

- 6 (a)** Fig. 6.1 represents the waveform of a sound wave. The wave is travelling at constant speed.

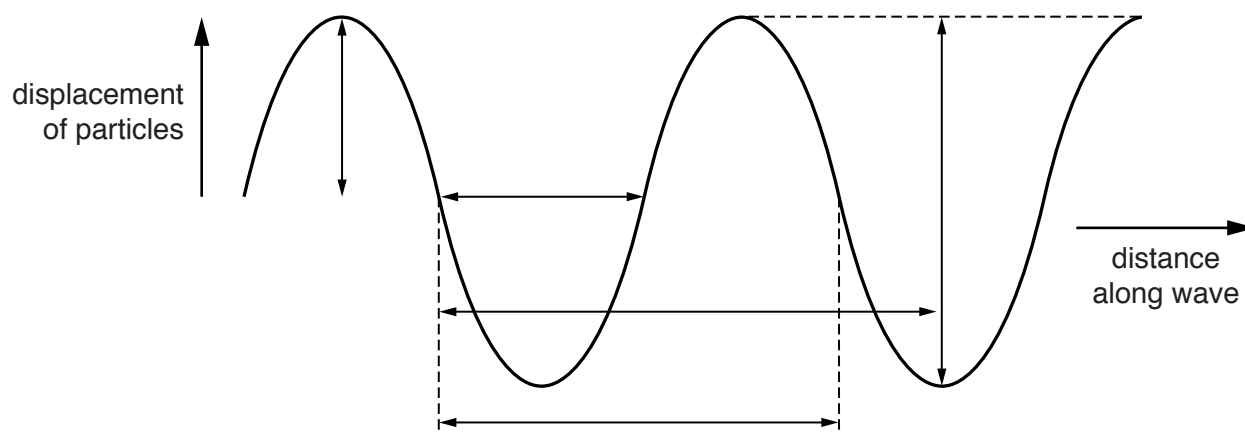


Fig. 6.1

- (i)** On Fig. 6.1,

1. label with the letter X the marked distance corresponding to the amplitude of the wave, [1]
2. label with the letter Y the marked distance corresponding to the wavelength of the wave. [1]

- (ii)** State what happens to the amplitude and the wavelength of the wave if

1. the loudness of the sound is increased at constant pitch,
 amplitude
 wavelength [1]
2. the pitch of the sound is increased at constant loudness.
 amplitude
 wavelength [1]

- (b)** A ship uses pulses of sound to measure the depth of the sea beneath the ship. A sound pulse is transmitted into the sea and the echo from the sea-bed is received after 54 ms. The speed of sound in seawater is 1500 m/s.

Calculate the depth of the sea beneath the ship.

depth = ... [3]

[Total: 7]

2. Question part 1/2 | 0625 Feb-March 2016 P4 V2 Q7

7 (a) Explain what is meant by

(i) *total internal reflection*,

.....
.....[1]

(ii) *critical angle*.

.....
.....[1]

(b) Fig. 7.1 shows a ray of light, travelling in air, incident on a glass prism.

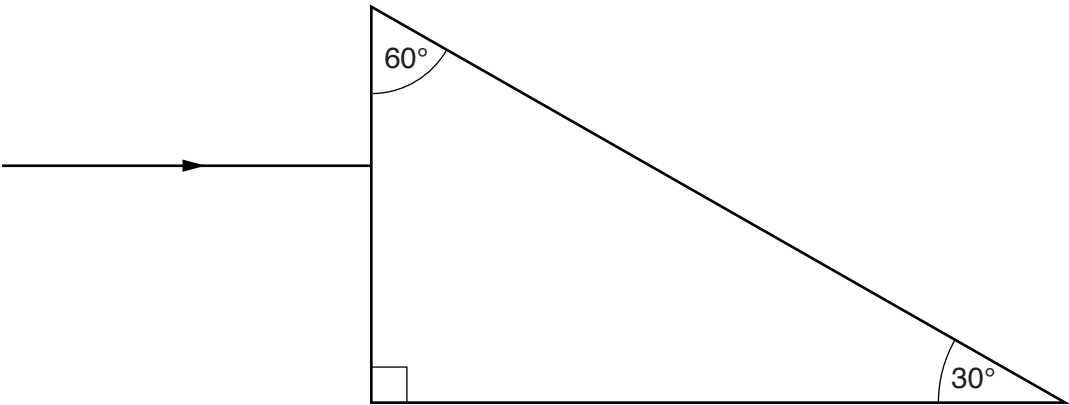


Fig. 7.1

(i) The speed of light in air is 3.0×10^8 m/s. Its speed in the glass is 2.0×10^8 m/s.

Calculate the refractive index of the glass.

refractive index = ...[2]

(ii) Show that the critical angle for the glass-air boundary is 42° .

[1]

(iii) On Fig. 7.1, draw carefully, without calculation, the continuation of the ray through the prism and into the air. [3]

[Total: 8]

6 (a) Two students are measuring the speed of sound.

The students are provided with a starting pistol, a stopwatch and a long measuring tape. The starting pistol, when fired, produces a loud sound and a puff of smoke at the same instant.

Describe how the students use the apparatus and how they calculate the speed. You may draw a diagram.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

3. Question part 2/2 | 0625 May-June 2016 P4 V1 Q6

(b) A device at the bottom of the sea emits a sound wave of frequency 200 Hz.

(i) The speed of sound in sea-water is 1500 m/s.

Calculate the wavelength of the sound in sea-water.

wavelength = ... [2]

(ii) The sound wave passes from the sea-water into the air.

State what happens, if anything, to

- the frequency of the sound, ...
.....
- the speed of the sound.
.....

[2]

[Total: 8]

4. Question part 1/2 | 0625 May-June 2016 P4 V1 Q7

7 (a) (i) A ray of light passes through a length of curved optical fibre.

Draw a diagram showing the fibre and the path of the ray of light.

[1]

(ii) Describe one use of optical fibres in medicine. You may draw a diagram.

.....

.....

.....

.....

.....

.....

.....

[3]

4. Question part 2/2 | 0625 May-June 2016 P4 V1 Q7

(b) Draw a straight line from each wave on the left to the most appropriate speed.

light in air

microwaves in
a vacuum

sound in steel

90 m/s
(9 × 10)

6000 m/s
(6 × 10³)

100 000 m/s
(1 × 10⁵)

1 000 000 m/s
(1 × 10⁶)

300 000 000 m/s
(3 × 10⁸)

60 000 000 000 m/s
(6 × 10¹⁰)

[3]

(c) The refractive index of a block of glass is 1.5.

Use your value for the speed of light from (b) to calculate the speed of light in this block.

speed = ... [2]

[Total: 9]

5. Question part 1/2 | 0625 May-June 2016 P4 V2 Q6

- 6 (a) Fig. 6.1 shows a protractor superimposed on the path of a ray of light. The light is travelling in glass towards the boundary with air.

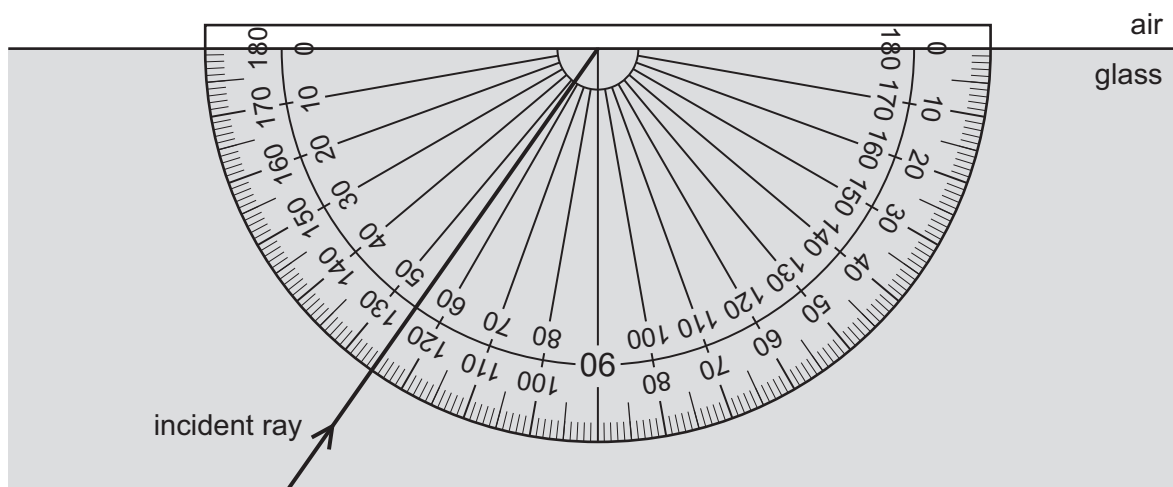


Fig. 6.1

- (i) Use the protractor to measure the angle of incidence of the ray of light at the boundary with the air.

angle of incidence = ... [1]

- (ii) The refractive index of the glass is 1.56.

Calculate the angle of refraction in the air.

angle of refraction = ... [3]

- (b) (i) State what is meant by *critical angle*.

.....

.....

[1]

- (ii) Calculate the critical angle of light in glass of refractive index 1.56.

critical angle = ... [2]

- (c) Fig. 6.2 shows a water wave crossing a boundary from shallow water to deep water.

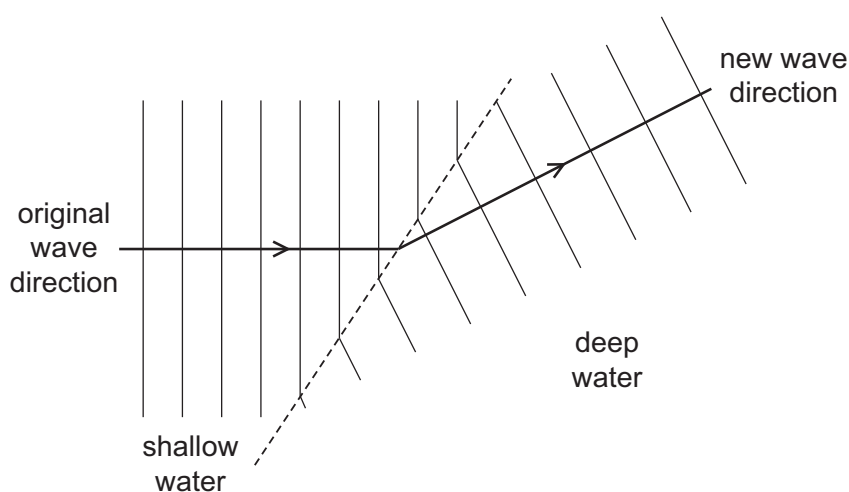


Fig. 6.2

- (i) Name the process that takes place at the boundary between the shallow water and the deep water.

..... [1]

- (ii) Tick **one** box corresponding to the property of the wave that is the same in the shallow water as in the deep water.

- ☐ amplitude
- ☐ frequency
- ☐ speed
- ☐ wavelength

[1]

[Total: 9]

7 (a) Describe the use of X-rays in a security application. Include a diagram.

.....

.....

.....

.....

.....

[3]

6. Question part 2/2 | 0625 May-June 2016 P4 V2 Q7

(b) Draw a straight line from each wave to the most appropriate speed.

radio waves
in air

ultrasound
in air

X-rays in
a vacuum

300 m/s
(3×10^2)

6000 m/s
(6×10^3)

1 000 000 m/s
(1×10^6)

300 000 000 m/s
(3×10^8)

60 000 000 000 m/s
(6×10^{10})

1 000 000 000 000 m/s
(1×10^{12})

[3]

[Total: 6]

5 (a) Radio waves, ultrasound and visible light are all waves.

(i) State what is meant by *ultrasound* and suggest a value for the minimum possible frequency of ultrasound waves.

.....

.....

.....

[2]

(ii) State which of these waves are

- electromagnetic,

.....

- longitudinal.

.....

[2]

- (b) Ultrasound passes through both human flesh and bone.

Fig. 5.1 shows an ultrasound source sending an ultrasound wave into human flesh.

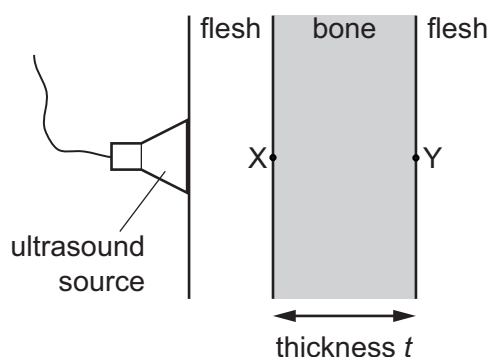


Fig. 5.1

The ultrasound wave travels through the flesh to point X and then through the thickness of the bone to point Y. At Y, some ultrasound is reflected and returns to X.

The total time taken for ultrasound to travel in the bone from X to Y and back to X is 9.0×10^{-6} s.
The speed of ultrasound in bone is 4100 m/s.

Calculate the thickness t of the bone.

thickness t = ... [3]

[Total: 7]

- 6 (a)** A block is made from a particular type of glass.

Fig. 6.1 shows light passing from air into the glass block.

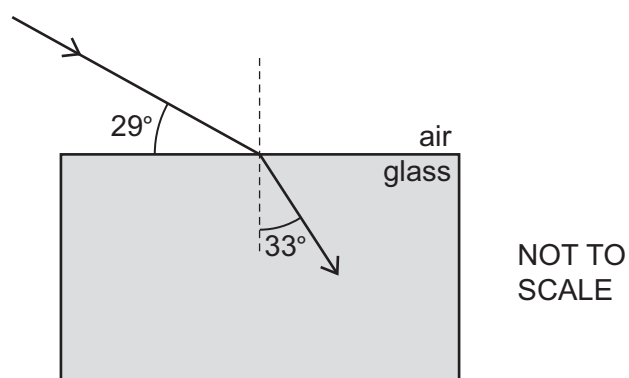


Fig. 6.1

Using information from Fig. 6.1, calculate

- (i) the refractive index of light in this type of glass,

refractive index = ... [3]

- (ii) the critical angle for light travelling in this type of glass.

critical angle = ... [2]

(b) State one application of optical fibres. Draw a diagram that shows how an optical fibre is used in this application.

.....

.....

..... [3]

[Total: 8]

6 (a) (i) State a typical value for the speed of sound in air.

speed = ...[1]

(ii) State the range of frequencies that can be heard by a healthy human ear.

.....[1]

(b) A sound wave in air has a wavelength of 22 mm.

Fig. 6.1 represents wavefronts of this sound. These wavefronts are successive compressions.

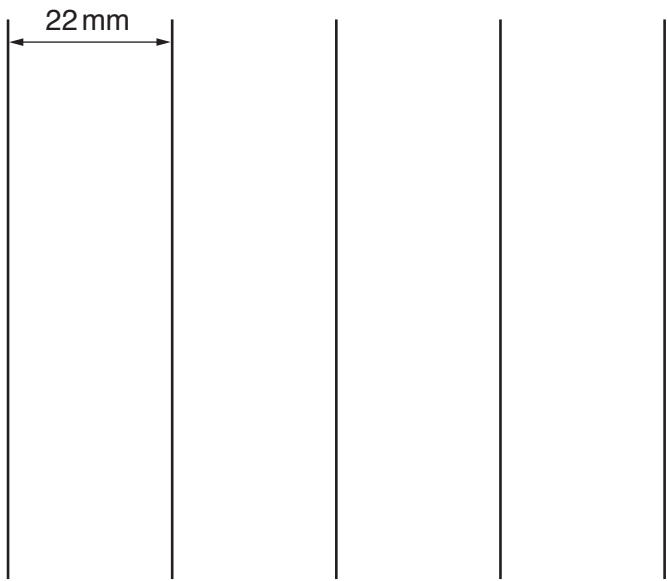


Fig. 6.1

(i) Using your value for the speed of sound in (a)(i), calculate the frequency of the sound wave.

frequency = ...[2]

(ii) On Fig. 6.1, draw dotted lines to represent **three** different rarefactions. [1]

(iii) State, in terms of both molecules and pressure, what is meant by a *rarefaction*.

.....
.....
.....
.....[2]

7 Fig. 7.1 shows a box ABCD.

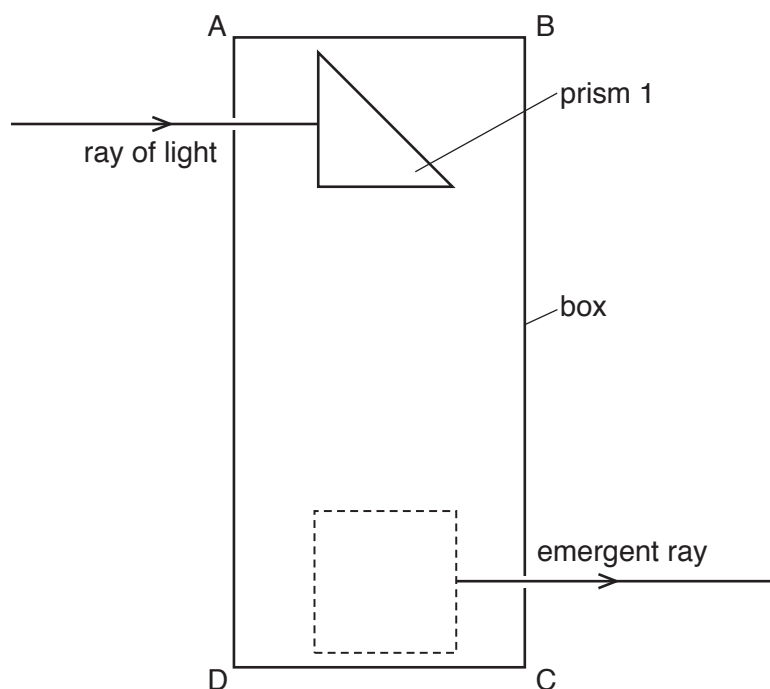


Fig. 7.1

The box contains two identical glass prisms, one of which is shown. Light incident on prism 1 undergoes total internal reflection within the glass.

(a) (i) On Fig. 7.1, complete the path of the ray of light through prism 1. [2]

(ii) On Fig. 7.1, draw a second prism inside the dashed square, positioned so that the light reflects inside the glass and emerges from the box as shown. Complete the path of the ray. [2]

(b) Select the statements that correctly describe the necessary conditions for the light to undergo total internal reflection. Tick **two** boxes.

