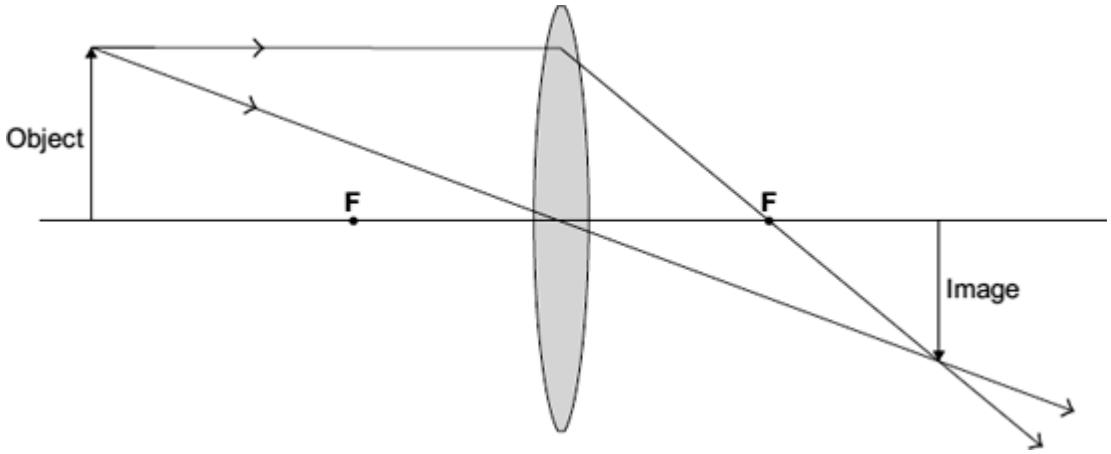
ELECTROMAGNETIC WAVES PART II

Q1.

The diagram shows a lens, the position of an object and the position of the image of the object.



(a) What type of lens is shown?

_____

(1)

(b) What is the name of the points, **F**, shown each side of the lens?

_____

(1)

(c) (i) The image is real and can be put on a screen.

How can you tell **from the diagram** that the image is real?

_____

_____

(1)

(ii) Draw a ring around a word in the box which describes the image produced by the lens.

inverted	**larger**	**upright**

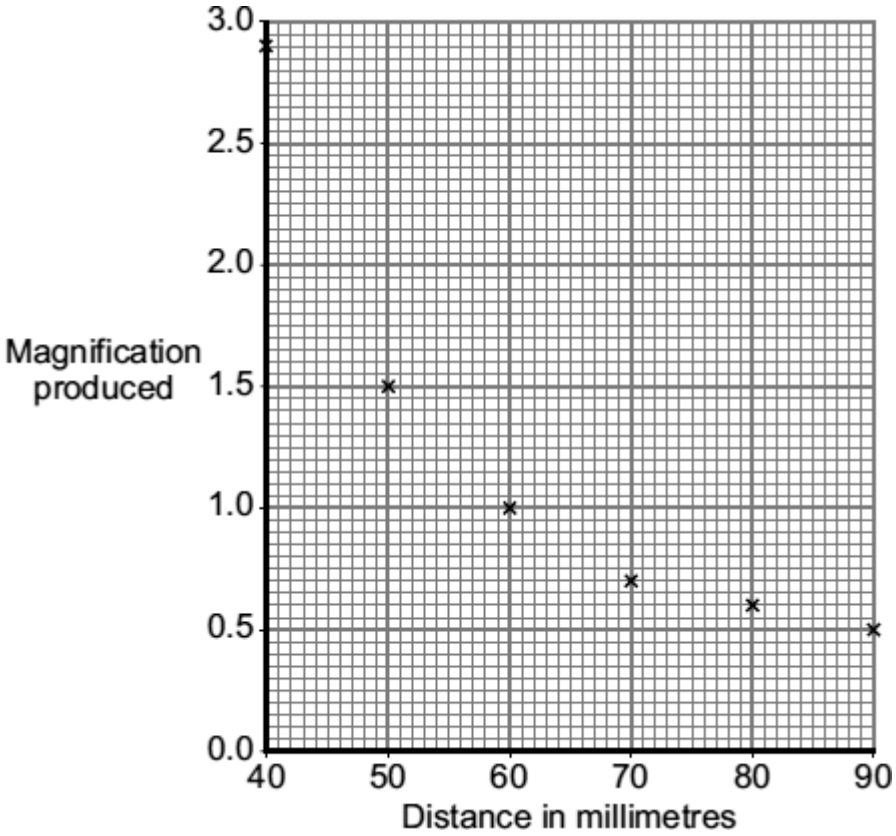
(1)

(d) A student investigates the relationship between the distance from the object to the lens and the magnification produced by the lens.
The student's results are given in the table.
The student did not repeat any measurements.

Distance in millimetres	Height of object in millimetres	Height of image in millimetres	Magnification produced

40	20	58	2.9
50	20	30	1.5
60	20	20	1.0
70	20	14	0.7
80	20	12	0.6
90	20	10	0.5

The student plots the points for a graph of *magnification produced* against *distance*.



(i) Draw a *line of best fit* for these points.

(1)

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

A line graph has been drawn because both variables are

described as being

categoric.
continuous.
discrete.

(1)

(iii) Describe the relationship between *magnification produced* and *distance*.

_____

_____

_____

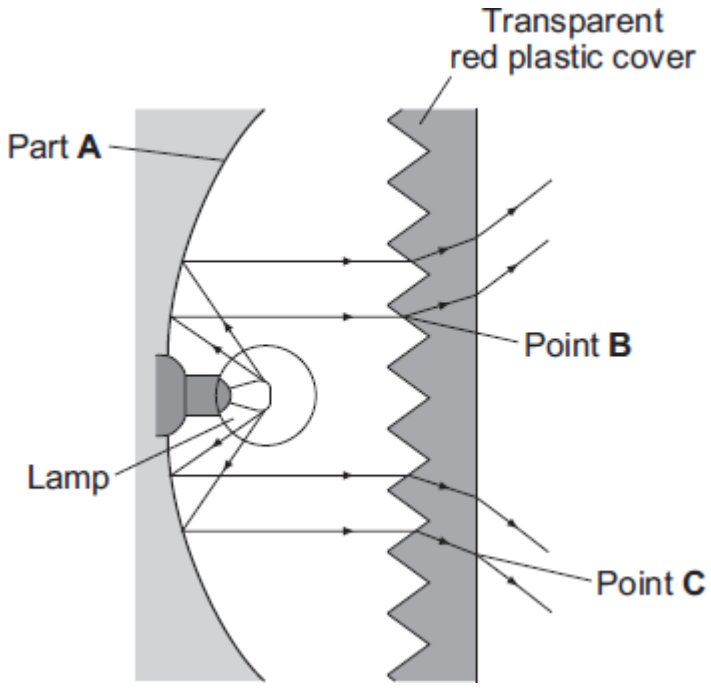
(2)

(Total 8 marks)

Q2.

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)

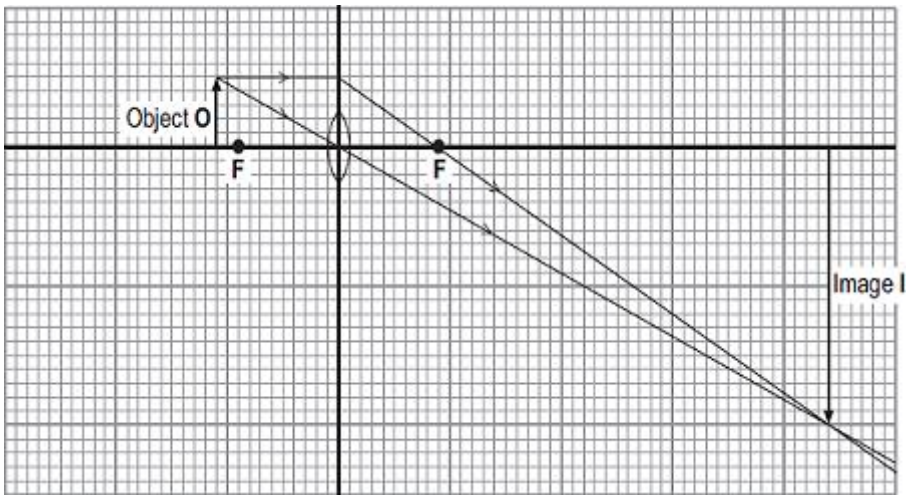
(ii) Name the process which occurs at point **B** and at point **C**.

_____

(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 = _____

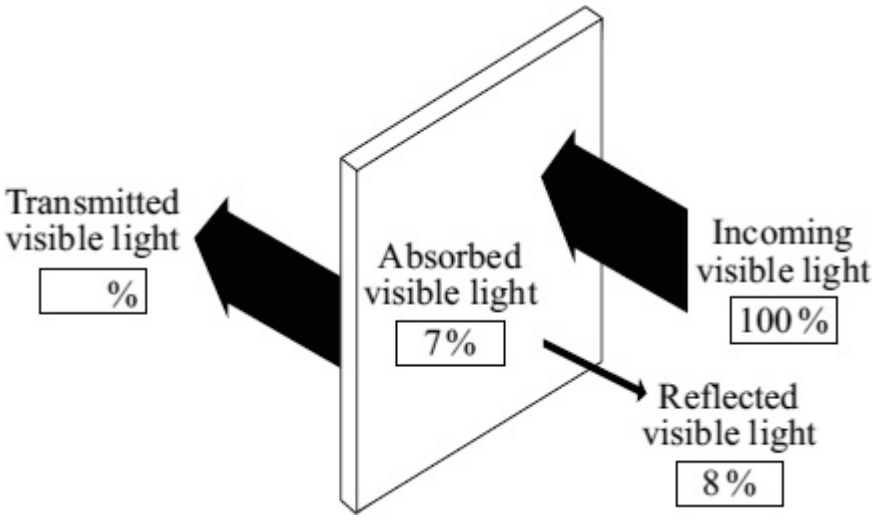
(2)

(Total 5 marks)

Q3.

Glass reflects, absorbs and transmits both infra red radiation and visible light.

(a) /The diagram shows the percentages of visible light that are reflected and absorbed by one type of glass.

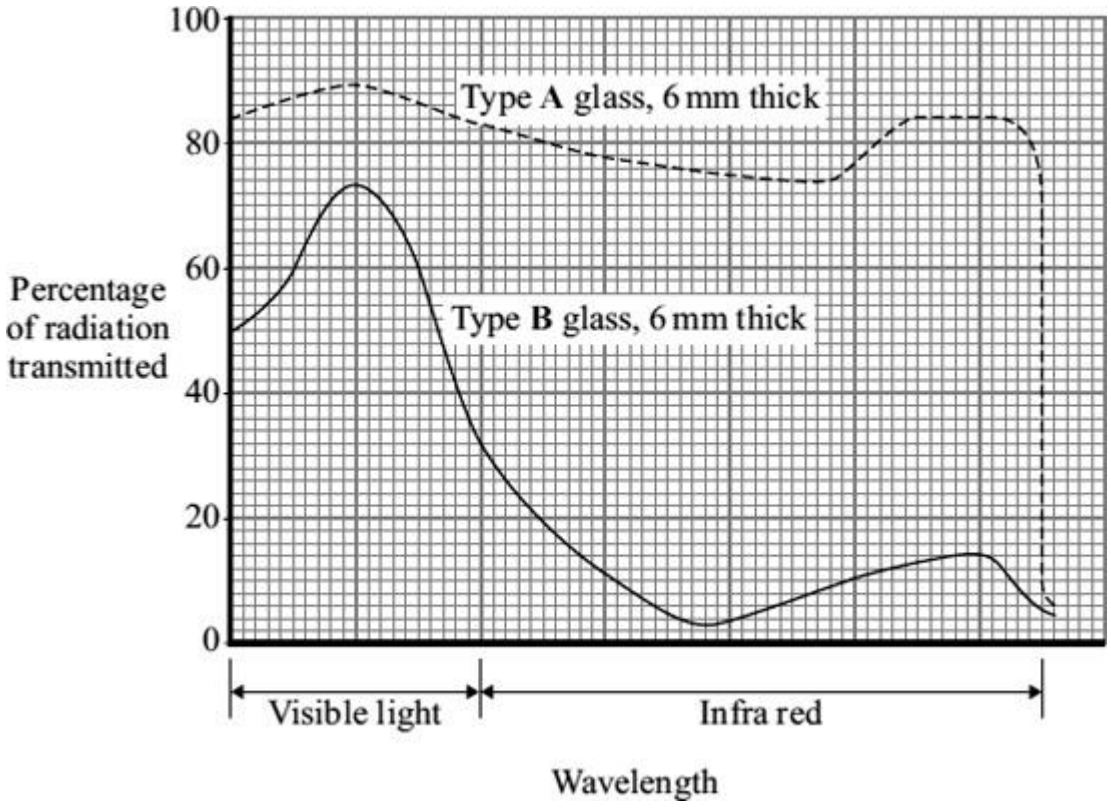


What percentage of visible light is transmitted by this type of glass?

_____ %

(1)

(b) The amounts of infra red radiation and visible light transmitted by glass depend on the type and thickness of glass. The data obtained from tests on two different types of glass is displayed in the graph below.



(i) To be able to compare the two types of glass, it was important to control one variable.

What variable was controlled in the tests?

_____

(1)

(ii) A homeowner has a glass conservatory built on the back of the house. The

homeowner tells the builder that the inside of the conservatory should stay as cool as possible throughout the summer.

Explain why the builder uses 'type **B**' glass for the conservatory.

