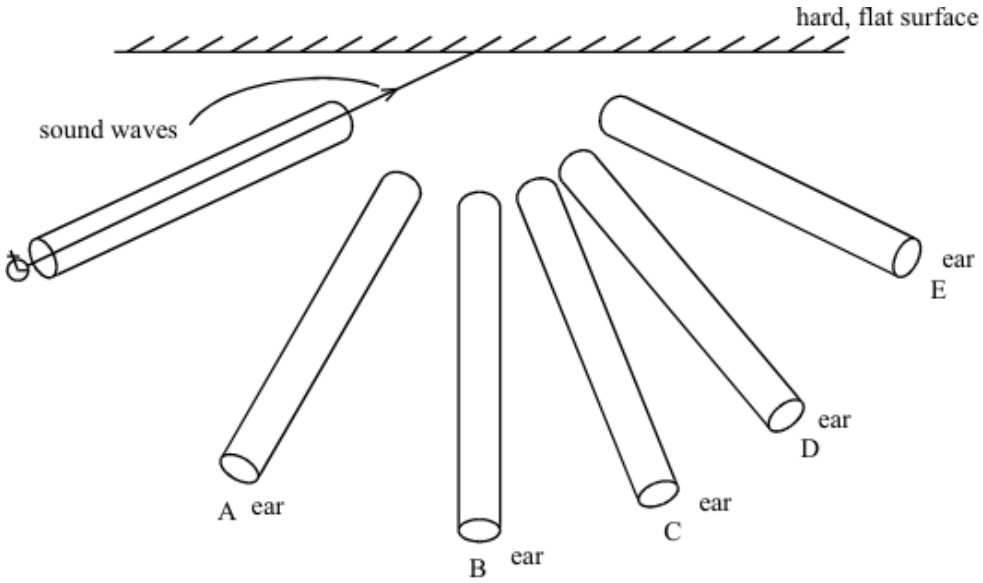
Q1. The diagram shows some of the kinds of waves in the electromagnetic spectrum. Choose words from this list to complete the empty boxes on the diagram.

alpha radiation **infrared radiation** **radio waves** **X-rays**

Shortest wavelength						Longest wavelength
gamma radiation		ultraviolet radiation	light		microwaves	

(Total 3 marks)

Q2. A hard, flat surface reflects sound just like a plane (flat) mirror reflects light.



You want to hear the reflection (echo) of the ticking watch through a tube.

Which is the best position to put the tube?

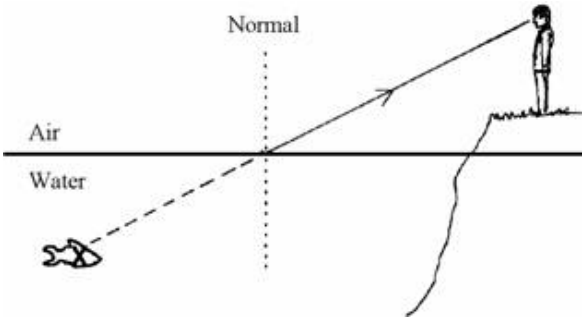
Choose from positions A-E on the diagram .....

(You may draw on the diagram if you want to.)

(Total 2 marks)

Q3. A man is walking along the bank of a river.

He sees a fish which seems to be at X.



(a) Show, on the diagram, where the fish **really** is.

Complete the ray of light which goes from the fish into the man's eye.

(2)

(b) Complete the sentence.

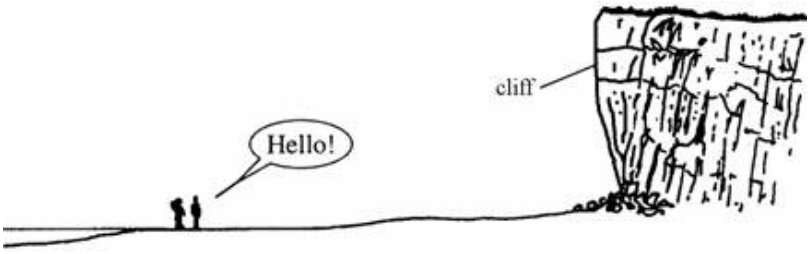
The ray of light is ..... as it passes from the water into the air.

(1)

(Total 3 marks)

Q4. Two friends are standing on a beach.

When they shout they can hear themselves a second later.



Explain, as fully as you can, why this happens.
(You may answer on the diagram if you want to.)

.....

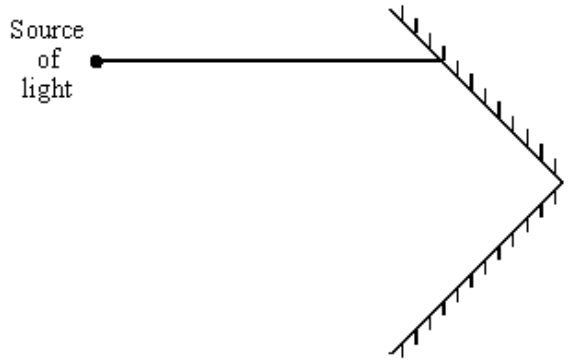
.....

(Total 2 marks)

Q5. (a) The diagram shows two mirrors at right angles to each other. A ray of light shines onto one mirror as shown.

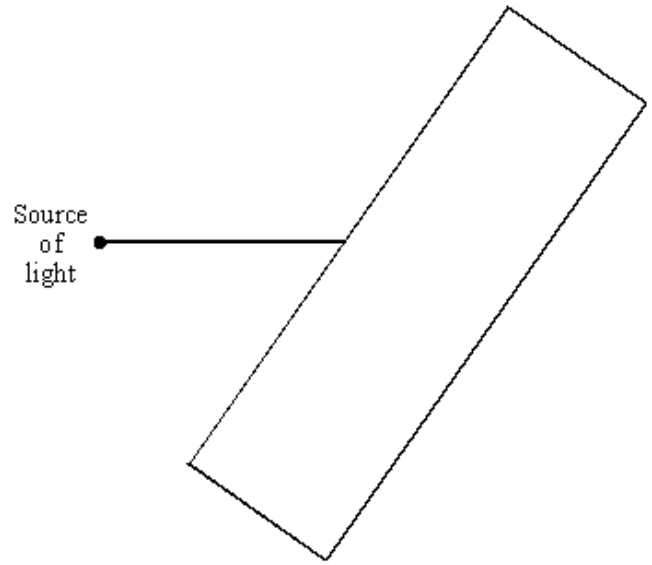
Carefully draw the path of the ray which is reflected from both mirrors.

Draw an arrow on the ray to show the direction of the light.



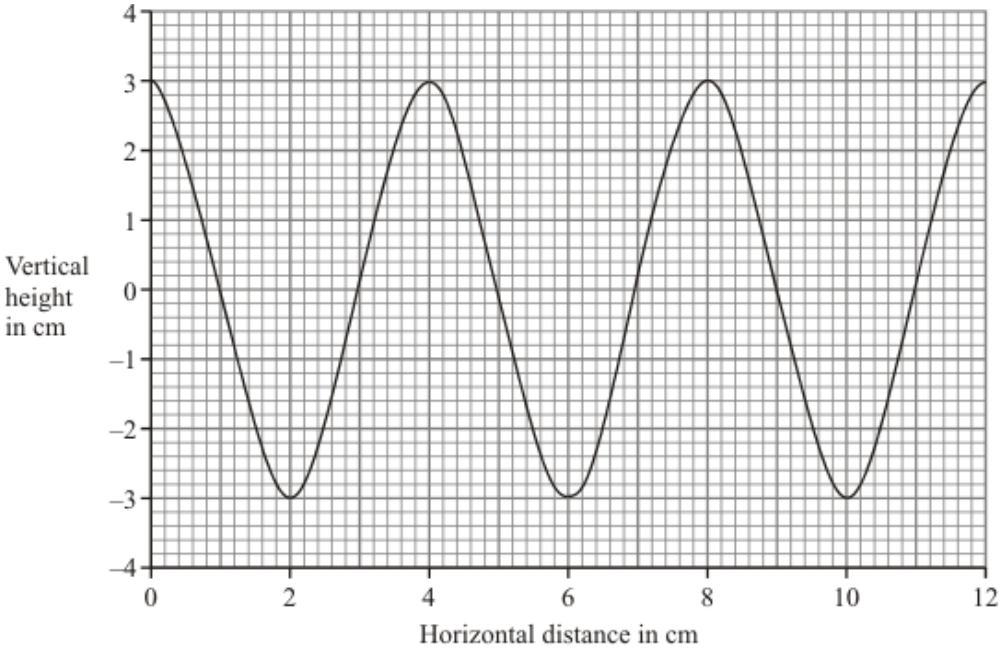
(3)

(b) Light can also be made to change direction as it passes into and out from a block of glass. Complete the ray diagram below.



(2)
(Total 5 marks)

Q6. The diagram shows a water wave drawn to scale.



(a) What is the wavelength of this water wave? ..... cm

(1)

(b) What is the amplitude? ..... cm

(1)

(c) Twelve waves pass an observer in four seconds.

What is the frequency of the waves? Show clearly how you work out your answer and give the unit.

.....