- ☐ The angle of incidence in the glass is less than the critical angle of light in the glass.
- ☐ The angle of incidence in the glass is greater than the critical angle of light in the glass.
- ☐ The angle of reflection in the glass is equal to the angle of refraction.
- ☐ The speed of light in the glass is greater than the speed of light in air.
- ☐ The speed of light in the glass is equal to the speed of light in air.
- ☐ The speed of light in the glass is less than the speed of light in air.

[2]

[Total: 6]

11. Question part 1/3 | 0625 Oct-Nov 2016 P4 V2 Q6

- 6 (a) (i) The pitch of a sound wave increases.

Tick **one** box to indicate the change that occurs.

- | | |
|--------------------------|---------------------|
| ☐ | amplitude decreases |
| ☐ | amplitude increases |
| ☐ | frequency decreases |
| ☐ | frequency increases |

[1]

- (ii) The loudness of a sound wave increases.

Tick **one** box to indicate the change that occurs.

- | | |
|--------------------------|---------------------|
| ☐ | amplitude decreases |
| ☐ | amplitude increases |
| ☐ | frequency decreases |
| ☐ | frequency increases |

[1]

- (b) Fig. 6.1 shows an astronaut and a spacecraft on the surface of the Moon, where there is no atmosphere.

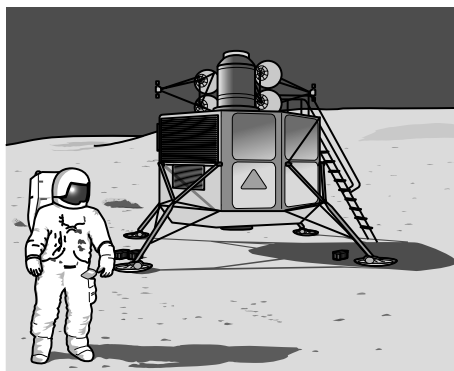


Fig. 6.1

A piece of machinery within the spacecraft produces a loud sound of frequency 12 kHz.

Tick the **one** box that indicates the reason why the astronaut cannot hear this sound.

- | | |
|--------------------------|---|
| ☐ | The material of the space suit is soundproof. |
| ☐ | Sound cannot travel through a vacuum. |
| ☐ | Sound of frequency 12 kHz cannot travel through the air in the spacesuit. |
| ☐ | Sound of frequency 12 kHz cannot be heard by any human ear. |

[1]

(c) Some training for space travel is carried out under water.

(i) State an approximate value for the speed of sound in water.

..... [1]

(ii) Calculate the wavelength in water of a sound wave of frequency 12 kHz.

wavelength = ... [2]

(d) Fig. 6.2 shows successive crests of a water wave approaching a narrow gap in a barrier.

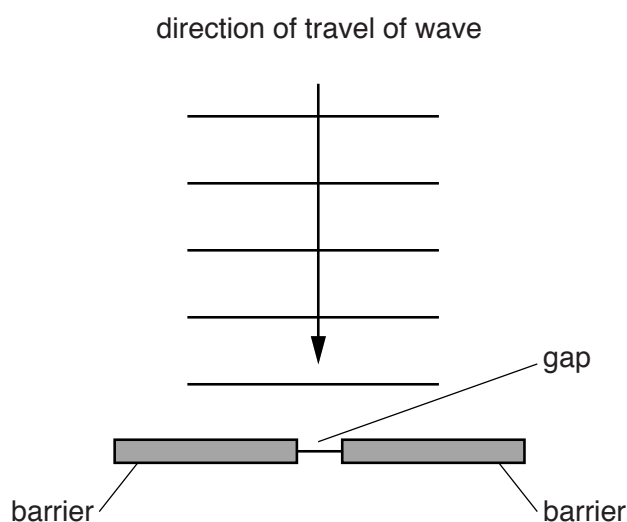


Fig. 6.2

On Fig. 6.2, draw three crests of the wave that have just passed through the gap in the barrier. [3]

[Total: 9]

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12. Question part 1/2 | 0625 Oct-Nov 2016 P4 V2 Q8

- 8** A student draws a diagram to represent the electromagnetic spectrum.

Fig. 8.1 is the student's diagram.

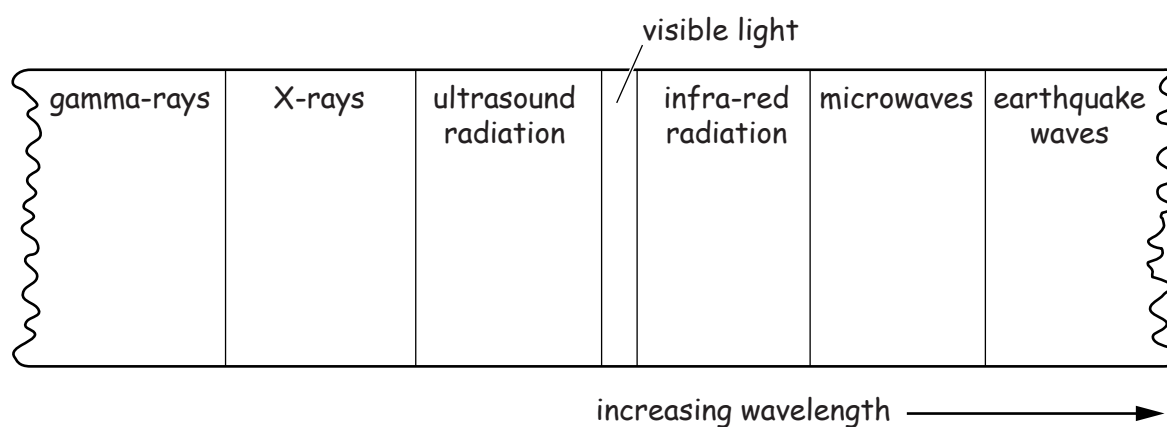


Fig. 8.1

The student has made two mistakes.

- (a)** On Fig. 8.1, cross out what is wrong and correct the diagram. [2]

- (b)** The speed of light in an optical fibre is $2.0 \times 10^8 \text{ m/s}$.

- (i)** State the speed of light in a vacuum.

speed of light = ... [1]

- (ii)** For light in the material from which the optical fibre is made, calculate

- 1.** the refractive index,

refractive index = ... [2]

- 2.** the critical angle.

critical angle = ... [2]

(iii) Fig. 8.2 shows a section of the optical fibre.

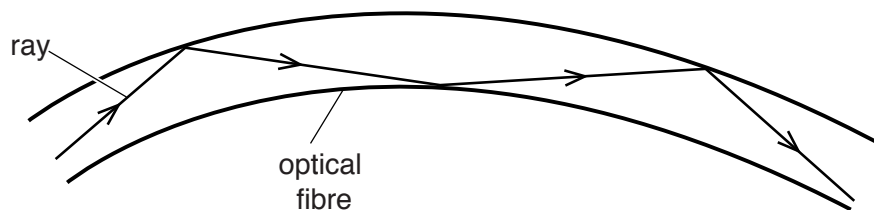


Fig. 8.2

Light is travelling in the optical fibre.

State the full name of the process that takes place each time the light changes direction.

..... [1]

[Total: 8]

- 6 (a)** Fig. 6.1 shows the crests of a wave in the sea as it reaches the entrance to a harbour.

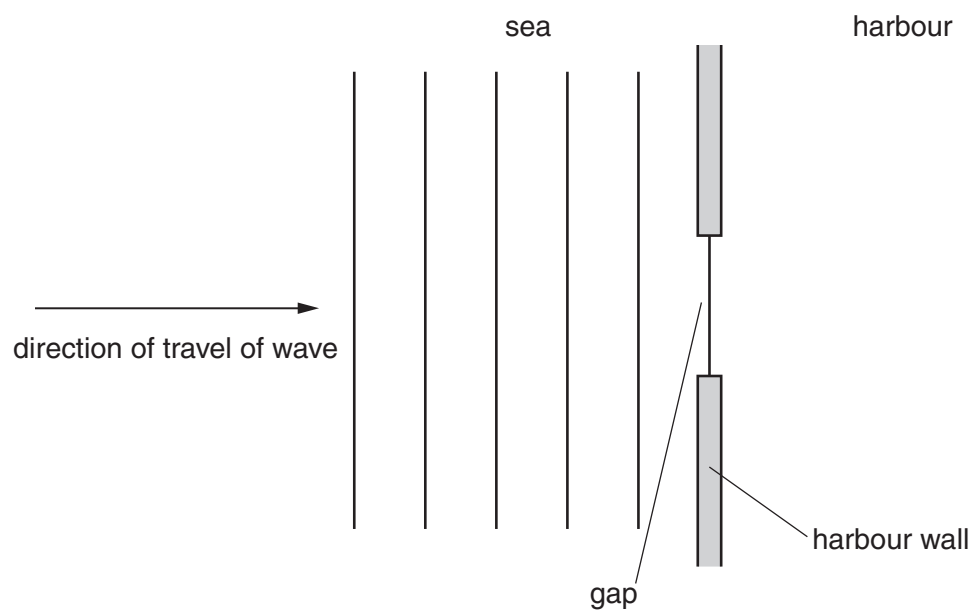


Fig. 6.1

- (i)** The wave reaches the gap in the harbour wall and passes into the harbour.

On Fig. 6.1, draw the first three crests to the right of the harbour wall.

[3]

(ii) A wave with a larger wavelength approaches the harbour. Fig. 6.2 shows this wave.

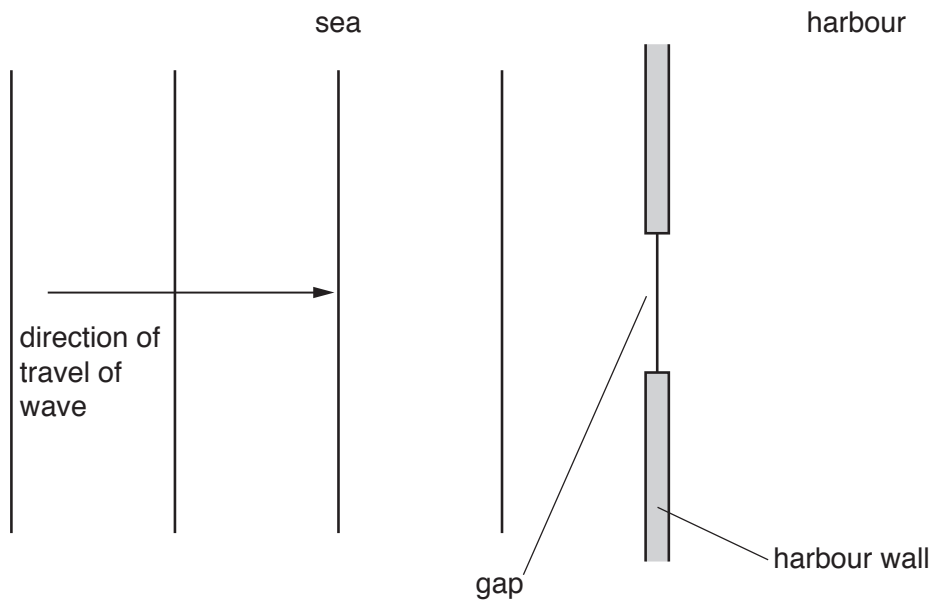


Fig. 6.2

This second wave reaches the gap in the harbour wall and passes into the harbour.

On Fig. 6.2, draw the first three crests to the right of the harbour wall. [1]

(b) An earthquake produces two types of wave, P-waves and S-waves.

The vibrations in P-waves are parallel to the direction of travel of the wave.
The vibrations in S-waves are perpendicular to the direction of travel of the wave.

Place **one** tick for each type of wave, to indicate whether it is longitudinal or transverse.

type of wave	longitudinal wave	transverse wave
electromagnetic wave		
P-wave		
S-wave		
sound wave		
ultrasound wave		

[3]

[Total: 7]

- 7 Some of the components of the electromagnetic spectrum, in order of decreasing wavelength, are shown.

radio waves microwaves visible light ultraviolet radiation gamma rays

- (a) (i) State the speed at which all electromagnetic waves travel in a vacuum.

..... [1]

- (ii) State which of the components of the electromagnetic spectrum shown has the lowest frequency.

..... [1]

- (iii) Two components of the electromagnetic spectrum are not listed above.

State the names of these components.

1.

2.

[2]

- (b) One application of microwaves is in microwave ovens, which cook food very quickly.

Fig. 7.1 shows the inside of the glass door of a microwave oven, covered with a metal mesh.

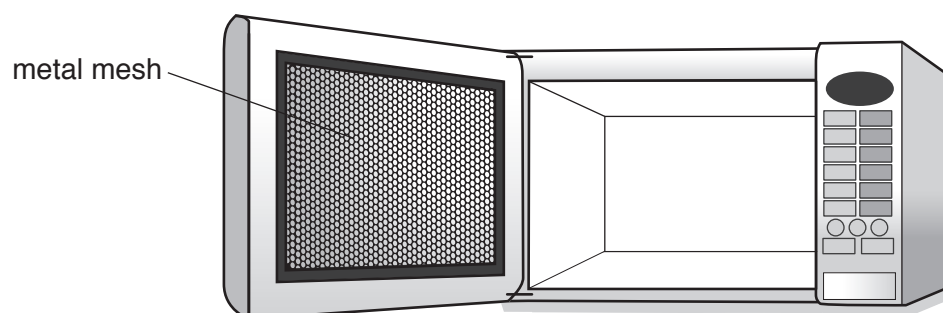


Fig. 7.1

The metal mesh prevents the microwaves from escaping by reflecting them back into the oven.

- (i) Suggest **one** reason why it is sensible to prevent microwaves from escaping.

.....

..... [1]

- (ii) State **one** further application of microwaves, other than in microwave ovens.

..... [1]

[Total: 6]

8 For blue light, the refractive index of a particular type of transparent plastic is 1.5.

(a) Calculate the critical angle for blue light in this type of plastic.

critical angle = ... [2]

(b) A block is made of this type of plastic. Blue light travelling in a vacuum is incident on the side of the block at point P.

Fig. 8.1 shows that the angle of incidence is 45° .

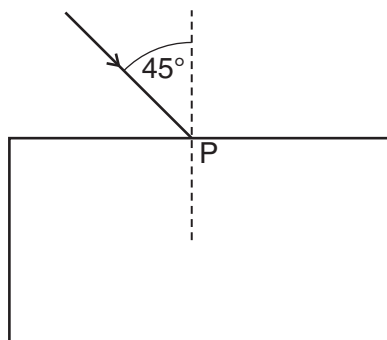


Fig. 8.1

At P, some of the light is refracted into the block and some of the light is reflected.

(i) The blue light used in this experiment is monochromatic.

State, in terms of a measurable quantity, what is meant by *monochromatic*.

..... [1]

(ii) Calculate the angle of refraction of the light in the block.

angle of refraction = ... [2]

(iii) On Fig. 8.1, draw the path taken by the light that passes into the block and the path of the light that is reflected at P. [1]

[Total: 6]

- 6 Fig. 6.1 shows a scale drawing of plane wavefronts approaching a gap in a barrier.

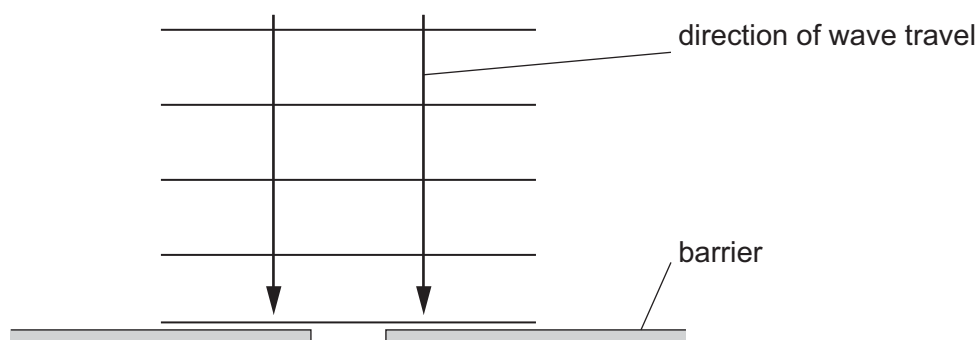


Fig. 6.1

- (a) On Fig. 6.1, draw the pattern of the wavefronts after the wave has passed through the gap. [2]
- (b) The wave approaching the barrier has a wavelength of 2.5 cm and a speed of 20 cm/s.
- Calculate the frequency of the wave.

frequency = ... [2]

- (c) State what happens, if anything, to the frequency of the wave as it passes through the gap.

..... [1]

(d) Explain, in terms of diffraction, why a car radio may pick up low frequency radio signals but not pick up high frequency radio signals when the car is travelling behind a hill.

.....

.....

..... [2]

[Total: 7]

- 7 Fig. 7.1 shows an object and its image formed by a converging lens. One ray from the tip of the object to the tip of the image is shown.

Fig. 7.1 is drawn full size.

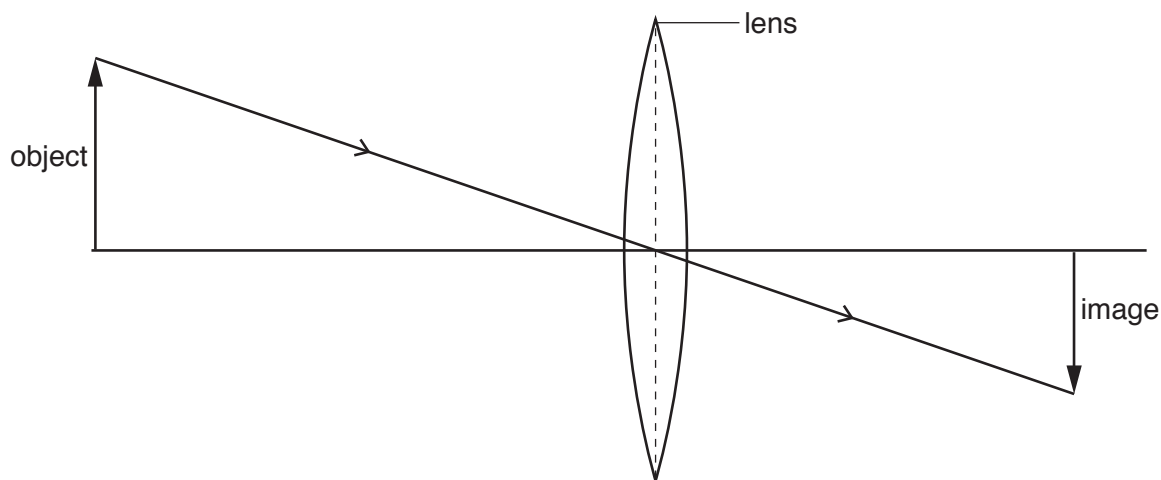


Fig. 7.1

- (a) Place a tick (✓) in **all** boxes that correctly describe the image.

