AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.6.2 ELECTROMAGNETIC WAVES (PACK 3)

SCORE	PERCENTAGE
/204	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

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.

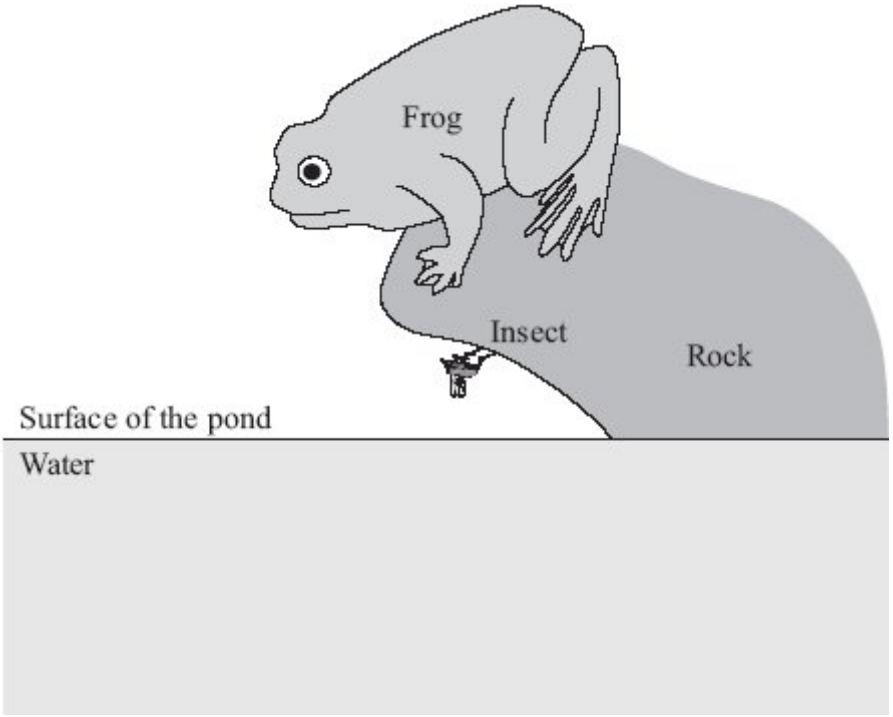
bigger	**inverted**	**real**	**smaller**	**upright**	**virtual**

(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.



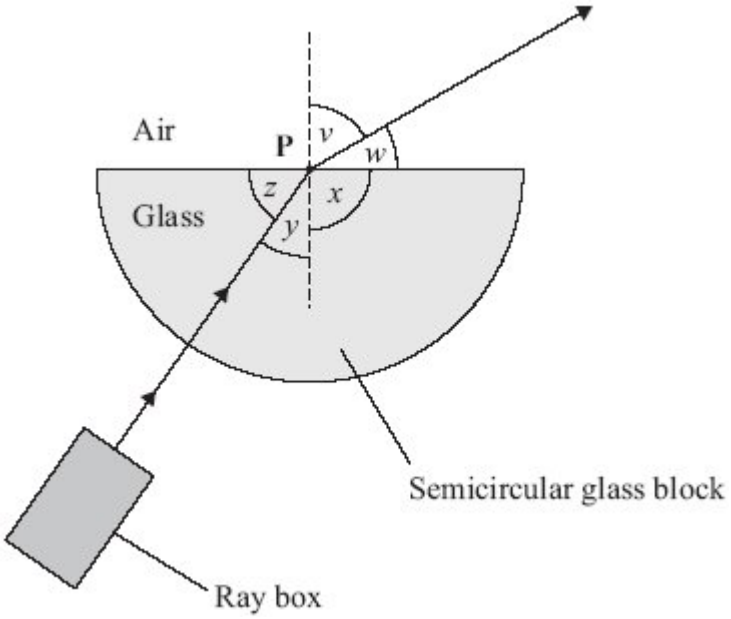
(3)

(Total 6 marks)

STEMUP.CO.UK

Q2.

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

STEMUP.CO.UK

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°?

_____

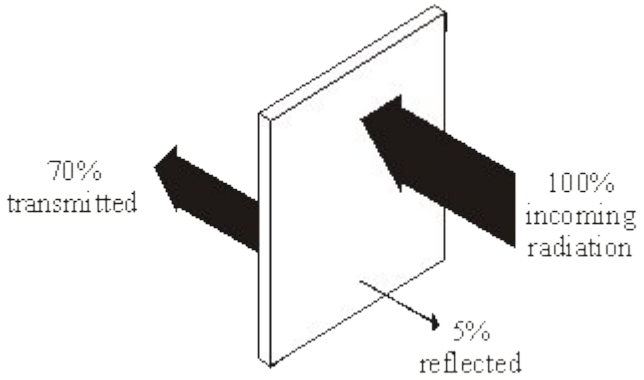
_____

(1)

(Total 7 marks)

Q3.

(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.

STEMUP.CO.UK

The absorbed 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 objects absorb infra red radiation.	
Black surfaces are poor emitters of infra red radiation.	
A hot object emits more infra red than a cooler object.	

(1)

(c) The following statement is false.

Black surfaces 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)

Q4.

(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.

STEMUP.CO.UK

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?

_____

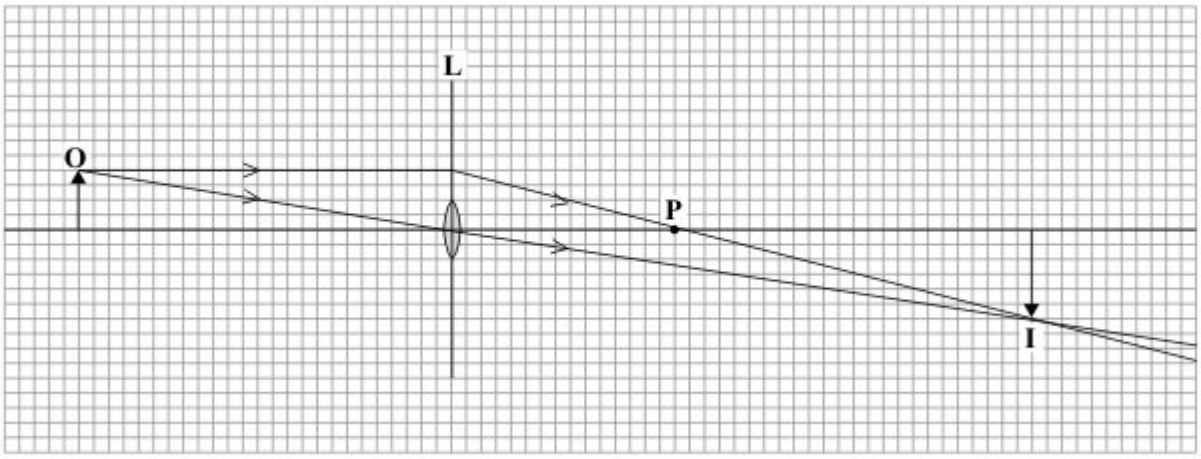
_____

(1)

(Total 6 marks)

Q5.