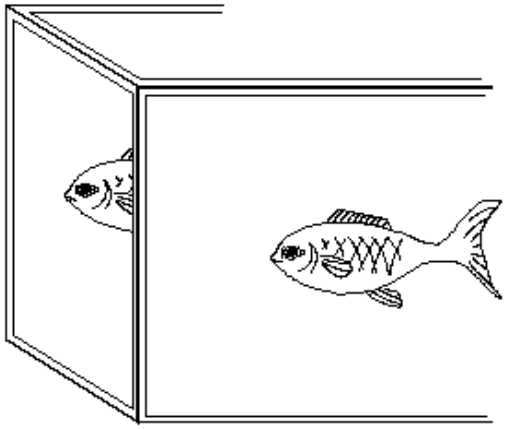
.....

Frequency = ...

(3)

(Total 5 marks)

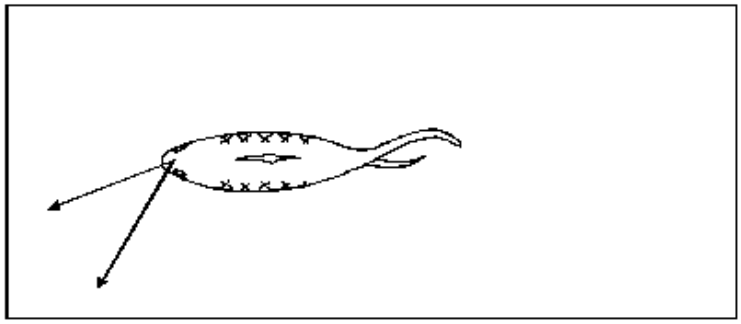
Q7. An aquarium contains only one fish. But if you look at the comer of the aquarium, there seem to be two fish.



The diagram below shows the top of the aquarium.

Two light waves have been drawn from the fish.

(a) Complete the diagram to show how the light waves reach the eye.



(2)

(b) Complete each sentence by using the correct words from the box.

colour	diffraction	longitudinal	reflection
refraction	speed	transverse	

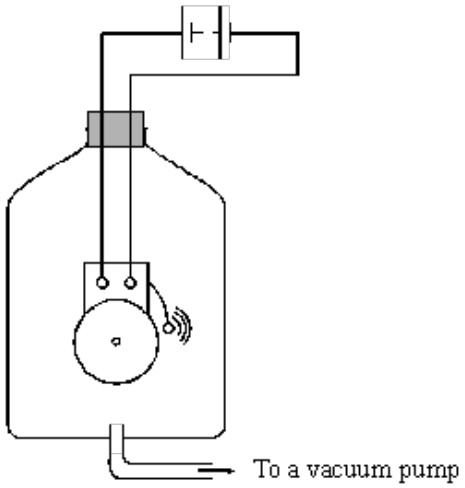
When the light waves pass from glass into the air they change .....

This causes a change in direction called .....

Light waves are ..... waves.

(3)
(Total 5 marks)

Q8. (a) The diagram shows an electric bell inside a glass jar. The bell can be heard ringing.



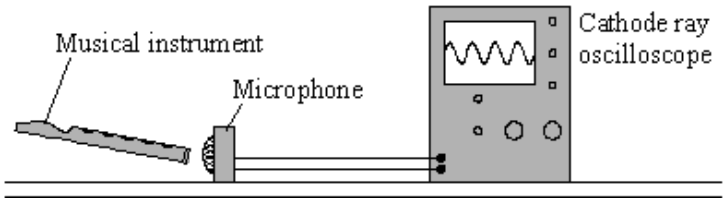
In the following sentences, cross out the **two** lines that are wrong in each box.

When all the air has been taken out of the glass jar, the ringing sound will

stop. get louder. get quieter.	This is because sound	travels faster travels slower cannot travel	through a vacuum.

(2)

(b) The microphone and cathode ray oscilloscope are used to show the sound wave pattern of a musical instrument.



One of the following statements describes what a microphone does. Tick the box next to the correct statement.

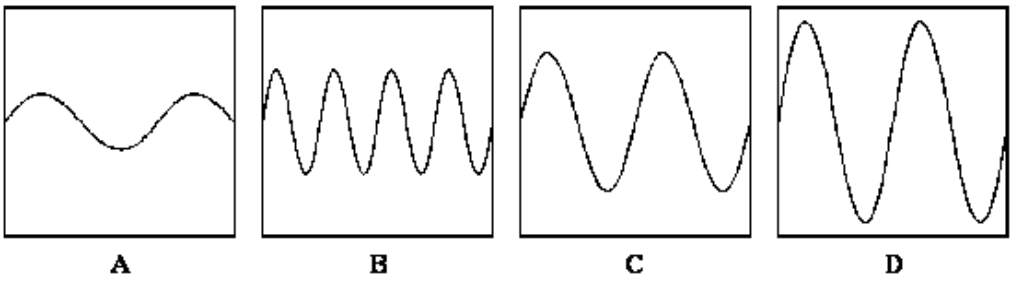
A microphone transfers sound energy to light energy. ☐

A microphone transfers sound energy to electrical energy. ☐

A microphone transfers electrical energy to sound energy. ☐

(1)

(c) Four different sound wave patterns are shown. They are all drawn to the same scale.



(i) Which sound wave pattern has the highest pitch?

.....

Give a reason for your answer.

.....

(2)

(ii) Which sound wave pattern is the loudest?

.....

Give a reason for your answer.

.....

.....

(2)

(Total 7 marks)

Q9. (a) A swimming pool has a wave making machine. The diagram shows the water wave pattern for 3 seconds.

(i) How many water waves are shown in the diagram?

.....

(1)

(ii) What is the frequency of the water waves?

.....

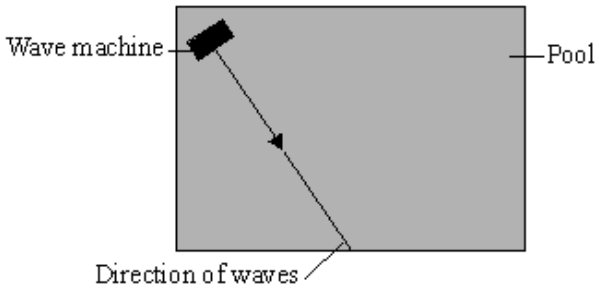
(1)

(iii) Which **one** of the units below is used to measure frequency? Underline your answer.

hertz joule watt

(1)

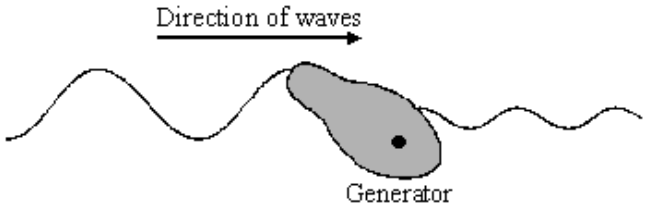
(b) The diagram shows the direction of the waves across the pool. The waves reflect off the side of the pool.



Draw a line on the diagram to show the direction of the waves after they hit the side of the pool.

(1)

(c) The swimming pool is used to test a model of an electricity generator. The waves make the floating generator move up and down. This energy is transferred to electricity.



(i) In the following sentence, cross out the **two** lines that are wrong in the box.

The diagram shoes that the amplitude of the waves

gets larger
stays the same
gets smaller

as the waves pass the generator.

(1)

(ii) What type of energy does the generator transfer to electricity?

.....

(1)

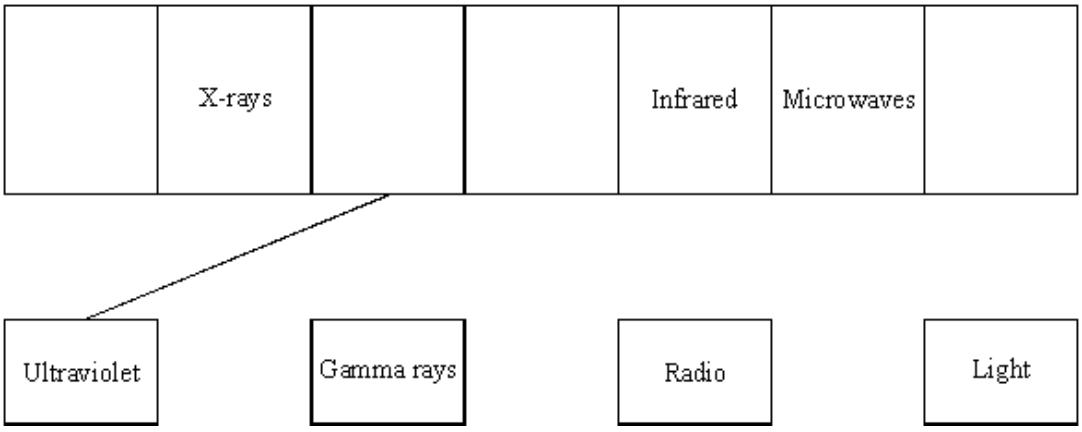
(iii) Energy from ocean waves could be used to generate electricity. Would this be a renewable or non-renewable energy resource?

.....

(1)

(Total 7 marks)

Q10. (a) The diagram represents the electromagnetic spectrum. Four of the waves have not been named. Draw lines to join each of the waves to its correct position in the electromagnetic spectrum. One has been done for you.



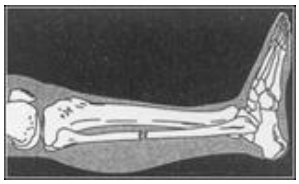
(2)

(b) Complete the following sentence by choosing the correct answer and crossing out in the box the two lines which are wrong.

The speed of radio waves through a vacuum is | faster than
the same as
slower than | the speed of light through a vacuum.