_____

_____

_____

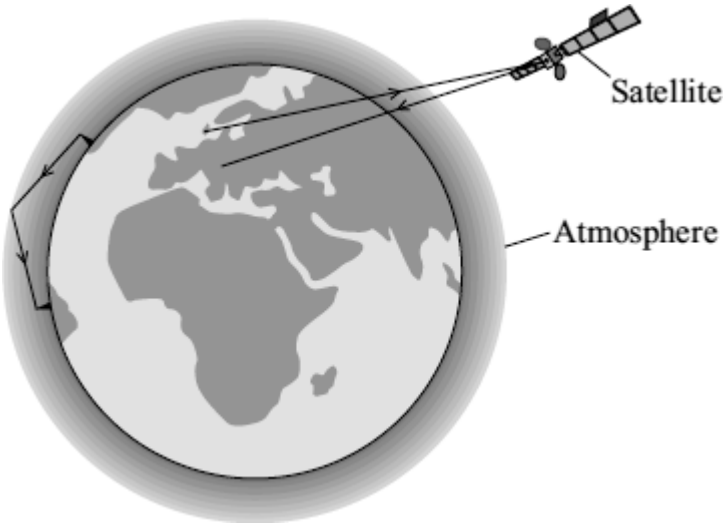
_____

(2)

(Total 4 marks)

Q4.

(a) Electromagnetic waves have many uses. The diagram shows two ways of sending information using electromagnetic waves.



(i) What type of wave is used to send information to and from satellites?

_____

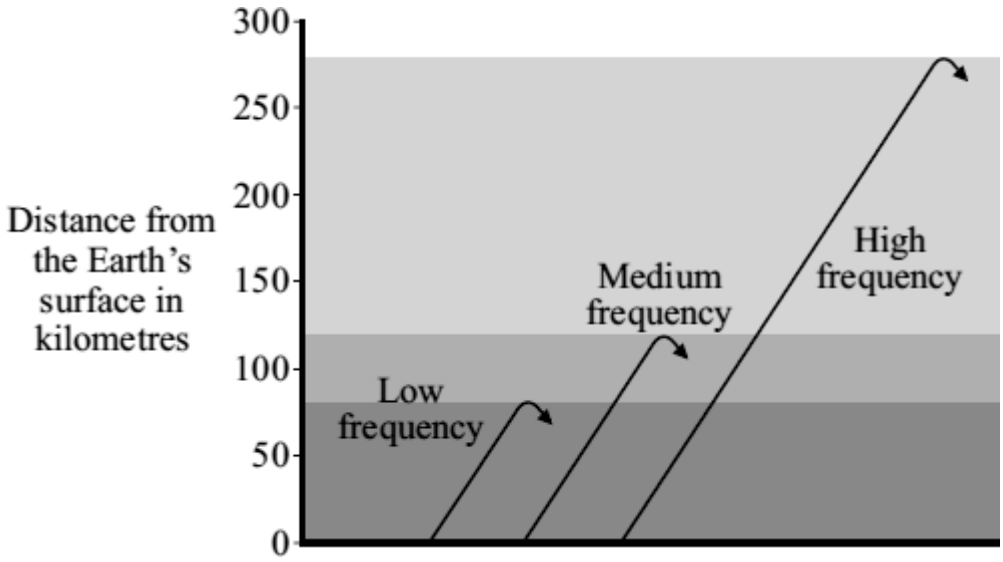
(1)

(ii) What property of this type of wave makes it suitable for satellite communications?

_____

(1)

(b) Different frequency radio waves travel different distances through the atmosphere before being reflected.



Use the information in the diagram to describe the connection between the frequency of a radio wave and the distance the radio wave travels through the atmosphere before it is reflected.

_____

_____

(1)

(c) Electromagnetic waves travel at a speed of 300 000 000 m/s.

A radio station transmits waves with a wavelength of 20 metres.

Calculate the frequency, in kilohertz (kHz), of these waves.

Show clearly how you work out your answer.

_____

_____

_____

_____

Frequency = _____ kHz

(2)

(Total 5 marks)

Q5.

(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.

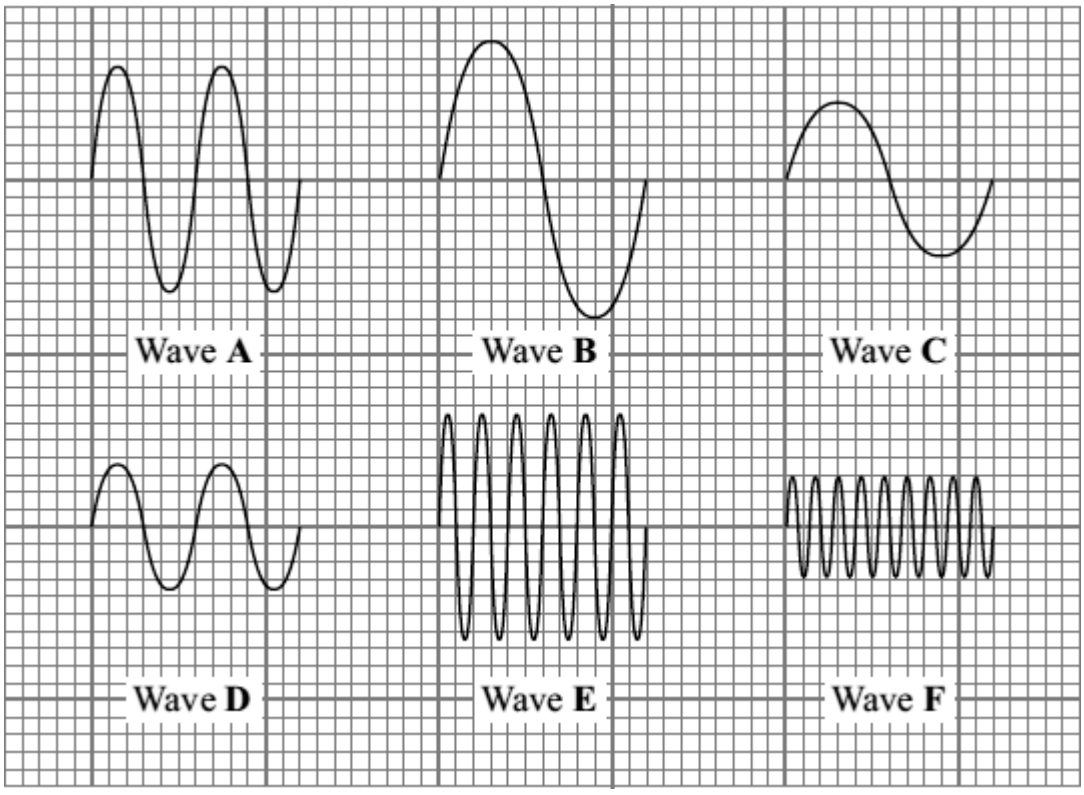
Include the unit in your answer.

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 _____

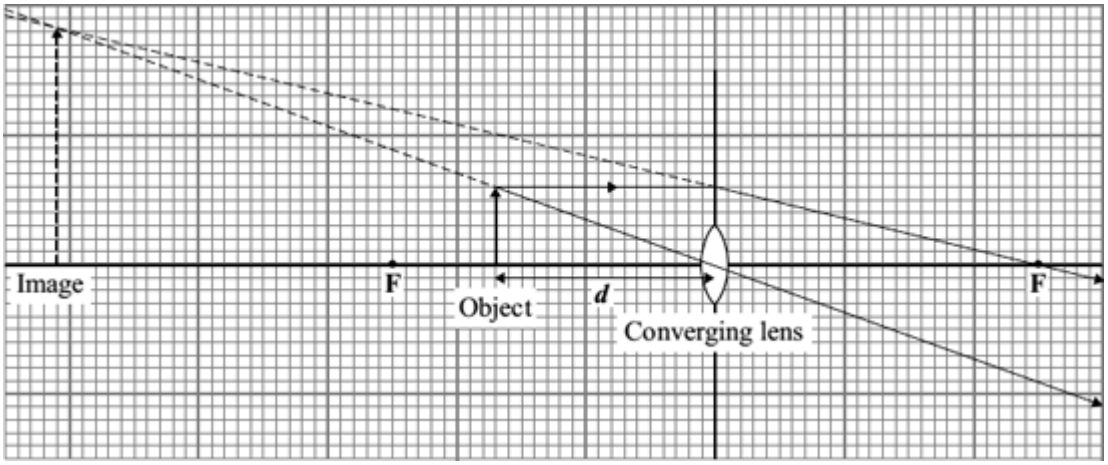
(1)

(Total 5 marks)

Q6.

A student investigates how the magnification of an object changes at different distances from a converging lens.

The diagram shows an object at distance ***d*** from a converging lens.



(a) (i) The height of the object and the height of its image are drawn to scale.

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

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

Show clearly how you work out your answer.

_____

_____

_____

Magnification = _____

(2)

(ii) The points **F** are at equal distances on either side of the centre of the lens.

State the name of these points.

_____

(1)

(iii) Explain how you can tell, **from the diagram**, that the image is virtual.

_____

_____

(1)

(b) The student now uses a different converging lens. He places the object between the lens and point **F** on the left.

The table shows the set of results that he gets for the distance $\boldsymbol{d}$ and for the magnification produced.

Distance d measured in cm	**Magnification**
5	1.2
10	1.5
15	2.0
20	3.0
25	6.0

His friend looks at the table and observes that when the distance doubles from 10 cm to 20 cm, the magnification doubles from 1.5 to 3.0.

His friend's conclusion is that:

The magnification is directly proportional to the distance of the object from the lens.

His friend's observation is correct but his friend's conclusion is **not** correct.

(i) Explain, with an example, why his friend's conclusion is **not** correct.

_____

_____

_____

_____

(2)

(ii) Write a correct conclusion.

_____

_____

(1)

(iii) The maximum range of measurements for $\boldsymbol{d}$ is from the centre of the lens to **F** on the left.

The student **cannot** make a correct conclusion outside this range.

Explain why.

_____

_____

(1)

(Total 8 marks)

Q7.

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)

Q8.

(a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

(i) Give **two** properties that are common to both visible light and microwaves.

1. _____

_____

2. _____

_____

(2)

(ii) Name **two** more types of electromagnetic wave that can be used for communications.

_____ and _____

(1)

(b) Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12.5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.

Calculate the frequency of the microwaves used to link the computer to the router.

Show clearly how you work out your answer and give the unit.

_____

_____

_____

Frequency = _____

(3)

(c) Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.

A politician commented on the increasing use of WiFi. He said: 'I believe that these systems may be harmful to children.'

However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

(i) Suggest what the politician could have done to persuade people that what he said was not just an opinion.

_____

_____

(1)

(ii) Why did the group of scientists suggest that there is a need for further research?

_____

_____

(1)

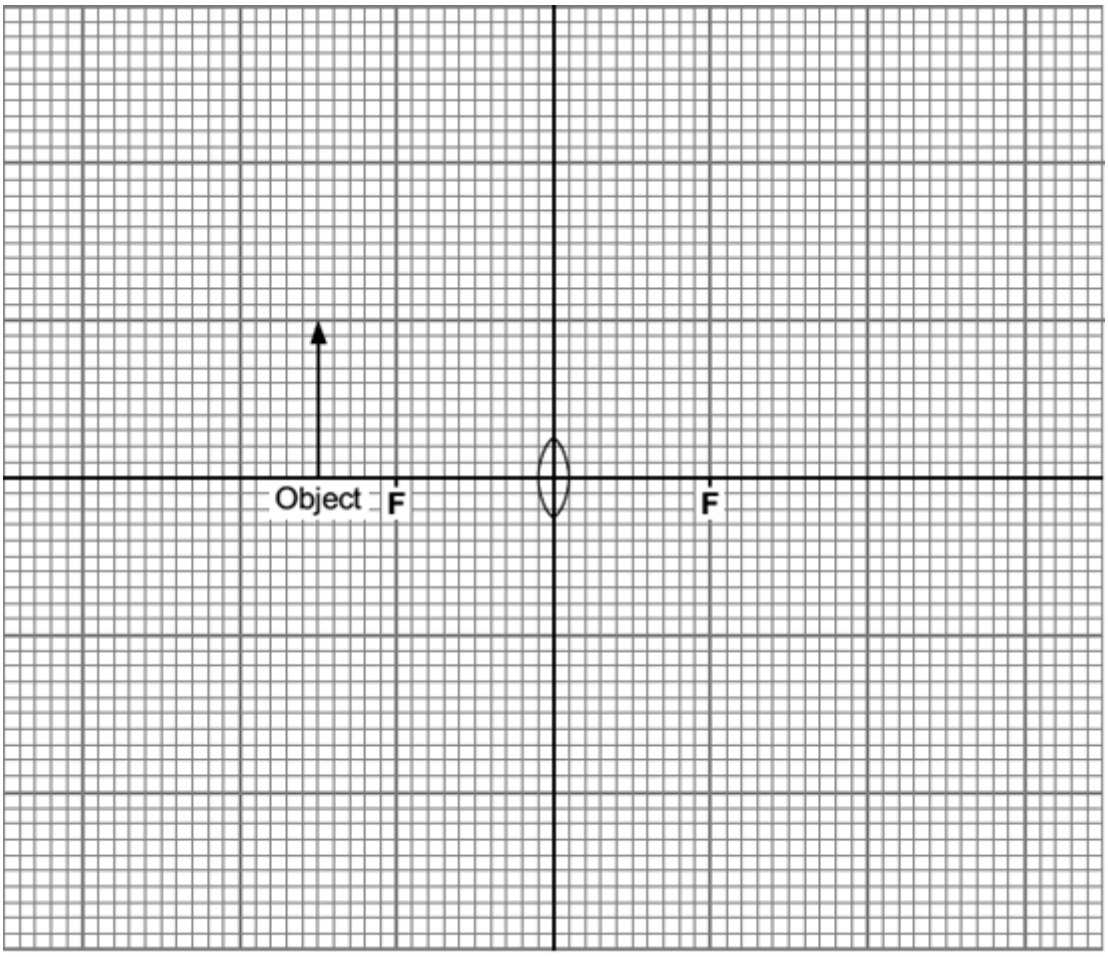
(Total 8 marks)

Q9.

A student investigated how the nature of the image depends on the position of the object in front of a large converging lens.

The diagram shows one position for the object.

(a) Use a ruler to complete a ray diagram to show how the image of the object is formed.



Key: **F** = principal focus

(4)

(b) Describe the nature of this image relative to the object.

