



## Exampro GCSE Physics

### P3 Foundation - Medical Application Self Study Questions

Name:

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Class:

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Author:

Date:

Time: 110

Marks: 110

Comments:

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**Q1.** The figure below shows an X-ray image of a human skull.



Stockdevil/iStock/Thinkstock

(a) Use the correct answers from the box to complete the sentence.

<b>absorbs</b>	<b>ionises</b>	<b>reflects</b>	<b>transmits</b>
----------------	----------------	-----------------	------------------

When X-rays enter the human body, soft tissue ..... X-rays  
and bone ..... X-rays.

(2)

(b) Complete the following sentence.

The X-rays affect photographic film in the same way that ..... does.

(1)

- (c) The table below shows the total dose of X-rays received by the human body when different parts are X-rayed.

Part of body X-rayed	Dose of X-rays received by human body in arbitrary units
Head	3
Chest	4
Pelvis	60

Calculate the number of head X-rays that are equal in dose to one pelvis X-ray.

.....  
 .....  
 .....

Number of head X-rays = .....

(2)

- (d) Which **one** of the following is another use of X-rays?

Tick (✓) **one** box.

- Cleaning stained teeth
- Killing cancer cells
- Scanning of unborn babies

(1)

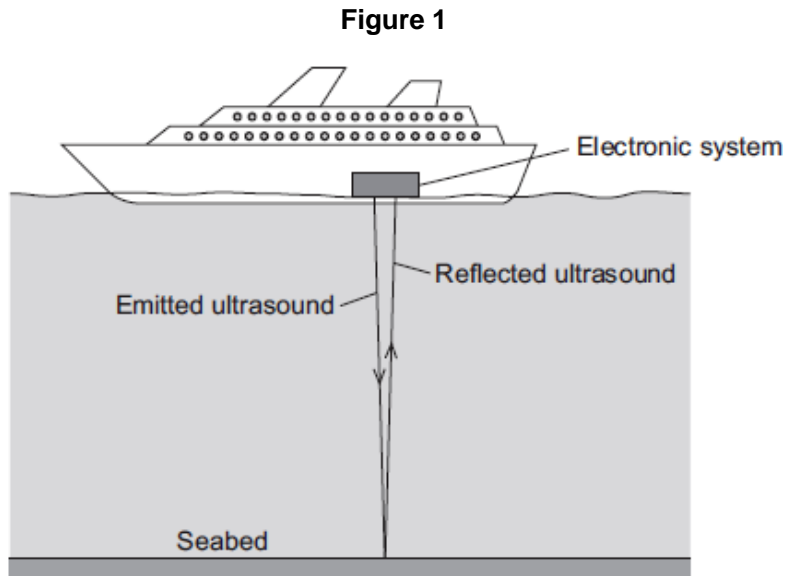
(Total 6 marks)

- Q2.** (a) What is ultrasound?

.....  
 .....

(1)

(b) **Figure 1** shows how ultrasound is used to measure the depth of water below a ship.



A pulse of ultrasound is sent out from an electronic system on-board the ship.  
It takes 0.80 seconds for the emitted ultrasound to be received back at the ship.  
Calculate the depth of the water.

Speed of ultrasound in water = 1600 m / s

Use the correct equation from the Physics Equations Sheet.

.....  
.....  
.....  
.....

Depth of water = ..... metres

(3)

(c) Ultrasound can be used in medicine for scanning.

State **one** medical use of ultrasound scanning.

.....

(1)

- (d) Images of the inside of the human body can be made using a Computerised Tomography (CT) scanner. The CT scanner in **Figure 2** uses X-rays to produce these images.

**Figure 2**



monkeybusinessimages/iStock/Thinkstock

State **one** advantage and **one** disadvantage of using a CT scanner, compared with ultrasound scanning, for forming images of the inside of the human body.

Advantage of CT scanning .....

.....  
.....

Disadvantage of CT scanning .....

.....  
.....

(2)  
(Total 7 marks)

**Q3.** (a) Digital cameras and human eyes both form images.

Complete **Table 1** by putting a tick in the correct column(s) to show if the parts are found in the digital camera or in the human eye or in both.

The first part has been completed for you.

**Table 1**

Part	In a digital camera	In the human eye
Cornea		✓
Lens		
Pupil		
Charge-coupled device (CCD)		

(3)

(b) Some humans are short-sighted.

Complete the following sentence.

Short sight can be caused by the eyeball being too .....

(1)

(c) Spectacles can be worn to correct short sight.

**Table 2** gives information about three different lenses that can be used in spectacles.

**Table 2**

	Lens feature		
	Material	Mass in grams	Type
<b>Lens A</b>	Plastic	5.0	Concave (diverging)
<b>Lens B</b>	Glass	6.0	Convex (converging)
<b>Lens C</b>	Glass	5.5	Convex (converging)

Which lens from **Table 2** would be used to correct short sight?

Draw a ring around the correct answer.

**Lens A                      Lens B                      Lens C**

Give the reason for your answer.

.....  
 .....

(2)

(d) Every lens has a focal length.

Which factor affects the focal length of a lens?

Tick (✓) **one** box.

The colour of the lens

The refractive index of the lens material

The size of the object being viewed

(1)

(e) A lens has a focal length of 0.25 metres.

Calculate the power of the lens.

Use the correct equation from the Physics Equations Sheet.

.....  
.....  
.....

Power of lens = ..... dioptries

(2)

(f) Laser eye surgery can correct some types of eye defect.

Which of the following is another medical use for a laser?

Tick (✓) **one** box.

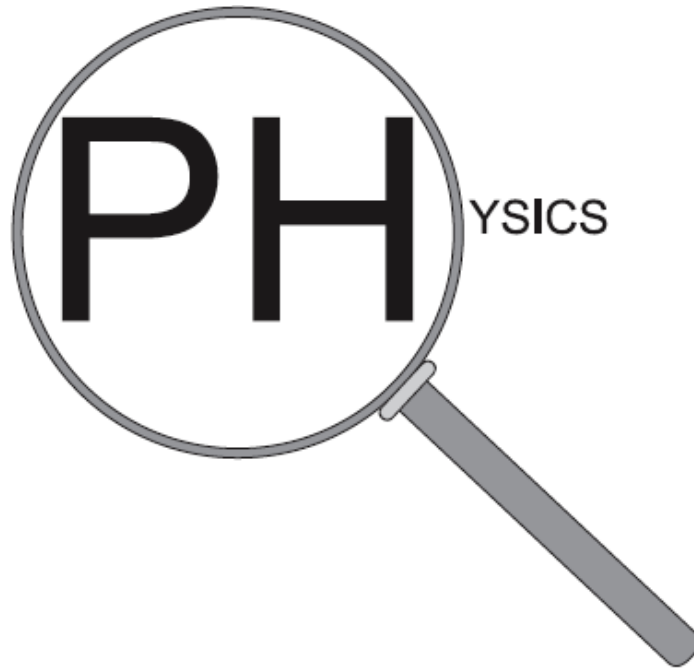
Cauterising open blood vessels

Detecting broken bones

Imaging the lungs

(1)

(g) The figure shows a convex lens being used as a magnifying glass.