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?

_____

STEMUP.CO.UK

(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)

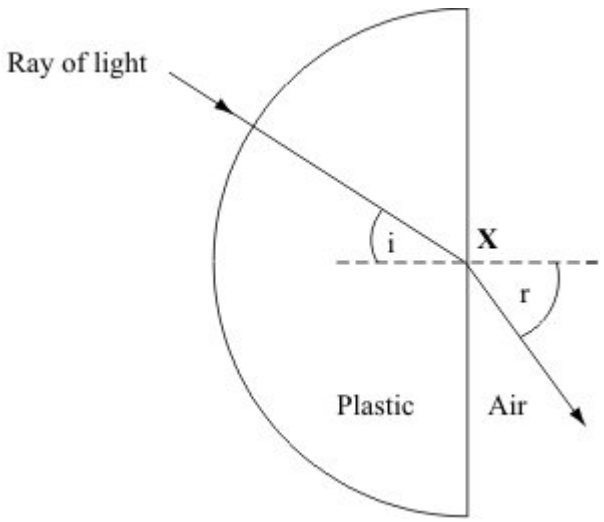
(Total 5 marks)

Q6.

(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.



STEMUP.CO.UK

(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.

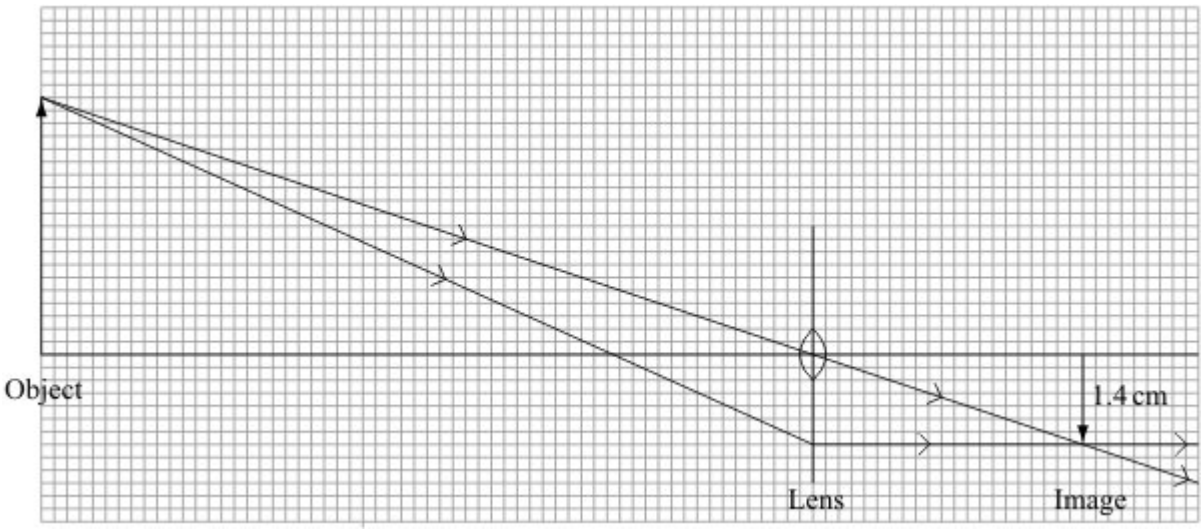


Name a light detecting device which may be used in a camera.

_____

(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.

STEMUP.CO.UK

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

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?

_____

_____

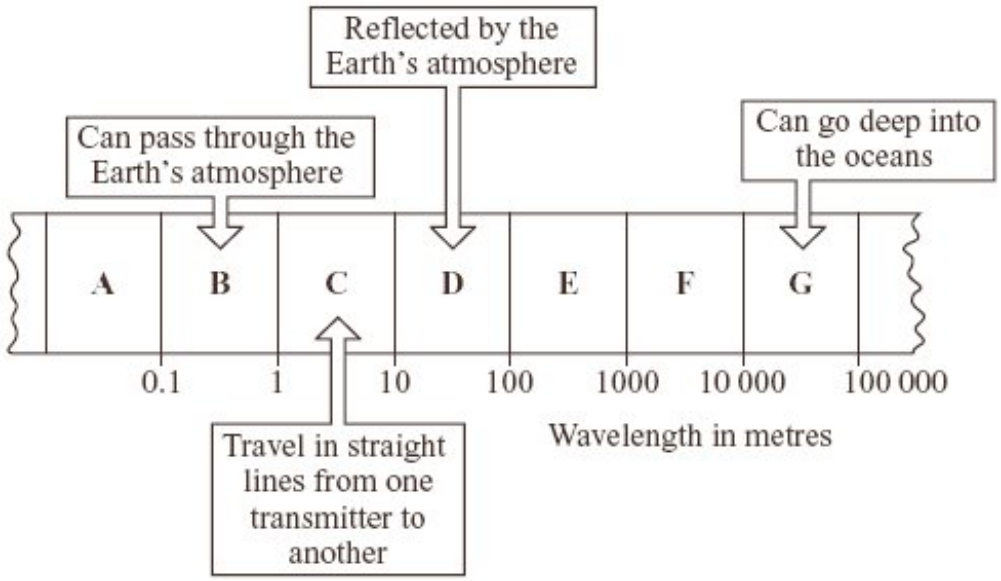
(1)

(Total 7 marks)

Q7.

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

_____

STEMUP.CO.UK

(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)

Q8.

(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?

_____

STEMUP.CO.UK

_____

_____

_____

(2)

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

What information in the article supports this view?

