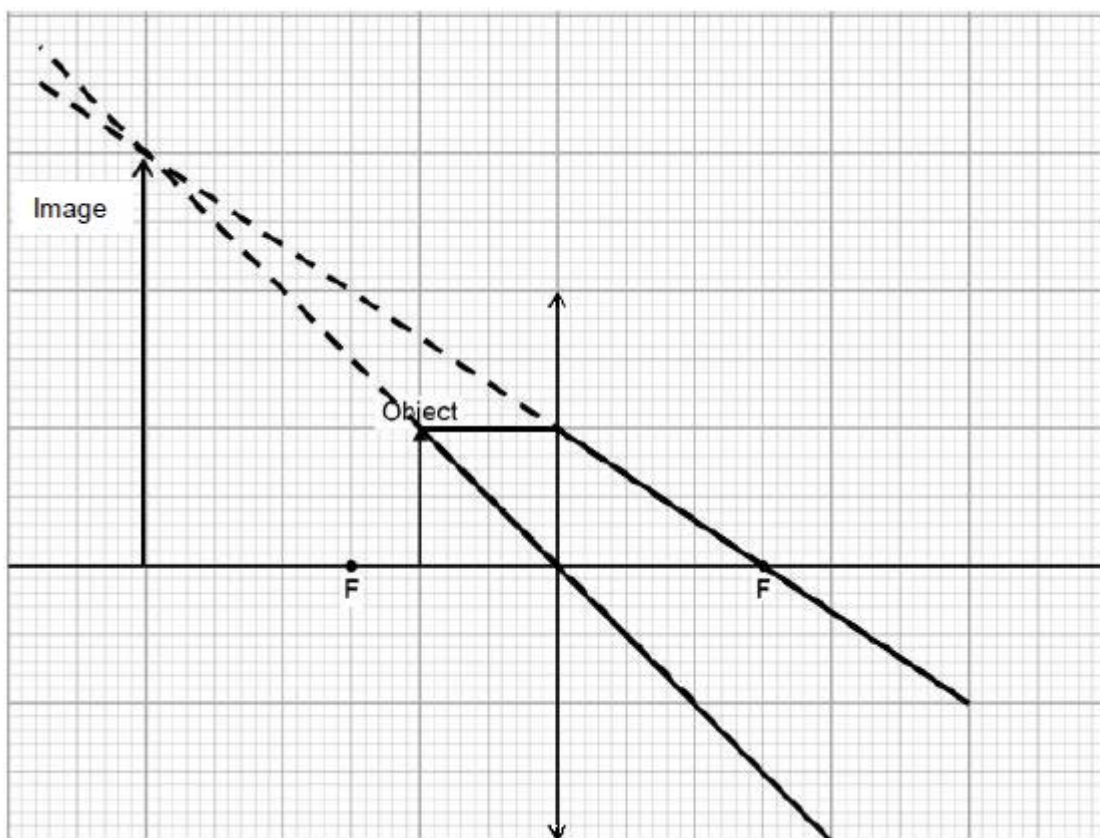
*accept a ray drawn as if from the principal focus to the left of the lens, emerging parallel to the principal axis*

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*

**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

- 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

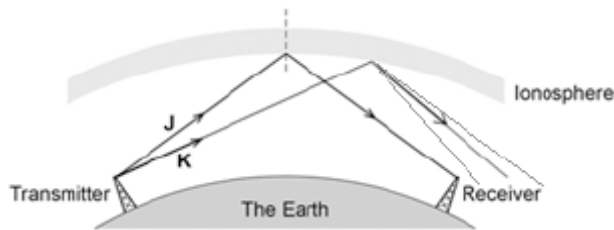
[12]

### 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 2<sup>nd</sup> mark*

*additional rays shown don't score 2<sup>nd</sup> 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]

**Q19.**

(a) (i) microwave

1

(ii) refraction

1

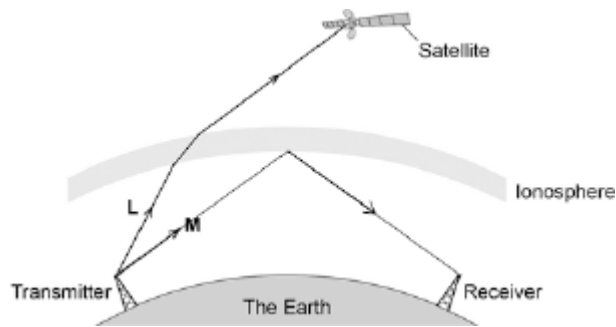
(b) (i) wave M continues as a straight line to the ionosphere and shown reflected