Not to scale

An object of height 14 mm is viewed through a magnifying glass.

The image height is 70 mm.

Calculate the magnification produced by the lens in the magnifying glass.

Use the correct equation from the Physics Equations Sheet.

.....  
.....  
.....

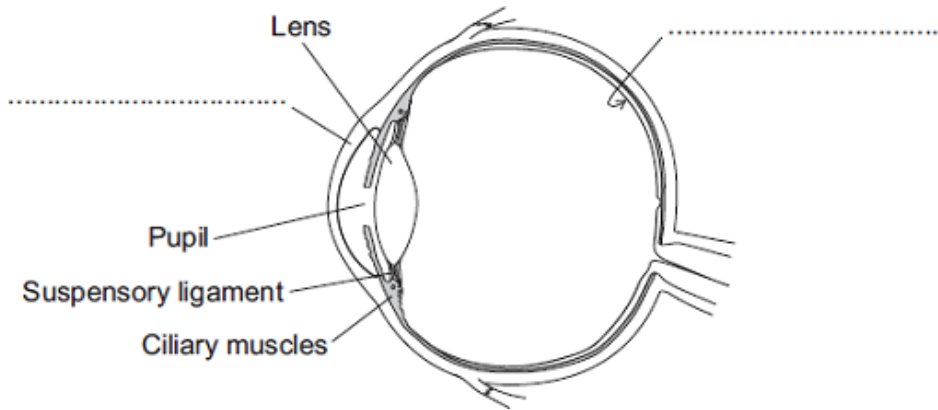
Magnification = .....

(2)  
(Total 12 marks)



**Q4.** (a) The diagram shows parts of the human eye.

Complete the missing labels.



(2)

(b) Each part of the human eye has a function.

Complete the table below.

Part of the human eye	Function of the part
.....	Changes size to make sure the correct amount of light enters the eye.
Ciliary muscles	..... ..... .....
Lens	..... ..... .....

(3)

- (c) The human eye can focus on near objects. The closest distance the eye can bring into sharp focus is called the near point.

A student measured the near point of four people of different ages. The table shows her data.

Age of human in years	Near point in millimetres
10	200
20	250
40	400
55	800

What can you conclude from the data in the table above?

.....  
.....  
.....  
.....

(2)

- (d) Suggest how the data obtained by the student could be improved.

.....  
.....

(1)

- (e) Spectacles are worn to correct vision. One of the lenses in a pair of spectacles has a focal length of 40 centimetres.

Calculate the power of the lens.

Use the correct equation from the Physics Equations Sheet.

.....  
.....  
.....

Power of lens = ..... diopres

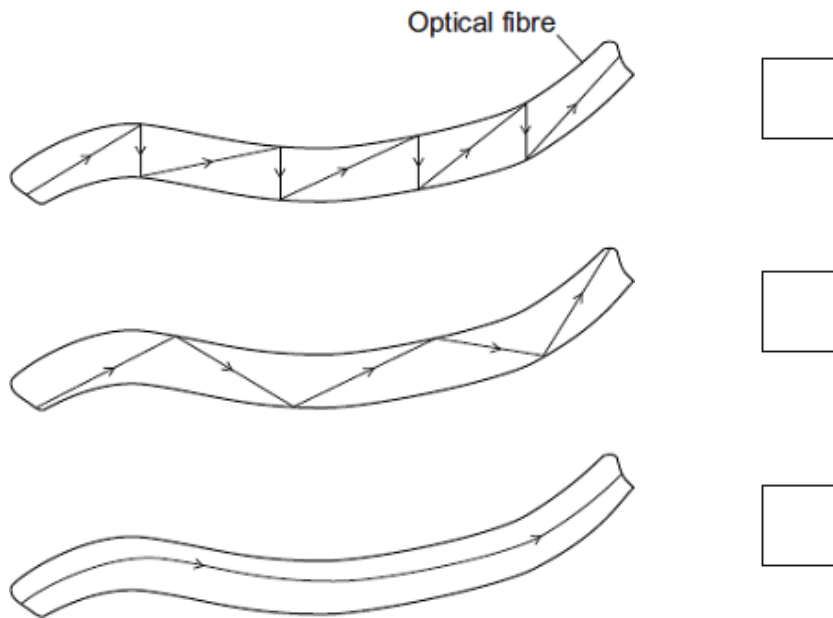
(2)

(Total 10 marks)

**Q5.** (a) Visible light can be sent along optical fibres.

Which diagram correctly shows the path of light along an optical fibre?

Tick (✓) **one** box.



(1)

(b) Complete the sentence to describe what happens to light as it travels through an optical fibre.

At the walls of the optical fibre, light undergoes total internal .....

(1)

(c) Which device passes light through optical fibres to produce images of the inside of the body?

Draw a ring around the correct answer.

**endoscope**

**stethoscope**

**X-ray machine**

(1)

(d) Lasers are an energy source.

Which **one** of the following is a use for a laser?

Draw a ring around the correct answer.

**CT scanning**

**digital camera**

**eye surgery**

(1)  
(Total 4 marks)

**Q6.** Ultrasound and X-rays are waves used in hospitals to create images of the inside of the human body. To produce the images below, the waves must enter the human body.

**Ultrasound scan of an unborn child**



© Isabelle Limbach/Thinkstock

**X-ray of a broken bone**



© itsmejust/iStock

(a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe the features of ultrasound and X-rays, and what happens to each type of wave after it has entered the human body.

.....

.....

.....

.....

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.....

.....

(6)

(b) It would **not** be safe to use X-rays to produce an image of an unborn child.

Explain why.

.....  
.....  
.....  
.....

(2)

(c) Ultrasound can be used for medical treatments as well as for imaging.

Give **one** use of ultrasound for medical treatment.

.....  
.....

(1)

(Total 9 marks)

**Q7.** An event involved paddling a homemade raft down a fast-flowing river. The rafts were made using empty barrels.



By Reidrac [CC BY-SA 2.0], via Flickr

(a) (i) Which **two** factors would most affect the raft's stability?

Tick (✓) the **two** correct factors.