_____

_____

_____

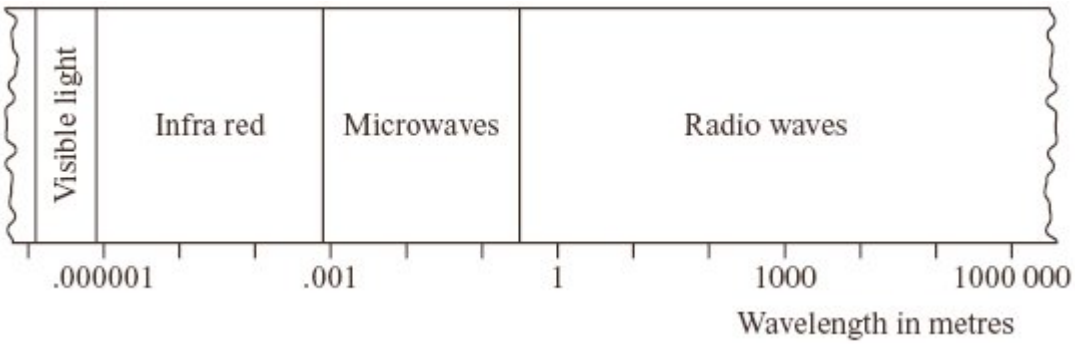
_____

(2)

(Total 6 marks)

Q9.

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.

STEMUP.CO.UK

(1)
(Total 4 marks)

Q10.

(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)

STEMUP.CO.UK

Q11.

(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 of Stag Hill Court, a luxury block of flats, are shocked at the plans to site a mobile phone mast on the roof of the flats. They oppose the mast on health grounds, quoting research in Germany that has found a possible increase in cases of cancer around mobile phone masts.
>
> A spokesperson for the telecoms company said, 'The residents should not worry. The research carried out by our own scientists has found no link between ill health and mobile phone masts'.
>
> This has not reassured the residents, who argue that new independent research is urgently needed.

(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. _____

_____

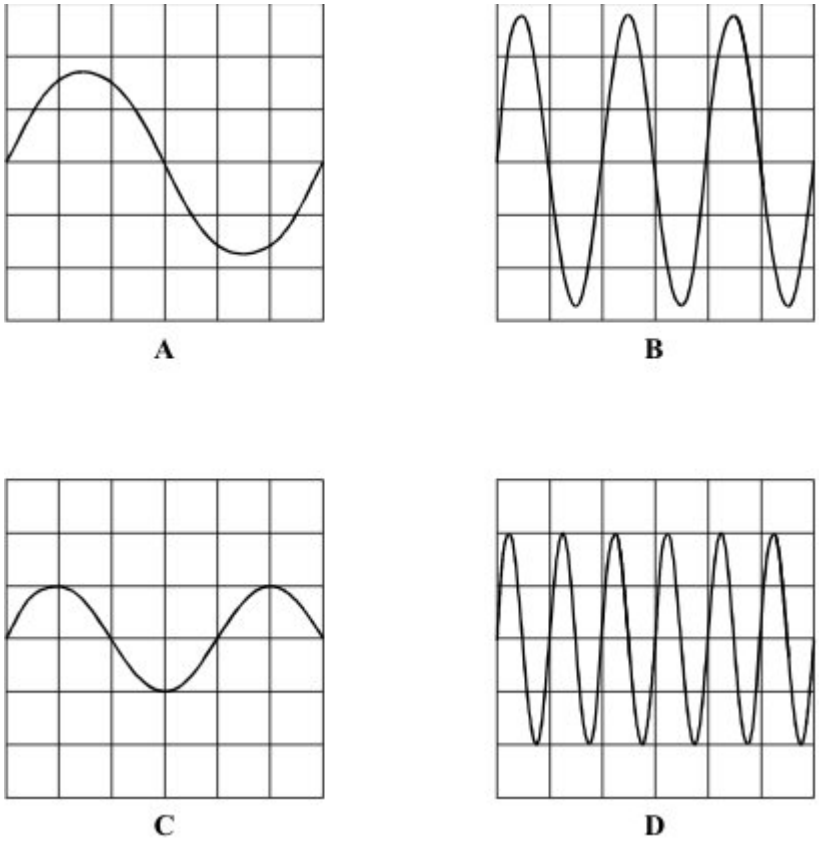
(2)

(Total 7 marks)

STEMUP.CO.UK

Q12.

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



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

(i) the largest amplitude," _____

(1)

(ii) the lowest frequency? _____

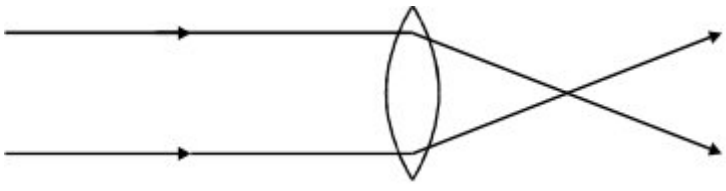
(1)

(Total 2 marks)

Q13.

(a) 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**?

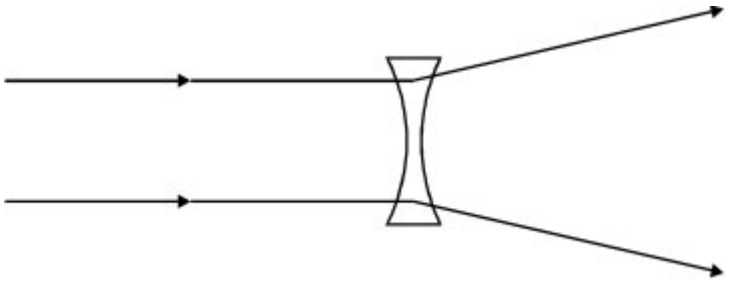
_____

(1)

STEMUP.CO.UK

(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
.