_____

_____

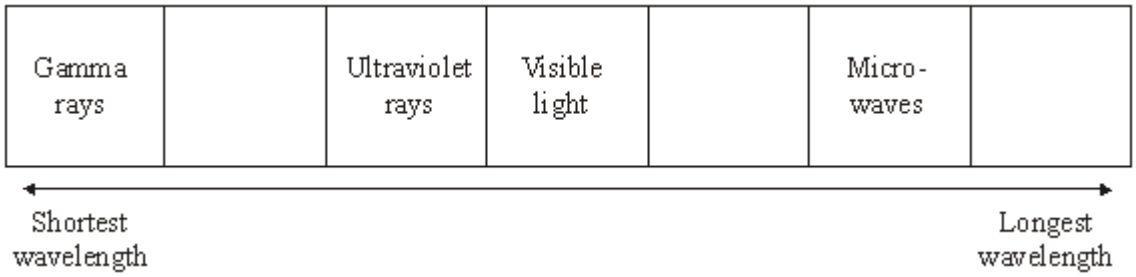
_____

(2)

(Total 6 marks)

Q10.

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.

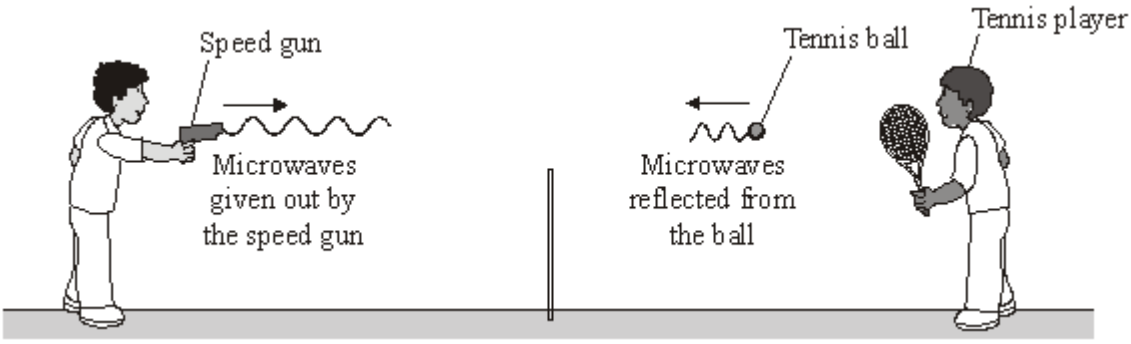
All electromagnetic waves move | energy / gases / particles | from one place to another.

(1)

(Total 4 marks)

Q11.

(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)

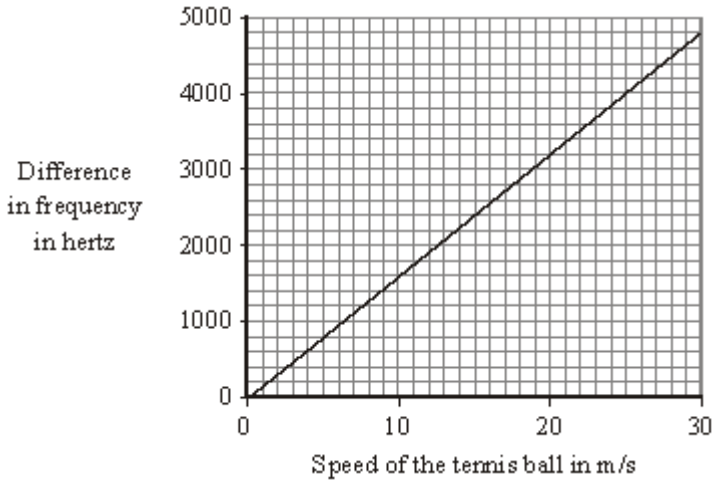
(ii) Complete the following sentence by drawing a ring around the correct line in the box.

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)

Q12.

(a) Microwaves are one type of electromagnetic wave.

(i) Which type of electromagnetic wave has a lower frequency than microwaves?

_____

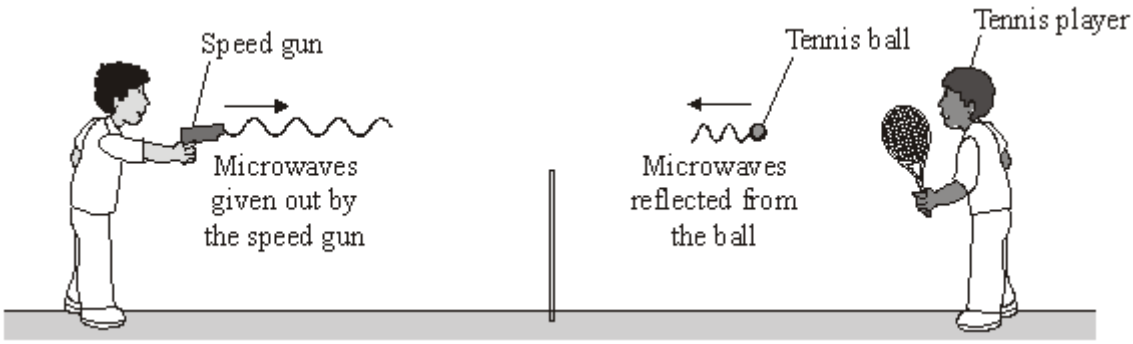
(1)

(ii) What do all types of electromagnetic wave transfer from one place to another?

_____

(1)

(b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



(i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Calculate the wavelength of the microwaves emitted from the speed gun.

Show clearly how you work out your answer.

_____

_____

Wavelength = _____ m

(2)

(ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

_____

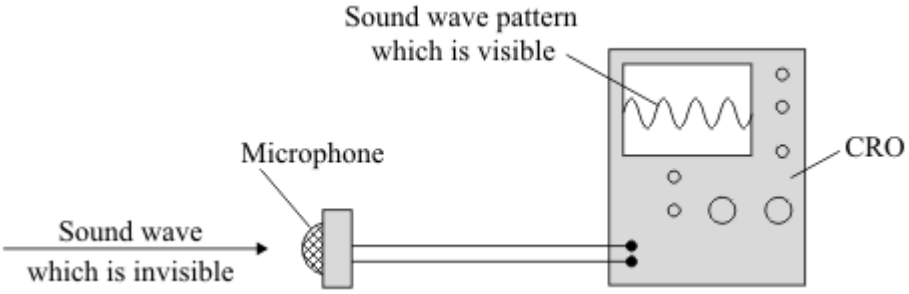
_____

(1)

(Total 5 marks)

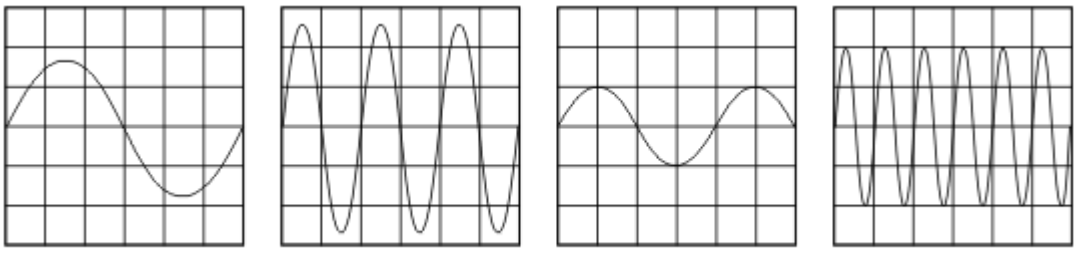
Q13.

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.



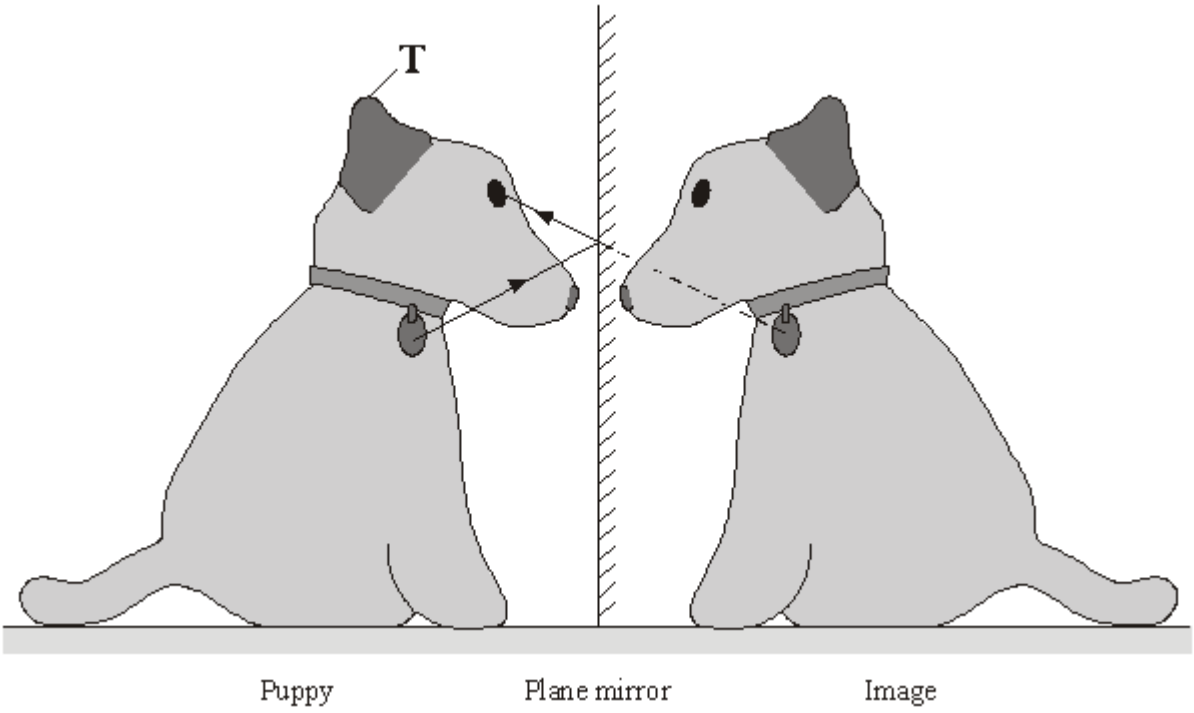
(a) Which **one** of the patterns has the smallest amplitude? _____

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

(Total 2 marks)

Q14.

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)

Q15.

(a) Some scientists think that there is a link between using a mobile phone and some types of illness. Other scientists disagree. They say that the evidence is limited and unreliable.

(i) Suggest what scientists could do to show a link between using a mobile phone and illness.

_____

_____

(1)

(ii) How could scientists improve the reliability of the evidence?

_____

_____

(1)

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

There has been little or no experimental research into the health of children who use mobile phones.

This is partly because of the

economic
environmental
ethical

issues involved in using children in scientific research.

(1)

(b) Before being sold, new mobile phones must be tested and given a SAR value. The SAR value is a measure of the energy absorbed by the head while a mobile phone is being used.

The table gives the SAR value for three mobile phones made by different companies.
To be sold in the UK, a mobile phone must have a SAR value lower than 2.0 W/kg.

Mobile phone	SAR value in W/kg
J	0.18
K	0.86
L	1.40

(i) All companies use the same test to measure a SAR value.

Why is using the same test important?

_____

_____

(1)

(ii) Would the companies that make the mobile phones, **J**, **K** and **L**, be correct to claim that these three phones are totally safe to use?

Answer yes or no. _____

Give a reason for your answer.

_____

_____

(1)

(c) Devices designed to protect a mobile phone user from microwave radiation are now available.

Why is it important that these devices are tested by scientists who are **not** working for the company that makes the devices?

_____

_____

(1)

(Total 6 marks)

Q16.

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.

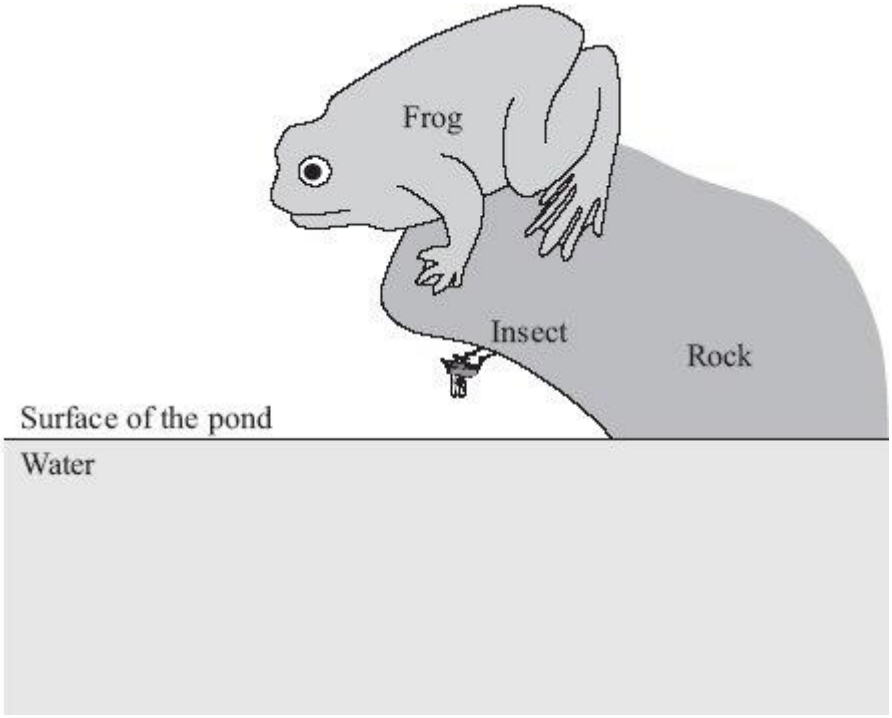
bigger	**inverted**	**real**	**smaller**	**upright**	**virtual**

(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.