(1)

(d) The diagram shows an X-ray photograph of a broken leg.



Bones show up white on the photographic film. Explain why.

.....

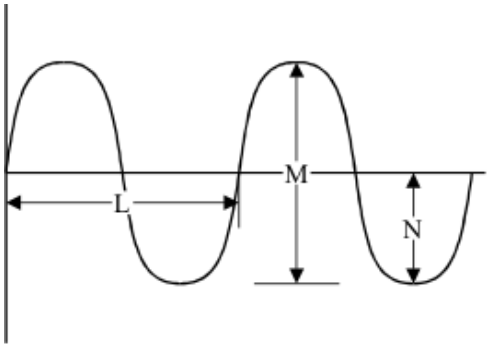
.....

.....

(2)

(Total 5 marks)

Q11. (a) The diagram shows a wave pattern.



Which letter, **L**, **M** or **N** shows:

(i) the wavelength? .....

(ii) the amplitude? .....

(2)

(c) Describe how you could show that visible light travels in straight lines. You may wish to draw a diagram to help explain your answer.

.....

.....

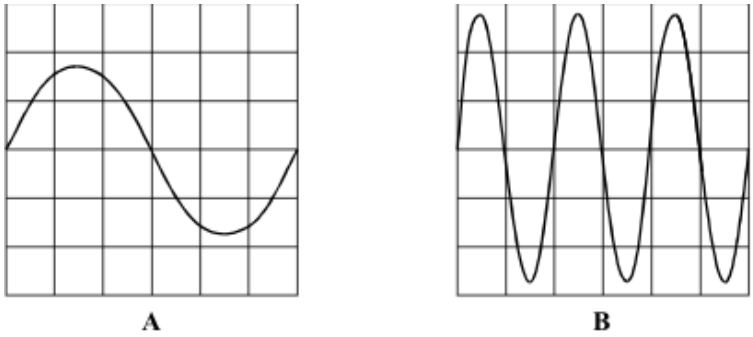
.....

.....

.....

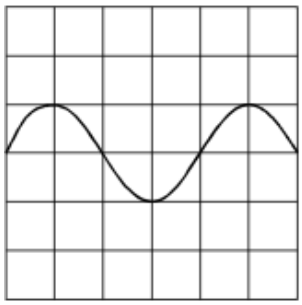
(2)
(Total 4 marks)

Q12. The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.

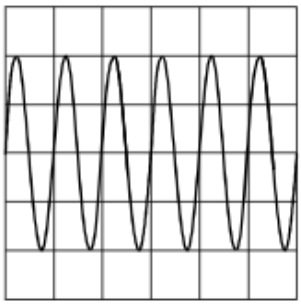


A

B



C



D

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, ...

(1)

(ii) the lowest frequency? .....

(1)

(Total 2 marks)

Q13. (a) Mobile phones send *digital* signals using electromagnetic waves.

(i) Which **one** of the following types of electromagnetic wave is used to carry information between masts in a mobile phone network?

Draw a ring around your answer.

light	**microwave**	**radio**

(1)

(b) Some people worry that using a mobile phone may be bad for their health.

Look at this information taken from a recent newspaper article.

- Scientists in Sweden found that the regular use of a mobile phone increases the risk of a cancerous growth between the ear and the brain.
- Some people who use mobile phones for a long time complain of headaches and tiredness. The same effect has not been noticed in laboratory tests.
- There is no reliable evidence to link using mobile phones with ill health.
- The waves from a mobile phone are not strong enough to cause long-term heat damage to cells in the body.

(i) Complete the following sentence by drawing a ring around the word in the box that is correct.

The evidence from different scientists doing the same investigation is reliable if

all the scientists get | different / identical / random | results.

(1)

(ii) What information in the article supports the idea that mobile phones are bad for your health?

.....

.....

.....

.....

(2)

(iii) Some scientists say that using a mobile phone is totally safe.

What information in the article supports this view?

.....

.....

.....

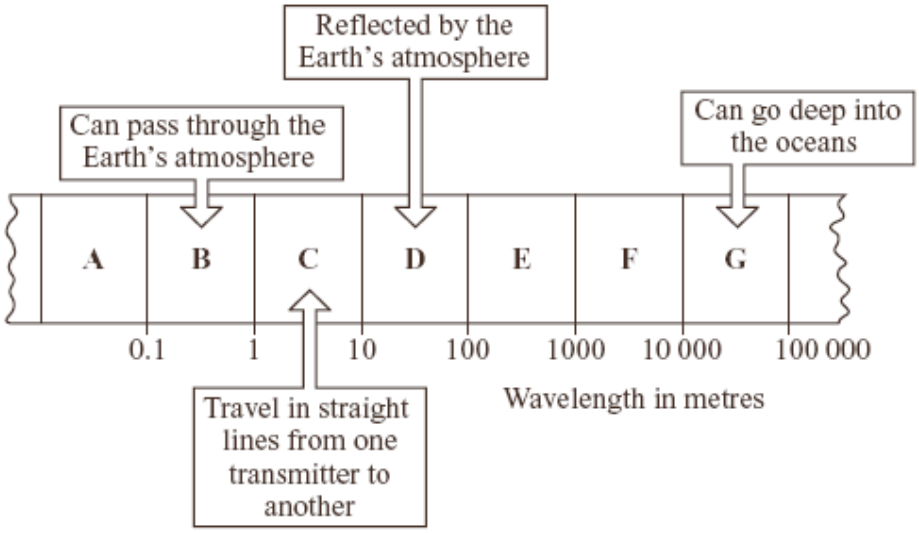
.....

(2)

(Total 6 marks)

Q14. The diagram shows a small part of the electromagnetic spectrum divided into seven sections.

The different properties of the waves in each section make them useful in different ways.



The waves in which section, **A**, **B**, **C**, **D**, **E**, **F** or **G**, are:

(a) used to send a signal to a satellite in space

.....

(1)

(b) used to communicate with a submarine under the water

.....

(1)

(c) used by a radio station to broadcast programmes around the world

.....

(1)

(d) the waves with the shortest wavelength?

.....

(1)

(Total 4 marks)

Q15. In the diagram below, a frog sits on a rock in a pond.

(a) Complete the following sentences by drawing a ring around the correct line in the box.

(i) The frog can see its image in the pond because the surface of the pond acts

like a | concave / convex / plane | mirror.

(1)

(ii) Draw a ring around each of **two** words from the box below to describe the image in the pond.

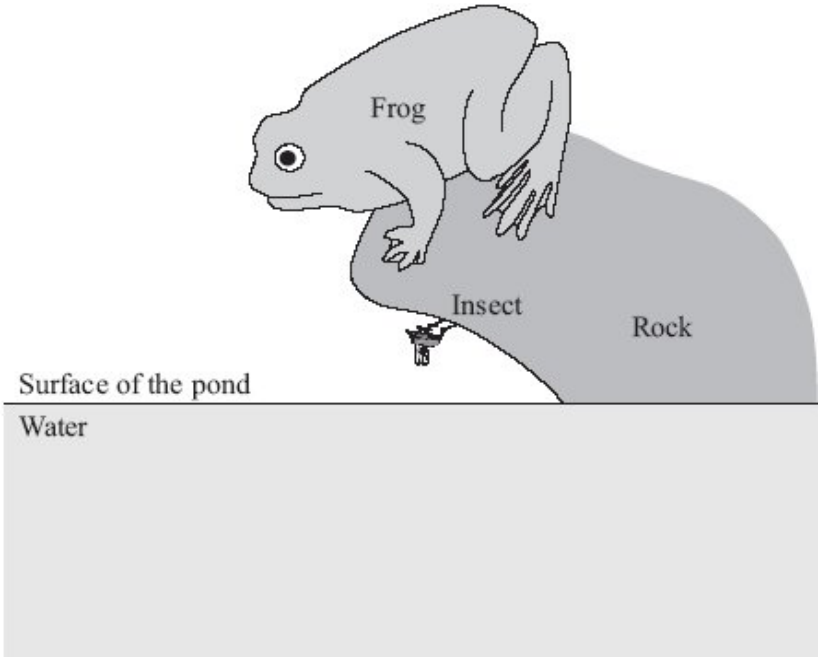
bigger	**inverted**	**real**	**smaller**	**upright**	**virtual**

(2)

(b) There is an insect underneath the rock.

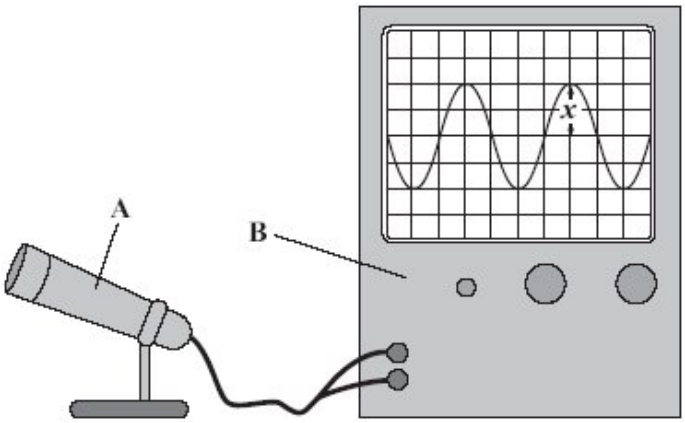
Use a ruler to draw rays of light on the diagram to show how the frog uses reflection to see the insect.

Mark the direction of the rays.



(3)
(Total 6 marks)

Q16. (a) A student uses two pieces of equipment, **A** and **B**, to display a sound wave.