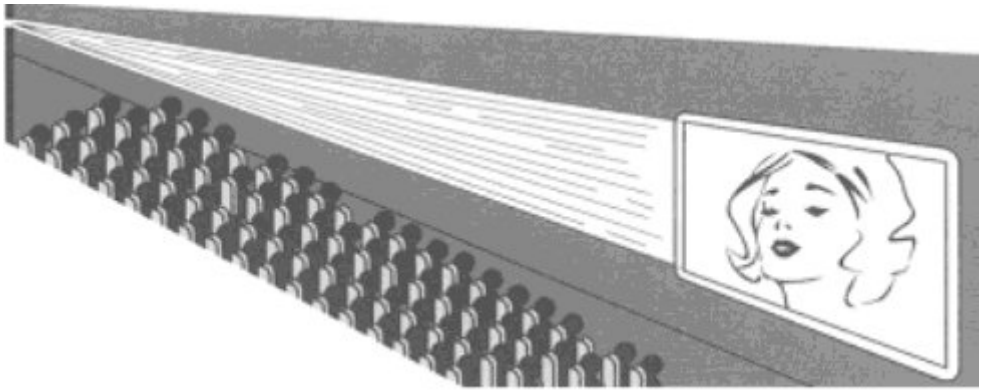
The image is
larger than
smaller than
the same size as
the object.

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.

STEMUP.CO.UK



(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)

Q14.

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

STEMUP.CO.UK



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

_____

_____

_____

_____

(Total 2 marks)

Q15.

(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)

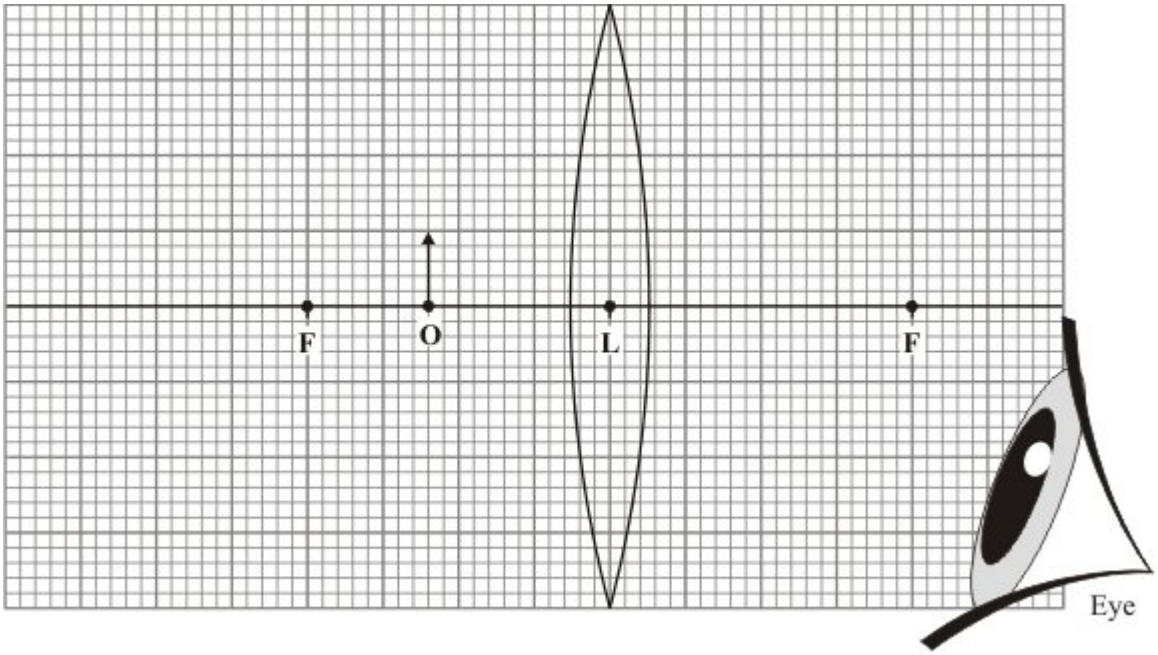
(iii) What is the name of the straight line which goes through the point **F**, through the point **L** at the centre of the lens, and through the point **F** on the other side?

_____

(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.

STEMUP.CO.UK



(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.

_____

_____

_____

_____

_____

_____

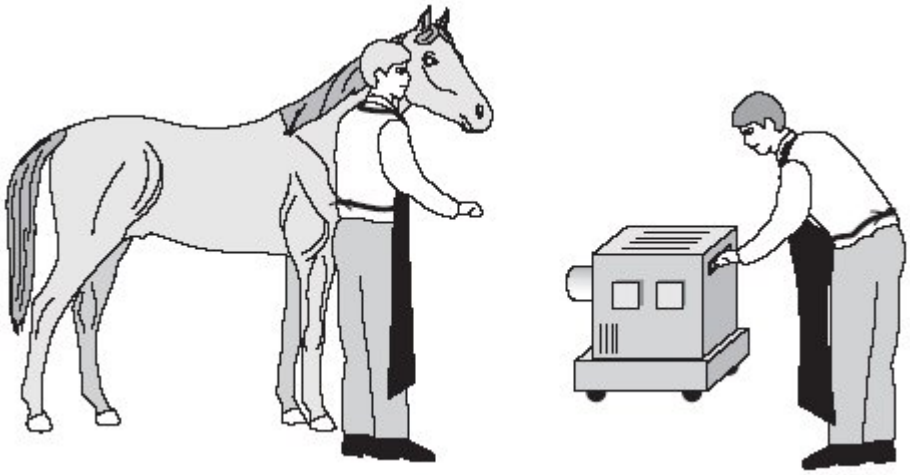
(3)

(Total 12 marks)

Q16.

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

STEMUP.CO.UK



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.

_____

_____

_____

_____

_____

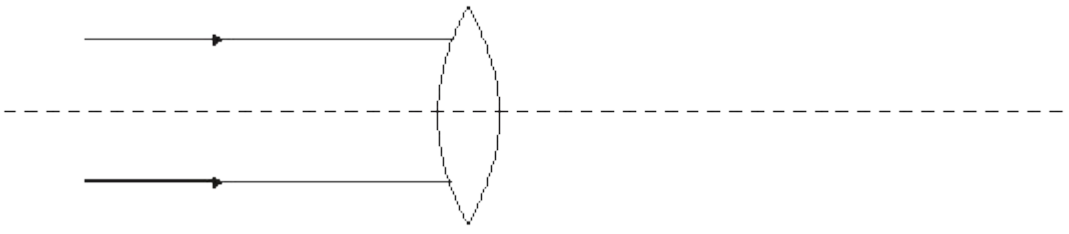
_____

(Total 3 marks)

Q17.