The cost of the raft

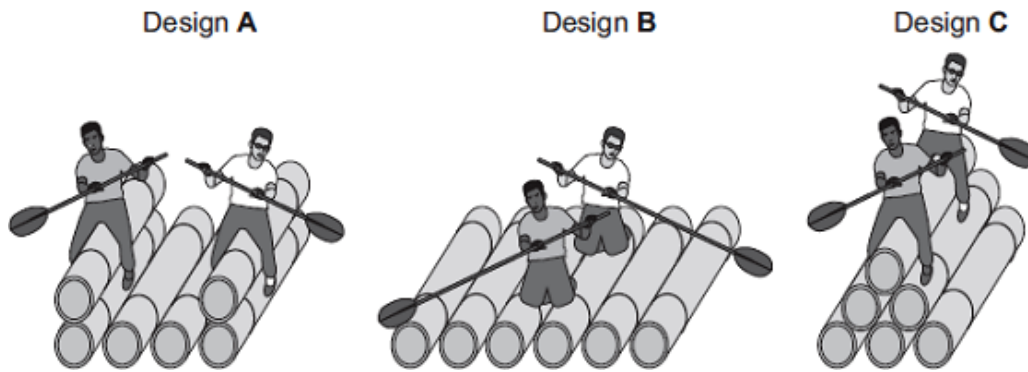
The width of the base of the raft

The position of the centre of mass of the raft

How streamlined the raft is

(2)

(ii) Here are three raft designs:



Which design of raft would be most stable?

Tick (✓) **one** box.

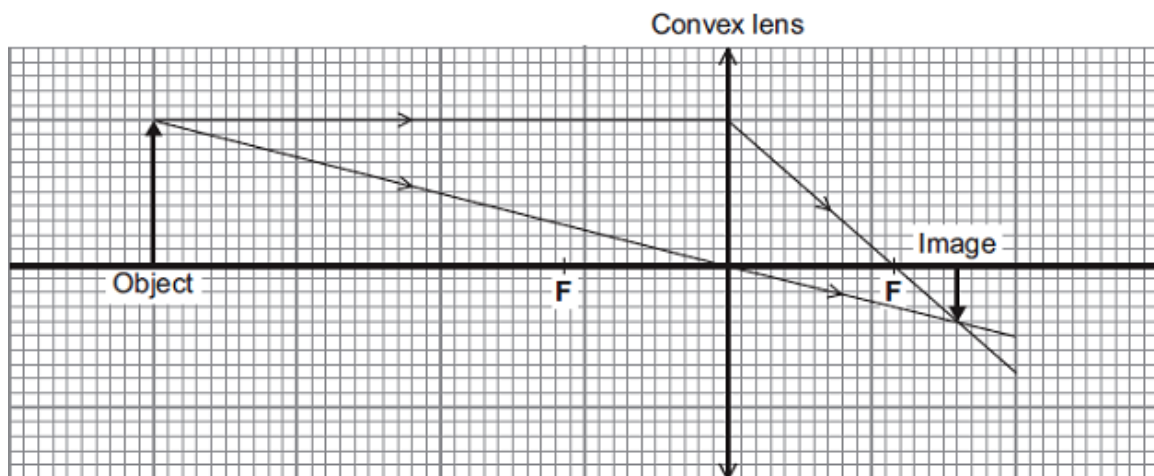
Design A

Design B

Design C

(1)

(b) A camera was used to take photographs of the rafts. The camera contains a convex (converging) lens. The ray diagram shows how the lens produces an image.



F = Principal focus

(i) Which **two** words from the list describe the nature of the image?

Draw a ring around each of the **two** correct answers.

upright      magnified      inverted      virtual      real

(2)

(ii) Use information from the ray diagram to calculate the magnification of the image.

Use the correct equation from the Physics Equations Sheet.

.....  
.....  
.....

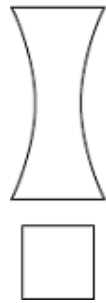
Magnification = .....

(2)

(c) A different type of lens is a concave (diverging) lens.

Which diagram shows a concave (diverging) lens?

Tick (✓) **one** box.



(1)  
(Total 8 marks)

**Q8.** (a) Explain what ultrasound is.

.....  
.....  
.....  
.....

(2)

(b) Ultrasound is used for pre-natal scanning. This is much safer than using X-rays. However, doctors were only sure ultrasound was safe after experiments on mice.

Do you think the ultrasound experiments on mice were justified?

Explain your answer.

.....  
.....  
.....  
.....

(2)



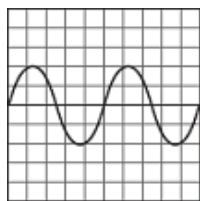
- (c) Explain what scientists should do if they find evidence that ultrasound may be harmful to human health.

.....  
 .....  
 .....

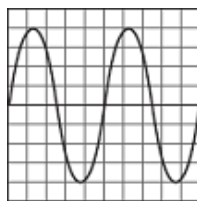
(2)  
 (Total 6 marks)

- Q9.** (a) The diagram shows four sound waves, **J**, **K**, **L** and **M**, represented on an oscilloscope screen.

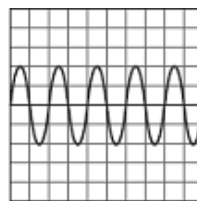
They are all drawn to the same scale.



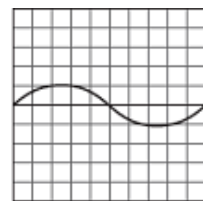
**J**



**K**



**L**



**M**

- (i) Which **two** of the waves have the same amplitude?

Wave ..... and wave .....

(1)

- (ii) Which of the waves would sound the loudest?

Wave .....

(1)

- (iii) Only **one** of the waves is an ultrasound wave.

Which **one** is the ultrasound wave?

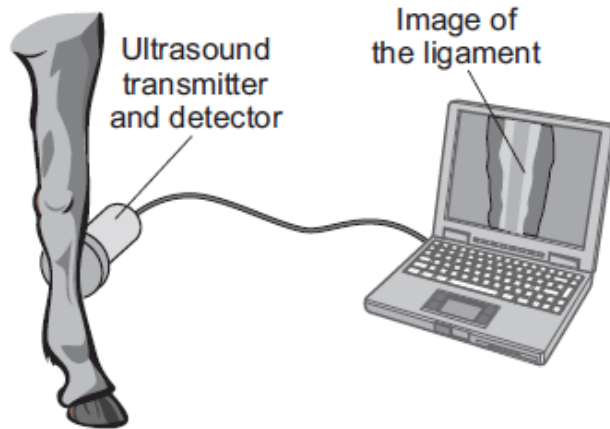
Wave .....

Give a reason for your answer.

.....  
 .....

(2)

- (b) The diagram shows ultrasound being used to examine the ligament inside the leg of a horse.



Use words from the box to complete the following sentences.

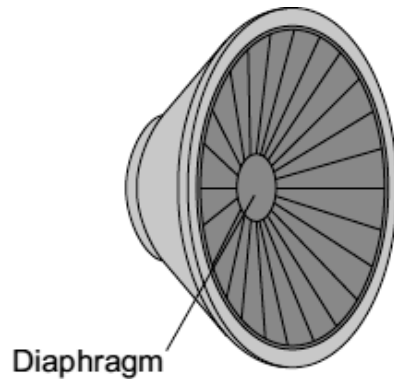
<b>computer</b>	<b>detector</b>	<b>transmitter</b>
-----------------	-----------------	--------------------

The ..... sends pulses of ultrasound into the leg. When the ultrasound meets the ligament, some is reflected back to the .....