☐	diminished
☐	enlarged
☐	inverted
☐	upright
☐	real
☐	virtual

[2]

- (b) On Fig. 7.1, draw a ray, passing through a principal focus of the lens, from the tip of the object to the tip of the image. Label the principal focus F. [1]

- (c) Use the ray you have drawn in (b) to determine the focal length of the lens.

focal length = ... [1]

- (d) Draw another ray, **not** passing through a principal focus of the lens, that passes from the tip of the object to the tip of the image. [1]

[Total: 5]

- 6 (a)** A ray of light in glass is incident on a boundary with air.

State what happens to the ray when the angle of incidence of the ray is

- (i) less than the critical angle of the glass,

.....[1]

- (ii) greater than the critical angle of the glass.

.....[1]

- (b)** Fig. 6.1 shows a ray of light incident on a glass block at A. The critical angle of the glass is 41° .

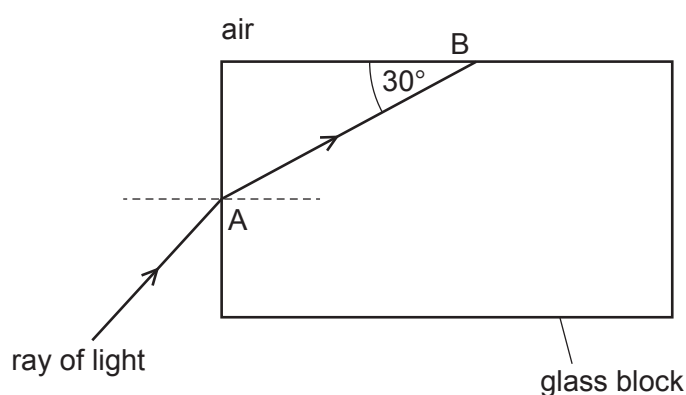


Fig. 6.1 (not to scale)

- (i) On Fig. 6.1, without calculation, continue the ray from point B until it leaves the glass block. [2]
- (ii) Calculate the refractive index of the glass.

refractive index = ...[2]

[Total: 6]

7 A loudspeaker produces a sound wave of constant frequency.

(a) State what is meant by *frequency*.

.....
[1]

(b) The sound wave travels in air towards a barrier with a small gap at its centre. Fig. 7.1 represents the compressions of the wave travelling towards the barrier.

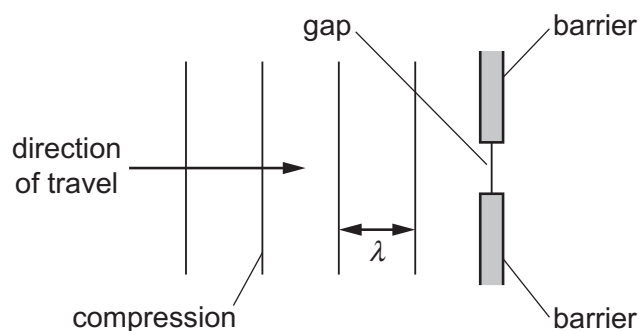


Fig. 7.1

(i) State what is meant by a *compression*.

.....[1]

(ii) The width of the gap is smaller than the wavelength λ of the wave.

On Fig. 7.1, draw the pattern of the compressions after the sound wave has passed through the gap. [2]

(iii) The barrier is adjusted so that the gap becomes wider.

Describe how this affects the pattern of the compressions after the sound wave has passed through the gap.

.....

[1]

0625 Physics Paper 4 - Waves

Topical questions | 131 questions

19. Question part 2/2 | 0625 May-June 2017 P4 V1 Q7

(c) The frequency of the sound wave is 6800 Hz. The speed of sound in air is 340 m/s.

(i) Calculate the wavelength of the sound wave in air.

wavelength = ...[2]

(ii) State a typical value for the speed of sound in a liquid.

.....[1]

[Total: 8]

- 6 (a)** The graph in Fig. 6.1 represents a wave on a rope.

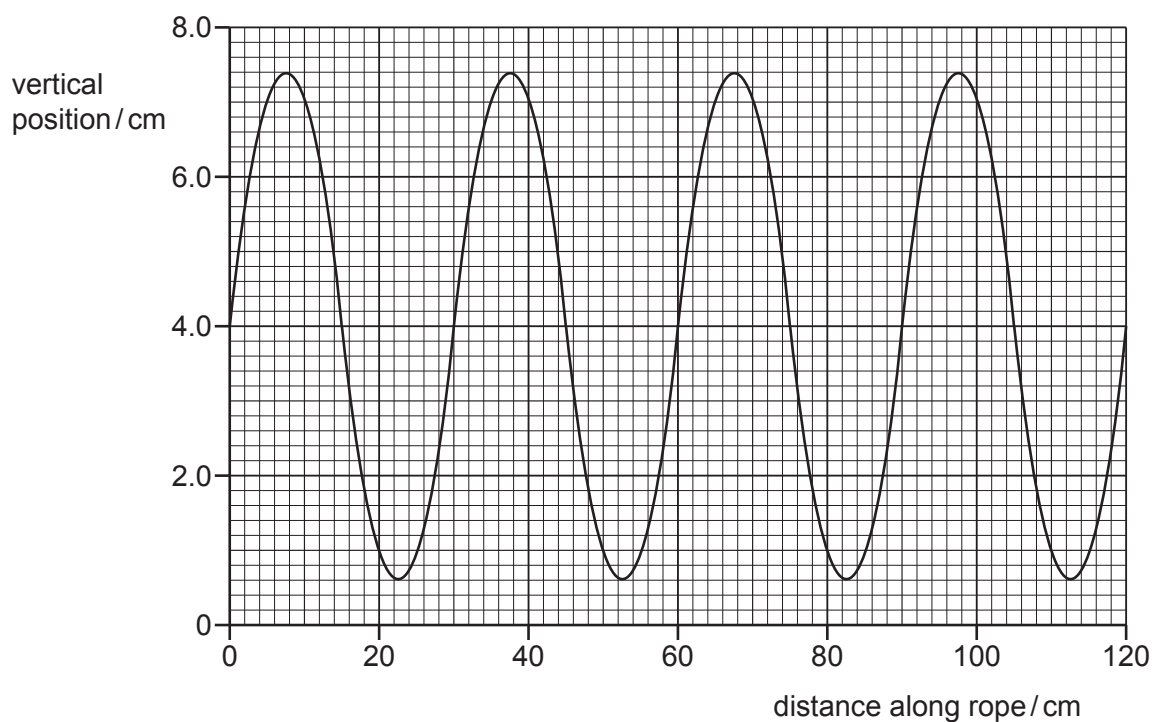


Fig. 6.1

Using Fig. 6.1, determine

- (i)** the amplitude of the wave,

amplitude = ...[1]

- (ii)** the wavelength of the wave.

wavelength = ...[1]

- (b) A wave travelling on the surface of water has a wavelength of 2.5 cm and a speed of 8.0 cm/s.

Calculate the frequency of the wave.

frequency = ...[2]

- (c) The wave in (b) approaches a barrier that has a large gap in its centre.

Fig. 6.2 shows the crests of the wave viewed from above.

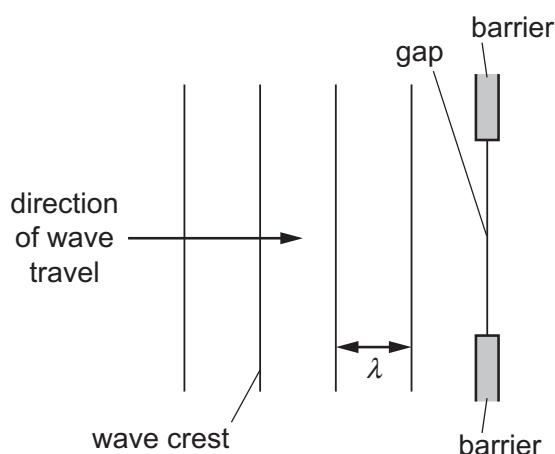


Fig. 6.2

The gap in the barrier is larger than the wavelength λ .

- (i) On Fig. 6.2, draw the pattern formed by three crests after the wave passes through the gap in the barrier. [2]
- (ii) Water is added to the tank and the speed of a wave in the deeper water is greater than that in the shallower water. The frequency of the wave remains constant but its wavelength is different.

1. State and explain how the wavelength in the deeper water has changed.

.....
[1]

2. Apart from the change in wavelength, describe **one** other difference in the pattern formed by the crests after the wave passes through the gap.

.....
[1]

[Total: 8]

0625 Physics Paper 4 - Waves

Topical questions | 131 questions

21. Question part 1/2 | 0625 May-June 2017 P4 V2 Q7

- 7 (a)** The speed of light in air is $3.0 \times 10^8 \text{ m/s}$.
The speed of light in a transparent liquid is $2.0 \times 10^8 \text{ m/s}$.

A ray of light is incident on the surface of the liquid at an angle of incidence of 40° .

Calculate

- (i)** the refractive index of the liquid,

refractive index = ...[2]

- (ii)** the angle of refraction in the liquid.

angle of refraction = ...[2]

- (b) Fig. 7.1 shows a side view of an object at the bottom of a tank of liquid. Light travels slower in this liquid than in air.

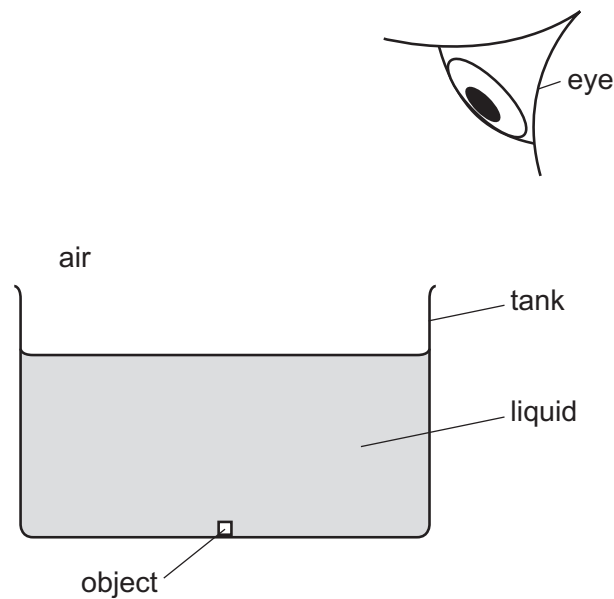


Fig. 7.1

On Fig. 7.1, draw **two** rays from the object into the air. Use these rays to locate the image. Label this image I.

[3]

[Total: 7]

- 7** A loudspeaker is built into the side of a swimming pool. The loudspeaker produces sound waves in the water of wavelength 0.25 m.

- (a) (i)** The frequency of the sound waves is 6.0 kHz.

Calculate the speed of the sound waves in water.

speed of sound waves in water = ...[2]

- (ii)** State a typical value for the speed of sound in air.

speed of sound in air = ...[1]

- (iii)** State and explain, for the sound produced by the loudspeaker, how the wavelength of the sound in air compares with the wavelength of the sound in water.

.....
.....[1]

- (b)** Sound is a longitudinal wave.

Explain what is meant by a *longitudinal wave*.

.....
.....
.....[2]

- (c)** The sound emerges from the loudspeaker through a gap. The sound diffracts as it passes through the gap.

- (i)** State how the width of the gap affects the diffraction.

.....
.....[1]

- (ii)** State how the wavelength of the sound affects the diffraction.

.....
.....[1]

[Total: 8]

- 8 Red light travelling in air strikes the curved surface of a semi-circular glass block at P. Fig. 8.1 shows the ray of light.

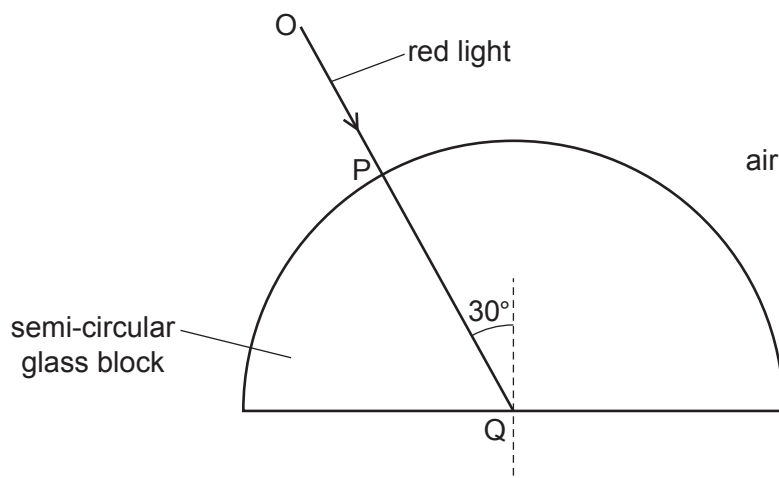


Fig. 8.1

The light travels in a straight line from O to Q.

- (a) Explain why the light does **not** change direction as it enters the glass block at P.

.....
[1]

- (b) The light travels in the glass to Q where it strikes the edge of the block at 30° to the normal. The light then emerges into the air.

- (i) The refractive index of the glass is 1.5.

Calculate the angle between the normal and the ray in the air after the light emerges from the block at Q.

angle = ...[3]

- (ii) On Fig. 8.1, sketch the path of the light in the air after it emerges at Q. [1]

- (c) The direction of the light striking the curved surface of the glass block is changed. The angle between the ray and the normal at Q gradually increases from 30° to 90° .

Describe what happens to the light that strikes the block at Q as this angle increases.

.....

.....

.....

.....

.....

.....[3]

[Total: 8]

- 5 (a) A wave passes through a gap in a barrier. The wavelength of the wave is the same magnitude as the width of the gap in the barrier.

Tick **one** box to indicate what happens to the wave.

diffraction and dispersion	
diffraction only	
dispersion only	
refraction and diffraction	
refraction and dispersion	
refraction only	

[1]

- (b) Fig. 5.1 shows six wavefronts of a wave travelling on the surface of deep water. The wave is incident on a boundary with a region where the water is shallow.

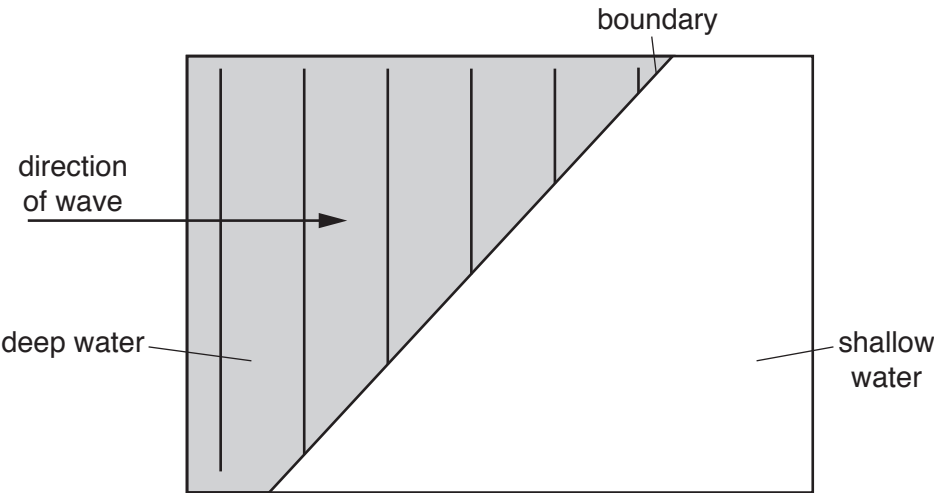


Fig. 5.1

- (i) On Fig. 5.1, draw the wavefronts of the wave in the shallow water where the wave travels more slowly. [2]
- (ii) The depth of the shallow water is now changed so that the speed of the wave in the shallow water is 0.60 m/s. The speed of the wave in the deep water is 0.80 m/s. The distance between successive wavefronts in the deep water is 1.4 cm.

Calculate the wavelength of the wave in the shallow water.

wavelength = ... [4]

[Total: 7]

- 6 (a) The left-hand column of the table shows some possible speeds of a sound wave.
- In the right-hand column, write down the medium in which a sound wave has this speed.
- Choose from solid, liquid or gas.

<u>speed of sound wave</u> m/s	medium
1500	
5000	
300	

[2]

- (b) Fig. 6.1 represents a series of compressions and rarefactions of a sound wave.



Fig. 6.1

- (i) On Fig. 6.1, mark, with the letters X and Y, the mid-points of **two** rarefactions. [1]
- (ii) State, in terms of pressure, what is meant by a *rarefaction*.

.....

.....[1]

- (c) Astronauts set up a mirror on the Moon’s surface. A laser beam is transmitted from the Earth’s surface to the mirror and is then reflected back to Earth.

On a certain day, the time between transmitting the beam from a point on the Earth’s surface and receiving the reflected signal at the same point is 2.56 s.

The speed of the laser beam is 3.00×10^8 m/s.

Calculate the distance between the Earth’s surface and the Moon’s surface.

distance = ...[3]

[Total: 7]

- 7 (a) Fig. 7.1 shows a converging lens and its principal axis. The points labelled F are each a principal focus of the lens.

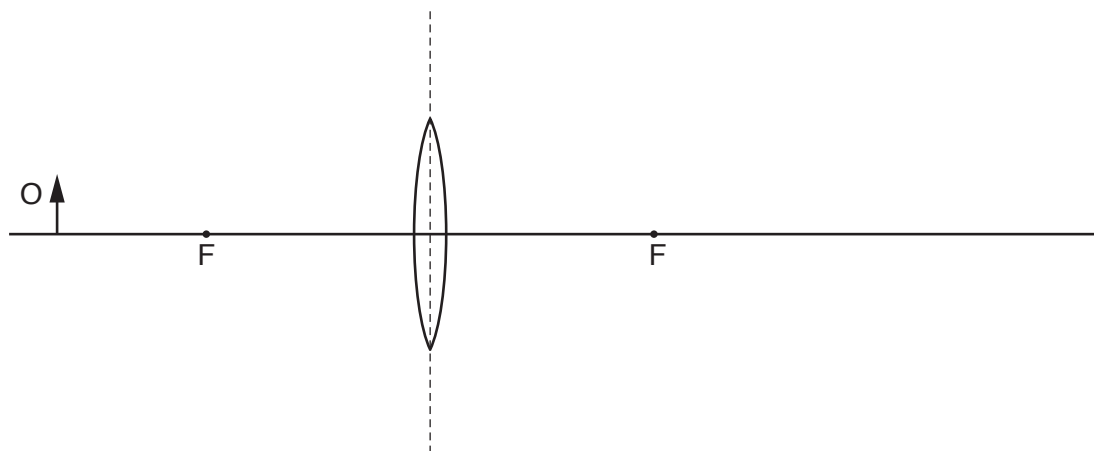


Fig. 7.1

On Fig. 7.1, draw **two** rays from the top of the object O, to locate the image of O.
Label the image I.