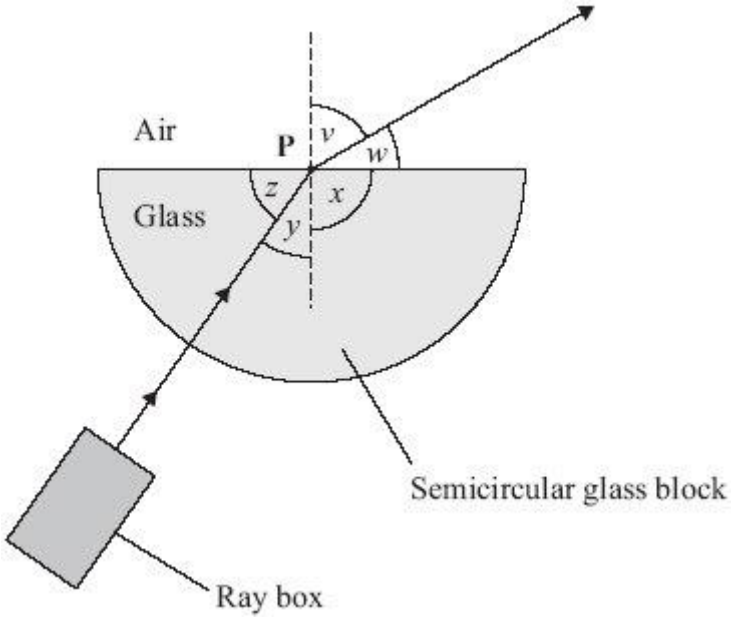


(3)

(Total 6 marks)

Q17.

A student uses a ray box and a semicircular glass block to investigate refraction.



(a) What is the vertical dashed line called?

_____

(1)

(b) Which angle, *v*, *w*, *x*, *y* or *z*, is the angle of refraction?

_____

(1)

(c) Why has refraction taken place?

_____

_____

(1)

(d) In an investigation, a student always aims the light from the ray box at point **P**.
She moves the ray box to give different values of angle *v*.
She records angle *y* for each of these values. The table shows her results.

Angle *v* measured in degrees	**Angle *y* measured in degrees**
30	19
40	25
50	31
60	35
70	39
80	41

The student studies the data and comes to the following conclusion.

Angle *y* is directly proportional to angle *v*.

Her friend says that this conclusion is **not** correct.

(i) Use data from the table to explain why the conclusion is **not** correct.

_____

_____

(2)

(ii) Write a correct conclusion for the experiment.

_____

_____

(1)

(iii) Why is your conclusion only valid when angle *v* is between 30° and 80°?

_____

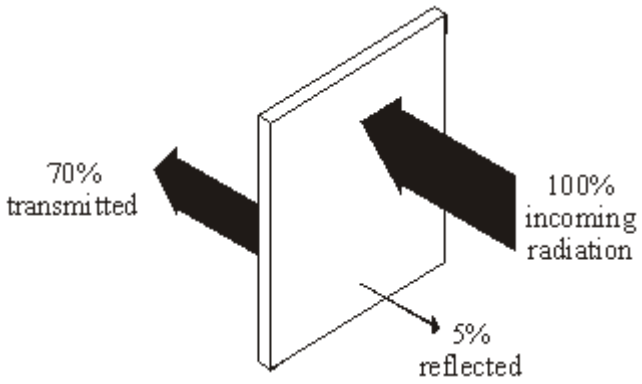
_____

(1)

(Total 7 marks)

Q18.

(a) Infra red radiation can be reflected, absorbed and transmitted by glass.



(i) What percentage of infra red is absorbed by the glass?

_____

(1)

(ii) Complete the following sentence by drawing a ring around the correct word or phrase.

Theabsorbed infra red	increases does not change decreases	the temperature of the glass.

(1)

(b) **Two** of the following statements are true. **One** of the statements is false.

Tick (✓) the boxes next to the **two** true statements.

All objectsabsorb infra red radiation.	
Blacksurfaces are poor emitters of infra red radiation.	
A hot objectemits more infra red than a cooler object.	

(1)

(c) The following statement is false.

Blacksurfaces are good reflectors of infra red radiation.

Change **one** word in this statement to make it true.

Write down your **new** statement.

_____

_____

(1)

(Total 4 marks)

Q19.

(a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B** or **C**, is an infra red wave? _____

(1)

(b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Calculate the wavelength of the waves broadcast by this station.

Show clearly how you work out your answer.

_____

_____

Wavelength = _____ m

(2)

(c) What happens when a metal aerial absorbs radio waves?

_____

_____

_____

_____

(2)

(d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth not be able to detect X-rays emitted from distant stars?

_____

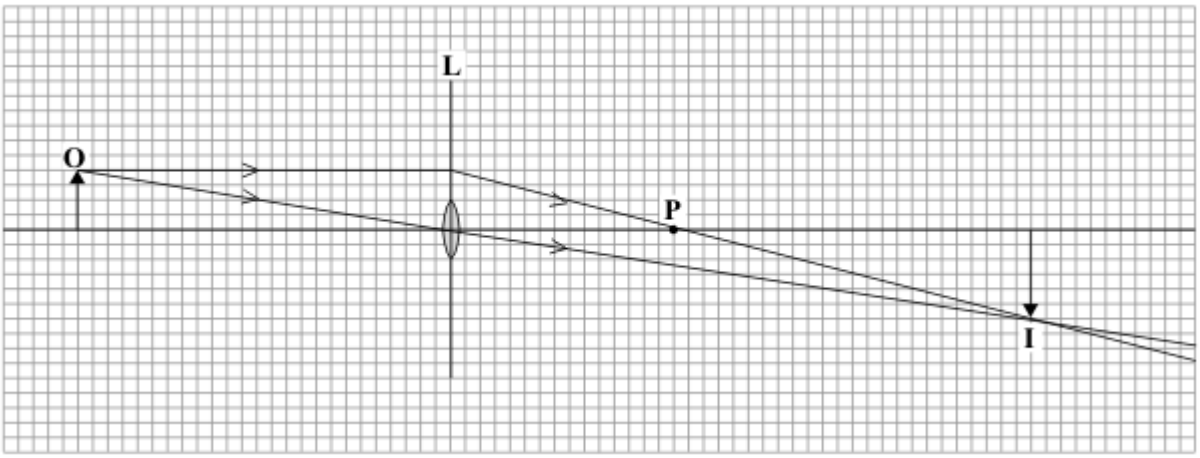
_____

(1)

(Total 6 marks)

Q20.

The ray diagram shows the position and size of the image, **I**, of an object, **O**, formed by a lens, **L**.



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

_____

(1)

(b) Name the point labelled **P**.

_____

(1)

(c) The ray diagram has been drawn to scale.

Use the equation to calculate the magnification.

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

Show clearly how you work out your answer.

_____

_____

Magnification = _____

(2)

(d) How can you tell from this ray diagram that the image is a real image?

_____

_____

(1)

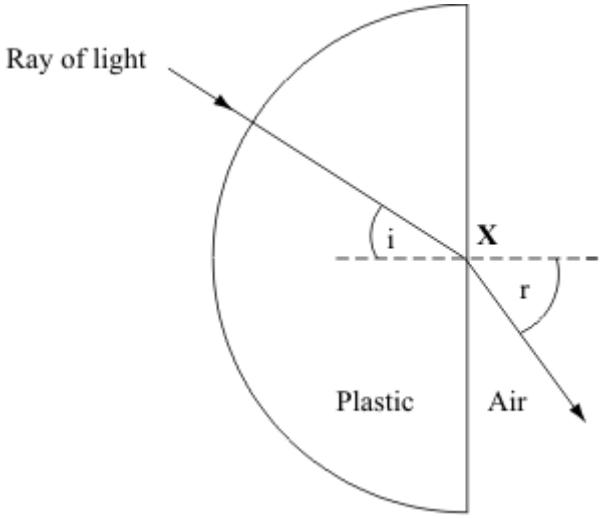
(Total 5 marks)

Q21.

(a) A student investigated the refraction of light as it passes out of a transparent plastic block.

She aimed a ray of light at point **X**. She marked the position of the ray as it passed through the transparent plastic block and into the air.

The angle *i* is the angle of incidence.



(i) What is the name of angle **r**?

_____

(1)

(ii) What is the name of the dashed line?

_____

(1)

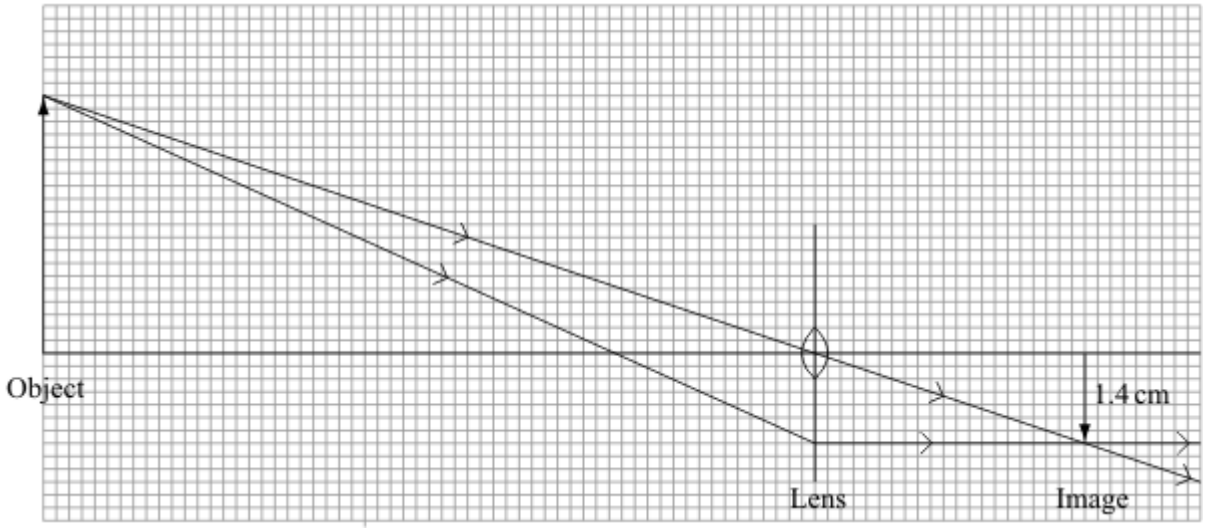
(b) A camera uses a lens to produce an image which falls on a light detector.

Name a light detecting device which may be used in a camera.

_____

(1)

(c) The diagram shows the position of an image formed in a camera.



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

_____

(1)

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

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

Show clearly how you work out your answer.

_____

_____

Magnification = _____

(2)

(d) Why does the image formed in a camera have to be a real image?

_____

_____

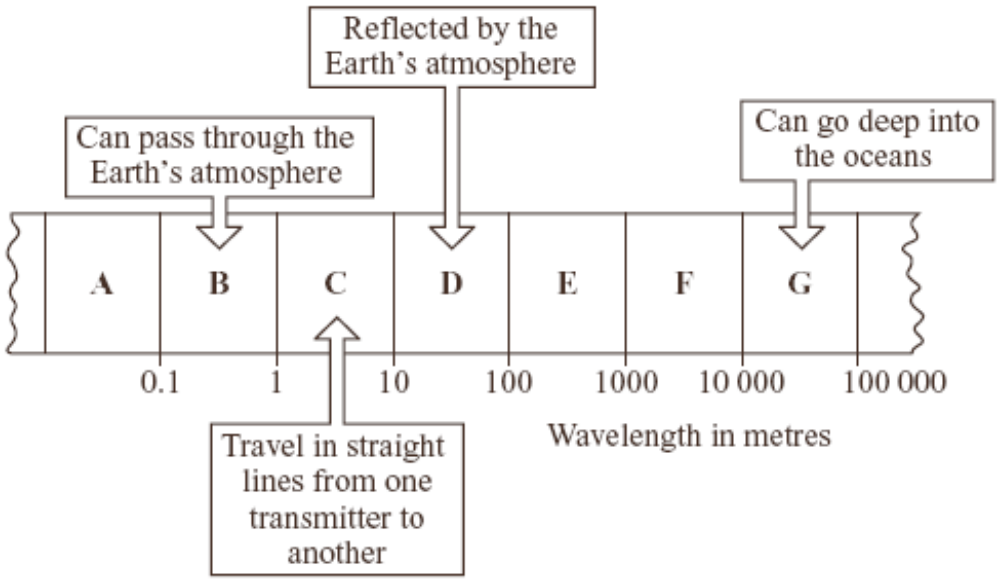
(1)

(Total 7 marks)

Q22.

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)

Q23.

(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?

_____

_____

_____

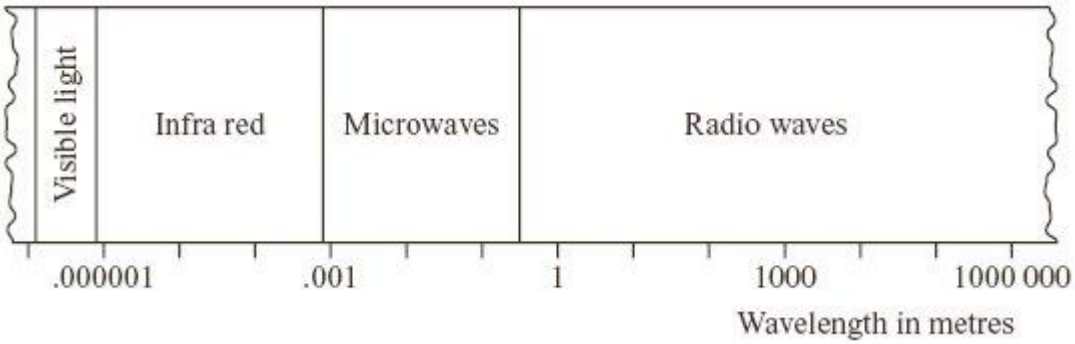
_____

(2)

(Total 6 marks)

Q24.

The diagram represents part of the electromagnetic spectrum.



(i) Visible light travels through air at 300 000 000 m/s.

Why can we assume that radio waves travel through air at the same speed as light?

_____

(1)

(ii) A radio station broadcasts at a frequency of 200 kHz.