The reflected pulses are converted by a ..... into an image that can be seen on the screen.

(2)  
(Total 6 marks)

**Q10.** The diaphragm of a loudspeaker moves in and out.

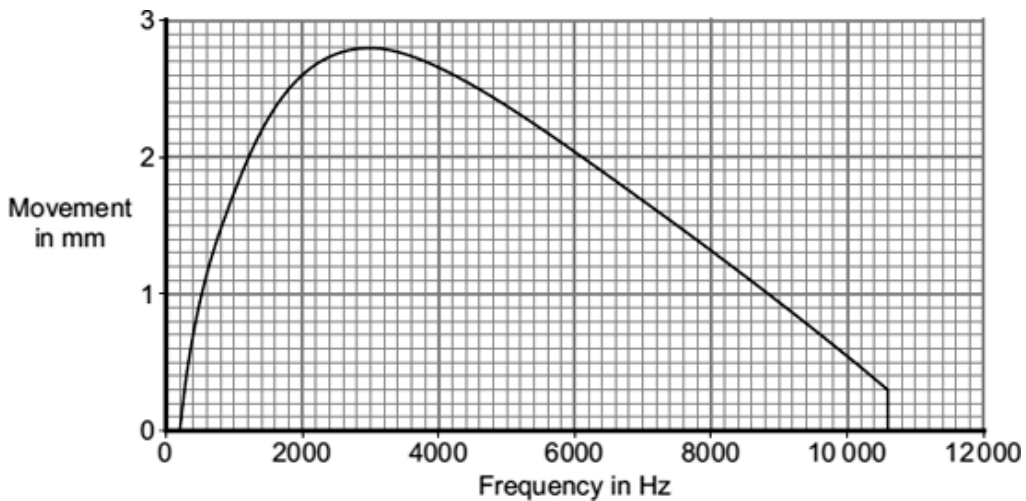


A team of scientists investigated loudspeakers.

The scientists measured the size of the movement of the diaphragm for signals of different frequencies.

They kept all the other variables constant.

The graph shows the average results for a large number of tests on one of the loudspeakers.



(a) What is the frequency of the highest pitched sound which this loudspeaker produces?

Frequency = ..... Hz

(1)

(b) The greater the movement of the diaphragm, the greater the amplitude of the sound produced.

What is the frequency of the loudest sound which this loudspeaker produces?

Show clearly on the graph how you get to your answer and then complete this answer space.

Frequency = ..... Hz

(2)

(c) Can this loudspeaker produce the full range of sound which most people can hear?

Put a tick (✓) in the box next to your answer.

Yes  No

Explain the reason for your answer.

.....  
.....  
.....  
.....

(2)

(d) Use **one** word to complete the sentence.

Repeating tests a large number of times and taking the average of the results improves the .....

(1)

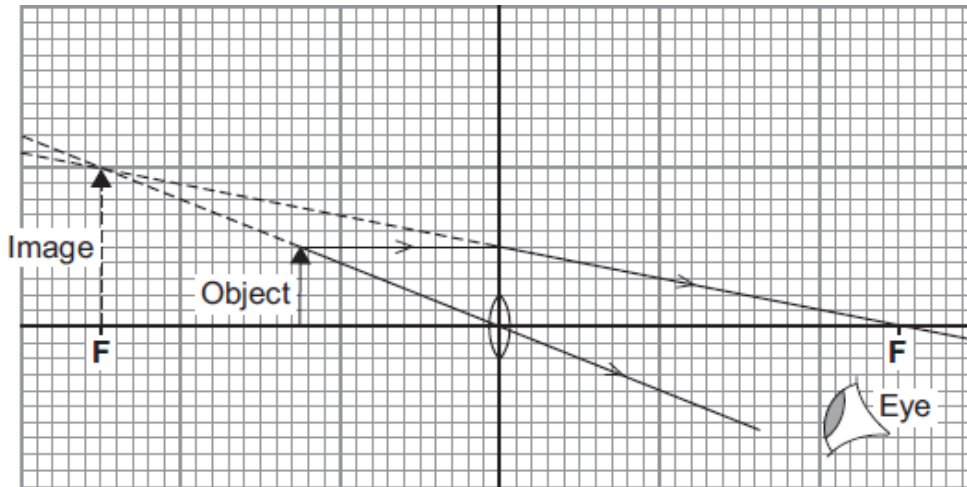
(e) Why did the scientists keep all the other variables constant?

.....  
.....

(1)

(Total 7 marks)

**Q11.** The diagram shows a lens being used as a magnifying glass.



(a) (i) What type of lens is shown in the diagram?

Draw a circle around your answer.

**concave**

**converging**

**diverging**

(1)

(ii) Use the equation in the box to calculate the magnification produced by the lens.

The object and image in the diagram have been drawn to full size.

$$\text{magnification} = \frac{\text{image height}}{\text{object height}}$$

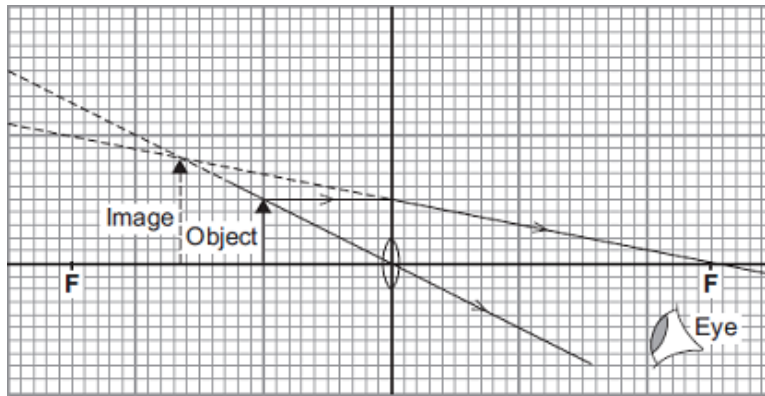
Show clearly how you work out your answer.

.....  
 .....

Magnification = .....

(2)

(b) The diagram shows how the image changes when the object has been moved closer to the lens.



Complete the following sentence by drawing a ring around the correct line in the box.