(i) Use words from the box to complete the sentence.

a loudspeaker	**a microphone**	**an oscilloscope**	**a screen**

A is ..... and **B** is ..... .

(2)

(ii) Use words from the box to complete the sentence.

the amplitude	**half the amplitude**	**the frequency**	**half the frequency**

The distance ***x*** marked on the diagram measures ..... of the sound wave.

(1)

(iii) Complete the sentence.

The distance ***x*** becomes smaller. This is because the sound has

become ..... .

(1)

(b) There is no air in space.

Astronauts in space cannot hear sounds from outside their spacesuits.

Explain this.

.....

.....

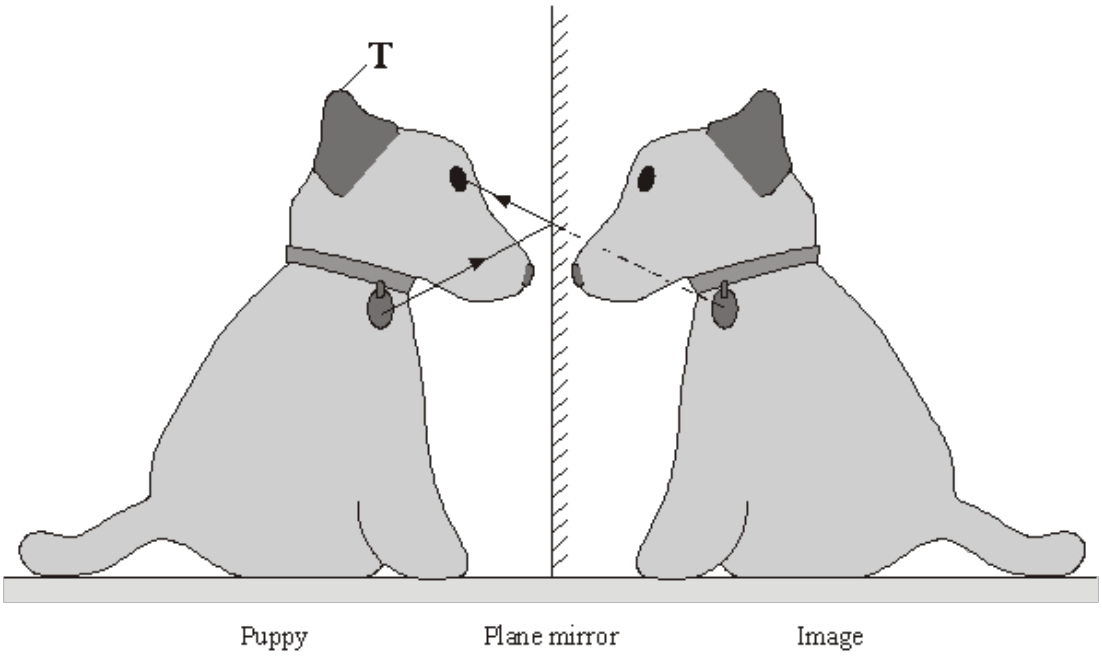
.....

.....

(2)

(Total 6 marks)

Q17. A puppy can see an image of himself in a plane mirror.



The diagram shows how the puppy can see his disc.

(a) On the diagram, use a ruler to draw a ray to show how the puppy can see the top of his ear, which is marked as **T**.

(3)

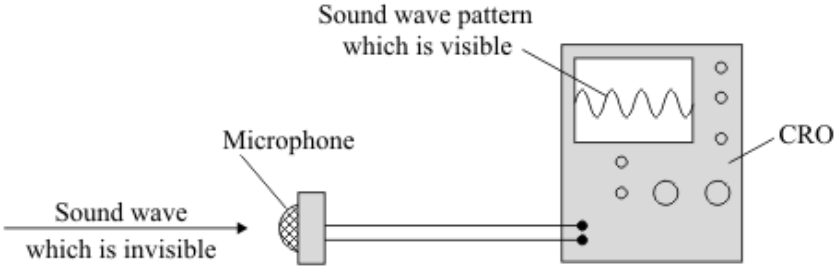
(b) What is a plane mirror?

.....

.....

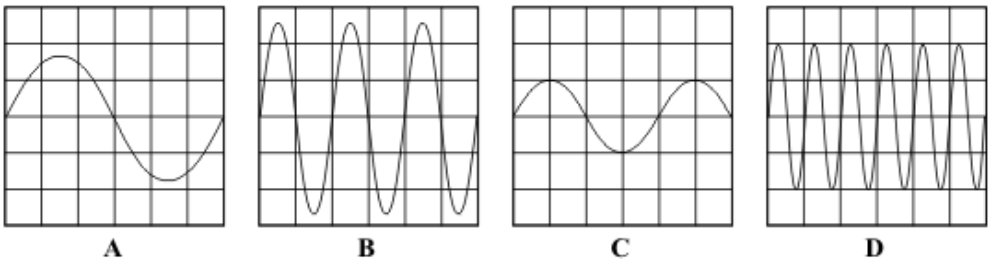
(1)
(Total 4 marks)

Q18. A microphone and a cathode ray oscilloscope (CRO) can be used to show the pattern of a sound wave.



Four sound wave patterns, **A**, **B**, **C** and **D**, are shown.

They are all drawn to the same scale.

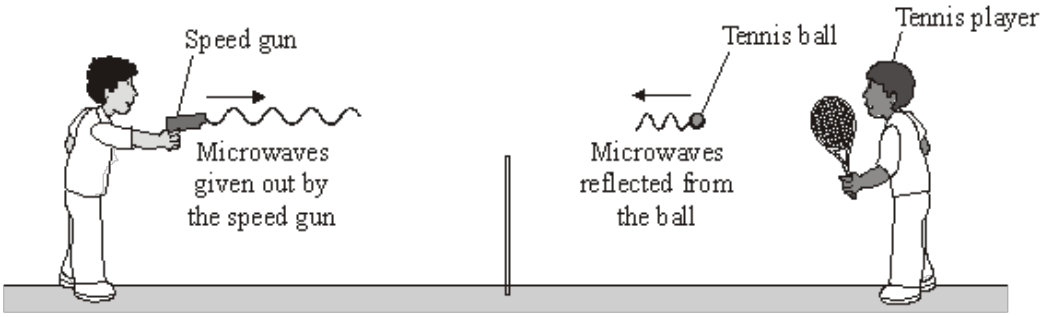


(a) Which **one** of the patterns has the smallest amplitude? .....

(b) Which **one** of the patterns has the lowest frequency? .....

(Total 2 marks)

Q19. (a) The picture shows a speed gun being used to measure how fast a tennis player hits the ball.



Some of the microwaves from the speed gun are absorbed by the ball and some are reflected by the ball.

(i) Complete the following sentence by choosing **one** of the phrases from the box.

longer than	**the same as**	**shorter than**

The wavelength of the microwaves reflected from the ball are

..... the wavelength of the microwaves

from the speed gun.

(1)

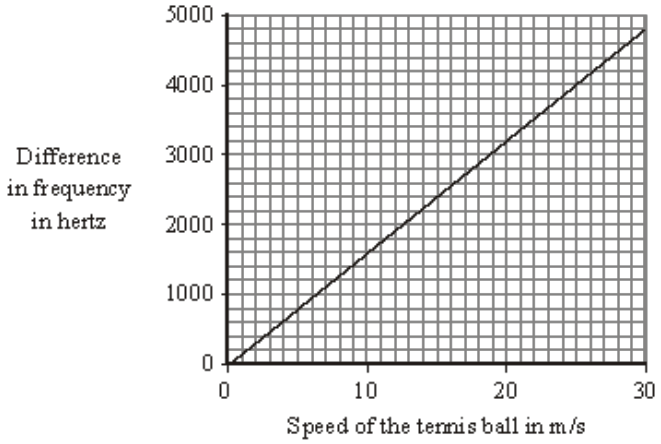
(ii) Complete the following sentence by drawing a ring around the correct line in the box.

When the ball absorbs microwaves, its temperature will

decrease slightly
not change
increase slightly

(1)

(b) The microwaves reflected from the ball have a higher frequency than the microwaves from the speed gun.
The graph shows how the difference between the two frequencies depends on the speed of the ball.



(i) Describe the pattern that links the difference between the two frequencies and the speed of the ball.

.....

.....

(1)

(ii) The speed gun measures the difference between the two frequencies as 3200 Hz.

Use the graph to find the speed of the tennis ball.
Show clearly on the graph how you obtain your answer.

Speed of the tennis ball = ... m/s

(2)

(iii) Which **one** of the following gives the reason why the data has been shown as a line graph and **not** as a bar chart?

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

Frequency and speed are both categoric variables. ☐

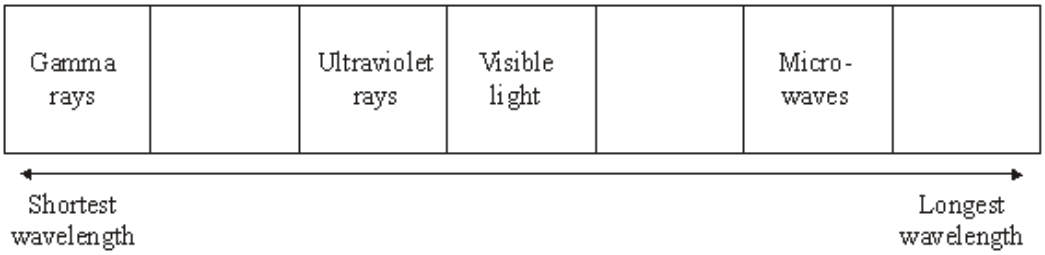
Frequency and speed are both continuous variables. ☐

Speed is a continuous variable and frequency is a categoric variable. ☐

(1)

(Total 6 marks)

Q20. The table shows the electromagnetic spectrum.
Three types of wave have been missed out.