Calculate the wavelength of the waves broadcast by this radio station. Show clearly how you work out your answer.

_____

_____

Wavelength = _____ m

(2)

(iii) Draw a vertical line on the diagram above to show the position of this radio wave in the electromagnetic spectrum.

(1)

(Total 4 marks)

Q25.

(a) Satellites fitted with various telescopes orbit the Earth. These telescopes detect different types of electromagnetic radiation.

Why are telescopes that detect different types of electromagnetic waves used to observe the Universe?

_____

_____

(1)

(b) In 2005 a space telescope detected a star that exploded 13 billion years ago. The light from the star shows the biggest *red-shift* ever measured.

(i) What is *red-shift*?

_____

_____

(1)

(ii) What does the measurement of its red-shift tell scientists about this star?

_____

_____

(1)

(c) Red-shift provides evidence for the ‘big bang’ theory.

(i) Describe the ‘big bang’ theory.

_____

_____

_____

_____

(2)

(ii) Suggest what scientists should do if new evidence were found that did not support the ‘big bang’ theory.

_____

_____

_____

(1)

(Total 6 marks)

Q26.

(a) The new Tetra communications system to be used by the police transmits signals using microwaves of wavelength 75 cm.

Calculate the frequency of the microwaves used by the Tetra system. Show clearly how you work out your answer.

_____

_____

Frequency = _____ hertz

(2)

(b) Read the following extract from a newspaper and then answer the questions that follow.

> Residents ofStag Hill Court, a luxuryblock of flats, are shocked at the plans to site a mobile phone mast on theroof of the flats. They oppose the mast on health grounds, quoting researchin Germany that has found apossible increase in cases of cancer around mobile phone masts.
>
> Aspokesperson for the telecoms company said, ‘The residents should not worry.The research carried out by our own scientists has found no link between illhealth and mobile phone masts’.
>
> This has notreassured the residents, who argue that new independent research is urgentlyneeded.

(i) Explain why living near a mobile phone mast could cause ill health.

_____

_____

_____

_____

_____

_____

(3)

(ii) Suggest **two** reasons why the residents have **not** been reassured by the research carried out by the telecoms company.

1. _____

_____

2. _____

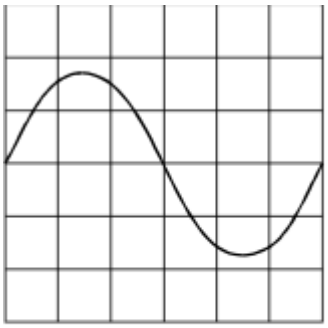
_____

(2)

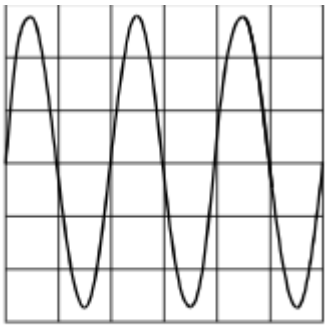
(Total 7 marks)

Q27.

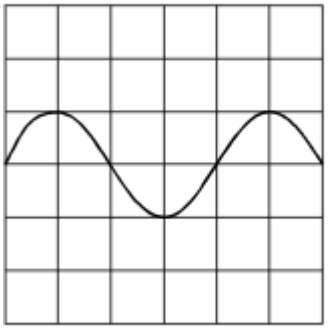
The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



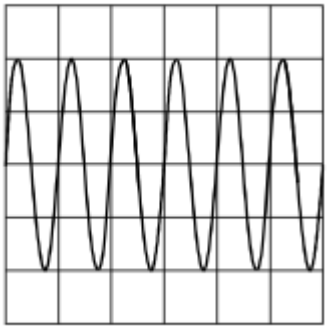
A



B



C



D

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

(i) the largest amplitude, _____

(1)

(ii) the lowest frequency? _____

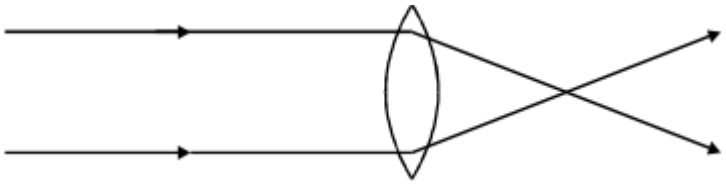
(1)

(Total 2 marks)

Q28.

(a) The diagram shows how parallel rays of light pass through a convex lens.

(i) Mark the position of the focus.



(1)

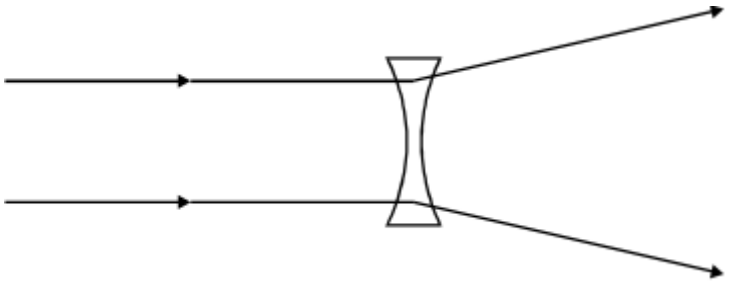
(ii) Is this a **converging** lens, a **diverging** lens, **both** or **neither**?

_____

(1)

(b) The diagram shows how parallel rays of light pass through a concave lens.

(i) Mark the position of the focus.



(1)

(ii) Is this a **converging** lens, a **diverging** lens, **both** or **neither**?

_____

(1)

(c) Complete these sentences by crossing out the **two** lines in each box that are wrong.

In a camera, a

converging
diverging
parallel

lens is used to produce an image of an object on a

film
lens
screen

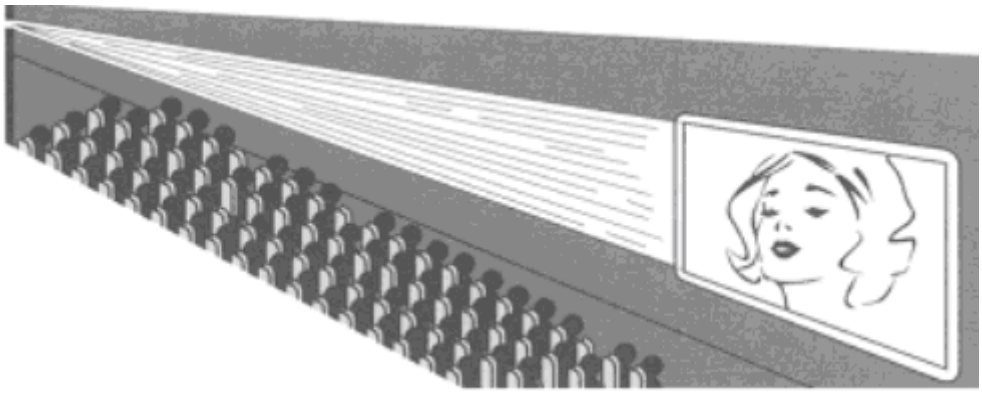
.

The image is [larger than / smaller than / the same size as] the object.

The image is [further from / nearer to / the same disrtance from] the lens, compared to the distance of the object from the lens.

(4)

(d) In a cinema projector, a convex lens is used to produce a *magnified*, *real* image.



(i) What does *magnified* mean?

_____

_____

(1)

(ii) What is a *real* image?

_____

_____

(1)

(e) You are in a dark room. You have a box containing some lenses. Only **one** of them is a converging lens.

Describe how, by just feeling the lenses, you can pick out the converging lens.

_____

_____

_____

_____

(2)

(Total 12 marks)

Q29.

The drawing shows someone ironing a shirt. The top of the ironing board is covered in a shiny silver-coloured material.

Explain why the shiny silver-coloured material helps to make ironing easier.

_____

_____

_____

_____

(Total 2 marks)

Q30.

(a) The diagram shows a lens used as a magnifying glass. The position of the eye is shown and the size and position of an object standing at point **O**.

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

_____

(1)

(ii) Two points are marked as **F**. What are these points?

_____

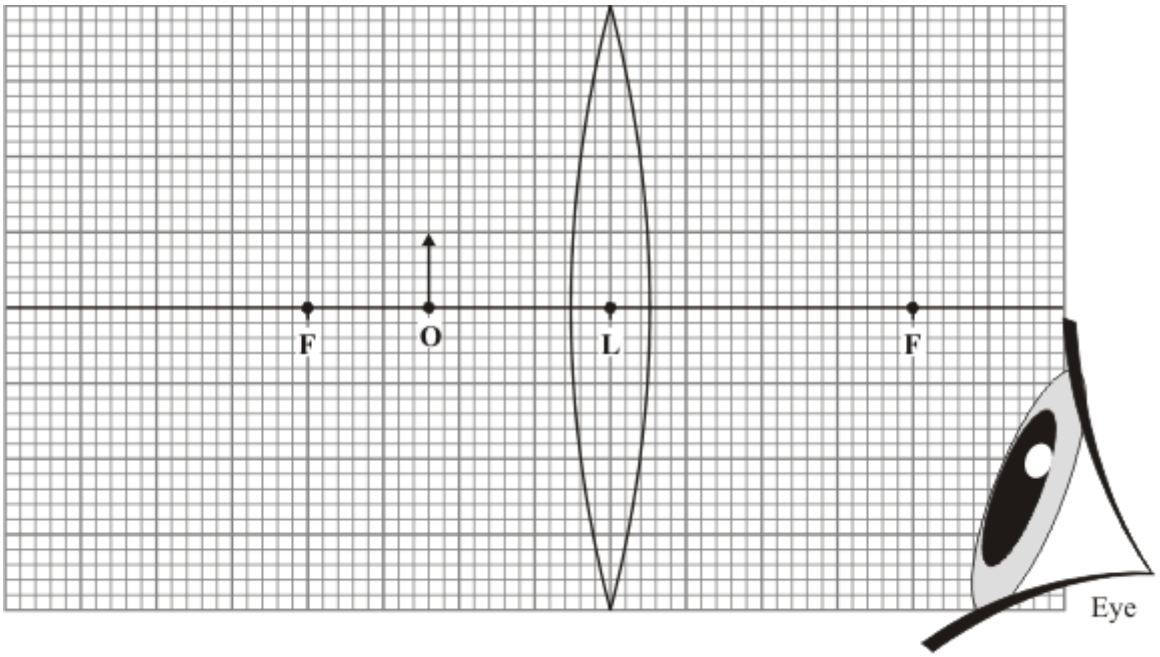
(1)

(iii) What is the name of the straight line which goes through the point **F**, through the point **L** at the centre of the lens, and through the point **F** on the other side?

_____

(1)

(iv) On the diagram, use a ruler to construct accurately the position of the image. You should show how you construct your ray diagram and how light appears to come from this image to enter the eye.



(5)

(v) The image is *virtual*. What is a *virtual* image?

_____

_____

(1)

(b) The lens shown in the diagram in part (a)(iv) can be used in a camera to produce a *real* image.

Explain why a *real* image must be produced in a camera and how the object and the lens are positioned to produce a *real* image which is **smaller** than the object.

Do **not** draw a ray diagram as part of your answer.

_____

_____

_____

_____

_____

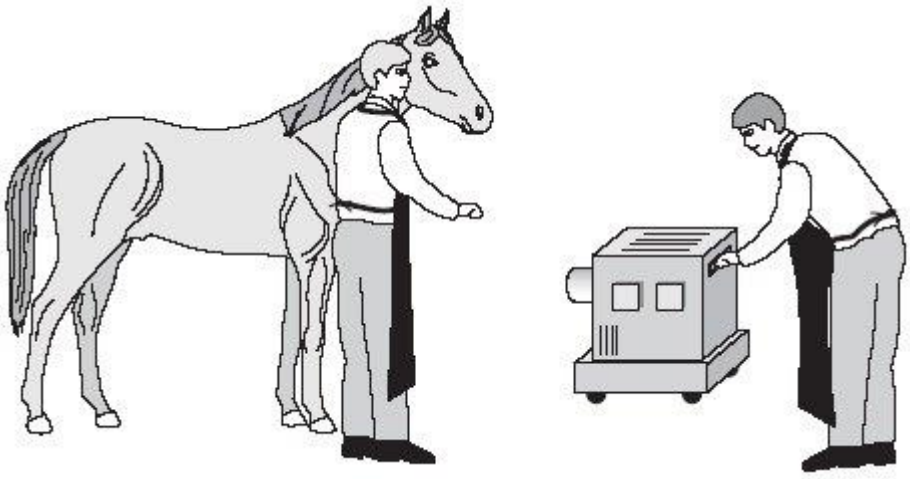
_____

(3)

(Total 12 marks)

Q31.

The picture shows a horse being prepared for an X-ray.



The person who will take the X-ray and the person holding the horse are wearing special aprons. These aprons have a lead lining.

Explain why the lead lining is important.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

_____

_____

_____

_____

_____

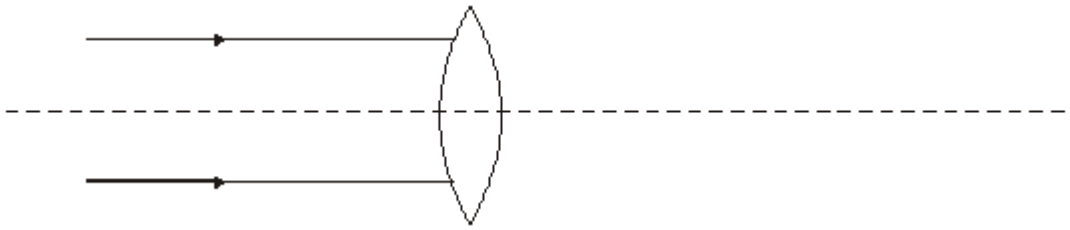
_____

(Total 3 marks)

Q32.

(a) The diagram shows two parallel rays of light, a lens and its axis.

(i) Complete the diagram to show what happens to the rays.



(2)

(ii) Name the point where the rays come together.