Moving the object closer to the lens

increases

does not change

decreases

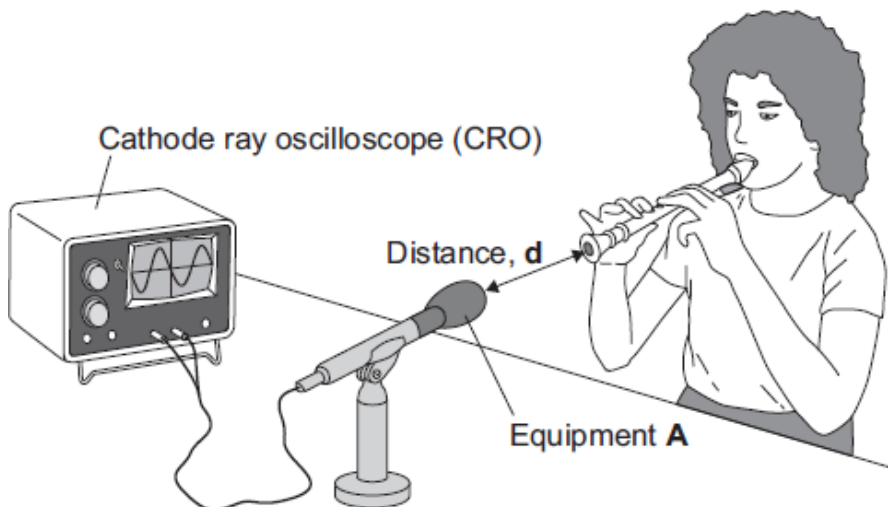
the magnification produced

by the lens.

(1)  
(Total 4 marks)

**Q12.** A group of students investigates sound waves.

The diagram shows part of their investigation.



(a) Identify the equipment labelled A.

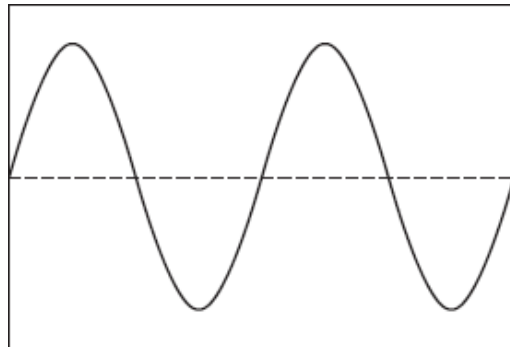
.....

(1)

(b) The student plays the same note in the same way at different distances from equipment A.

Another student records the amplitude of the wave shown on the cathode ray oscilloscope (CRO).

(i) Label this wave to show its amplitude.



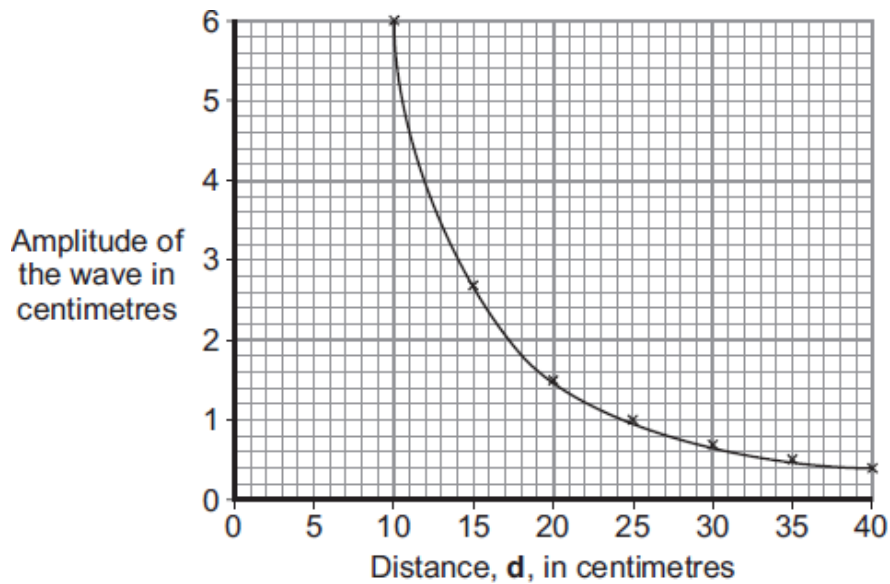
(1)

(ii) Complete the sentence.

Increasing the amplitude of a sound wave will increase the .....  
of the sound.

(1)

(c) The graph shows the students' average results from several sets of measurements.



Use the graph to find the distance,  $d$ , in centimetres, at which the average amplitude is likely to be 2 centimetres.

Distance = ..... cm.

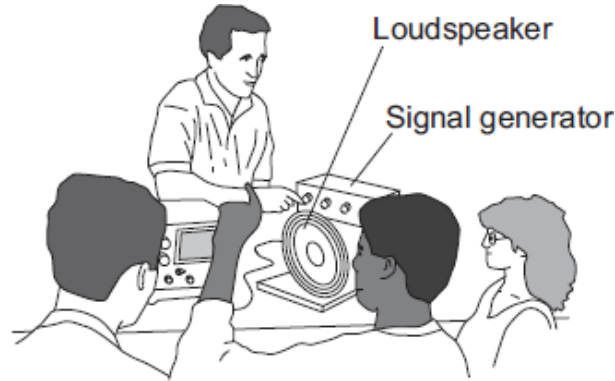
(1)

(d) Write a conclusion for this investigation.

.....  
.....

(1)

- (e) A physics teacher uses a signal generator and a loudspeaker to demonstrate the range of hearing of a group of students.



What is the range of frequencies most humans can hear?

Most humans can hear from ..... Hz to ..... Hz.

(2)  
(Total 7 marks)

**Q13.** Ultrasound waves are very high frequency sound waves. They cannot be heard by humans.

- (a) Ultrasound waves can be used to clean jewellery.

The jewellery is put into a container of cleaning fluid.



Complete each sentence to explain how ultrasound can clean jewellery.

The ultrasound generator makes the molecules of the cleaning fluid  
 ..... . The molecules knock particles of .....  
 from the surface of the jewellery.

(2)

- (b) Give a medical use for ultrasound.

.....

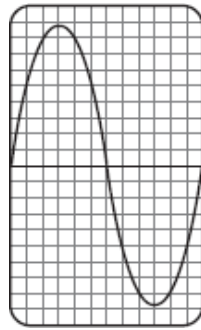
(1)



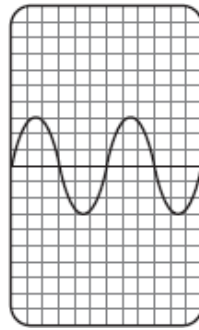
(c) Ultrasound waves can be represented on the screen of a cathode ray oscilloscope (CRO).

The diagrams show three ultrasound waves.

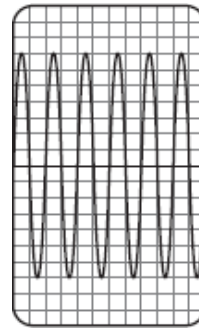
Each wave is represented on an identical CRO screen, **A**, **B** and **C**.



Screen **A**



Screen **B**



Screen **C**

(i) How many complete waves are shown on screen **B**? .....

(1)

(ii) Which screen shows the waves with the highest frequency?

Screen .....

(1)

(Total 5 marks)

**Q14.** (a) This information is from a science magazine.

Electronic systems can be used to produce ultrasonic waves. These waves have a frequency higher than the upper limit for hearing in humans.