(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)

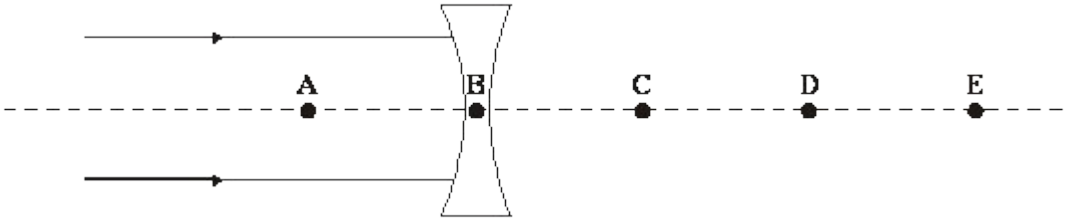
(iii) What word can be used to describe this type of lens?

STEMUP.CO.UK

_____

(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.

_____

STEMUP.CO.UK

_____

_____

_____

_____

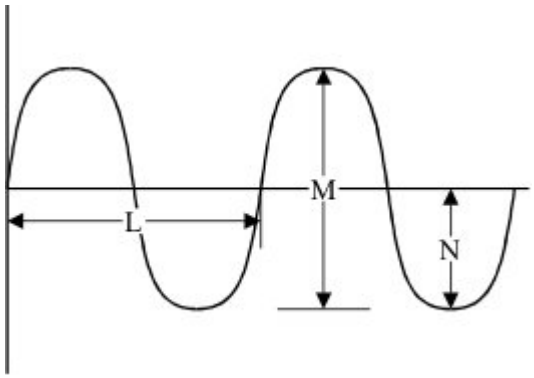
_____

(3)

(Total 13 marks)

Q18.

(a) The diagram shows a wave pattern.



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

(i) the wavelength? _____

(ii) the amplitude? _____

(2)

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

_____

_____

_____

STEMUP.CO.UK

_____

_____

(2)

(Total 4 marks)

Q19.

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.

_____

_____

_____

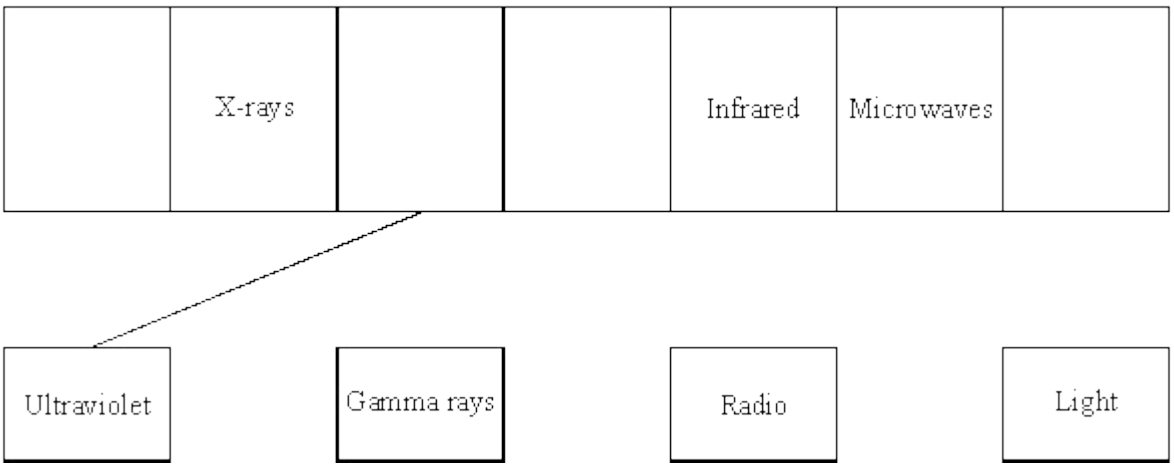
Wavelength = _____ metres

(2)

(Total 3 marks)

Q20.

(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)

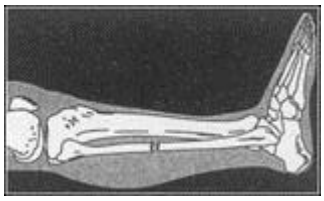
(b) Complete the following sentence by choosing the correct answer and crossing out in the box the two lines which are wrong.

STEMUP.CO.UK

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)

Q21.

(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)

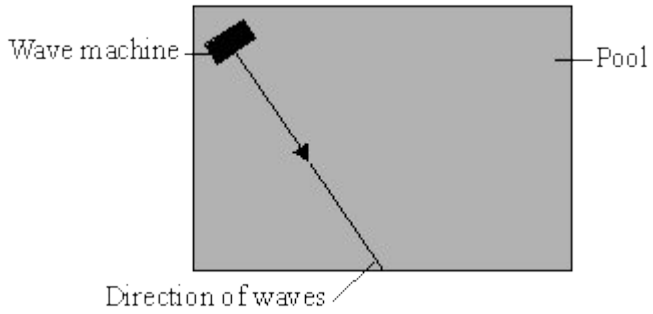
(iii) Which **one** of the units below is used to measure frequency? Underline your answer.

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.

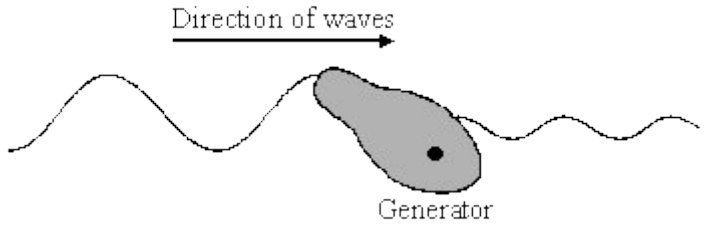
STEMUP.CO.UK



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)

Q22.

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)

STEMUP.CO.UK

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

_____

_____

_____

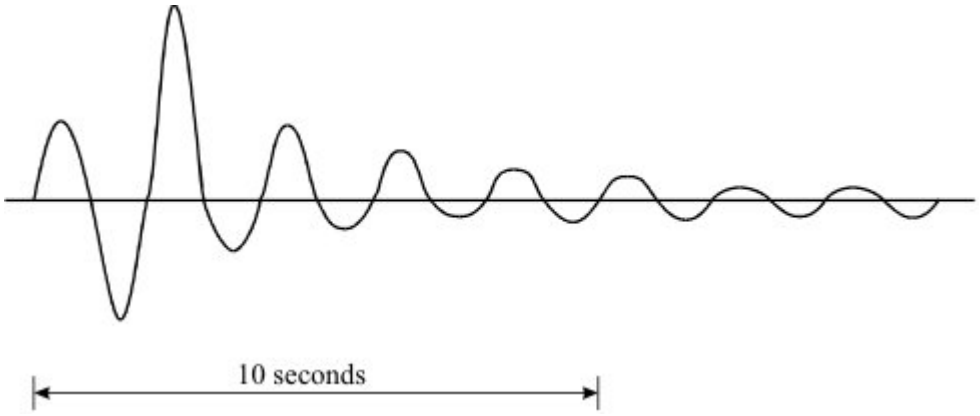
Frequency = _____

(3)

(Total 4 marks)

Q23.