(i) Use words from the box to complete the table.

infra red rays	**radio waves**	**X-rays**

(2)

(ii) Which **one** of the following gives a use of gamma rays?

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

to communicate with satellites ☐

to see objects ☐

to kill cancer cells ☐

(1)

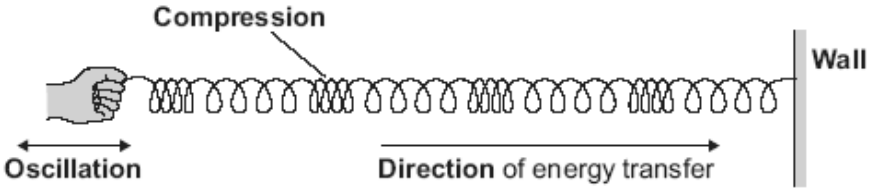
(iii) Complete the following sentence by drawing a ring around the correct word in the box.

All electromagnetic waves move | energy / gases / particles | from one place to another.

(1)

(Total 4 marks)

Q21. (a) The diagram shows a longitudinal wave being produced in a stretched spring.



(i) Use the bold words from the diagram to complete the following sentence. Put only **one** word in each space.

A longitudinal wave is one in which the ..... causing

the wave is parallel to the ..... of energy transfer.

(2)

(ii) Name the type of energy that is transferred by longitudinal waves.

.....

(1)

(b) The diagram shows water waves made by a wave machine in a swimming pool.

Every second, two waves go past a person standing in the swimming pool.

The waves have a wavelength of 0.8 metres.

Calculate the speed of the water waves.

Write down the equation you use, and then show clearly how you work out your answer.

.....

.....

.....

.....

.....

.....

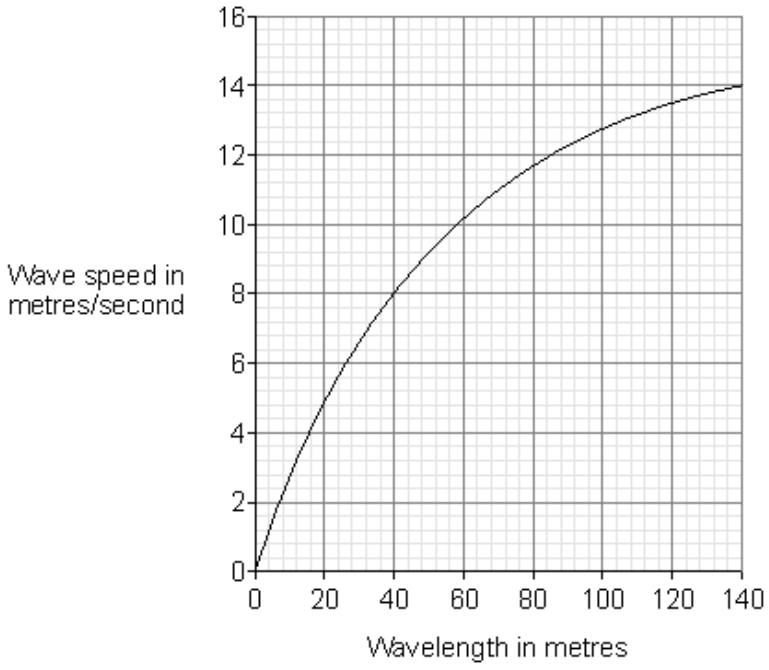
.....

.....

Wave speed = ... m/s

(2)

(c) The graph shows how the speed of deep ocean waves depends on the wavelength of the waves.



What can you conclude from the graph?

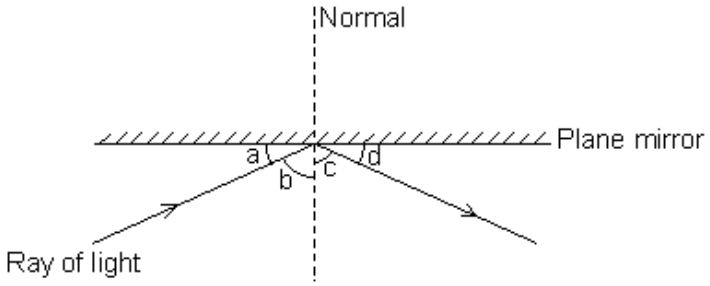
.....

.....

.....

(2)
(Total 7 marks)

Q22. (a) The diagram shows a ray of light being reflected by a plane mirror.



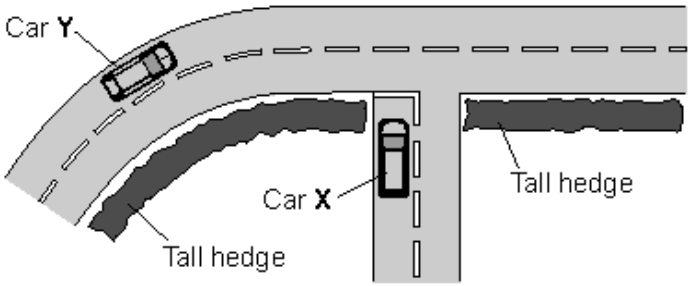
Which of the angles, **a**, **b, c** or **d,** is:

the angle of incidence; ☐

the angle of reflection? ☐

(2)

(b) The diagram shows a road junction seen from above.



A mirror placed at the side of the road allows the driver of car **X** to see car **Y**.

Using the same mirror symbol given in part (a), draw a plane mirror to show how it should be placed so that the driver of car **X** can see car **Y**.

(2)
(Total 4 marks)

Q23. The diagram shows the seven types of wave that make up the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet rays	Visible light	Infra red rays	Micro-waves	Radio waves

(a) (i) Microwaves and visible light can be used for communications.

Name **one** more type of electromagnetic wave that can be used for communications.

.....

(1)

(ii) Name **one** type of electromagnetic wave that has a longer wavelength than microwaves.

.....

(1)

(b) Wi-Fi is a system that joins a laptop computer to the internet without using wires.
A 2400 megahertz microwave signal is used to link a computer to a device called a router.

What quantity is measured in hertz?

Draw a ring around your answer.

frequency **wavelength** **wave speed**

(1)

(c) A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

(i) Suggest **one** reason why more scientific research into the safety of Wi-Fi systems is needed.

.....

.....

(1)

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

What the politician said was

a fact.
an opinion.
a prediction.

(1)
(Total 5 marks)

Q24. (a) The table gives information about the frequencies in the hearing ranges of six different mammals.

Name of mammal	Frequencies in hearing range
Bat	20 Hz → 160 kHz
Dog	20 Hz → 30 kHz
Dolphin	40 Hz → 110 kHz
Elephant	5 Hz → 10 kHz
Human	20 Hz → 20 kHz
Tiger	30 Hz → 50 kHz

(i) Which mammal in the table can hear the highest frequency?

.....

(1)

(ii) Which mammal in the table, apart from humans, **cannot** hear ultrasound?

.....

(1)

(iii) Give **one** example of a frequency which an elephant can hear but which a tiger **cannot** hear.

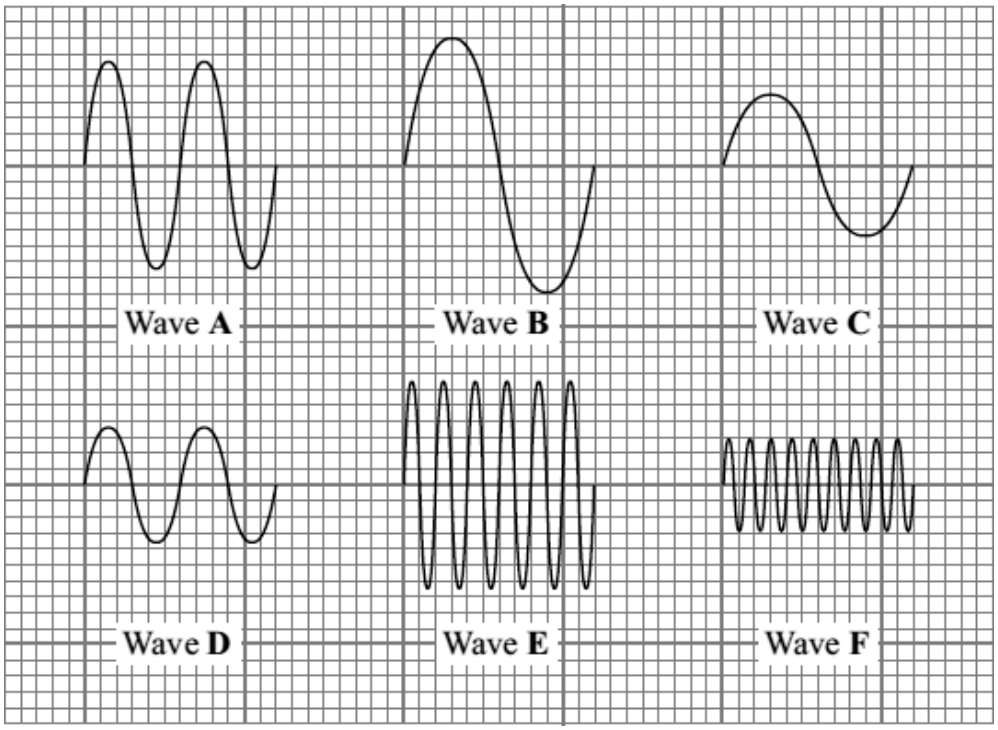
Include the unit in your answer.