Complete the sentence by choosing the correct number from the box.

<b>20</b>	<b>2000</b>	<b>20 000</b>	<b>200 000</b>
-----------	-------------	---------------	----------------

The upper limit for hearing in humans is a frequency of ..... Hz.

(1)

(b) An electronic system produces ultrasound with a frequency of 500 kHz.

What does the symbol kHz stand for?

.....

(1)

- (c) (i) State **one** industrial use for ultrasound.

.....

(1)

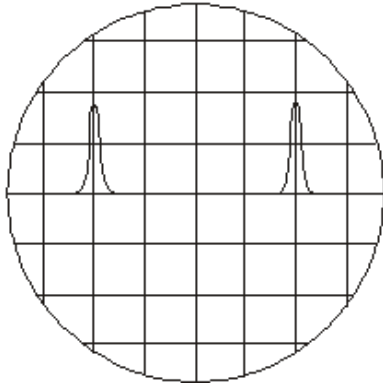
- (ii) State **one** medical use for ultrasound.

.....

(1)

- (d) An ultrasound detector is connected to an oscilloscope.

The diagram shows centimetre squares on an oscilloscope screen. Each horizontal division represents 2 microseconds.



Calculate the time, in microseconds, between one peak of one ultrasound pulse and the peak of the next.

.....

Time = ..... microseconds

(1)

- (e) Ultrasounds are partially reflected when they reach a boundary between two different media.

The time taken for the reflection from the boundary to reach the detector can be seen from the screen.

What can be calculated from this time interval?

.....

.....

(2)

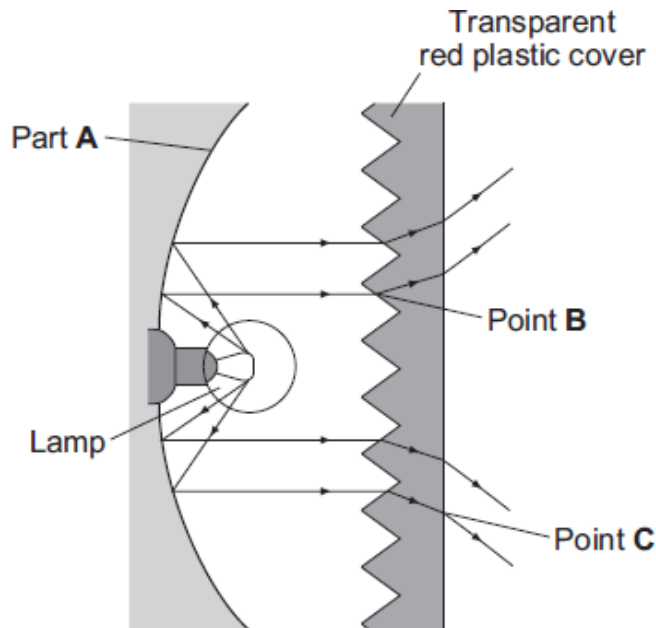
- (f) Explain what action scientists should take if they find evidence that ultrasonic waves may be harmful to human health.

.....  
.....  
.....

(2)  
(Total 9 marks)

- Q15.** At night, it is important that the lights of a car can be seen by other drivers but it is dangerous if these lights dazzle them.

The diagram shows a rear light of a car.



- (a) (i) Name part A.

.....

(1)

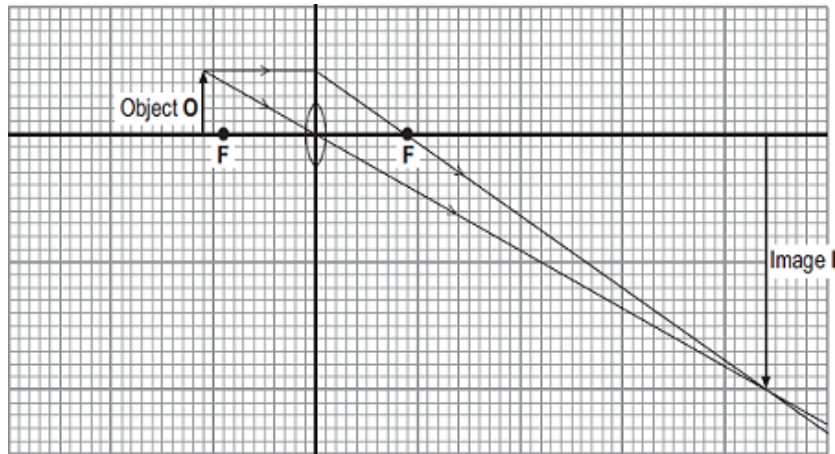
- (ii) Name the process which occurs at point B and at point C.

.....

(1)

(b) A headlamp of a car contains a lens.

The ray diagram shows the position and size of the image, **I**, of an object, **O**, formed by a lens similar to the one inside a car headlamp.



(i) What type of lens is shown in the ray diagram?

Draw a ring around your answer.

**converging                      diverging                      plane**

(1)

(ii) The ray diagram is drawn to scale.

Use the equation in the box to calculate the magnification produced by the lens.

$$\text{magnification} = \frac{\text{image height}}{\text{object height}}$$

Show clearly how you work out your answer.

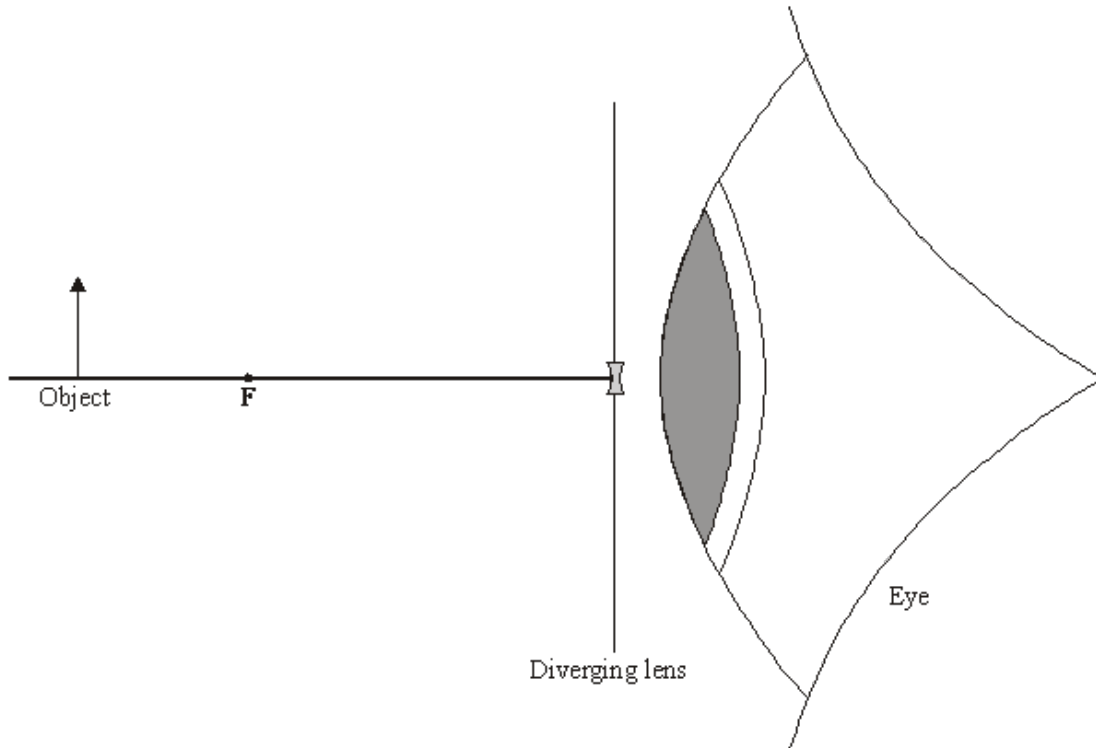
.....  
 .....