[3]

- (b) Underline **three** of the terms below to describe the nature of the image produced by a converging lens used as a magnifying glass.

diminished **enlarged** **inverted** **real** **same size** **upright** **virtual**

[2]

- (c) Fig. 7.2 shows the path of a ray of red light passing through a glass prism.

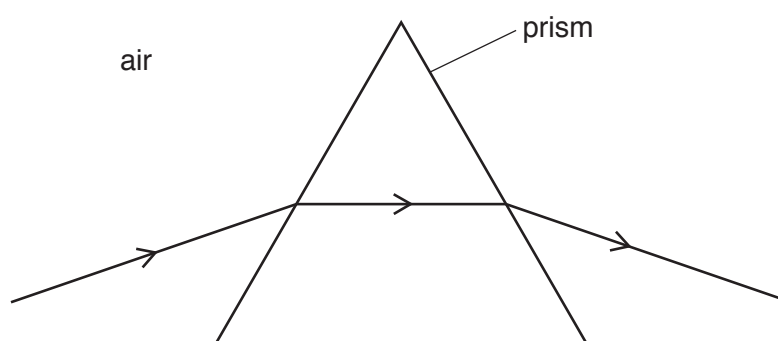


Fig. 7.2

A ray of green light enters the prism along the same path as the ray of red light.

On Fig. 7.2, draw the path of the ray of green light as it passes through the prism and emerges into the air.

[2]

[Total: 7]

- 6 Fig. 6.1 represents wavefronts of a water wave on the surface of water approaching a gap in a barrier.

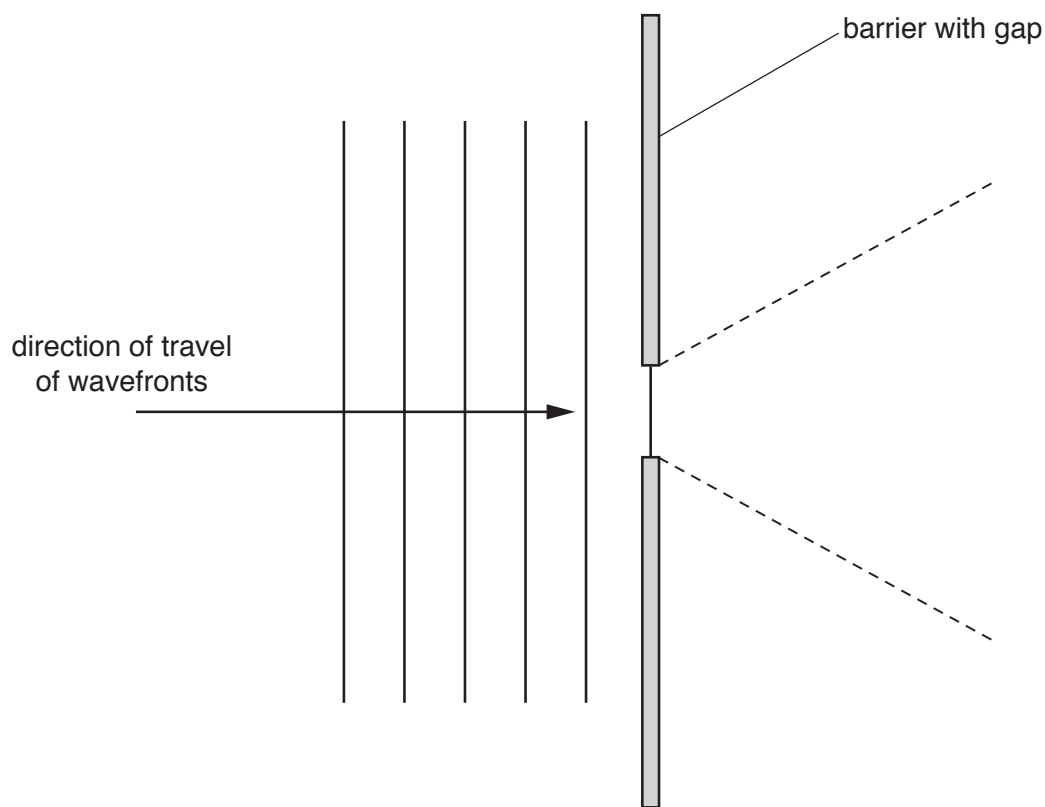


Fig. 6.1

- (a) The wavefronts to the right of the barrier spread out as far as the dashed lines in Fig. 6.1.

- (i) State the name of the process of spreading out.

.....[1]

- (ii) Draw **four** wavefronts to the right of the barrier. [2]

- (b) (i) State the effect of increasing the width of the gap in the barrier.

.....
[1]

- (ii) State and explain the effect of decreasing the frequency of the water wave.

.....

[2]

[Total: 6]

- 7 (a) Fig. 7.1 is a diagram of a converging lens used to produce an image of an object. Each point marked F is a principal focus.

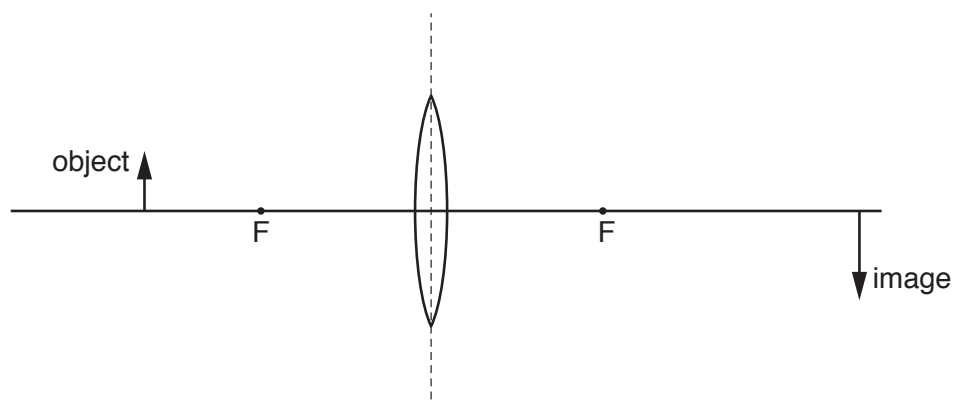


Fig. 7.1

Write down **three** terms that describe the image produced.

.....

.....

.....[3]

- (b) Fig. 7.2 shows a plane mirror, a point object O and an observer's eye.

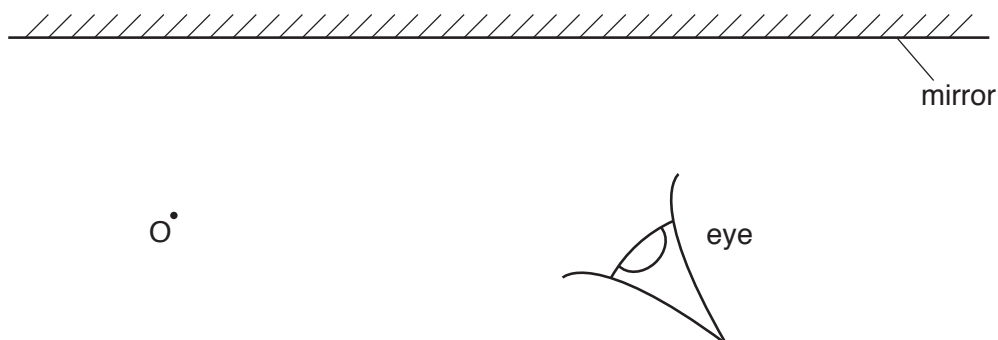


Fig. 7.2

- (i) On Fig. 7.2, draw **two** rays from the object reflected to the observer's eye. [2]
- (ii) On Fig. 7.2, complete your drawing to determine the position of the image of the object O. Label this image I. [2]

[Total: 7]

6 Visible light is one component of the electromagnetic spectrum.

(a) (i) In the table, place a tick in the box next to the approximate value of the speed of light in air. [1]

speed m/s	
3.0×10^{10}	
3.0×10^8	
3.0×10^6	
3.0×10^4	
3.0×10^2	

(ii) The frequency of a light wave is 4.8×10^{14} Hz.

Calculate the wavelength of this light in air.

wavelength = ...[2]

(b) Light is travelling in an optical fibre that is made of glass.

(i) The glass has a refractive index of 1.5.

1. Explain why the quantity *refractive index* does **not** have a unit.

.....
.....[1]

2. Calculate the speed of light in the glass.

speed = ...[2]

(ii) Describe **one** use of optical fibres in communication technology.

.....
.....
.....
.....
.....[3]

- 7 (a) Fig. 7.1 shows a converging lens and its principal axis. The points F_1 and F_2 are each a principal focus of the lens.

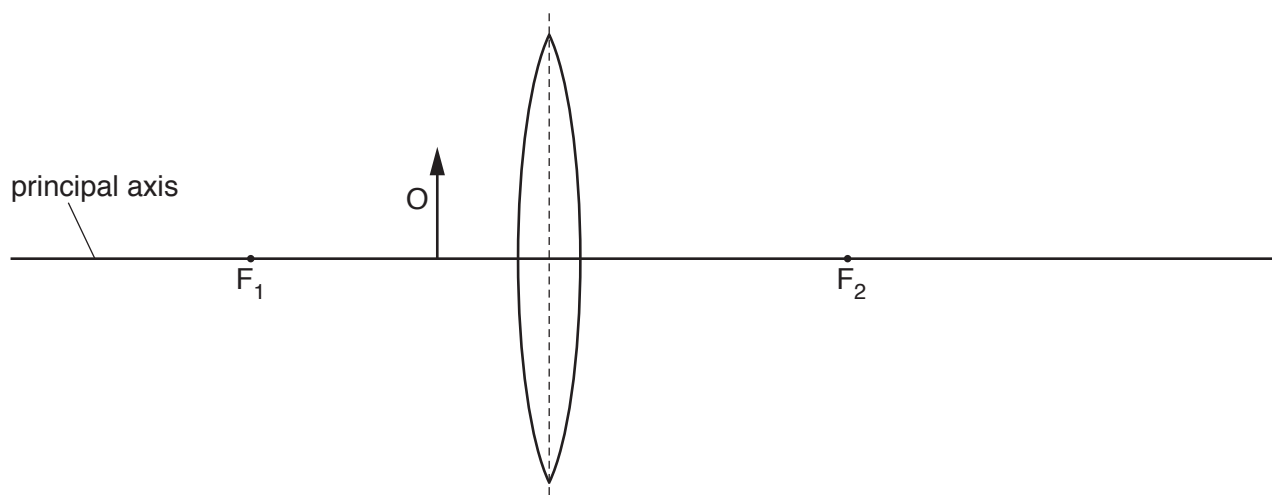


Fig. 7.1

An object O is placed between F_1 and the lens.

- (i) On Fig. 7.1, draw **two** rays from the top of the object O to locate the image. Label the image I. [3]
- (ii) The object O is moved to the left along the principal axis so that it is further from the lens than F_1 .

Fig. 7.2 is a diagram of the new arrangement with the new image shown.

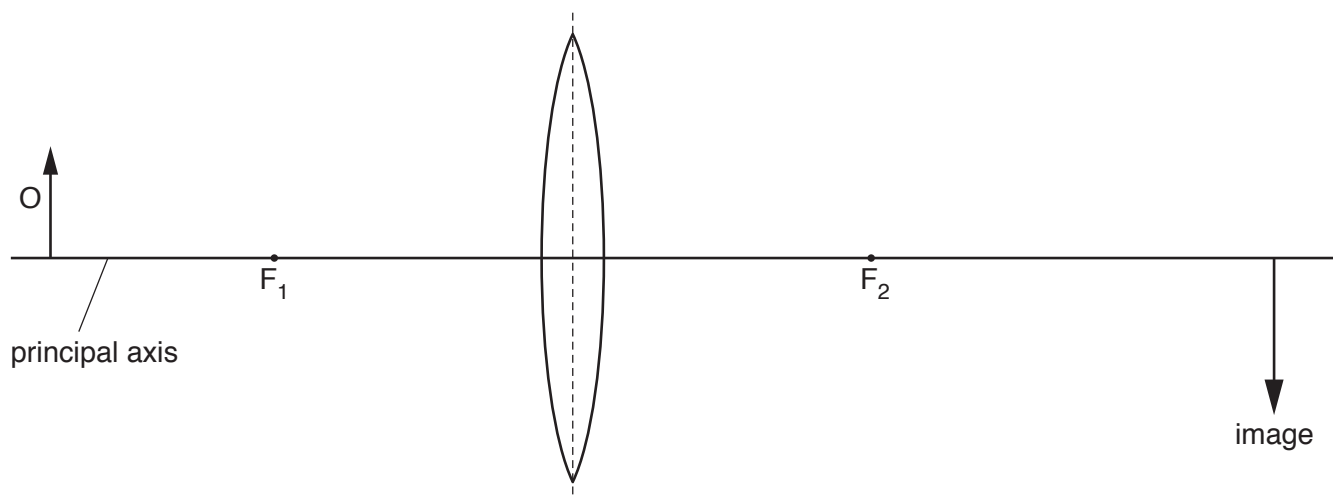


Fig. 7.2

Underline **three** of the terms below that describe the image shown in Fig. 7.2. [2]

diminished **enlarged** **inverted** **real** **same size** **upright** **virtual**

(b) Fig. 7.3 shows yellow light passing through a glass prism.

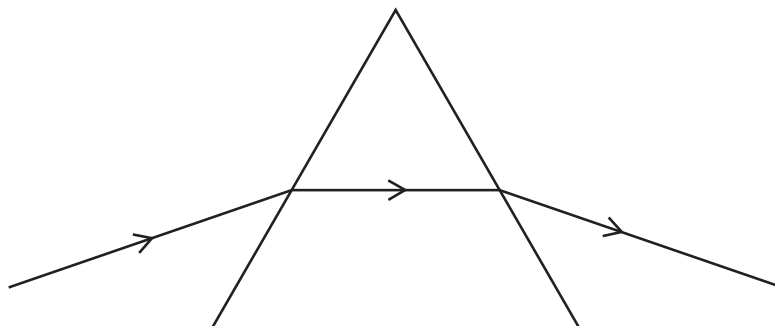


Fig. 7.3

Blue light enters the prism along the same path as the yellow light.

On Fig. 7.3, draw the path of the blue light as it enters, passes through and leaves the prism.
[2]

[Total: 7]

- 5 (a)** A ray of light in air is incident on a glass block. The light changes direction.

State

- (i) the name of this effect,

.....[1]

- (ii) the cause of this effect.

.....[1]

- (b)** Fig. 5.1, drawn to full scale, shows a thin converging lens of focal length 3.5 cm.

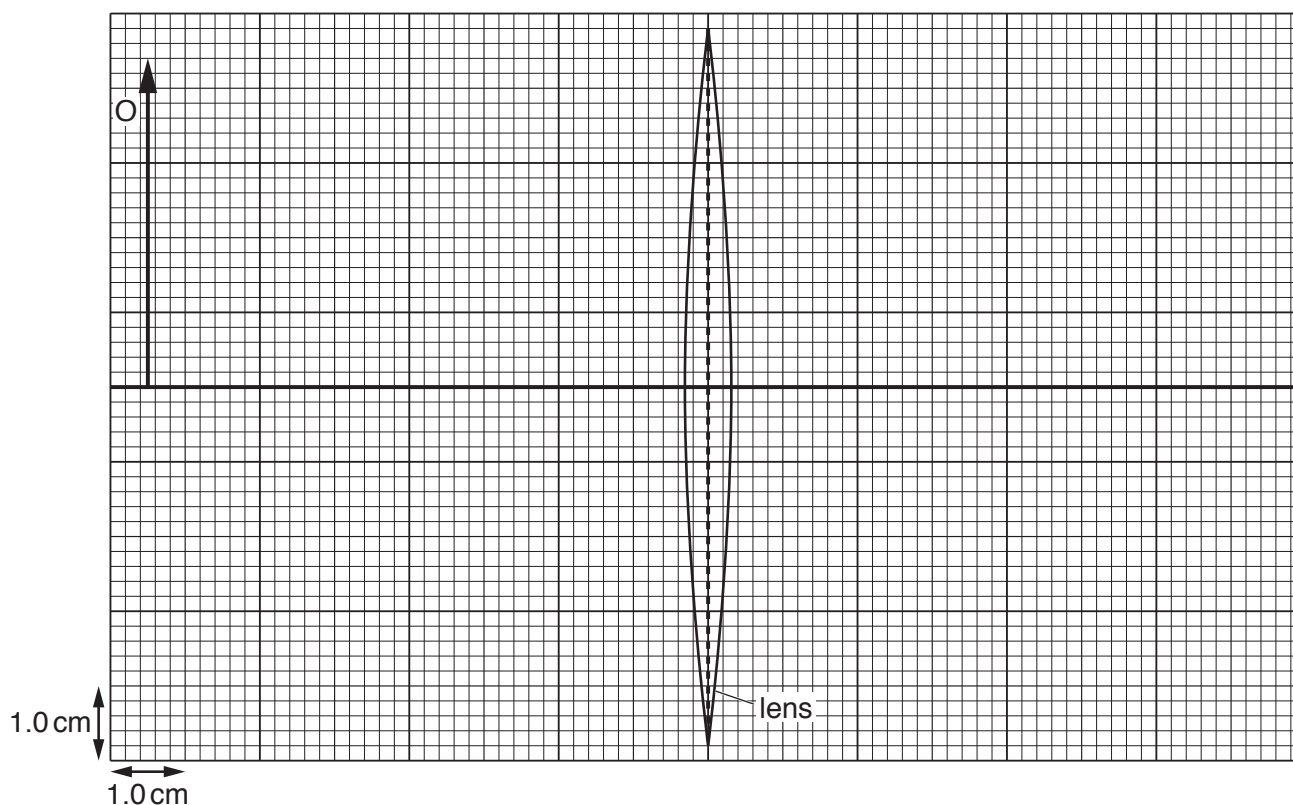


Fig. 5.1

- (i) On Fig. 5.1, mark each of the two principal focuses and label each with the letter F. [1]

- (ii) An object O of height 4.4 cm is placed a distance of 7.5 cm from the lens.