Frequency .....

(1)

(b) The diagrams show six sound waves, **A**, **B**, **C**, **D**, **E** and **F**, represented on an oscilloscope screen.

They are all drawn to the same scale.



(i) Which **one** of the waves has the greatest amplitude?

Wave ..... .

(1)

(ii) Which **one** of the waves has the highest frequency?

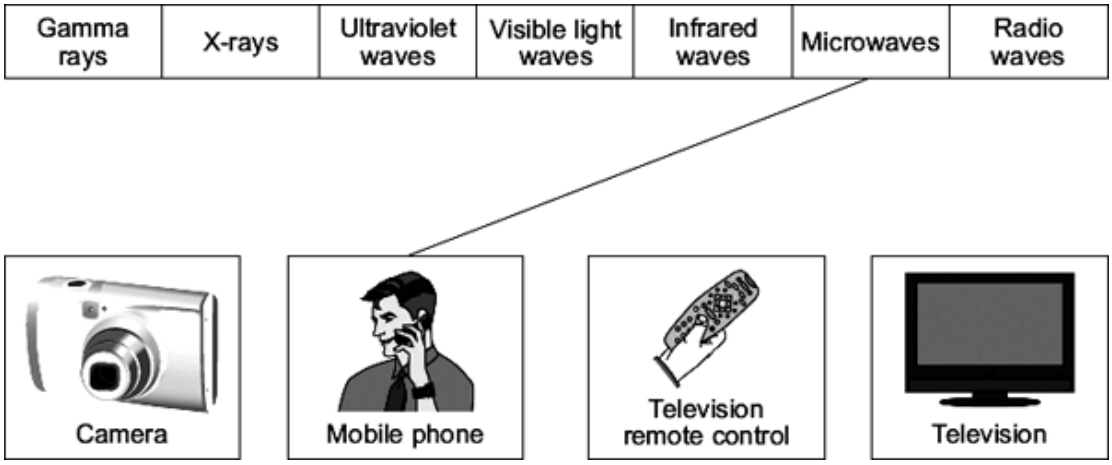
Wave ..... .

(1)
(Total 5 marks)

Q25. (a) The diagram shows the electromagnetic spectrum.

The pictures show four devices. Each device uses a different type of electromagnetic wave.

Draw **one** line from each device to the type of electromagnetic wave the device uses. One line has been drawn for you.



(3)

(b) Visible light waves travel through space at a speed of 300 000 km/s.

How fast do infrared waves travel through space?

.....

(1)

(c) Draw a ring around the correct answer in the box to complete the sentence.

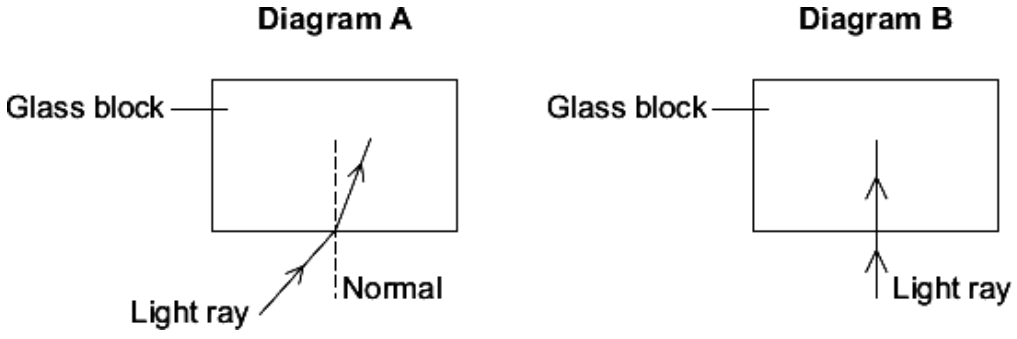
Infrared waves have

a longer wavelength than
the same wavelength as
a shorter wavelength than

visible light waves.

(1)

(d) The two diagrams, **A** and **B**, show a light ray travelling into a glass block.



(i) Look at **Diagram A.**

What name is given to the process that happens as the light enters the glass block?

.....

(1)

(ii) Look at **Diagram B.**

The light enters the glass block without changing direction.

Why?

.....

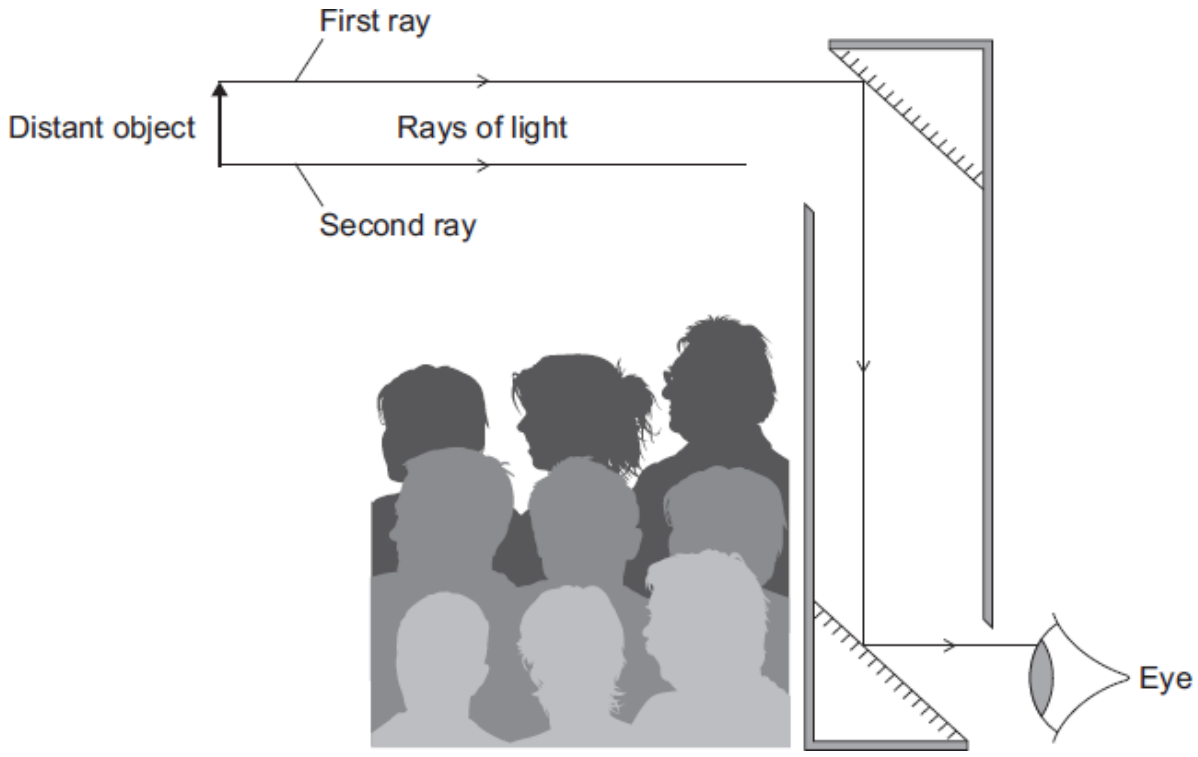
.....

(1)

(Total 7 marks)

Q26. The diagram shows a periscope being used to see over the heads of a crowd of people.

The periscope has been made using two plane mirrors.



(a) Using a ruler, complete the diagram to show how the second ray of light from a distant object reaches the person's eye.

(2)

(b) How big is the image produced by the periscope compared to the size of the object?

.....

(1)

(Total 3 marks)

Q27. (a) The diagram below shows six of the seven types of wave that make up the electromagnetic spectrum.

Gamma rays		Ultraviolet	Visible light	Infrared	Microwaves	Radio waves

(i) What type of electromagnetic wave is missing from the diagram?

.....

(1)

(ii) Which of the following electromagnetic waves has the most energy?

Draw a ring around the correct answer.

gamma rays **radio waves** **visible light**

(1)

(iii) Which of the following electromagnetic waves is given out by a TV remote control?

Draw a ring around the correct answer.

infrared **microwaves** **ultraviolet**

(1)

(b) Draw a ring around the correct answer in the box to complete the sentence.

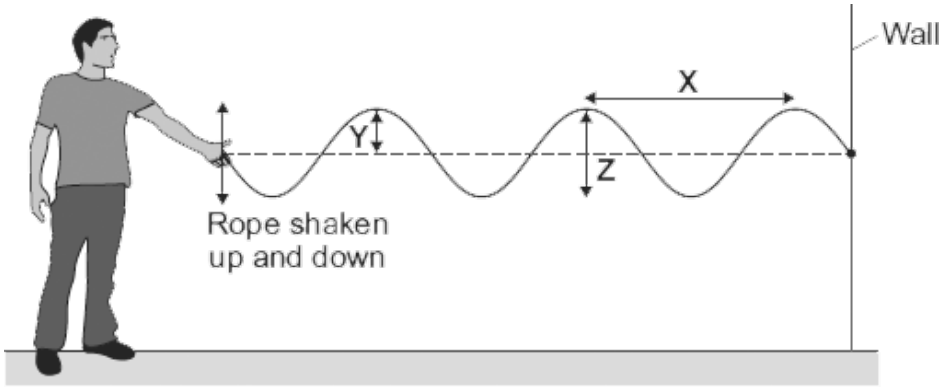
Microwaves travel through a vacuum at

a slower speed than
the same speed as
a faster speed than

radio waves.