Magnification = .....

(2)  
 (Total 5 marks)

**Q16.** The diagram shows an object located vertically on the principal axis of a diverging lens. A student looks through the lens and can see an image of the object.

- (a) Using a pencil and ruler to draw construction lines on the diagram, show how light from the object enters the student's eye and the size and position of the image.



(3)

- (b) Describe the nature of the image by comparing it to the object.

.....

.....

.....

.....

(2)

(Total 5 marks)

- M1.** (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]**

- M2.** (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*  
  
*allow 2 marks for the substitution  $\frac{1600 \times 0.80}{2}$*   
*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 flow1
- (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*

**M3.** (a)

	Digital Camera	Eye
Cornea		✓
Lens	✓	✓
Pupil		✓
CCD	✓	

*ignore shaded row  
each correct row = 1 mark*

3

(b) long

1

(c) 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

(d) The refractive index of the lens material

1

(e) 4

*ignore any signs*

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

2

(f) Cauterising open blood vessels

1

(g) 5

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

2

[12]

**M4.** (a) cornea (LHS gap)

*must be in correct space*

1



- retina (RHS gap) 1
- (b) iris **or** pupil 1
- to change the shape / curvature (of the surface) of the lens  
*accept to make the lens thinner / fatter*  
*to contract and relax is insufficient* 1
- to focus the light (from the object, onto the retina)  
*accept to refract / change direction of light*  
*accept rays for light*  
*accept to form / focus an image (on the retina)*  
*to focus is insufficient* 1
- (c) the older (a human), the longer the near point (or vice versa)  
*answer must be in terms of near point (or a description of), eg*  
*become increasingly long sighted as you get older* 1
- or**
- young people have the shortest near point (or vice versa)  
*allow near point increases with age*  
*do **not** accept eye sight deteriorates as you get older*  
*answers must be comparative*
- the (rate of) change of the near point increases as you get older (or vice versa)  
*accept near point increases most rapidly after 40*  
*this statement alone gains 2 marks:*  
*the (rate of) increase of the near point gets greater as you get older* 1
- (d) test / measure / use more people (to increase the range of ages)  
*accept test older / younger people*  
*accept increase sample size*
- or**
- test / measure / use more people with ages in between (those already measured)  
*repeat the measurements (of the same people) is insufficient* 1
- (e) 2.5  
*allow 1 mark for correct substitution and conversion to metres, ie*  
 $\frac{1}{0.4}$  *provided no subsequent step shown*  
*an answer of 0.025 gains 1 mark* 2

[10]

M5. (a) middle box ticked



1

(b) reflection

*do **not** accept refraction*

1

(c) endoscope

1

(d) eye surgery

1

[4]

M6. (a) 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 to the information in the [Marking guidance](#), and apply a 'best-fit' approach to the marking.

**0 marks**

No relevant / correct content.

**Level 1 (1-2 marks)**

There is a basic description of either wave

**OR**

What happens to either wave when they enter the body. However there is little other detail.

**Level 2 (3-4 marks)**

There is either:

A clear description of BOTH waves

**OR**

A clear description as to what happens to BOTH waves inside the body

**OR**

A clear description of ONE of the waves with clear detail as to what happens to either wave inside the body.

**Level 3 (5-6 marks)**

There is a detailed description of BOTH of the waves

**AND**

A detailed description as to what happens to EITHER wave inside the body.

## Examples of the points made in the response:

### Description of an X-ray

- X-rays are electromagnetic waves / part of the electromagnetic spectrum  
*do not allow a description of a property – eg X-rays travel*
- X-rays are (very) high frequency (waves)  
*through a vacuum / at the speed of light*
- X-rays are (very) high energy (waves)
- X-rays have a (very) short wavelength
- Wavelength (of X-rays) is of a similar size to (the diameter of) an atom
- X-rays are a transverse wave  
*correct description acceptable – oscillations / vibrations are perpendicular (at 90°) to direction of energy transfer*
- X-rays are ionising radiation

### Description of ultrasound

- ultrasound has a frequency above 20 000 (hertz)
- or**
- ultra sound is above 20 000 hertz
- ultrasound is above / beyond the human (upper) limit (of hearing)  
*accept ultrasound cannot be heard by humans*
  - ultrasound is a longitudinal wave  
*correct description acceptable – oscillations / vibrations (of particles) are parallel (in same direction) to direction of energy transfer*

### Statement(s) as to what happens to X-rays inside the human body:

- X-rays are absorbed by bone
- X-rays travel through / are transmitted by tissue / skin

### Statement as to what happens to ultrasound inside body:

- ultrasound is (partially) reflected at / when it meets a boundary between two different media
- travel at different speeds through different media

6

- (b) (because the X-rays) are ionising  
*accept a description of what ionising is*

1

(they will) damage cells

*instead of cell, any of these words can be used:*

*DNA / genes / chromosomes / nucleus*

**or**

mutate cells / cause mutations / increase chances of mutations

**or**

turn cells cancerous / produce abnormal growths / produce rapidly growing cells

*do **not** accept they can be dangerous (to human health)*

*do **not** accept damage to soft tissue*

**or**

kill cells

1

(c) any **one** from:

- removal / destruction of kidney / gall stones

- repair of damaged tissue / muscle

*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*

- removing plaque from teeth

*cleaning teeth is insufficient*

1

[9]

**M7.** (a) (i) The width of the base of the raft

1

The position of the centre of mass of the raft

1

(ii) Design B

1

(b) (i) inverted

1

real

1

(ii) 0.4

allow 1 mark for correct substitution, eg  $\frac{8}{20}$  (in mm)

or  $\frac{0.8}{2}$  (in cm)

or  $\frac{0.008}{0.02}$  (in m)

or  $\frac{4}{10}$  (number of squares)

ignore any units

ignore negative sign

2

(c) this shape ticked:



1

[8]