On Fig. 5.1, draw rays from the tip of the object O to locate the image. Draw and label the image. [3]

- (iii) Determine the height of the image.

height of the image = ...[1]

- (iv) State and explain whether the image is real or virtual.

.....
[1]

[Total: 8]

- 6 (a) Fig. 6.1 shows wavefronts approaching a gap in a barrier.

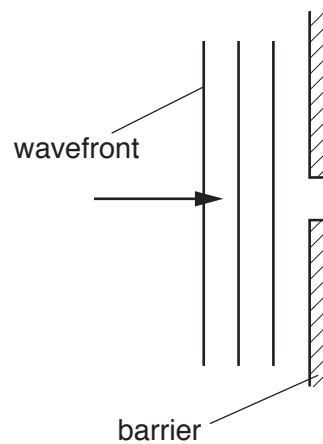


Fig. 6.1

- (i) On Fig. 6.1, draw **three** wavefronts to the right of the barrier. [2]
- (ii) Fig. 6.2 shows the gap in the barrier increased to five times the gap in Fig. 6.1.

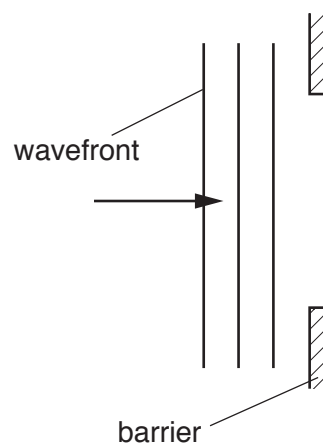


Fig. 6.2

- On Fig. 6.2, draw **three** wavefronts to the right of the barrier. [2]

(b) Describe, with a labelled diagram, an experiment using water waves that shows the reflection of wavefronts that occur at a straight barrier.

.....

.....

.....

.....

.....

.....[4]

[Total: 8]

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33. Question part 1/2 | 0625 May-June 2018 P4 V2 Q6

6 (a) Circle **two** of the following that apply to an ultrasound wave travelling in air.

- frequency 3.5 Hz frequency 350 Hz frequency 35 000 Hz longitudinal
- transverse speed 1.5 m/s speed 1.5×10^3 m/s speed 1.5×10^6 m/s

[2]

(b) Calculate the wavelength in a vacuum of X-rays of frequency 1.3×10^{17} Hz.

wavelength = ...[3]

(c) A dentist takes an X-ray photograph of a patient’s teeth. Explain why it is safe for the patient to be close to the source of X-rays, but the dentist must stand away from the source.

.....

.....

.....

.....[2]

(d) State, with a reason, why microwave ovens are designed only to work with the door closed.

.....

.....

.....[2]

[Total: 9]

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34. Question part 1/2 | 0625 May-June 2018 P4 V2 Q7

- 7 (a) Fig. 7.1 shows a ray of light in water that is incident on a submerged, transparent plastic block.

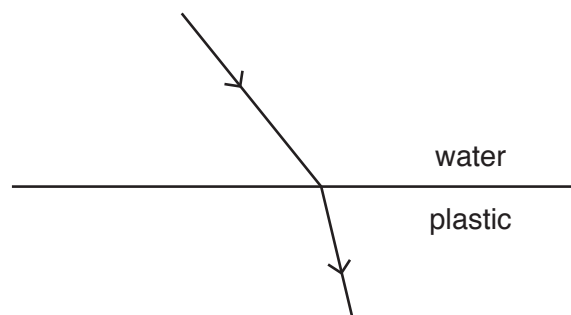


Fig. 7.1

State what happens to the speed of light as it enters the plastic block. Explain your answer.

.....

 [2]

- (b) Fig. 7.2 shows the two principal focuses F_1 and F_2 of a thin converging lens.

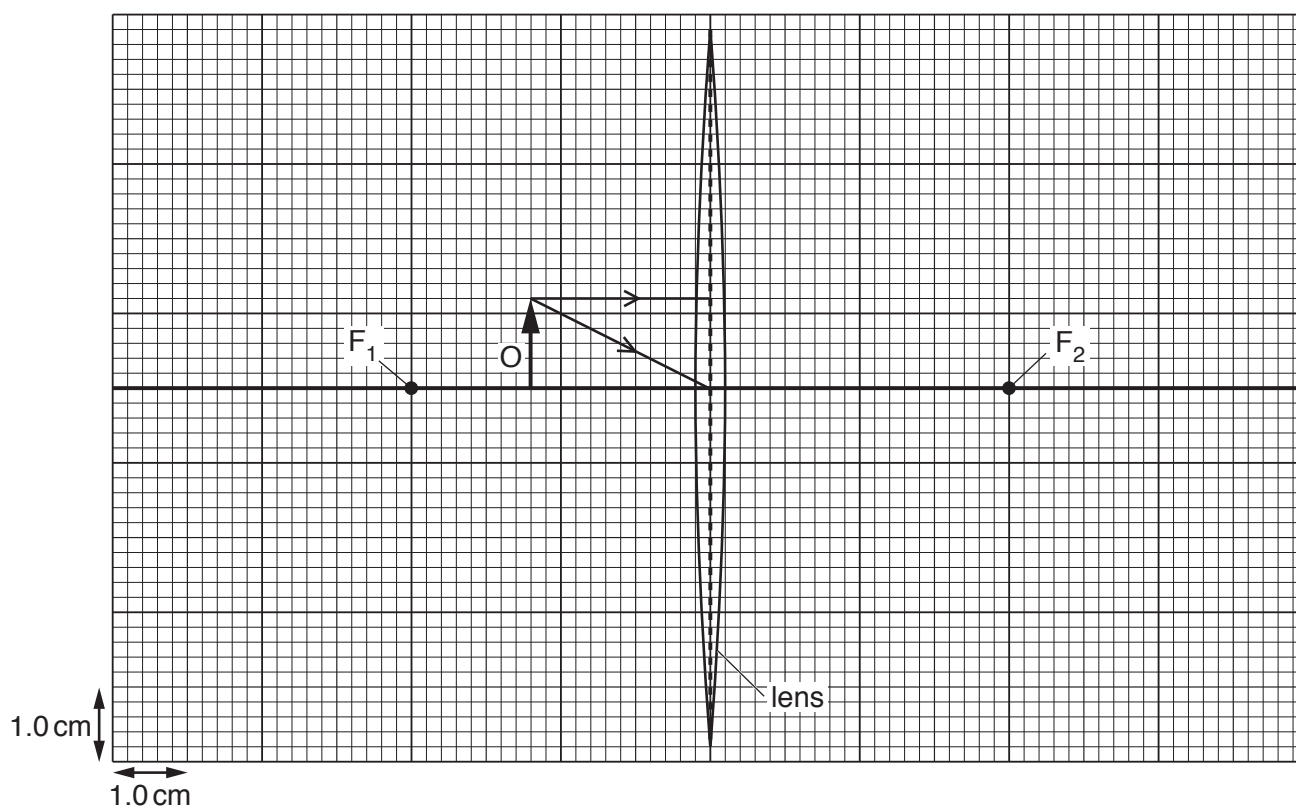


Fig. 7.2

Fig. 7.2 also shows an object O of height 1.2 cm placed close to the lens. Two rays from the tip of the object O are incident on the lens.

34. Question part 2/2 | 0625 May-June 2018 P4 V2 Q7

- (i) On Fig. 7.2, continue the paths of these two rays for a further distance of at least 5 cm. [2]
- (ii) Using your answer to (b)(i), find and mark on Fig. 7.2 the image I of object O and label this image. [2]

(iii) Determine the height of image I.

height = ...[1]

(iv) State and explain whether I is a real image or a virtual image.

.....
.....[1]

[Total: 8]

6 Sound is a longitudinal wave.

(a) Sketch a representation of a longitudinal wave. On your sketch

- indicate and label a distance to show the wavelength,
- mark and label the centre of one compression,
- mark and label the centre of one rarefaction.

[3]

(b) A longitudinal wave passes from one medium into another medium. The speed of the wave is slower in the second medium.

State what happens to

(i) the frequency of the wave,

.....[1]

(ii) the wavelength of the wave.

.....[1]

(c) State a typical value for the speed of sound in air.

.....[1]

[Total: 6]

- 7 (a) A ray of light travelling in air strikes a glass block at an angle of 30° to the normal. The light slows down as it enters the glass block.

State and explain, in terms of wavefronts, what happens to the light.

.....

.....

.....

.....[3]

- (b) The speed of light in this block of glass is $1.9 \times 10^8 \text{ m/s}$.

Calculate the refractive index of the glass.

refractive index = ...[2]

[Total: 5]

37. Question part 1/2 | 0625 May-June 2018 P4 V3 Q8

- 8 (a) A thin converging lens is used to produce an image I of object O.

Fig. 8.1 shows O, I and the screen on which the image is produced.

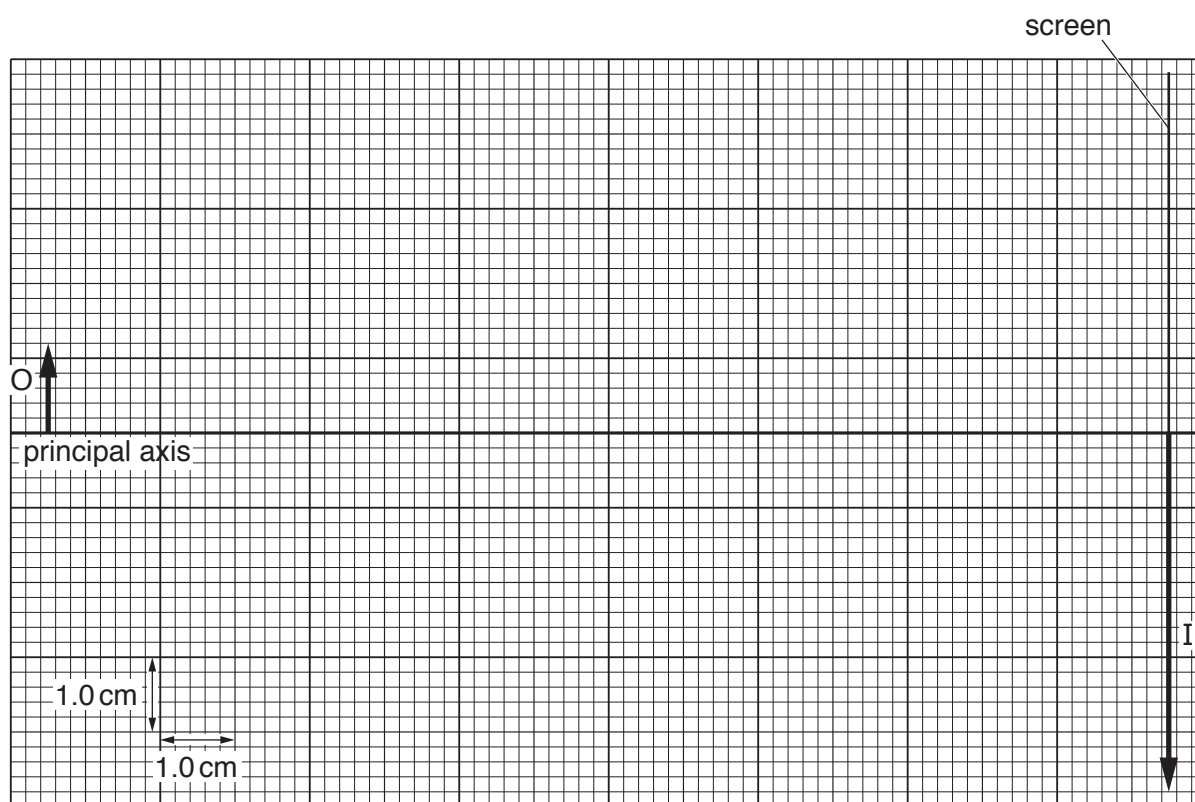


Fig. 8.1

- (i) On Fig. 8.1, draw a straight line to represent a ray from the tip of the arrowhead of O to the tip of the arrowhead of I. Draw a vertical dotted line to indicate the position of the lens. This dotted line must extend above and below the principal axis. [2]
- (ii) Draw a second ray from the tip of the object O to the tip of image I. This ray should pass through a principle focus. Label the principle focus, F. [1]
- (iii) Determine the focal length of the lens.

focal length = ...[1]

- (iv) Image I is further from the lens than object O is from the lens. Image I is described as enlarged and inverted.

State and explain one other characteristic of I.

.....

.....[1]

- (b) Fig. 8.2 shows a spherical fishbowl, full of water, by a window. A black curtain hangs behind the fishbowl.

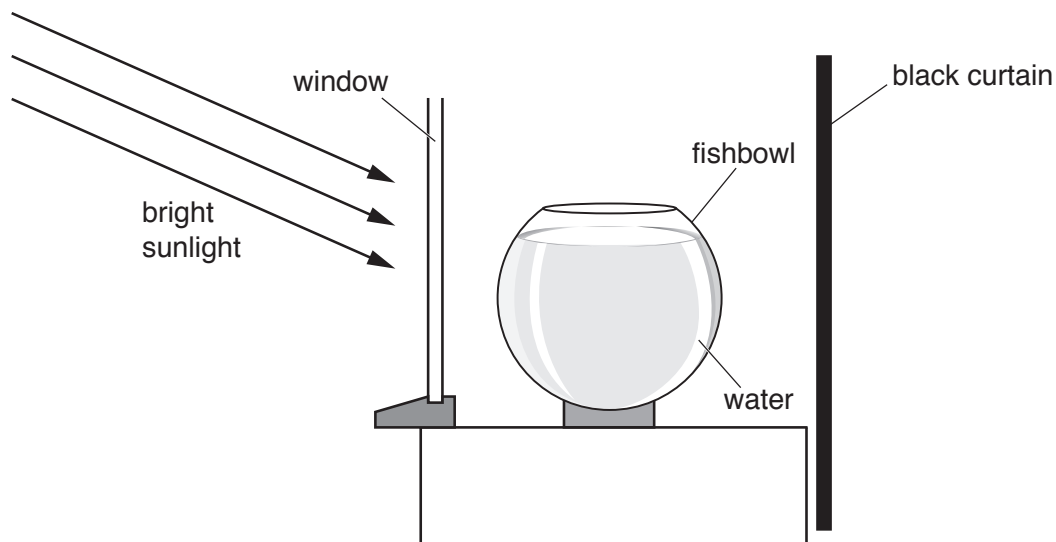


Fig. 8.2

When full of water, the fishbowl can act as a converging lens.

Suggest one possible hazard of leaving the fishbowl next to the window in bright sunlight.

.....
.....[1]

[Total: 6]

- 7 (a) A laser produces a beam of monochromatic light. State what is meant by the term *monochromatic*.

.....[1]

- (b) A wave, in air, is incident on a glass block. Fig. 7.1 shows the wavefronts at the air-glass boundary. The arrow shows the direction of travel of the wavefronts.

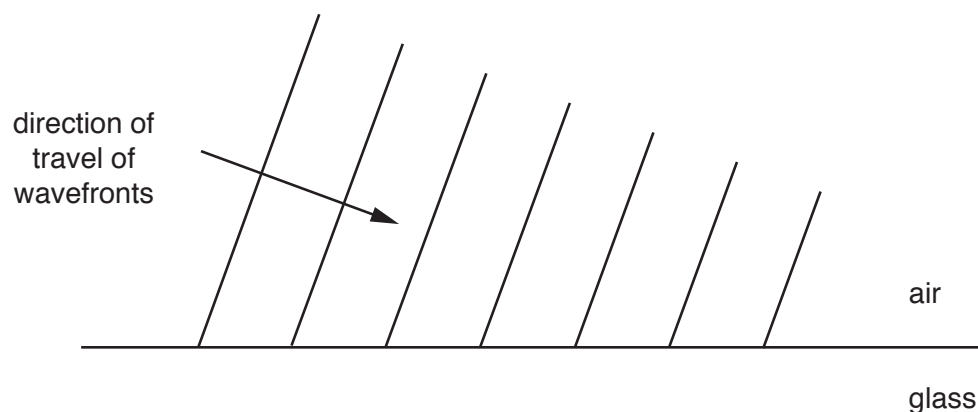


Fig. 7.1

The wave undergoes reflection and refraction at the air-glass boundary.

On Fig. 7.1 draw:

- (i) the wavefronts of the reflected wave [3]
- (ii) the wavefronts of the refracted wave. [3]
- (c) A transverse wave is produced in a long, horizontal rope. The rope is much longer than the wavelength of the wave.

In the space below, sketch a diagram to show the appearance of the rope as the wave passes along it. Label **two** important features of the wave.

[2]

[Total: 9]

8 A vibrating source on a ship produces a sound wave that travels through the ocean. The wave produced is a longitudinal wave.

(a) Explain what is meant by the term *longitudinal wave*.

.....

.....

.....

.....[3]

(b) The frequency of the sound wave is 800 Hz.

(i) The speed of sound in air is 330 m/s.

State a typical value for the speed of sound in a liquid.

..... [1]

(ii) Using your value from **(b)(i)**, calculate the wavelength of the sound wave in the ocean.

wavelength = ...[2]

[Total: 6]

- 5 (a) Fig. 5.1 shows a visible spectrum focused on a screen by passing light from a source of white light through a lens and a prism.