(1)

(c) The diagram shows waves being produced on a rope.
The waves are **not** reflected by the wall.



(i) Draw an arrow on the diagram to show the direction in which the waves transfer energy.

(1)

(ii) Which **one** of the arrows, labelled, **X**, **Y** or **Z**, shows the amplitude of a wave?

Write the correct answer in the box.

(1)

(iii) The waves produced on the rope are transverse.

Name **one** other type of transverse wave.

.....

(1)

(d) The rope is shaken up and down, producing 3 waves every second.
The waves have a wavelength of 1.2 metres.

(i) State the frequency of the waves.

..... Hz

(1)

(ii) Calculate the speed of the waves.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

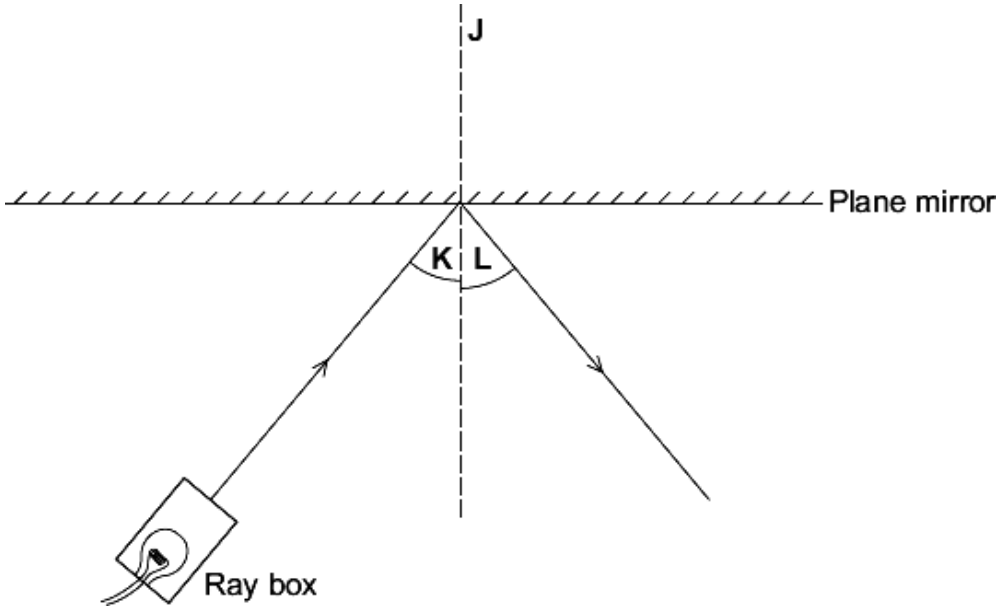
.....

Wave speed = ... m/s

(2)

(Total 10 marks)

Q28. The diagram shows a ray of light from a ray box that is reflected by a plane mirror.



(a) What name is given to the dashed line labelled **J**?

Draw a ring around the correct answer.

incident **normal** **reflection**

(1)

(b) Draw a ring around the correct answer in the box to complete the sentence.

If the angle marked **K** is halved, then the angle marked **L** will

be doubled.
not change.
be halved.

(1)

(c) A student looking into the mirror can see an image of the ray box.

Which **two** words can be used to describe the image that the student sees?

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

inverted **magnified** **real** **upright** **virtual**

(2)
(Total 4 marks)

Q29. (a) The table gives information about the frequencies in the hearing ranges of six different mammals.

Name of mammal	Frequencies in hearing range
Bat	20 Hz → 160 kHz
Dog	20 Hz → 30 kHz
Dolphin	40 Hz → 110 kHz
Elephant	5 Hz → 10 kHz
Human	20 Hz → 20 kHz
Tiger	30 Hz → 50 kHz

(i) Which mammal in the table can hear the highest frequency?

.....

(1)

(ii) Give **one** example of a frequency which an elephant can hear but which a tiger **cannot** hear.

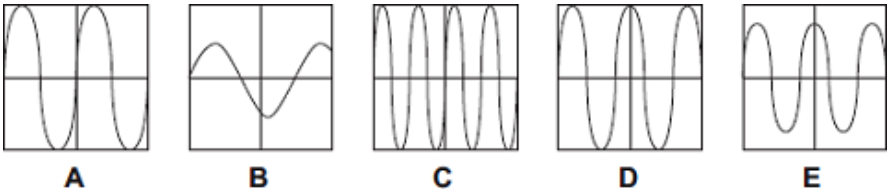
Include the unit in your answer.

Frequency .....

(1)

(b) A sound wave can be represented as a trace on the screen of an oscilloscope.

The diagrams show five traces, **A**, **B**, **C**, **D** and **E**, on the oscilloscope. All the traces aredrawn to the same scale.



(i) Which **three** diagrams show traces with the same amplitude?

Diagrams ..... , ... and ..... .

(1)

(ii) Which **two** diagrams show traces with the same frequency?

Diagrams ..... and ....

(1)

(c) There is no air in space.

Astronauts in space cannot hear sounds from outside their spacesuits.

Explain this.

.....

.....

.....

.....

(2)
(Total 6 marks)

Q30. Using an optical telescope to look at stars is not always easy because:

- too many street lights often make it too light to see faint stars
- clouds reduce the light getting to the telescope
- atmospheric pollution often distorts the images.

Large optical telescopes are often positioned high up a mountain.

Describe the advantages of positioning a telescope high up a mountain.

.....

.....

.....

.....

.....

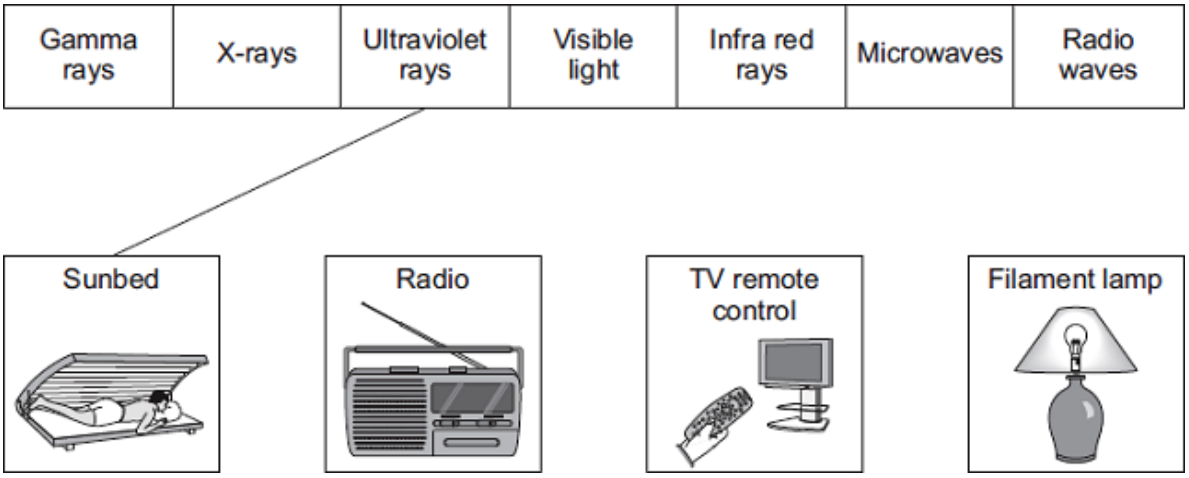
.....

(Total 3 marks)

Q31. (a) The diagram shows the electromagnetic spectrum.

The pictures show four devices that use electromagnetic waves. Each device uses a different type of electromagnetic wave.

Draw a line from each device to the type of electromagnetic wave that it uses. One has been done for you.



(3)

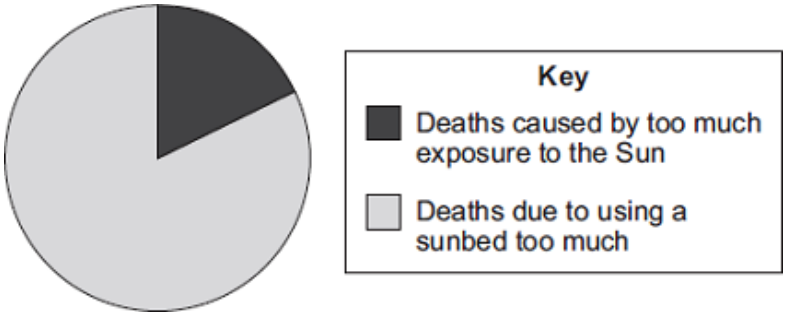
(b) A headline from a recent newspaper article is shown below.

(i) What serious health problem may be caused by using a sunbed too much?

.....

(1)

(ii) The pie chart compares the number of deaths in Britain each year which may have been caused by using sunbeds too much, with those which may have been caused by too much exposure to the Sun.



It is difficult for a doctor to be certain that a person has died because of using a sunbed too much.

Suggest why.

.....

.....

(1)

(iii) A spokesperson for a leading cancer charity said:

> 'We want people, especially young people, to know the possible dangers of using a sunbed.'

Why is it important that you know the possible dangers of using a sunbed?