_____

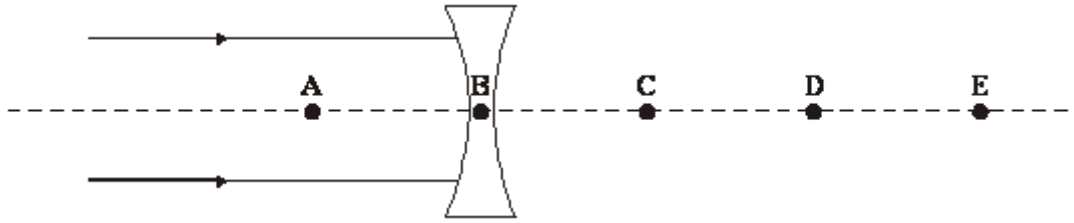
(1)

(iii) What word can be used to describe this type of lens?

_____

(1)

(b) The diagram shows two parallel rays of light, a lens and its axis.



(i) Which point **A**, **B**, **C**, **D** or **E** shows the focal point for this diagram?

Point _____

(1)

(ii) Explain your answer to part (b)(i).

_____

_____

(1)

(iii) What word can be used to describe this type of lens?

_____

(1)

(c) Complete the following **three** sentences by crossing out the **two** lines in each box which are wrong

In a camera a converging lens is used to produce an image on a

film
lens
screen

The image is

larger than
smaller than
the same size as

the object.

Compared to the distance of the image from the lens, the object is

further away from
nearer to
the same distance from

the lens.

(3)

(d) Explain the difference between a *real* image and a *virtual* image.

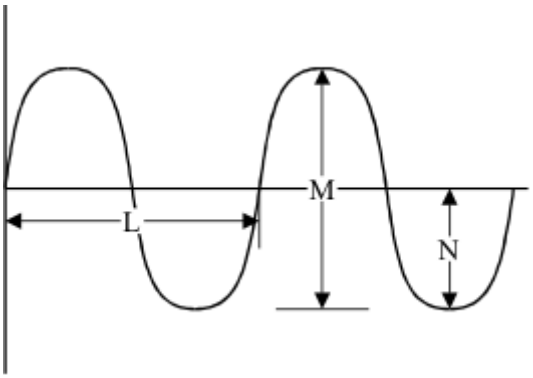
_____

(3)

(Total 13 marks)

Q33.

(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)

Q34.

All radio waves travel at 300 000 000 m/s in air.

(i) Give the equation that links the frequency, speed and wavelength of a wave.

_____

(1)

(ii) Calculate the wavelength, in metres, of a radio wave which is broadcast at a frequency of 909 kHz. Show clearly how you work out your answer.

_____

_____

_____

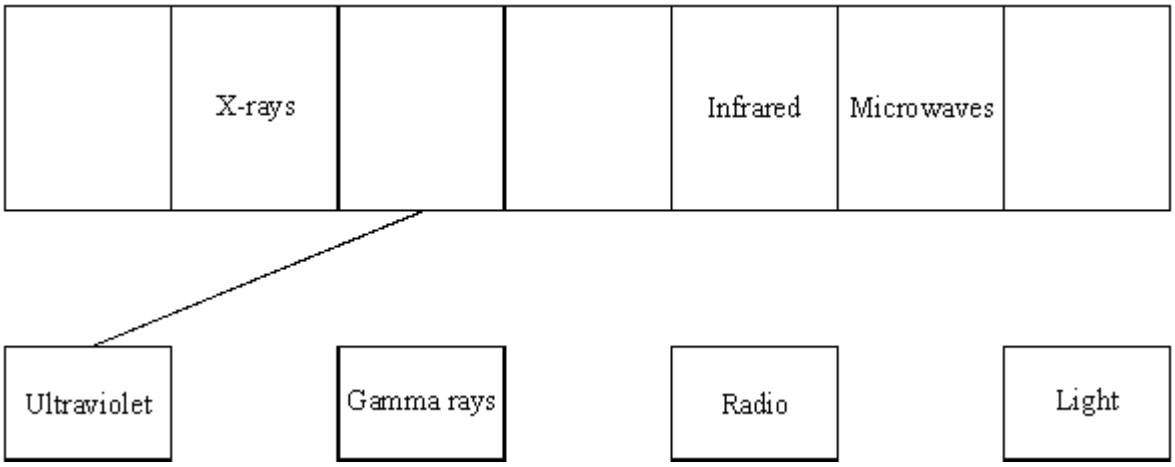
Wavelength = _____ metres

(2)

(Total 3 marks)

Q35.

(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.

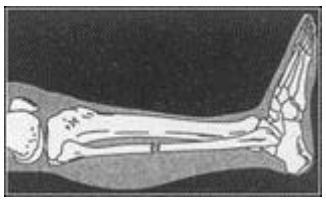
The speed of radio waves through a vacuum is

faster than
the same as
slower than

the speed of light through a vacuum.

(1)

(c) 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)

Q36.

(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?

_____

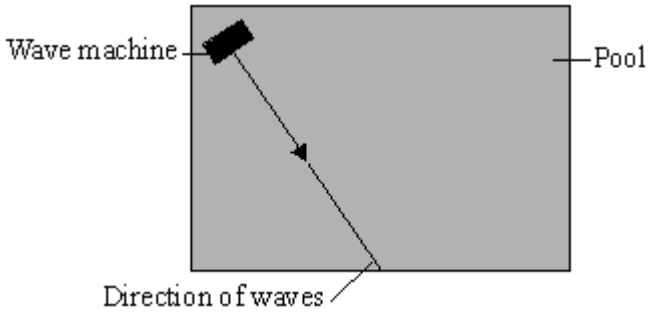
(1)

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

hertz joule watt

(1)

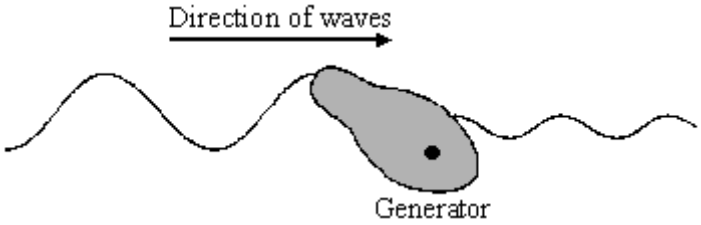
(b) The diagram shows the direction of the waves across the pool. The waves reflect off the side of the pool.



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)

Q37.

Microwaves are used to transmit signals to the satellite. The microwaves have a wavelength of 0.6 metres (m) and travel through space at a speed of 300 000 000 metres per second (m/s).

(i) Write down the equation which links frequency, wavelength and wave speed.

_____

(1)

(ii) Calculate the frequency of the microwaves. Show clearly how you work out your answer and give the unit.

_____

_____

_____

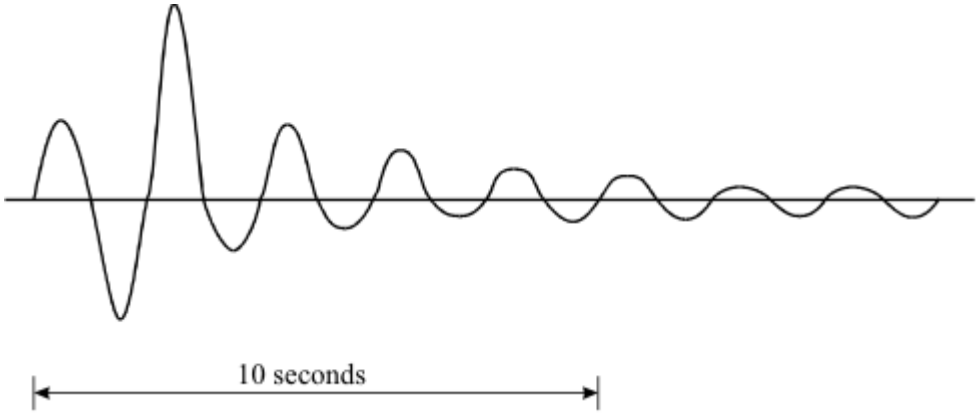
Frequency = _____

(3)

(Total 4 marks)

Q38.

The vibration caused by a P wave travelling at 7.6 km/s has been recorded on a seismic chart.



(i) How many waves are produced in one second?

_____

(1)

(ii) Write down the equation which links frequency, wavelength and wave speed.

_____

(1)

(iii) Calculate the wavelength of the P wave. Show clearly how you work out your answer and give the unit.

_____

_____

_____

Wavelength = _____

(2)

(Total 4 marks)

Q39.

After a person is injured a doctor will sometimes ask for a photograph to be taken of the patient's bone structure, e.g. in the case of a suspected broken arm.

(i) Which type of electromagnetic radiation would be used to take the photograph?

_____

(1)

(ii) Describe the properties of this radiation which enable it to be used to photograph bone structure.

_____

_____

_____

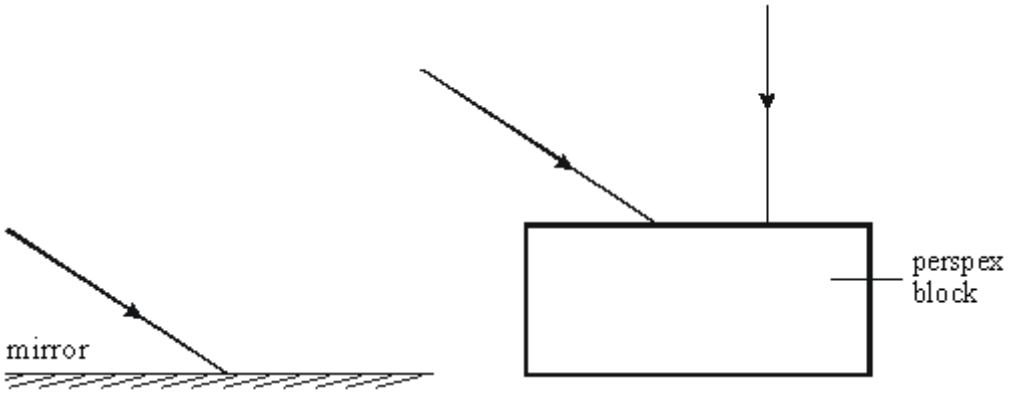
_____

(2)

(Total 3 marks)

Q40.

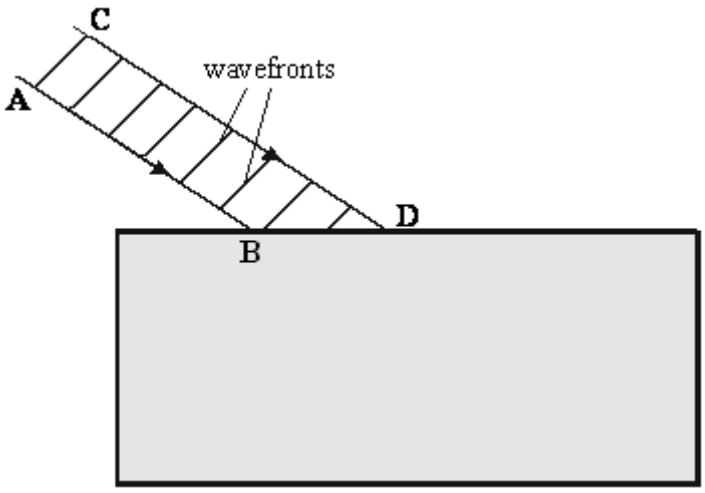
(a) The diagrams below show rays of light striking a mirror and a perspex block.



Complete the paths of the three rays of light on the diagrams to show the rays leaving the mirror and the perspex block.

(4)

(b) The diagram below shows a beam of light striking a perspex block.



(i) Continue the paths of the rays AB and CD inside the perspex block.

(ii) Draw the wavefronts of the beam of light in the perspex.

(iii) Explain why the beam behaves in the way you have shown.

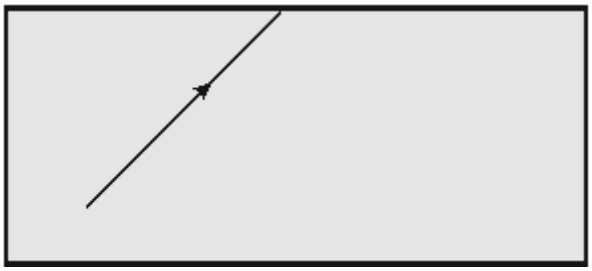
_____

_____

_____

(7)

(c) The diagram below shows a ray of light striking a perspex-air surface from inside the perspex. The critical angle is 45º.



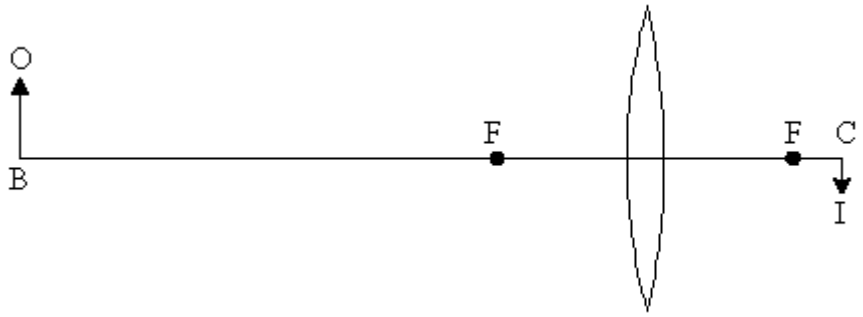
Draw the path of the ray after it reaches the perspex-air boundary.

(2)

(Total 13 marks)

Q41.

The diagram shows the image IC formed by a lens, of an object OB a long way from it. The points F mark the focal points of the lens.



(a) Describe, either by writing below or drawing on the diagram, how the size and position of the image changes:

(i) when the object OB is moved towards the focal point F.

_____

_____

(ii) when the object OB is moved past F to a point nearer the lens than the focal point.

_____

_____

(4)

(b) Explain how a converging lens in a camera is used to produce sharp images on the film when the object is a long distance away from the camera, and when it is close to the camera.