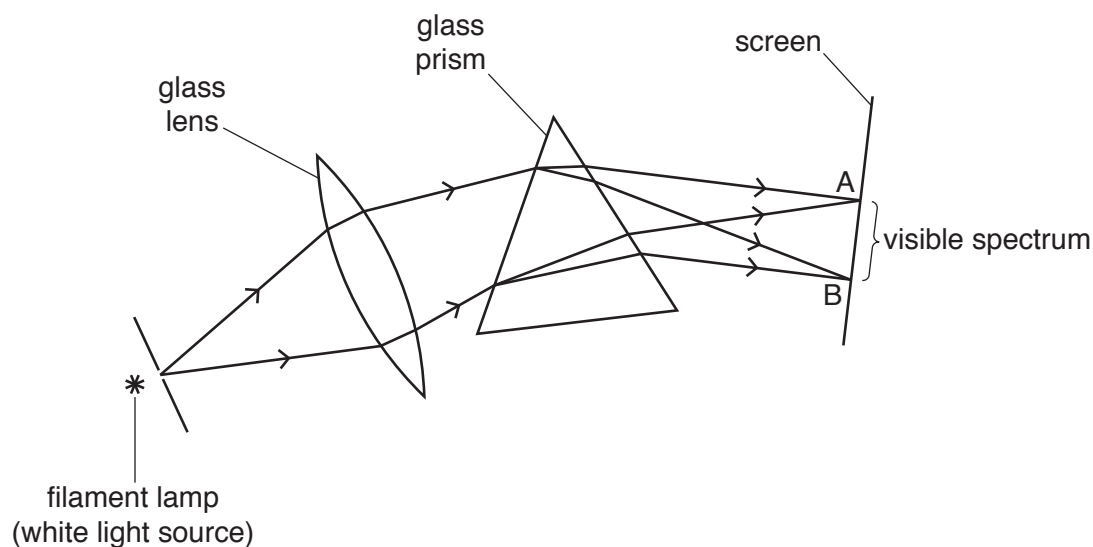


Fig. 5.1

- (i) State the name of the process that separates the colours in white light.

.....[1]

- (ii) State the colour of the light on the screen at:

point A

point B

[1]

- (iii) State the property of the glass of the prism that causes white light to be split into the different colours of the spectrum.

.....[1]

(b) Fig. 5.2 shows a section of an optical fibre in air. A ray of light is incident on the fibre wall at X.

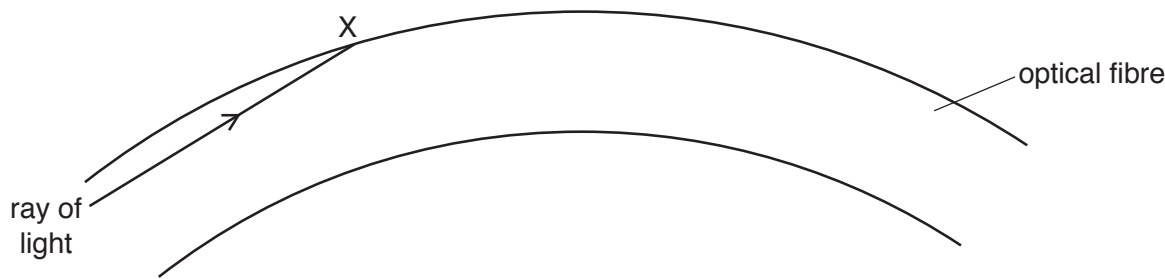


Fig. 5.2

- (i) On Fig. 5.2, continue the path of the ray of light up to the end of the fibre. [1]
- (ii) The refractive index of the material of the fibre is 1.46. Calculate the critical angle of the material of the fibre.

critical angle = ...[2]

(iii) State **two** uses of optical fibres.

- 1
- 2 [2]

[Total: 8]

- 6 Fig. 6.1 represents a sound wave of wavelength 0.45 m travelling from left to right.

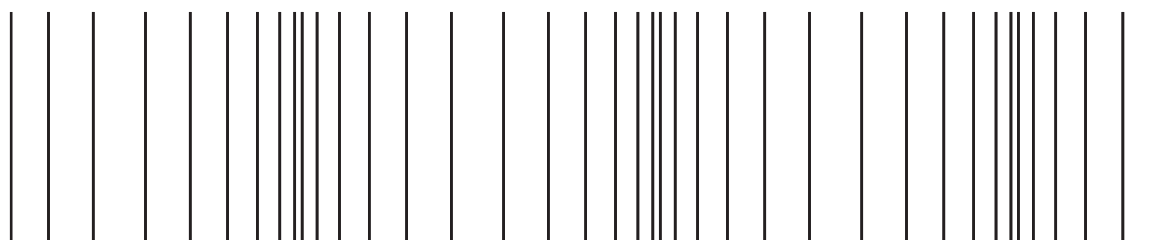


Fig. 6.1 (not to scale)

- (a) On Fig. 6.1:

(i) at the centre of a compression, mark a cross and label it C [1]

(ii) at the centre of a rarefaction, mark a cross and label it R [1]

(iii) draw a double-headed arrow to represent a distance of 0.90 m. [1]

- (b) The frequency of the wave is 750 Hz.

Calculate the speed of the wave.

speed = ...[2]

- (c) Suggest a medium through which the sound wave is travelling and state your reasoning.

medium

reason

[1]

- (d) Another type of wave that consists of compressions and rarefactions is ultrasound.

(i) State **one** other similarity between sound of frequency 750 Hz and ultrasound.

.....

.....[1]

(ii) State **one** way in which sound of frequency 750 Hz is different from ultrasound.

.....

.....[1]

[Total: 8]

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4 A wave is travelling across the surface of water in a tank at a speed of 0.15 m/s.

(a) The wavelength of the wave is 0.030 m.

Calculate the frequency of the wave.

frequency = ...[2]

(b) This water wave is a transverse wave.

(i) Explain what is meant by the term *transverse wave motion*.

.....
.....
.....
.....[3]

(ii) Draw a diagram that represents a transverse wave travelling from left to right across the page. On your diagram, label:

- the wavelength
- the amplitude.

[3]

[Total: 8]

6 (a) Fig. 6.1 shows white light incident at point X on a glass prism.

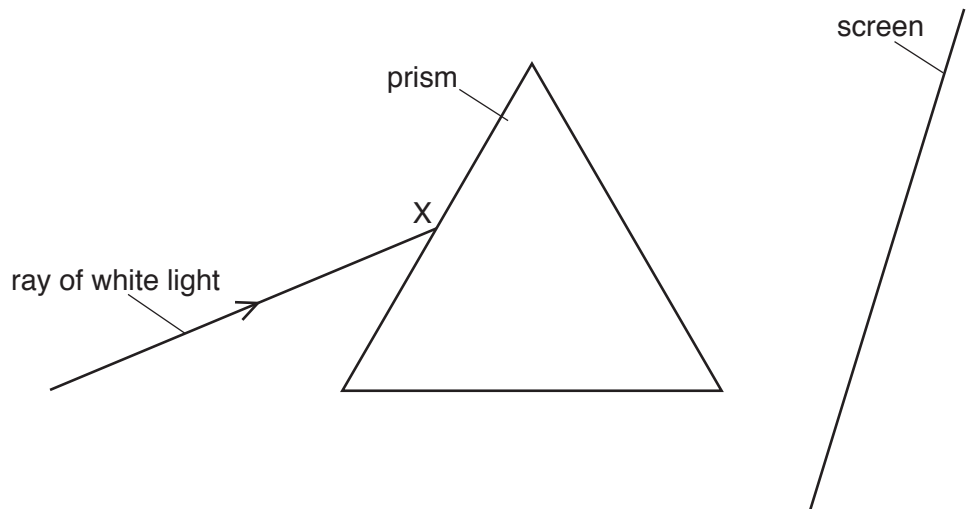


Fig. 6.1

(i) From point X on Fig. 6.1, draw a ray of red light, labelled R and a ray of violet light, labelled V, to show how a spectrum is formed on the screen. [2]

(ii) State the colour of light in the visible spectrum with the shortest wavelength.

.....[1]

(b) The critical angle for a type of glass is 42° .

Fig. 6.2 and Fig. 6.3 show two prisms ABC and PQR made of this type of glass. A ray of monochromatic red light passes into each of the prisms.

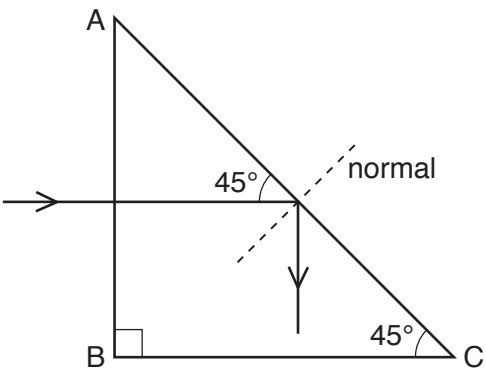


Fig. 6.2

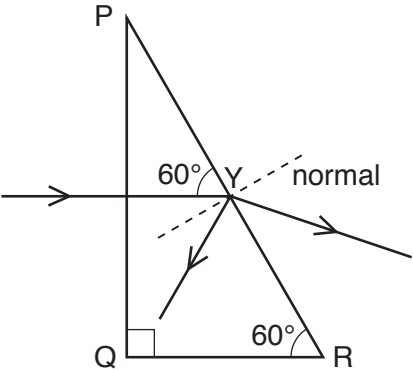


Fig. 6.3

(i) State what is meant by *monochromatic* light.

.....

.....[1]

(ii) Describe and explain what happens to the ray of light in Fig. 6.2 as it strikes side AC of the prism.

.....

.....

.....[2]

(iii) Describe and explain what happens to the ray of light in Fig. 6.3 as it strikes the glass at point Y.

.....

.....

.....

.....[3]

[Total: 9]

44. Question part 1/2 | 0625 Feb-March 2019 P4 V2 Q8

- 8 Fig. 8.1 shows parallel wavefronts of a light wave in ice. The wavefronts are incident on a boundary with air.

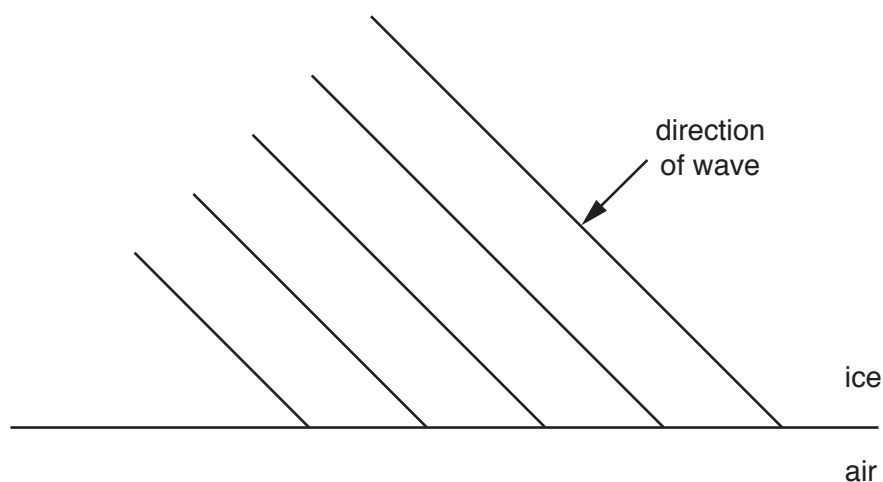


Fig. 8.1

The speed of the light wave in air is 3.0×10^8 m/s. The refractive index of the ice is 1.3.

(a) On Fig. 8.1:

(i) draw the wavefronts of the wave that passes into the air [3]

(ii) draw arrows to show the direction of travel of the refracted wave [1]

(iii) label the angle of incidence i and the angle of refraction r . [1]

(b) Calculate the speed of the light wave in the ice.

speed = ... [2]

[Total: 7]

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45. Question part 1/2 | 0625 May-June 2019 P4 V1 Q6

- 6** Green light of frequency 5.7×10^{14} Hz is travelling in air at a speed of 3.0×10^8 m/s. The light is incident on the surface of a transparent solid.

Fig. 6.1 shows the wavefronts and the direction of travel of the light in the air.

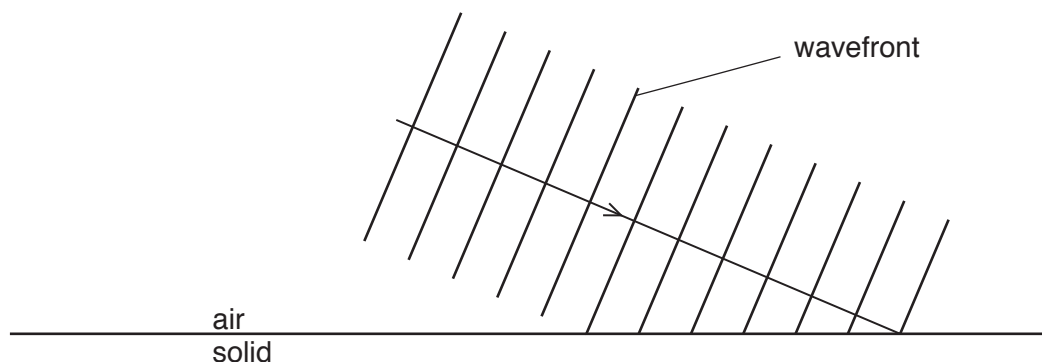


Fig. 6.1

The light travels more slowly in the transparent solid.

- (a)** Explain, in terms of the wavefronts, why the light changes direction as it enters the solid. You may draw on Fig. 6.1 as part of your answer.

.....

.....

.....

..... [3]

- (b)** The refractive index of the transparent solid is 1.3.

- (i)** The light is incident on the surface of the solid at an angle of incidence of 67° .

Calculate the angle of refraction of the light in the solid.

angle of refraction = ... [2]

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45. Question part 2/2 | 0625 May-June 2019 P4 V1 Q6

(ii) Determine the wavelength of the green light in the transparent solid.

wavelength = ... [4]

[Total: 9]

- 6 (a)** Fig. 6.1 shows a water wave in a ripple tank.

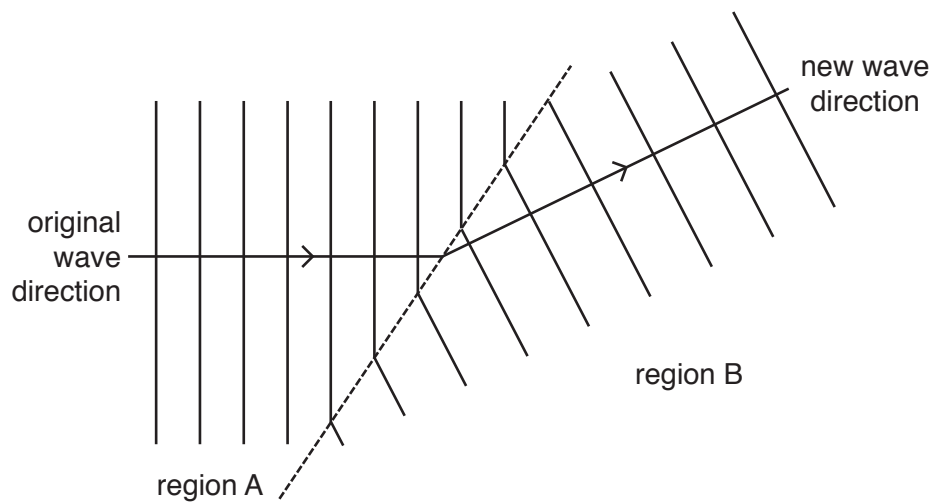


Fig. 6.1

- (i)** State the name of the process that occurs as the wave moves from region A to region B.

..... [1]

- (ii)** Suggest a cause for the change in direction of the wave.

..... [1]

- (b) Fig. 6.2 shows a transverse wave.

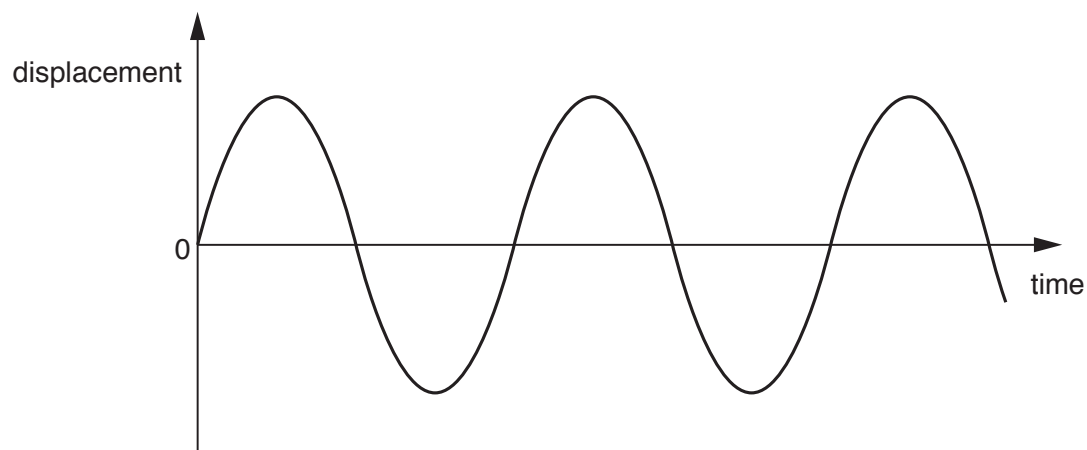


Fig. 6.2

On Fig. 6.2, draw a wave which has half the amplitude and a greater frequency than the wave shown. [2]

- (c) A train travels along steel rails. A person waiting at a station hears the sound of the train through the rails before he hears the sound through the air.

- (i) Explain why this happens.

.....
..... [1]

- (ii) The speed of sound in the rails is 5800 m/s.

Calculate the wavelength of sound of frequency 1100 Hz travelling at this speed.

wavelength = ... [2]

[Total: 7]

- 7 (a) In Fig. 7.1, a converging lens projects a sharp image of an object O on to a screen.

Complete the paths of the two rays from the object to the screen.

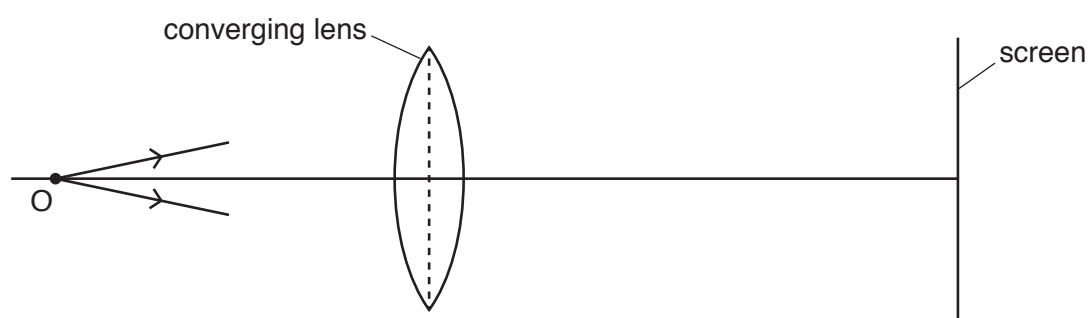


Fig. 7.1

[2]

- (b) The converging lens in (a) is replaced with a thinner converging lens. The object O and the screen remain in the same positions as in (a). The thinner converging lens has a longer focal length than the converging lens in (a).