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)

Q24.

STEMUP.CO.UK

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.

_____

_____

_____

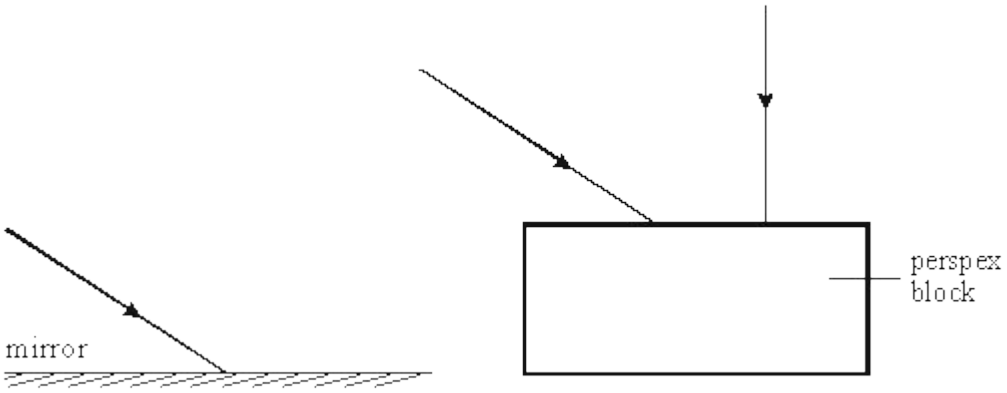
_____

(2)

(Total 3 marks)

Q25.

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

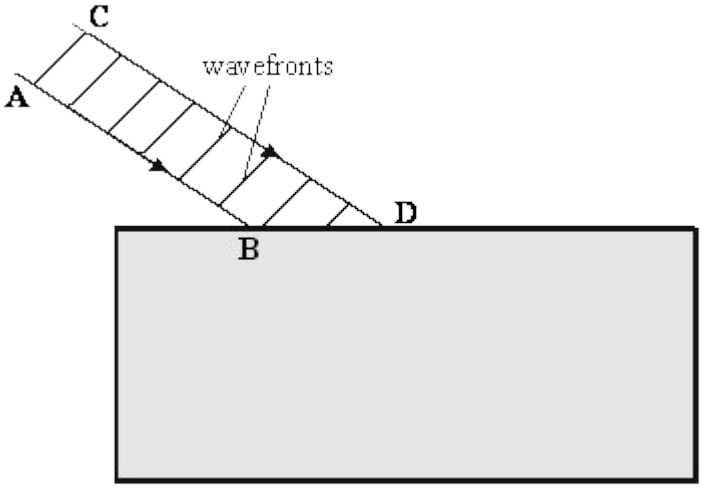


Complete the paths of the three rays of light on the diagrams to show the rays leaving the mirror and the perspex block.

(4)

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

STEMUP.CO.UK



(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.

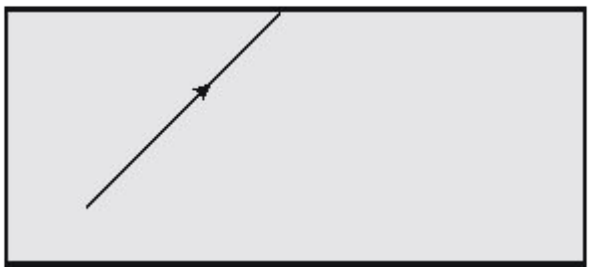
_____

_____

_____

(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.

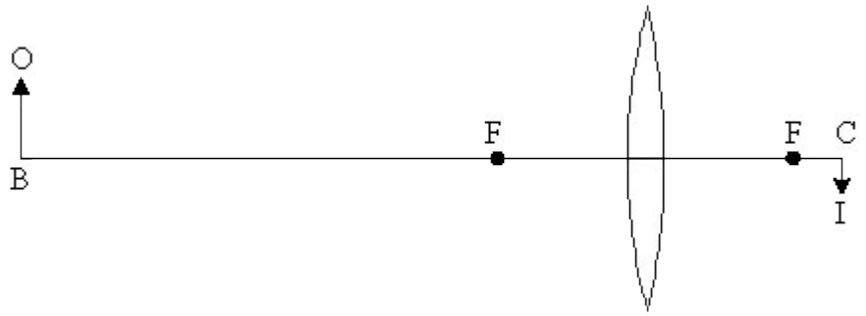
(2)

(Total 13 marks)

Q26.

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.

STEMUP.CO.UK



(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.

_____

_____

_____

_____

_____

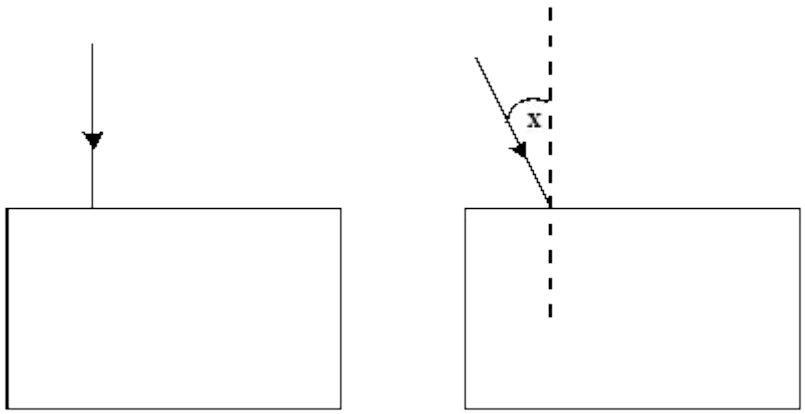
(3)

(Total 7 marks)

Q27.