_____

_____

_____

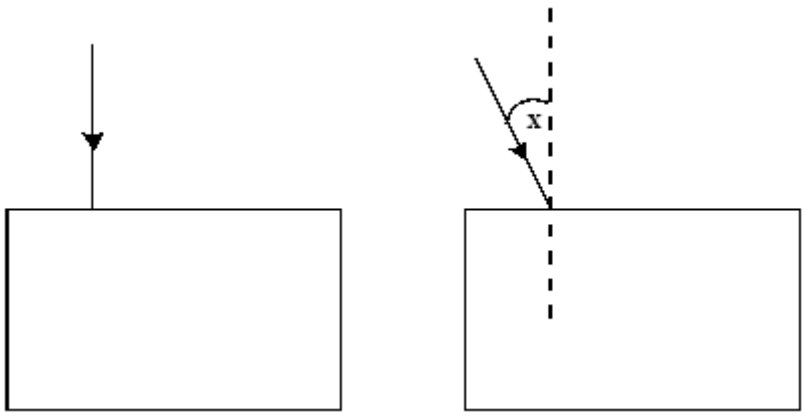
_____

_____

(3)
(Total 7 marks)

Q42.

(a) The diagrams show rays of light. Each ray strikes a surface of a glass block.

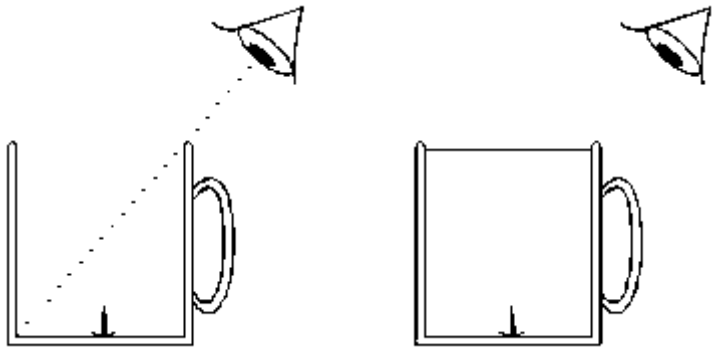


(i) On the diagram draw the path of each ray through the glass block and out into the air again.

(ii) Label another angle on the diagram which is equal to the angle marked **X**. Label this angle **Y**.

(4)

(b) The diagrams show two beakers. Both beakers have a drawing pin inside as shown.



The first beaker is empty. The eye cannot see the drawing pin.
The second beaker is full of water and the eye can see the drawing pin.

Explain how the eye is able to see the drawing pin in the second beaker. You may add to the diagram if it helps your answer.

_____

_____

_____

(3)
(Total 7 marks)

Q43.

Lenses are used in many optical devices.

Complete the table below about the images formed by some optical devices.

OPTICAL DEVICE	NATURE OF IMAGE	SIZE OF IMAGE	POSITION OF IMAGE
Eye	real		
Projector		Magnified	
camera			Closer to lens than the object

(Total 6 marks)

Q44.

Radio waves, ultra-violet, visible light and X-rays are all types of electromagnetic radiation.

(a) Choose wavelengths from the list below to complete the table.

3×10^{-8} m 1×10^{-11} m 5×10^{-7} m 1500 m

TYPE OF RADIATION	WAVELENGTH (m)
Radio waves	
Ultra-violet	
Visible light	
X-rays	

(4)

(b) Microwaves are another type of electromagnetic radiation.

Calculate the frequency of microwaves of wavelength 3 cm.
(The velocity of electromagnetic waves is 3×10^8 m/s.)

_____

_____

_____

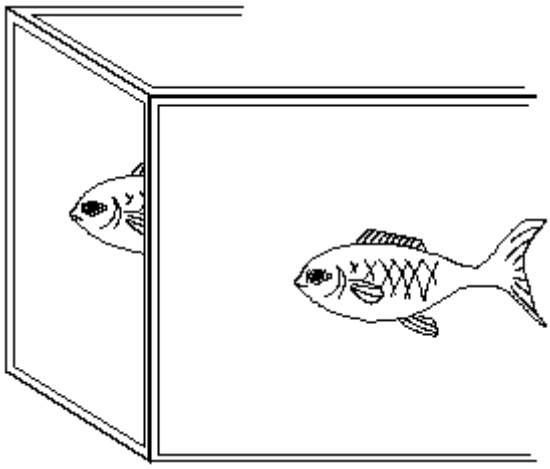
_____

(4)

(Total 8 marks)

Q45.

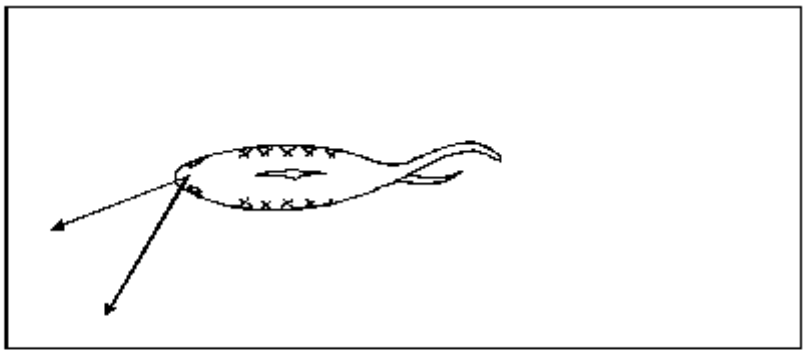
An aquarium contains only one fish. But if you look at the comer of the aquarium, there seem to be two fish.



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 _____

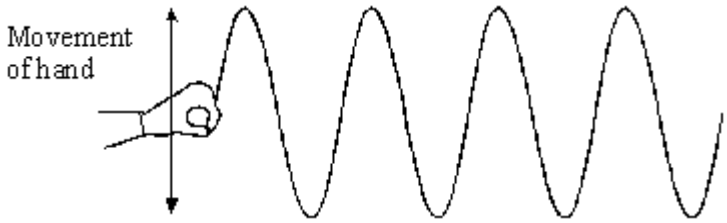
Light waves are _____ waves.

(3)

(Total 5 marks)

Q46.

The diagram shows a wave travelling along a rope.



(a) On the diagram:

(i) show the wavelength and label it **W**;

(ii) show the amplitude and label it **A**.

(2)

(b) The wavelength of the wave is 0. I m. Its frequency is 2 Hz.

Calculate the speed of the wave. Show clearly how you work out your answer and give the unit.

_____

_____

_____

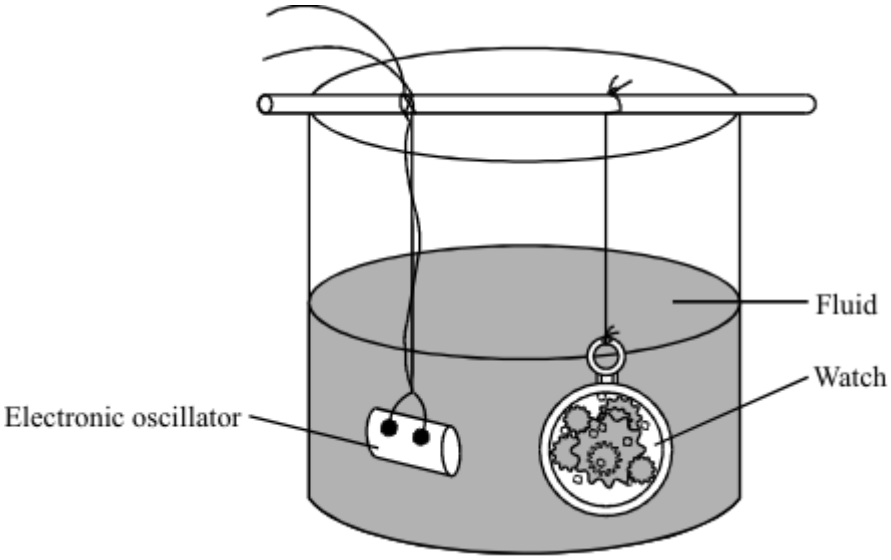
Speed of wave _____

(3)

(Total 5 marks)

Q47.

The diagram shows how ultrasonic waves can be used to clean a watch.



Suggest how this method cleans the watch.

_____

_____

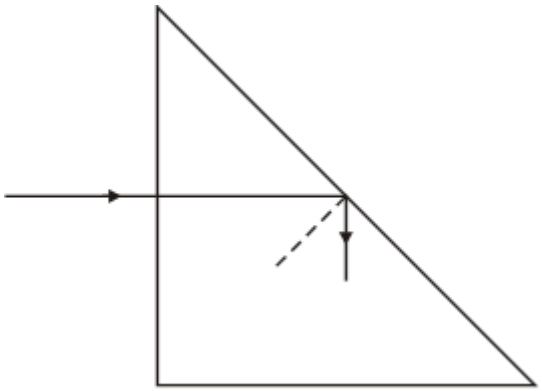
_____

(Total 2 marks)

Q48.

Glass prisms are used in many optical devices.

(a) The diagram shows what happens to a ray of light as it travels through a glass prism.



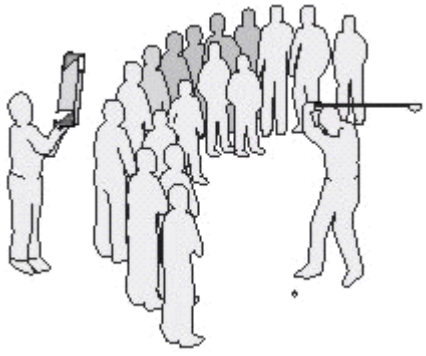
To gain full marks for this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

Use the words in the box to help you to explain why the ray behaves in this way.

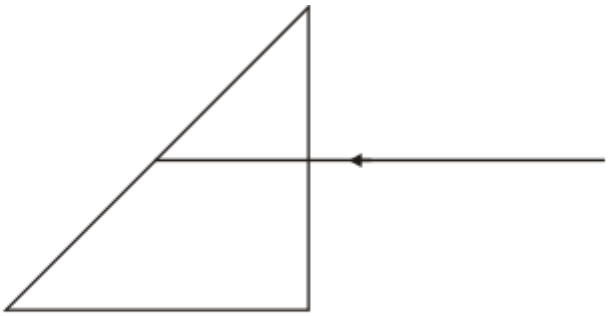
angle	critical	normal

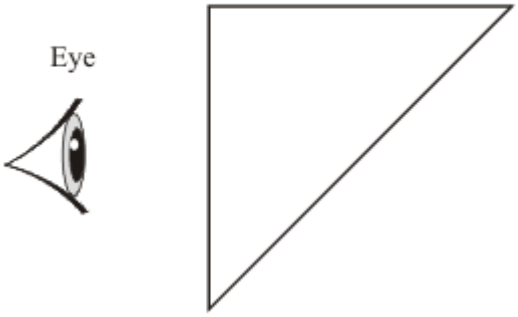
(3)

(b) Periscopes can be used to look over the heads of other people.



A periscope contains two glass prisms.
Complete the diagram to show the ray of light reaching the person's eye.



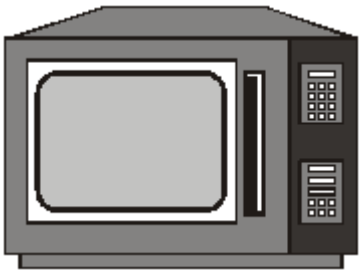


(3)

(Total 6 marks)

Q49.

Microwave ovens can be used to heat many types of food.



(i) Describe, in as much detail as you can, how microwaves heat food.

_____

_____

_____

_____

(2)

(ii) Microwaves have a frequency of 10 000 million Hz. Their wavelength is 0.03 m.

Calculate the speed of microwaves.

Show clearly how you work out your answer.

_____

_____

_____

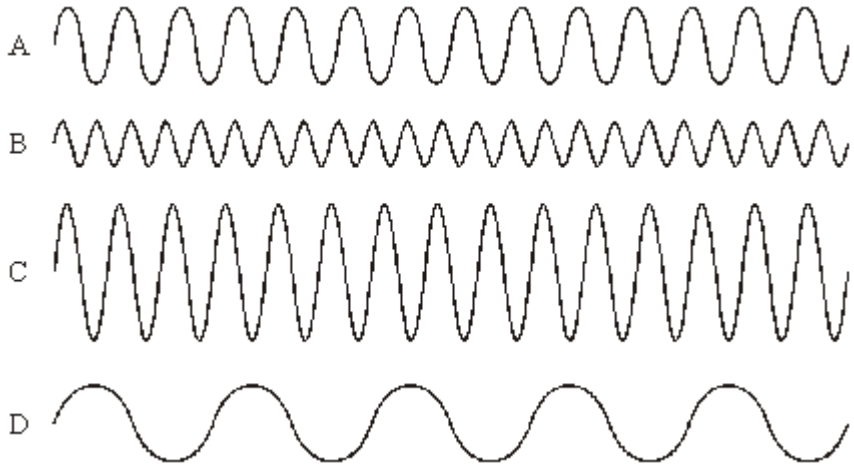
Speed of microwaves_____ m/s

(2)

(Total 4 marks)

Q50.

The diagram shows oscilloscope traces of four waves, **A**, **B**, **C** and **D**. All four waves are drawn to the same scale.



Which wave has:

(a) the longest wavelength; _____

(b) the greatest amplitude; _____

(c) the highest frequency? _____

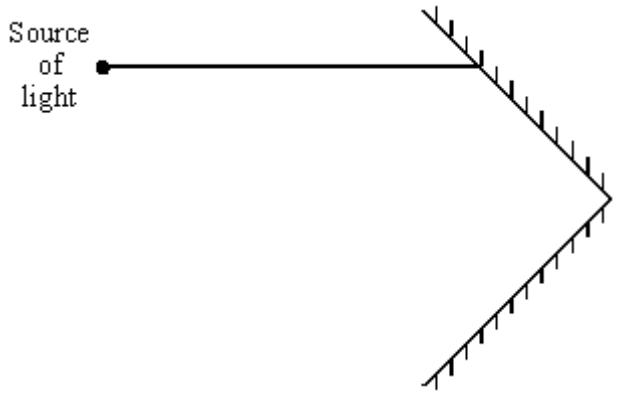
(Total 3 marks)

Q51.