Complete the paths of the two rays from the object to the screen in Fig. 7.2.

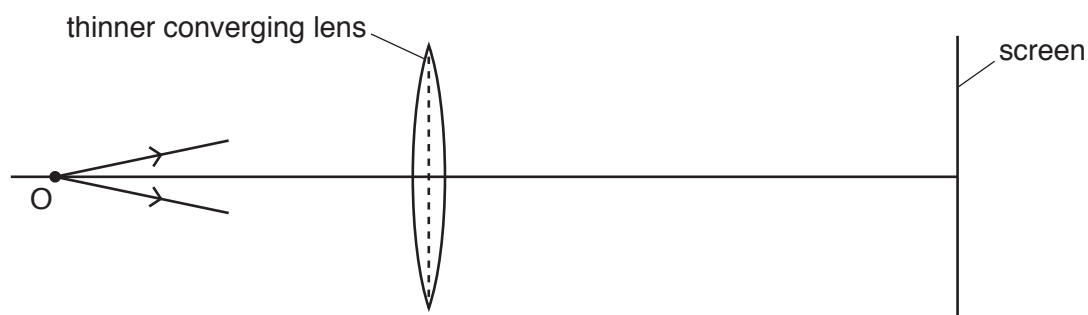


Fig. 7.2

[2]

- (c) A converging lens is used as a magnifying glass.
The focal length of the lens is 10 cm.

- (i) Describe the position of the object in relation to the lens.

.....
..... [1]

- (ii) Describe the position of the image in relation to the lens and the object.

.....
..... [1]

- (iii) Give three properties of the image formed by a magnifying glass.

.....
.....
..... [2]

[Total: 8]

- 3 Fig. 3.1 shows a small submarine submerged below the surface of the sea.

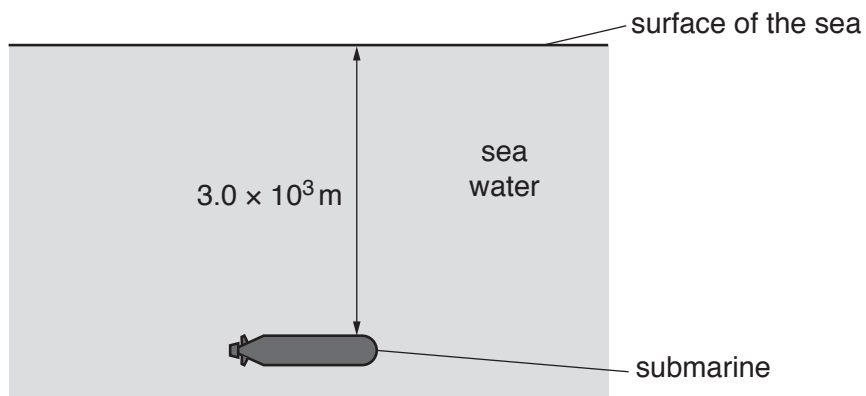


Fig. 3.1

- (a) The density of sea water is 1030 kg/m^3 .

Calculate the pressure due to the sea water on the top of the submarine when it is $3.0 \times 10^3 \text{ m}$ below the surface.

pressure = ... [2]

- (b)** The submarine emits a pulse of sound to detect other objects in the sea. The speed of sound in sea water is 1500 m/s . An echo is received with a time delay of 0.50 s after the original sound is emitted.

(i) Calculate the distance between the submarine and the other object.

distance = ... [3]

- (ii)** Another pulse of sound is emitted through the air when the submarine is on the surface.

An echo is received from a second object that is in the air. This echo is received 0.50 s after the pulse of sound is emitted.

Compare the distance of the second object from the submarine with the distance calculated in **(b)(i)**. Tick **one** box. Give a reason for your answer.

distance is smaller ☐

distance is the same ☐

distance is larger ☐

Reason [1]

[Total: 6]

- 6 (a)** Fig. 6.1 shows wavefronts of a wave approaching a narrow gap and passing through the gap. The wavelength is λ .

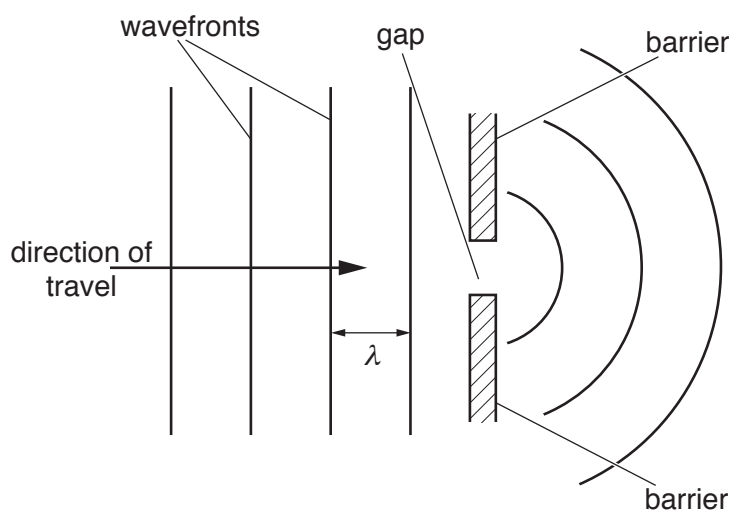


Fig. 6.1

- (i)** State the name of the process that occurs as the wave passes through the gap.

..... [1]

- (ii)** A wave with a wavelength $\frac{\lambda}{2}$ approaches the same gap.

On Fig. 6.2, draw three wavefronts for this wave as it approaches the gap and three more wavefronts as the wave continues beyond it. [3]



Fig. 6.2

(b) Table 6.1 shows 5 different types of electromagnetic wave.

In the blank column in Table 6.1, write the numbers 1 to 5 to show the order of wavelength. Write 1 for the wave with the shortest wavelength and 5 for the wave with the longest wavelength. [2]

Table 6.1

type of electromagnetic wave	order of wavelength
gamma rays	
light	
microwaves	
ultraviolet	
X-rays	

(c) (i) State the speed of radio waves in air.

..... [1]

(ii) A radio station transmits radio waves with a frequency of 96 MHz. Calculate the wavelength of these radio waves.

wavelength = ... [3]

[Total: 10]

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- 7 Fig. 7.1 shows light approaching a boundary between two materials at speed v . The speed of the light after crossing the boundary is $1.3v$.

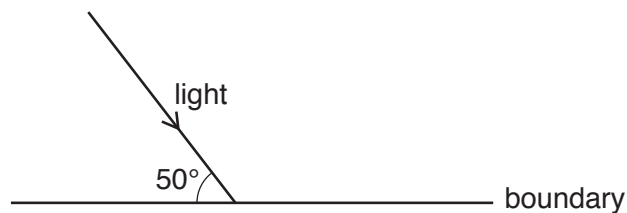


Fig. 7.1

- (a) Determine the angle of incidence.

angle of incidence = ... [1]

- (b) Calculate the angle of refraction.

angle of refraction = ... [3]

[Total: 4]

- 4 Fig. 4.1 shows a loudspeaker that is producing a sound wave in air of frequency 15 000 Hz.

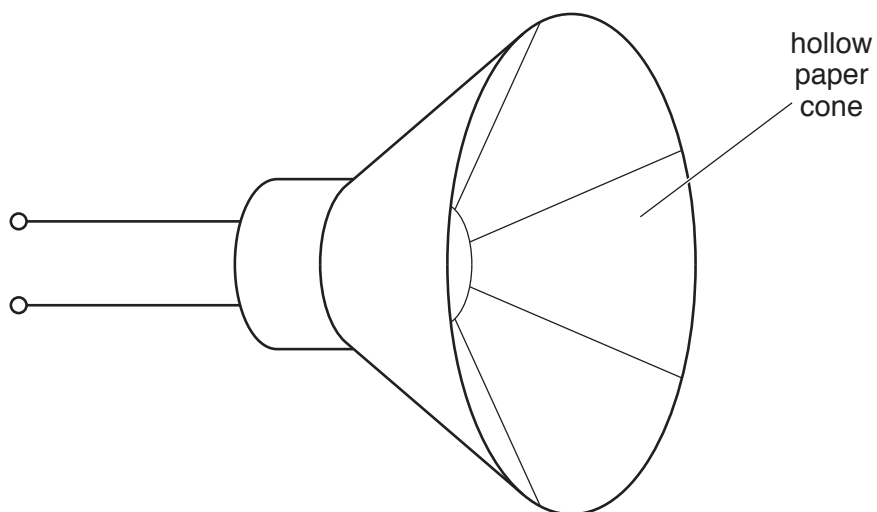


Fig. 4.1

- (a) Describe how the cone of the loudspeaker produces this sound.

.....

.....

.....

..... [3]

- (b) The speed of sound in air is 330 m/s.

Calculate the wavelength of this sound.

wavelength = ... [2]

- (c) The loudspeaker is placed a considerable distance to the left of a barrier with a gap. The width of the gap is double the wavelength of the sound. Sound from the loudspeaker reaches the barrier and passes through the gap.

Fig. 4.2 shows the gap in the barrier.

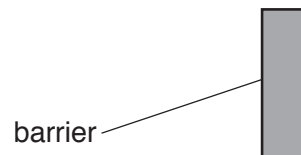
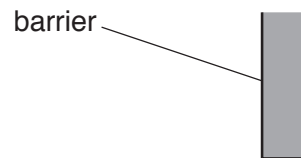


Fig. 4.2 (not to scale)

On Fig. 4.2, sketch a diagram that represents the sound wave as a series of wavefronts

- travelling towards the barrier
- in the gap
- and travelling away from the barrier.

[3]

[Total: 8]

- 8 Fig. 8.1 shows a ray of red light incident on one side of a glass prism in air.

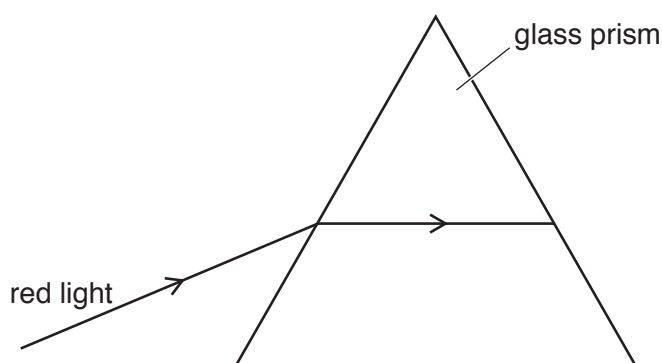


Fig. 8.1

For red light, the refractive index of glass is n_R .

- (a) The angle of incidence is 53° and the angle of refraction in the glass is 30° .

- (i) Calculate n_R .

$n_R = \dots\dots\dots$ [2]

- (ii) On Fig. 8.1, sketch a line to indicate the path of the red light when it emerges from the glass prism. Label this path R. [1]

- (iii) Explain why the quantity *refractive index* does not have a unit.

$\dots\dots\dots$
 $\dots\dots\dots$ [1]

- (b) For violet light, the refractive index n_V of glass is slightly larger than n_R .

- (i) A ray of violet light is incident on the prism along the same path as the ray of red light.

On Fig. 8.1, sketch a line to indicate the path of the violet light in the prism and when it emerges into the air. Label this path V. [1]

- (ii) When a ray of white light is incident on the prism, dispersion produces a continuous spectrum of coloured light.

State how the speed of light in glass depends on its frequency. Explain how this is shown by the dispersion of white light in the prism.

statement $\dots\dots\dots$

explanation $\dots\dots\dots$

$\dots\dots\dots$ [3]

[Total: 8]

BLANK PAGE

- 5 (a) One difference between a longitudinal wave and a transverse wave is that a longitudinal wave consists of compressions and rarefactions.

- (i) Explain the terms compression and rarefaction using ideas about particles.

compression

.....

.....

rarefaction

.....

.....

[2]

- (ii) Describe **one** other way in which longitudinal wave motion differs from transverse wave motion.

Longitudinal wave motion

.....

.....

Transverse wave motion

.....

.....

[2]

- (b) (i) A sound wave of frequency 0.120 kHz travels through a rock at a speed of 3500 m/s.

Calculate the wavelength of the wave.

wavelength = ... [3]

- (ii) The wave travels from the rock into the air.

State and explain whether the wave will be audible to a healthy human ear.

statement

explanation

.....

[2]

[Total: 9]

- 6 (a)** Fig. 6.1 shows an empty container and an observer's eye. There is a small coin at position O. The observer is unable to see the coin.

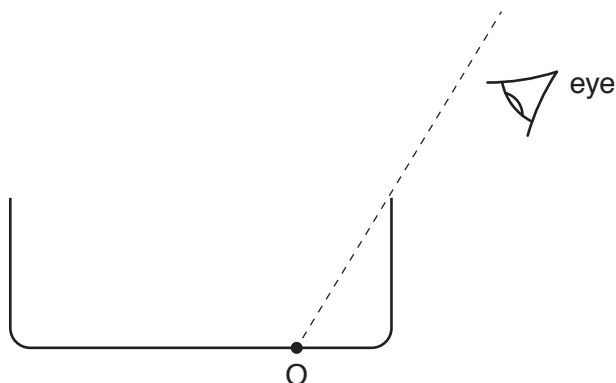


Fig. 6.1

The observer and the coin stay in the same position and the container is filled with water. The observer can now see the coin.

- (i)** Explain why the coin can be seen by the observer.

.....
 [2]

- (ii)** State the name of the wave process which occurs as the light passes from the water into the air.

..... [1]

- (iii)** Explain why the image of the coin is a virtual image.

..... [1]

- (b)** State the speed of light in air.

..... [1]

- (c)** The refractive index of water is 1.3.

Calculate the speed of light in water.

speed of light in water = ... [3]

[Total: 8]

- 6 Fig. 6.1 represents wavefronts of a sound wave travelling in air from left to right.

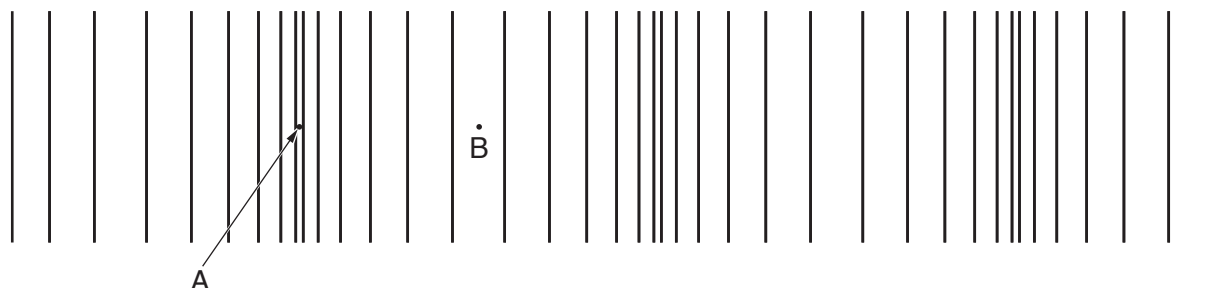


Fig. 6.1

- (a) State the name given to the:

(i) region around A in the diagram [1]

(ii) region around B in the diagram. [1]

- (b) On Fig. 6.1, draw a double-headed arrow to show **one** wavelength. [1]

- (c) The loudness of the sound increases at the same pitch.

State and explain any change there would be in the pattern of wavefronts shown in Fig. 6.1.

.....

 [3]

- (d) The wave passes into water.

State and explain any change in the pattern of wavefronts shown in Fig. 6.1.

.....

 [3]

[Total: 9]

- 7 (a) Fig. 7.1 shows the position of a converging lens, its principal axis and an object O.

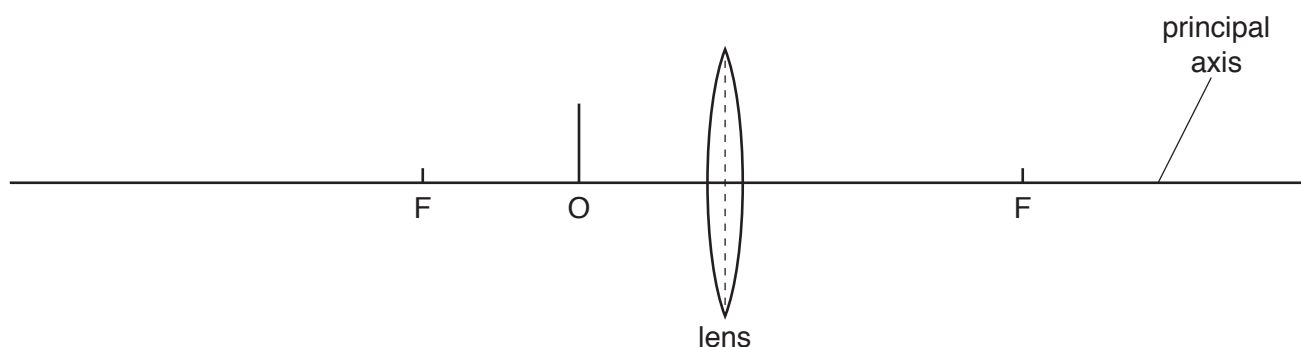


Fig. 7.1

Each principal focus of the lens is labelled F.

On Fig. 7.1, draw a ray diagram to locate the position of the image formed by the lens.

Label the image I. [3]

- (b) Describe the nature of the image I.

..... [2]

- (c) Images formed by lenses sometimes have coloured edges.

Suggest a reason for this.

.....
..... [1]

[Total: 6]

- 6 (a)** Fig. 6.1 shows crests of a water wave moving from left to right in a harbour.

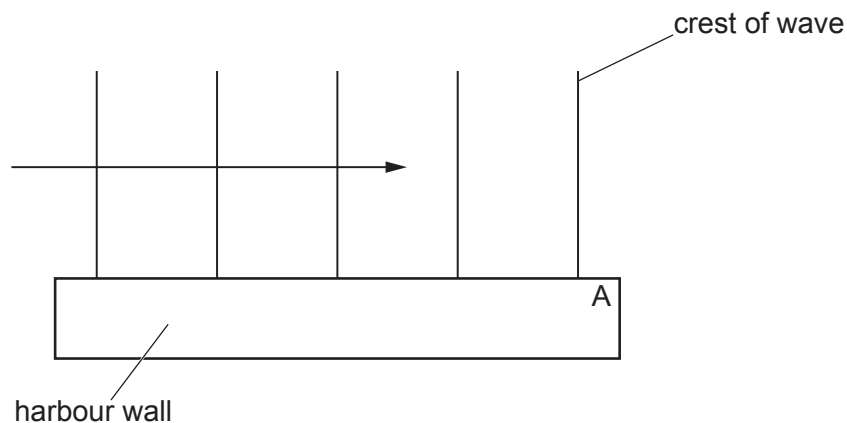


Fig. 6.1

- (i) On Fig. 6.1, draw three more crests to the right of point A. [2]

- (ii) State the name of the wave process that occurs as the wave passes point A.