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

STEMUP.CO.UK

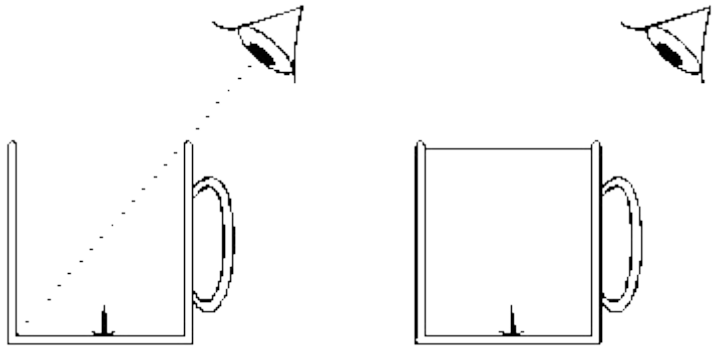


(i) On the diagram draw the path of each ray through the glass block and out into the air again.

(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)

Q28.

Lenses are used in many optical devices.

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

OPTICAL	NATURE OF	SIZE OF	POSITION OF

STEMUP.CO.UK

DEVICE	IMAGE	IMAGE	IMAGE
Eye	real		
Projector		Magnified	
camera			Closer to lens than the object

(Total 6 marks)

Q29.

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.)

_____

_____

_____

_____

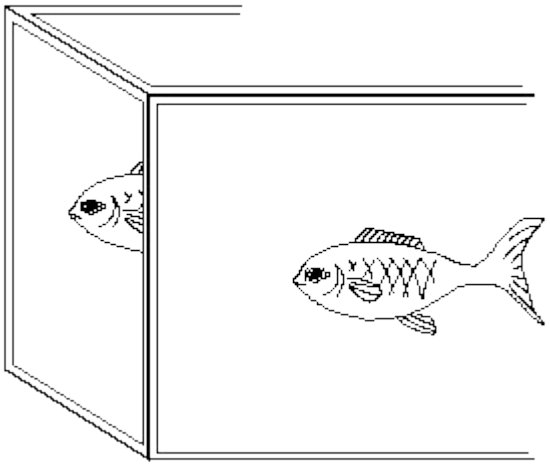
(4)

(Total 8 marks)

Q30.

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

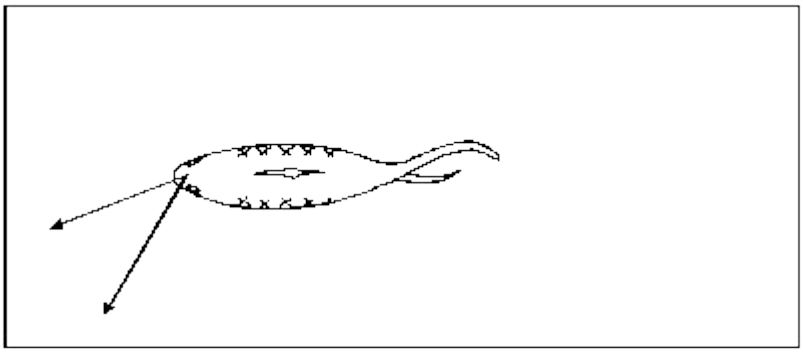
STEMUP.CO.UK



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.

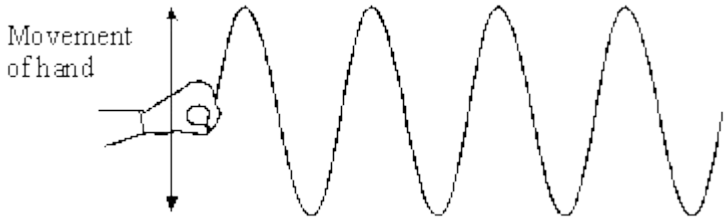
(3)

(Total 5 marks)

Q31.

The diagram shows a wave travelling along a rope.

STEMUP.CO.UK



(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.

_____

_____

_____

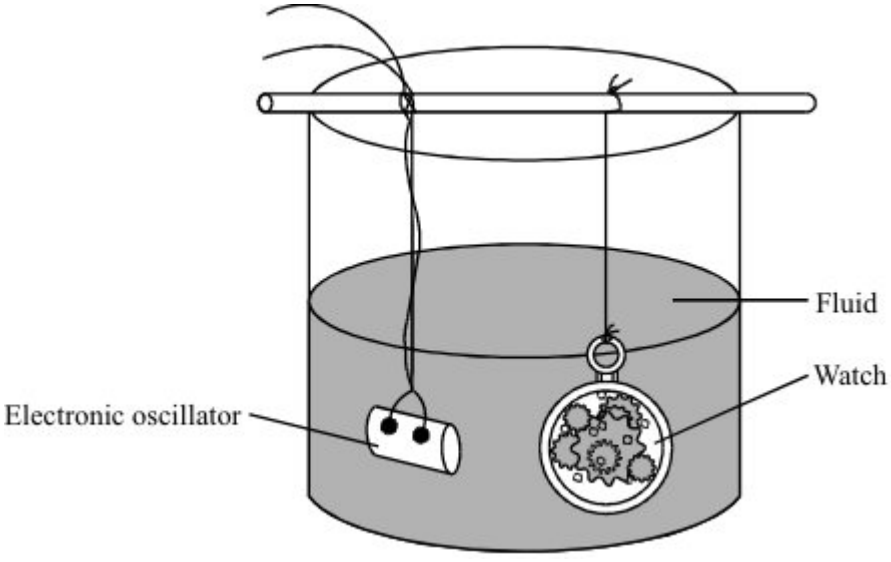
Speed of wave _____

(3)

(Total 5 marks)

Q32.

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



Suggest how this method cleans the watch.

_____

_____

STEMUP.CO.UK

_____

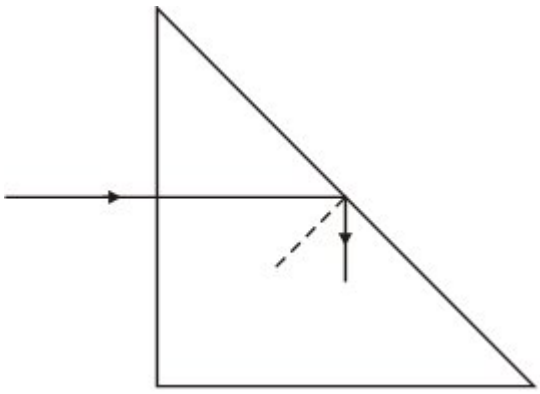
_____

(Total 2 marks)

Q33.