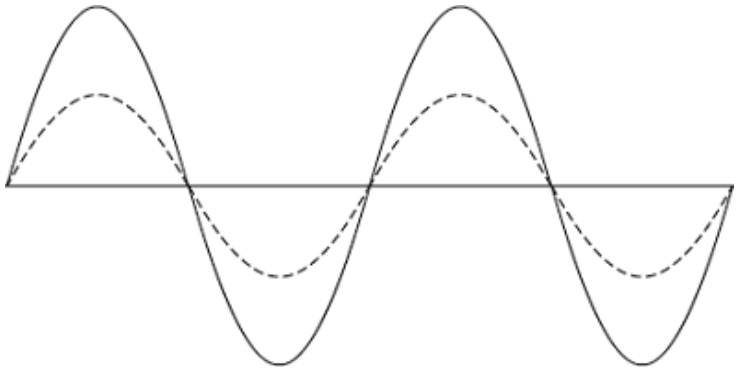
.....

.....

(1)
(Total 6 marks)

Q32. (a) **Diagram 1** shows two waves.

Diagram 1



(i) Name **one** wave quantity that is the same for the two waves.

.....

(1)

(ii) Name **one** wave quantity that is different for the two waves.

.....

(1)

(iii) The waves in **Diagram 1** are transverse.

Which **one** of the following types of wave is **not** a transverse wave?

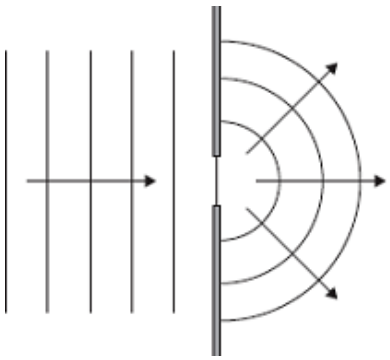
Draw a ring around the correct answer.

gamma rays **sound** **visible light**

(1)

(b) **Diagram 2** shows water waves in a ripple tank moving towards and passing through a gap in a barrier.

Diagram 2



(i) The water waves spread out after passing through the gap in the barrier.

What name is given to the process causing the waves to spread out?

.....

(1)

(ii) Every second, 8 waves pass through the gap in the barrier. The waves have a wavelength of 0.015 metres.

Calculate the speed of the water waves and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Speed = ...

(3)

(Total 7 marks)

Q33. (a) A lorry has an air horn. The air horn produces sound waves in the air.

(i) Use **one** word to complete the following sentence.

Sound waves cause air particles to ..... .

(1)

(ii) The air horn produces sound waves at a constant frequency of 420 Hz.

The wavelength of the sound waves is 0.80 m.

Calculate the speed of the sound waves.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Speed = ... m/s

(2)

(b) A person standing at the side of the road, as the lorry goes past, hears the sound from the air horn change pitch.

(i) What determines the pitch of a sound?

Draw a ring around the correct answer.

amplitude **frequency** **loudness**

(1)

(ii) As the lorry moves away from the person, the air horn continues to produce sound waves with a wavelength of 0.80 m.

What is the wavelength of the sound waves the person heard?

Draw a ring around the correct answer.

shorter than 0.8 m **equal to 0.8 m** **longer than 0.8 m**

(1)

(iii) The sound waves the person heard from the moving air horn are different to the sound waves the air horn produced.

What name is given to this effect?

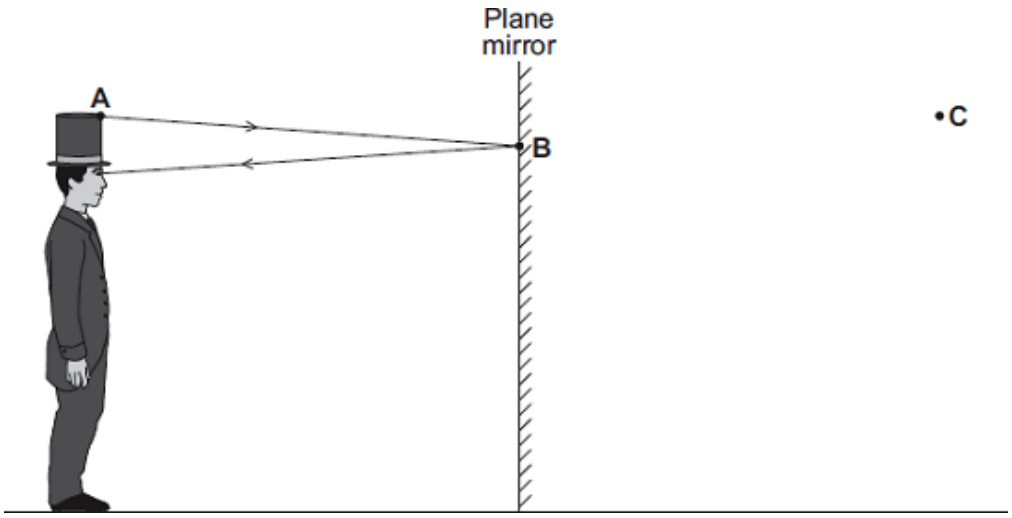
Draw a ring around the correct answer.

diffraction **Doppler** **refraction**

(1)

(Total 6 marks)

Q34. A person can see an image of himself in a tall plane mirror.



The diagram shows how the person can see his hat.

(a) Which point, **A**, **B** or **C**, shows the position of the image of his hat?

Write the correct answer, **A**, **B** or **C**, in the box.

(1)

(b) On the diagram, use a ruler to draw a light ray to show how the person can see his shoe.

(3)

(c) Which **one** of the words in the box is used to describe the image formed by a plane mirror?

Draw a ring around the correct answer.

imaginary	**real**	**virtual**

(1)

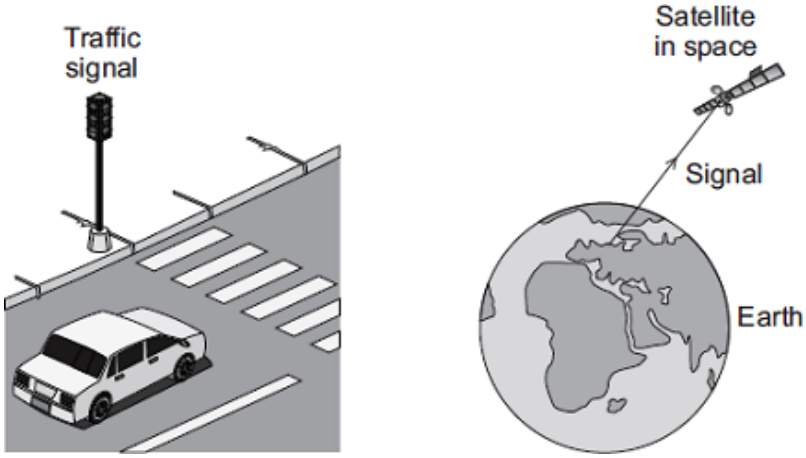
(Total 5 marks)

Q35. **Diagram 1** shows four of the seven types of wave in the electromagnetic spectrum.

Diagram 1

J	**K**	**L**	Visible light	Infrared	Microwaves	Radio waves

(a) The **four** types of electromagnetic wave named in **Diagram 1** above are used for communication.



(i) Which type of electromagnetic wave is used when a traffic signal communicates with a car driver?

.....

(1)

(ii) Which type of electromagnetic wave is used to communicate with a satellite in space?

.....

(1)

(b) Gamma rays are part of the electromagnetic spectrum.

Which letter, **J**, **K** or **L**, shows the position of gamma rays in the electromagnetic spectrum?

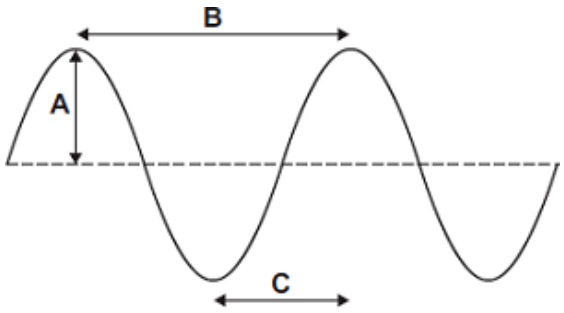
Draw a ring around the correct answer.

J **K** **L**

(1)

(c) **Diagram 2** shows an infrared wave.

Diagram 2



(i) Which **one** of the arrows, labelled **A**, **B** or **C**, shows the wavelength of the wave?

Write the correct answer, **A**, **B** or **C**, in the box. ☐

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

The wavelength of infrared waves is | shorter than / the same as / longer than | the wavelength of radio waves.

(1)

(d) Mobile phone networks send signals using microwaves. Some people think the energy a person's head absorbs when using a mobile phone may be harmful to health.

(i) Scientists have compared the health of people who use mobile phones with the health of people who do not use mobile phones.

Which **one** of the following statements gives a reason why scientists have done this?

Tick (✓) **one** box.

To find out if using a mobile phone is harmful to health. ☐

To find out if mobile phones give out radiation. ☐

To find out why some people are healthy. ☐

(1)

(ii) The table gives the specific absorption rate (SAR) value for two different mobile phones.

The SAR value is a measure of the maximum energy a person's head absorbs when a mobile phone is used.

Mobile Phone	SAR value in W/kg
X	0.28
Y	1.35

A parent buys mobile phone **X** for her daughter.

Using the information in the table, suggest why buying mobile phone **X** was the best choice.

.....

.....

.....

.....

(2)
(Total 8 marks)