*accept reflection at or within the ionosphere*

1

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

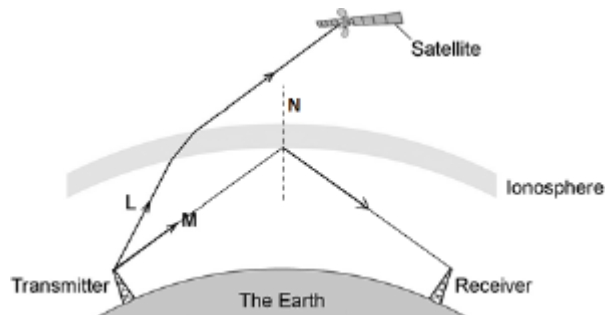
*if more than 2 rays shown 1 mark maximum*



*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  $3 \times 10^8 \text{ m / s}$*
- can be reflected
- can be refracted
- can be diffracted
- can be absorbed
- transfer energy



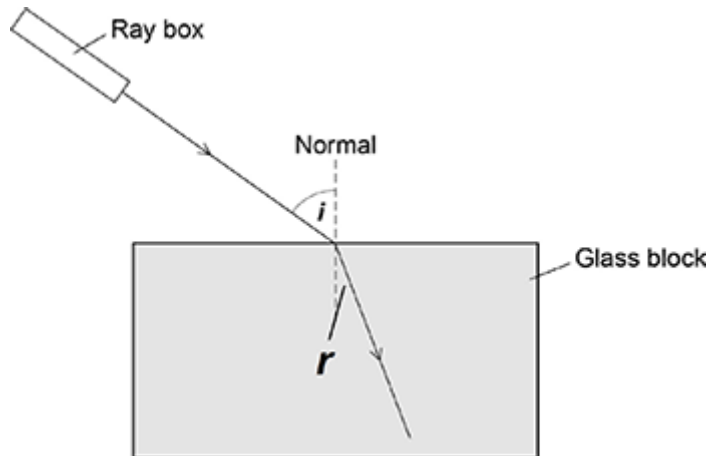
- can travel through a vacuum  
*an answer travel at the same speed though a vacuum scores 2 marks*
- can be polarised
- show interference.  
*travel in straight lines is insufficient*

2

[7]

**Q20.**

(a) (i)



1

(ii) 1 degree

1

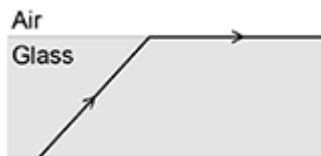
(iii) 1.6

*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) 2<sup>nd</sup> 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]

**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**

**Medical use of X-rays**

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*

- *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

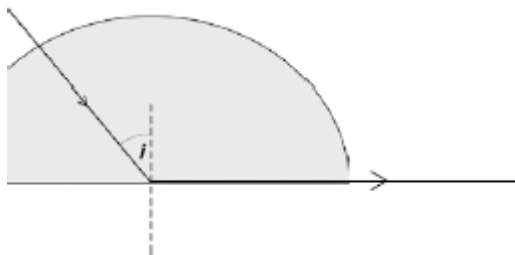
### **Precautions with ultrasound**

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

*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*

**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*

*or*

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

$$\frac{\sin 35}{\sin r}$$

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

*or*

*$\sin 35^\circ$  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*

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 <i>accept material from which it is made</i>	1
	(radius of) curvature (of the sides) <i>accept shape / radius</i> <i>do <b>not</b> accept power of lens</i> <i>ignore thickness / length</i>	1

[10]

**Q24.**

(a)	(i)	frequency	1
		wavelength	1
	(ii)	$10^{-15}$ to $10^4$	1
(b)		$2.0 \times 10^5$ <i>correct substitution of</i> <i><math>3.0 \times 10^8 / 1500</math> gains 1 mark</i>	2
		Hz	1
(c)	(i)	(skin) burns	1
	(ii)	skin cancer / blindness	1
(d)	(i)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• (detecting) bone fractures</li> <li>• (detecting) dental problems</li> <li>• treating cancer</li> </ul>	1
	(ii)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• affect photographic film</li> <li>• absorbed by bone</li> <li>• transmitted by soft tissue</li> </ul>	

- 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

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)

*allow 1 mark for correct substitution, ie  
 $330 = 15 \times \lambda$  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
- (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.

(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]

### 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  $1600 \times 0.40$  provided no subsequent step

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

allow 2 marks for the substitution

2

provided no subsequent step

allow 1 mark for the substitution  $1600 \times 0.80$  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 any 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 ionising  
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
- 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 ( $\times 10^{-7}$  metres), decreases the (percentage) transmission*

1

(for both fibres) the minimum transmission happens at  $5 \times 10^{-7}$  metres)

**or**

maximum transmission occurs at  $6.5 \times 10^{-7}$  metres)

*accept for a further 1 mark:*

*(for both fibres) increasing the wavelength of the light from 5 ( $\times 10^{-7}$  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:

*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)  $v = -6(\text{cm})$

*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 virtual

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

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*