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

_____

_____

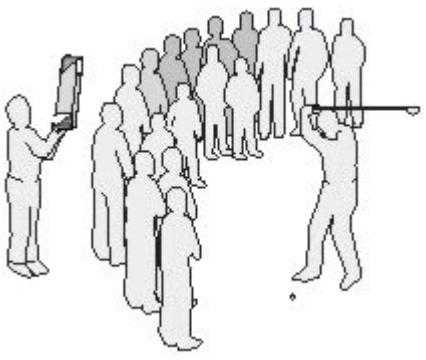
_____

_____

_____

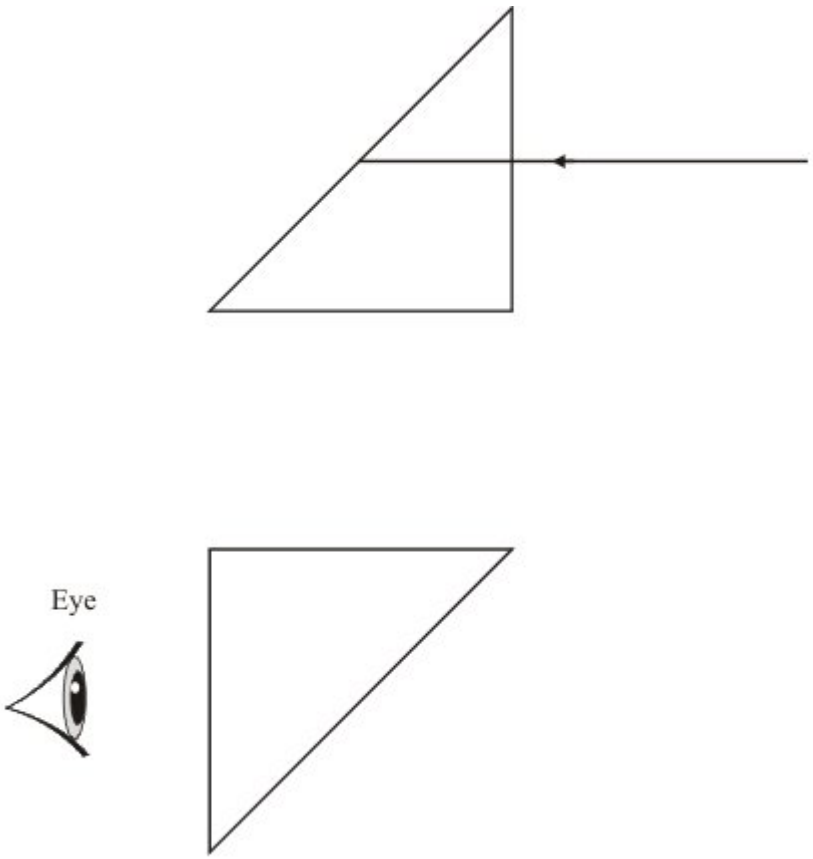
(3)

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



STEMUP.CO.UK

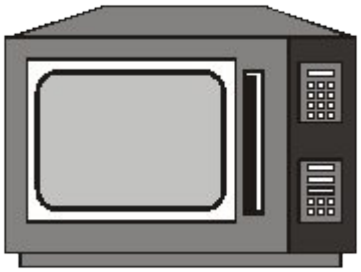
A periscope contains two glass prisms.
Complete the diagram to show the ray of light reaching the person's eye.



(3)
(Total 6 marks)

Q34.

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.

STEMUP.CO.UK

Calculate the speed of microwaves.

Show clearly how you work out your answer.

_____

_____

_____

Speed of microwaves_____ m/s

(2)

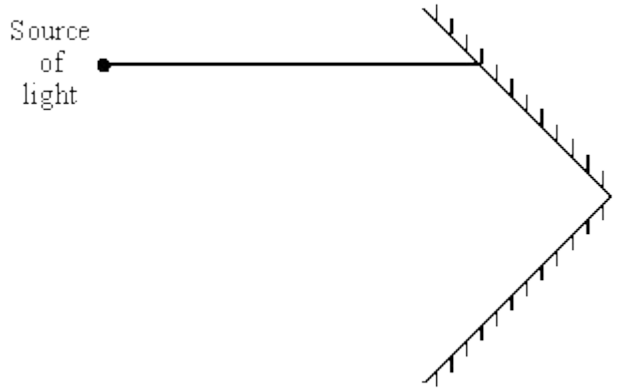
(Total 4 marks)

Q35.

(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.

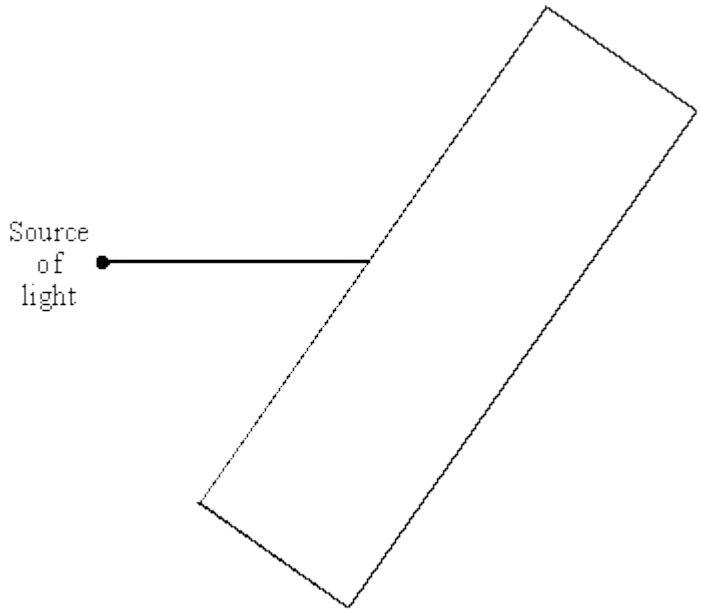
Draw an arrow on the ray to show the direction of the light.



(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.

STEMUP.CO.UK



(2)
(Total 5 marks)

STEMUP.CO.UK