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

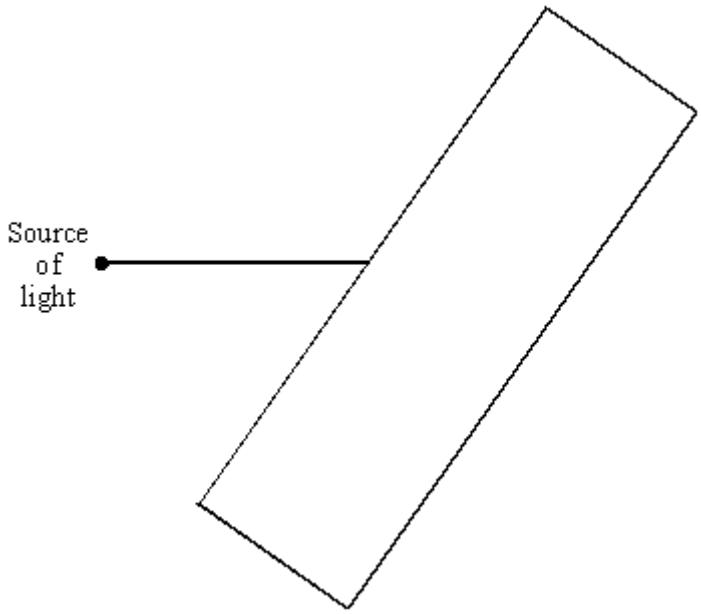
Carefully draw the path of the ray which is reflected from both mirrors.

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.



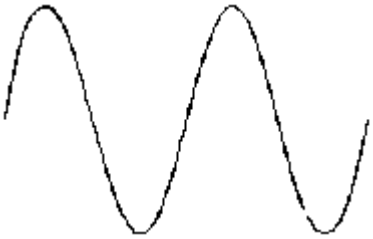
(2)

(Total 5 marks)

Q52.

Some students made a small hand-turned a.c. generator, similar to a bicycle dynamo. They connected it to the Y plates of a cathode ray oscilloscope, CRO, and turned the generator slowly. The trace on the CRO looked like this:

They then turned the generator faster and the trace looked like this:



(a) Why did the trace on the CRO show:

(i) an increase in frequency;

_____

(1)

(ii) a decrease in wavelength;

_____

(1)

(iii) an increase in amplitude?

_____

(1)

(b) One way to alter the output from the generator is to change the speed of turning. State **two** other ways to adapt parts of the generator to increase its output.

_____

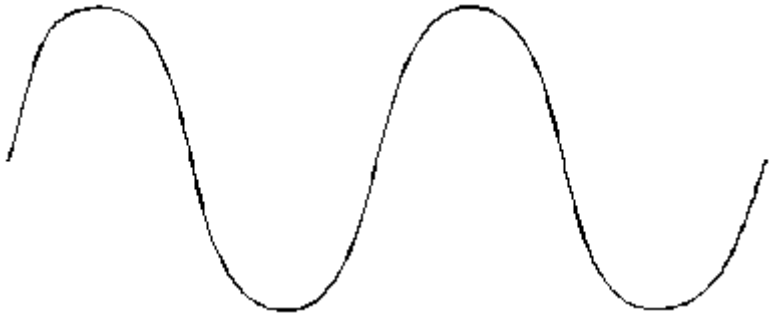
_____

(2)

(Total 5 marks)

Q53.

(a) On the wave drawn below, mark the amplitude and wavelength.



(2)

(b) A wave is said to have a frequency of 25 Hz.

Explain what the term *frequency* means.

_____

_____

_____

(1)

(c) From the electromagnetic spectrum, give the name and use of a radiation of lower frequency than light.

Name _____

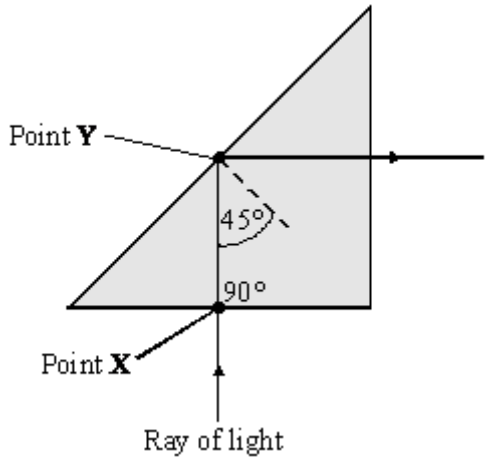
Use _____

(2)

(Total 5 marks)

Q54.

The diagram shows a glass prism.



(i) Explain why refraction has **not** occurred at point **X**.

_____

_____

(1)

(ii) (A) Give the full name for the process which has occurred at point **Y**.

_____

(1)

(B) Explain why this process has occurred.

_____

_____

_____

(2)

(Total 4 marks)

Q55.

(i) Use the words frequency, wavelength and wave speed to write an equation which shows the relationship between them.

_____

(1)

(ii) Calculate the speed of a sound wave with a frequency of 250 Hz and a wavelength of 1.3 m.

Show how you get to your answer and give the unit.

_____

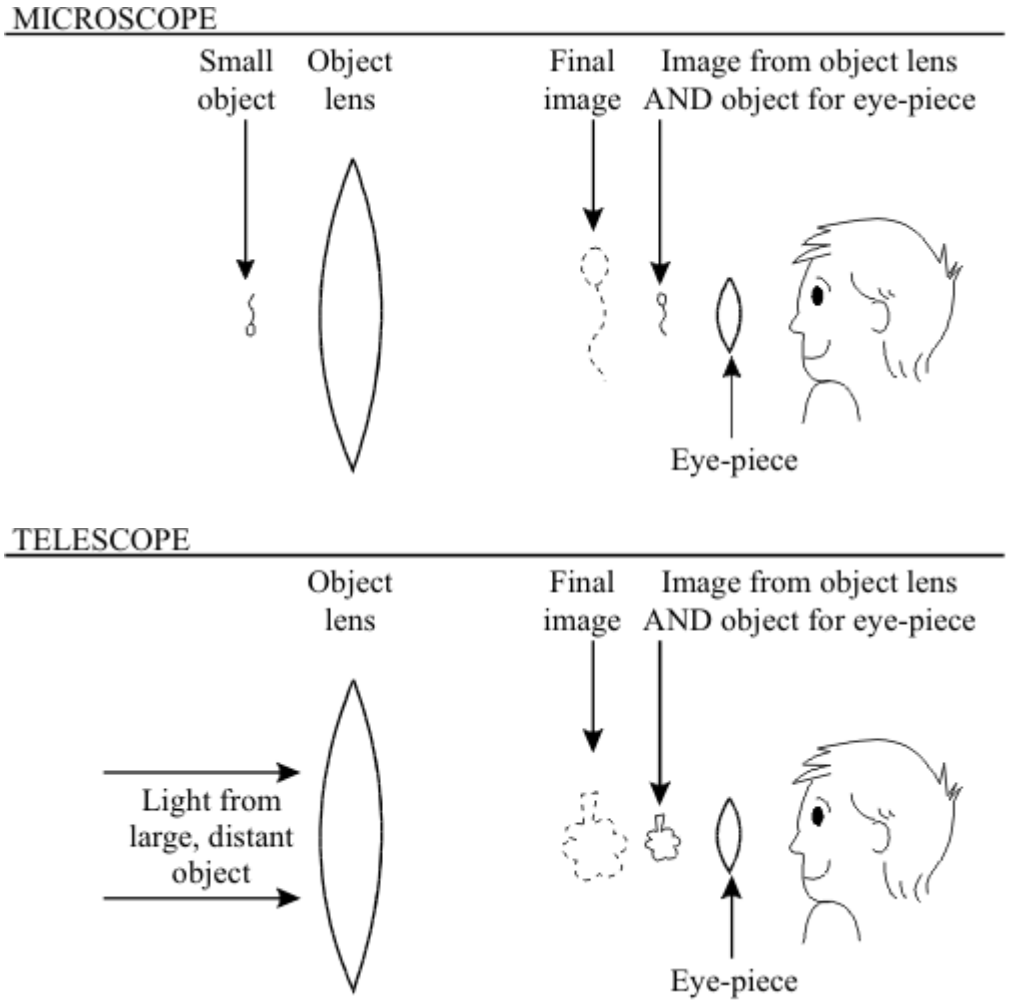
Speed = _____

(2)

(Total 3 marks)

Q56.

The diagrams show how the same two lenses can be used to make a microscope **or** a telescope.



The microscope and the telescope made from the two lenses are similar in some ways but different in others.

Complete the table to show these **similarities** and **differences**.

	Similarities	**Differences**
What the micro-scope and telescope are used for		
The job done by the eye-piece		
How the final image compares with the **original** object		

(Total 7 marks)

Q57.

Explain fully why pregnant women should not normally have X-rays of the lower body.

_____

_____

_____

_____

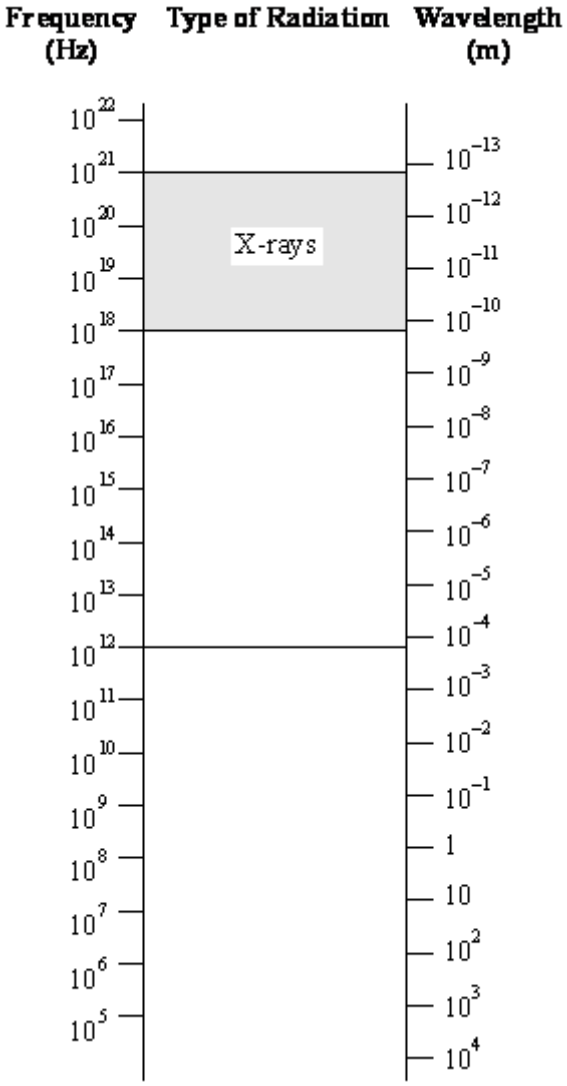
_____

(Total 4 marks)

Q58.

The diagram below shows the range of wavelengths and frequencies for all the types of radiation in the electromagnetic spectrum.

X–rays, which have frequencies in the range 10^{18}–10^{21} Hz are already marked on the diagram.



Complete the diagram by adding the following:

(a) *gamma* radiation, which has shorter wavelengths than X–rays;

(b) *radio* waves which have wavelengths longer than 0.1m;

(c) the *visible* spectrum which has wavelengths from 400 nm (violet) to 700 nm (red);

(d) *ultraviolet* radiation (i.e. radiation with a higher frequency than violet light);

(e) *microwaves* which have a shorter wavelength than radio waves and *infrared* radiation which has a higher frequency than microwaves;

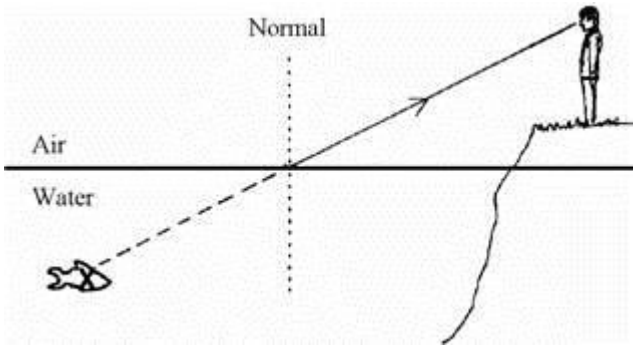
(f) an *FM* radio programme on 92MHz. (Show this with an arrow →)

(Total 7 marks)

Q59.

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.

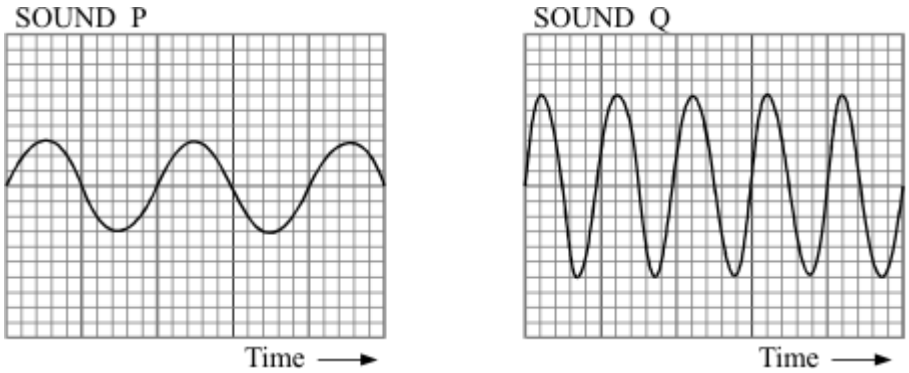
The ray of light is _____ as it passes from the water into the air.

(1)

(Total 3 marks)

Q60.

The diagram shows the oscilloscope traces of two different sounds P and Q. The oscilloscope setting is exactly the same in both cases.



P and Q **sound** different.
Write down **two** differences in the way they sound.
Explain your answers as fully as you can.

1. _____

_____

_____

2. _____

_____

_____

(Total 5 marks)