**M8.** (a) any **two** from:

- (sound with frequency) above 20 000 hertz / 20 kHz
- frequencies above (human) audible range
- (sound) cannot be heard by humans

2

(b) **either**

two appropriate points gain 1 mark each

**either both pro / con or one of each**

**or**

one appropriate point (and) appropriate qualification / amplification

*examples*

*other mammals (sufficiently) similar to humans (1)*

*so results appropriate (1)*

*unethical to experiment on humans (1)*

*so it is better to experiment on mice (1)*

*knowledge / techniques will benefit humans (1)*

*and also other animals (1)*

*experiments were justified because ultrasound has proved useful (1)*

2

(c) examples

*allow a wide variety of appropriate responses*

publish / tell doctors / the public (1)

...their evidence / results / research / data (1)

*valid point (1)*

*appropriate example / qualification / expansion / etc (1)*

carry out more research / tests (1)

...to make sure / check reliability (1)

*allow just 'stop using them / ultrasonic waves' for 1 mark only*

*allow using them (only) for industrial purposes for 1 mark only*

2

[6]

**M9.** (a) (i) **J and L**

*both required, either order*

1

(ii) **K**

1

(iii) **L**

1

highest frequency

*reason does not score if **L** not chosen*

*accept most waves (on screen)*

*do **not** accept frequency above 20 000(Hz)*

*do **not** accept cannot hear it*

1

(b) transmitter

detector

computer

*all three in correct order*

*allow 1 mark for one correct*

2

[6]

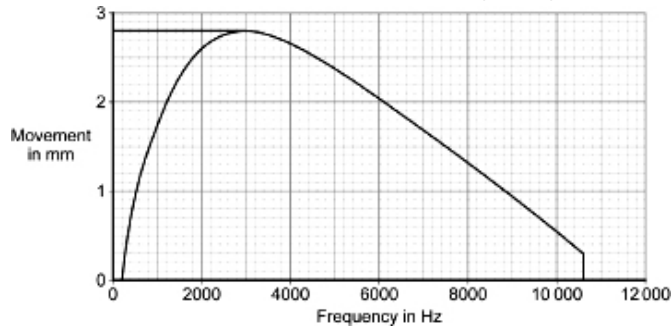
**M10.** (a) 10 600 (Hz)

*accept 10.6 kHz*

1

(b) 3000 (Hz)

*allow 1 mark for a line drawn to show greatest movement  
(allow only if frequency is between 2800 and 3200)  
accept other indication of correctly using the graph*



2

(c) (No)

*no marks for just the ticked box  
reasons can score even if yes is ticked*

(human hearing) range is 20 – 20 000 (Hz)

*accept (most) people hear up to 20 000 (Hz) / 20 kHz*

1

any **one** from:

- range on graph is within this range
- range on graph starts after 20 Hz
- range on graph is from to 200 – 10 600 (Hz)
- range on graph finishes before 20 000 Hz

1

(d) reliability

*this answer only*

1

(e) only 1 variable affects dependent variable / size of movement

*accept 'results' for 'size of movement'*

**or**

there is only one independent variable

*fair test is insufficient*

*do **not** accept to control the experiment*

**or**

to be able to compare (effect of different frequencies)

1

[7]

**M11.** (a) (i) converging

1

(ii) (x) 2

*allow 1 mark for correct substitution  
ie 10/5 or 20/10 or 2/1  
ignore any units*

2

(b) decreases

1

[4]

**M12.** (a) microphone

1

(c) (i) vertical line from any maxima or minima to axis

*do **not** penalise minor errors but  
do **not** allow unless intention is clear*

1

(ii) loudness / volume / intensity / energy

*do **not** accept noise*

1

(c) 17

*this answer only*

1

(d) the greater the distance, the smaller the amplitude

*accept volume / intensity / energy / loudness for amplitude*

**or**

there is a (strong) negative correlation between distance and amplitude

**or**

there is an inverse square relationship between distance and amplitude

*do **not** accept distance and amplitude are inversely proportional*

1

(e) 20 Hz

*either order*

1

20,000 Hz

*accept 20 kHz provided unit has been clearly changed*

1

[7]

**M13.** (a) vibrate

*allow move more (vigorously) but **not** just move*

1



	dirt / muck / grit / rust / dust etc. <i>do <b>not</b> accept bacteria</i>	1	
(b)	any <b>one</b> medical use eg <i>ignore incorrect biological detail</i>		
	• scanning unborn babies • destroying (kidney) stones	1	
(c)	(i) 2	1	
	(ii) C	1	[5]
<b>M14.</b>	(a) 20000 <i>accept any unambiguous indication</i>	1	
	(b) kilohertz <i>credit misspellings credit '1000 hertz' or '1000 Hz' accept 1000 oscillations/beats/waves <u>per second</u></i>	1	
	(c) (i) cleaning (e.g. something delicate such as a watch) <i><b>or</b> quality control/ flaw detection credit any appropriate extra Specification response e.g. sonar</i>	1	
	(ii) pre-natal (scanning) <i>do <b>not</b> credit just 'scanning'/medical scanning/ scanning a baby credit any appropriate extra Specification response e.g. destruction of (kidney) stones or cleaning teeth</i>	1	
	(d) 8 (µs)	1	
	(e) distance (1) between the <u>boundary</u> and the detector (1) <i>accept 'between the <u>boundary</u> and the source' accept any correct use of speed = distance/time</i>	2	

(f) examples

publish/tell doctors/the public (1) ... their evidence/results/research/data (1)

carry out more research/tests (1) ... to make sure/check reliability (1)

*allow a wide variety of appropriate responses*

*valid point (1) appropriate example/qualification/expansion/etc. (1)*

*allow just 'stop using them/ultrasonic waves' (1)*

*allow using them (only) for industrial purposes (1)*

2

[9]

**M15.** (a) (i) (concave) mirror / reflector

*do **not** allow convex mirror / reflector*

1

(ii) refraction

1

(b) (i) converging

1

(ii) 4

*allow 1 mark for correct substitution*

*ie 20 / 5 or 4 / 1*

*ignore any units*

2

[5]

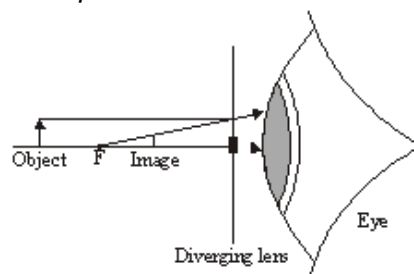
**M16.** (a) straight line from the tip of the object

... straight through the centre of the lens (1)

... parallel to the axis, then diverges from the lens as if from F (1)

image drawn from where **these** lines intersect, vertically to the axis (1)

*example*



3

(b) any **two** from:

- smaller (than the object)
- (both) upright
- image is virtual / imaginary (whereas object is real)  
*no errors carried forward from the candidate's diagram*  
*mark first **two** points given*

2

[5]