..... [1]

- (b)** Fig. 6.2 shows the crests of another wave moving from left to right in a different part of the harbour. This wave moves from deep water to shallow water.

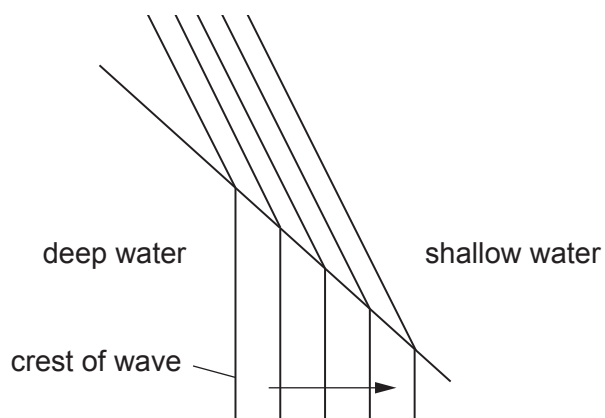


Fig. 6.2

- (i) On Fig. 6.2, draw an arrow to show the direction of movement of the wave after it has passed into the shallow water. [1]

- (ii) State the name of the process that occurs as the wave passes into the shallow water.

..... [1]

(iii) Complete Table 6.1 to state whether each of the properties of the wave **increases**, **decreases** or **stays the same** as the wave passes into the shallow water.

Table 6.1

property	effect
wavelength	
frequency	
speed	

[3]

[Total: 8]

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- 7 (a) Fig. 7.1 shows a converging lens and the image I formed when an object is placed to the left of the lens. The principal focuses are labelled A and B and the centre of the lens is labelled C.
- (i) On Fig. 7.1, draw two rays to locate the position of the object.
Draw the object and label it O.

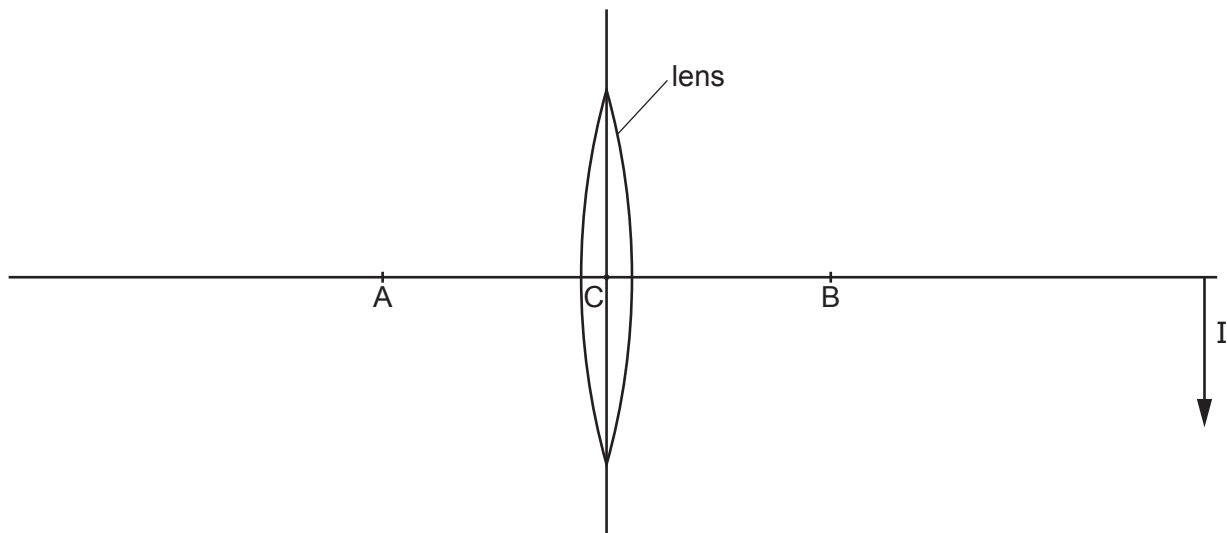


Fig. 7.1

[3]

- (ii) Ring all of the following distances that are equal to the focal length of the lens.

AB

AC

CB

2AB

[2]

- (b) Fig. 7.2 shows green light passing through a triangular glass block.

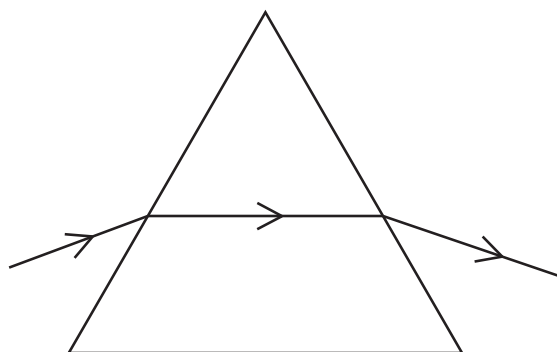


Fig. 7.2

Red light enters the triangular glass block shown in Fig. 7.2 along the same path as the green light.

- (i) On Fig. 7.2, draw the path of the red light within the triangular glass block. [1]

Fig. 7.3 shows green light passing through a rectangular glass block.

Red light enters the rectangular glass block shown in Fig. 7.3 along the same path as the green light.

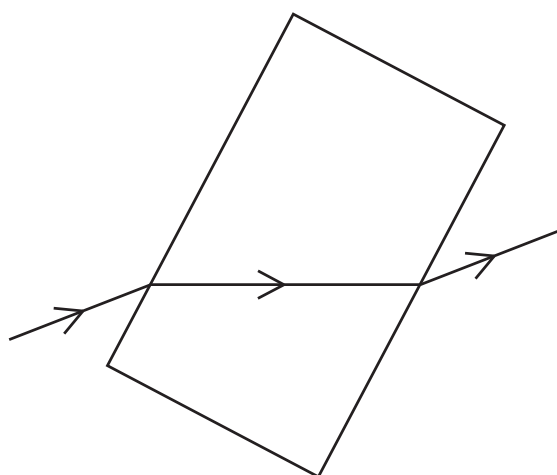


Fig. 7.3

On Fig. 7.3:

- (ii) draw the path of the red light within the rectangular glass block [1]
- (iii) draw the path of the red light after leaving the rectangular glass block. [1]

[Total: 8]

- 5 The distance between the centre of a thin converging lens and each principal focus is 5.0 cm.

(a) Describe what is meant by the term *principal focus* for a thin converging lens.

.....

 [2]

(b) The lens is used as a magnifying glass to produce an image I of an object O.

(i) Underline the terms that describe the nature of the image produced by a magnifying glass. [2]

diminished enlarged inverted real same size upright virtual

(ii) Fig. 5.1 is a full-scale diagram of the lens and the image I.

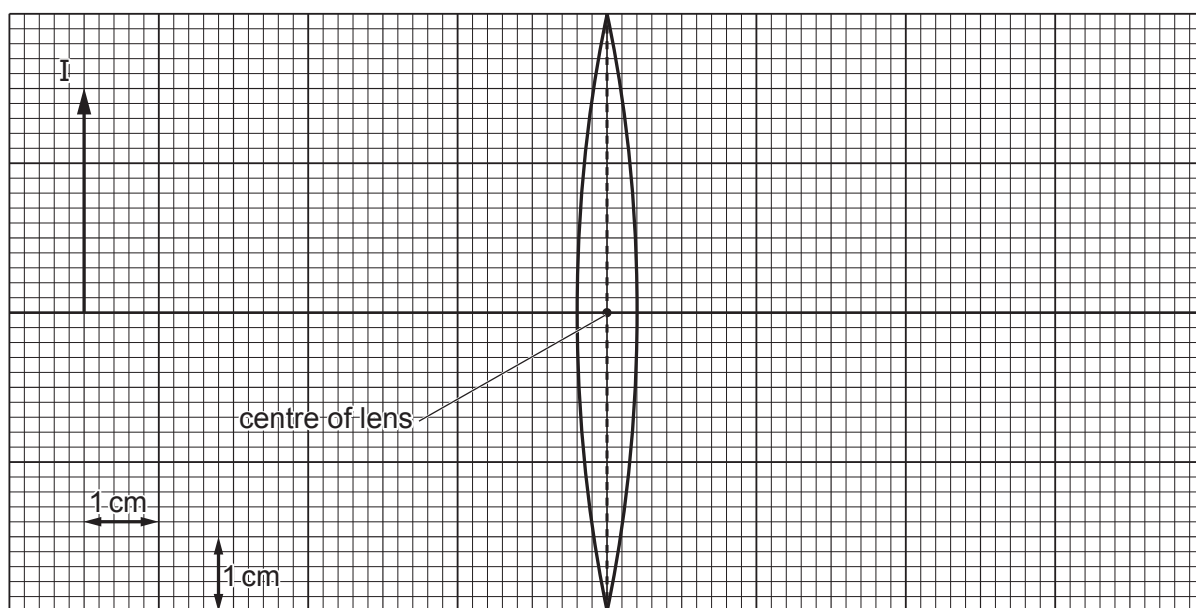


Fig. 5.1 (full-scale)

1. On Fig. 5.1, mark both principal focuses and label each of them F. [1]
2. By drawing on Fig. 5.1, find the position of object O and add object O to the diagram. [3]

(iii) Using Fig. 5.1, determine the distance of object O from the centre of the lens.

distance = ... [1]

[Total: 9]

6 The speed of sound in air is 340 m/s .

(a) Calculate the range of wavelengths for sounds that are audible by a healthy human ear.

wavelengths range from to [2]

(b) Sound waves are longitudinal waves.

Describe how a longitudinal wave differs from a transverse wave.

.....
.....
.....
..... [3]

(c) Fig. 6.1 shows a band in front of a building.

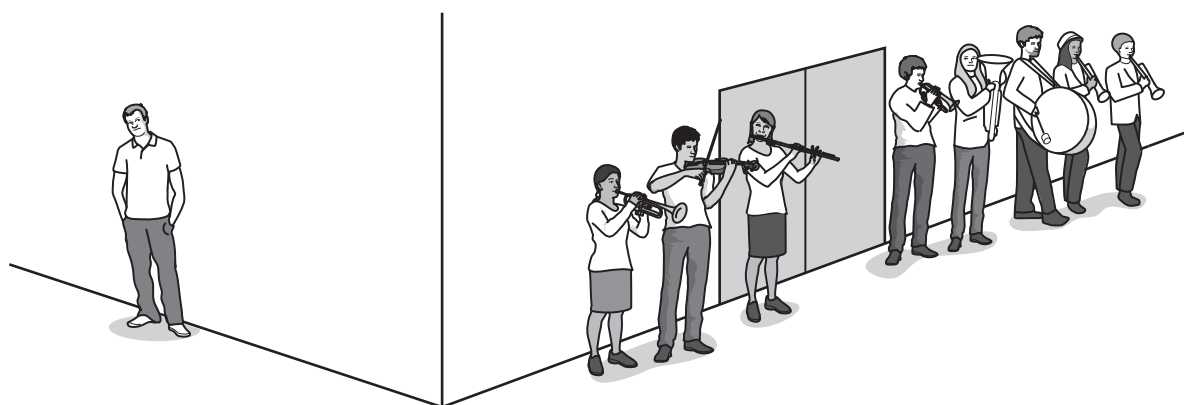


Fig. 6.1

The drum produces a low frequency sound. Other musical instruments produce a high frequency sound. These sounds are equally loud.

A young man at the side of the building hears the drum but not the high frequency sounds from the other musical instruments.

Explain why this happens.

.....
.....
..... [3]

[Total: 8]

- 5 Fig. 5.1 shows crests of a wave approaching a barrier where the wave is reflected.

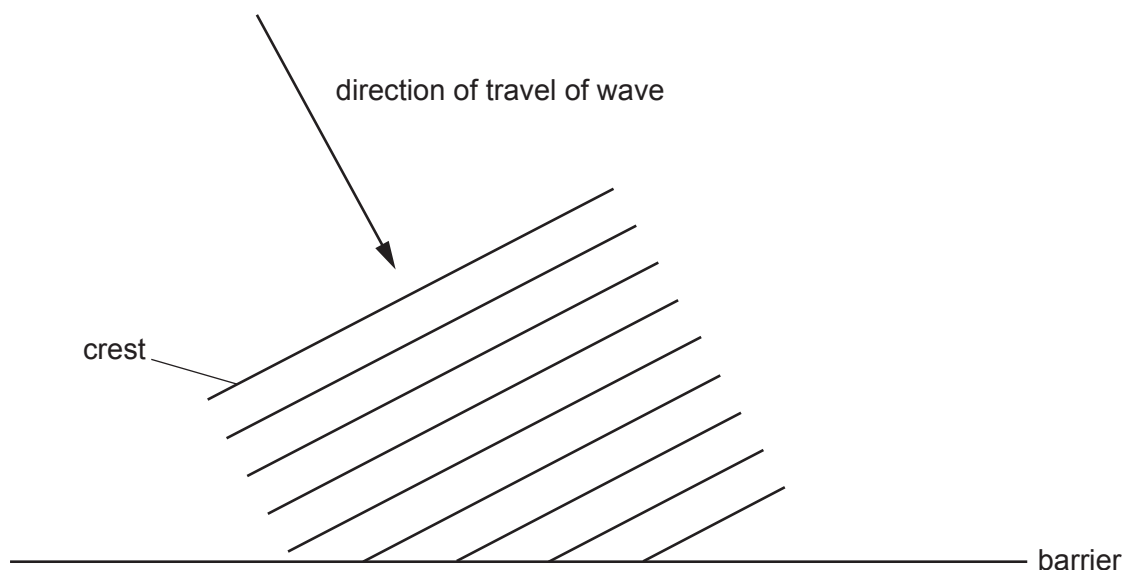


Fig. 5.1

- (a) On Fig. 5.1, draw **three** crests of the reflected wave. [3]

- (b) The wave has a wavelength of 36 cm and a speed of 1.2 m/s.

Calculate the frequency of the wave.

frequency = ... [3]

- (c) Complete the following sentences.

An echo is the name for a reflected wave.

The waves that form an echo are a type of longitudinal wave. Longitudinal waves are made up of and rarefactions.

[2]

[Total: 8]

- 6 (a)** Fig. 6.1 shows an arrangement of glass prisms inside a box. The angles of the prisms are 45° , 45° and 90° .

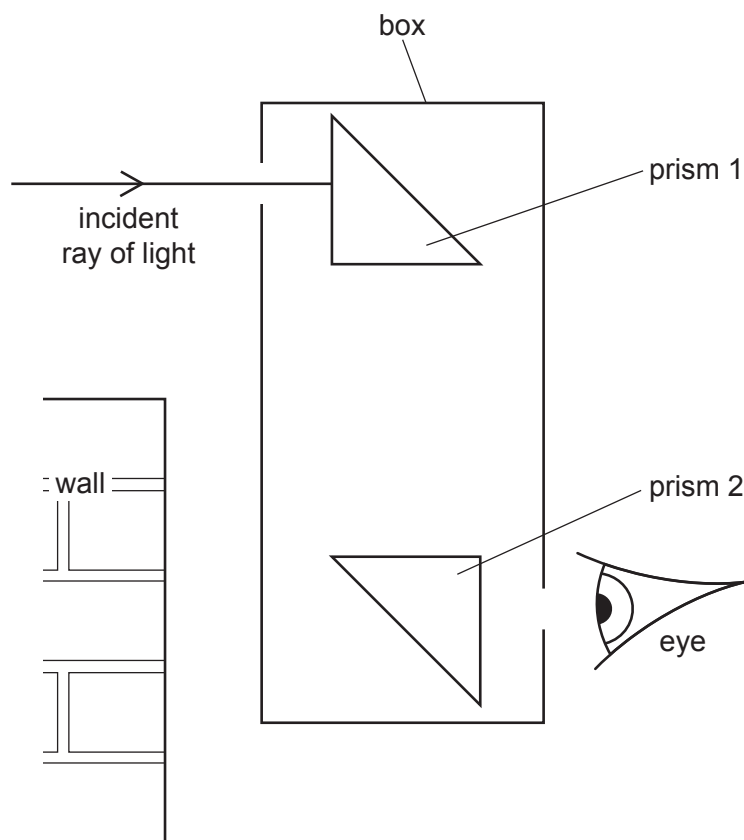


Fig. 6.1 (not to scale)

This is a device used to view objects that are behind a wall.
The incident ray of light undergoes total internal reflection in the prisms.

On Fig. 6.1, complete the path of the ray through the device and show the ray as it emerges from the box. [3]

- (b)** Show that the refractive index of glass with a critical angle of 45° is 1.41.

[2]

[Total: 5]

- 6 (a) Fig. 6.1 shows crests of a sound wave after reflection from a solid surface.

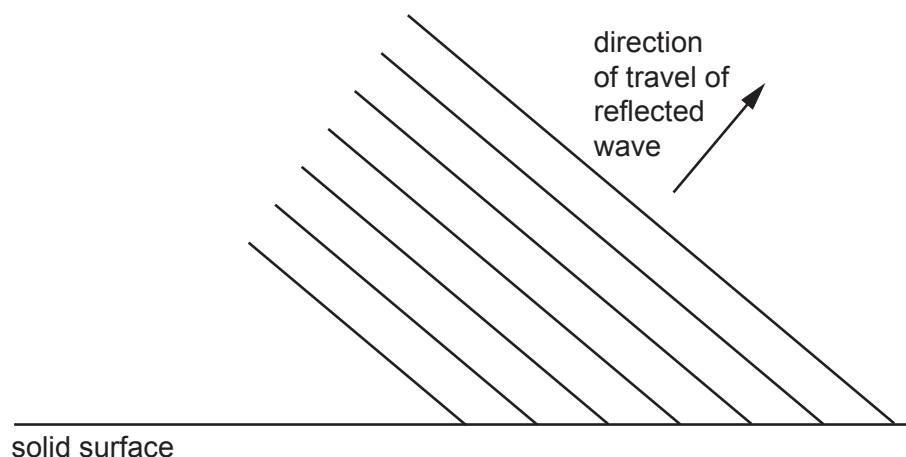


Fig. 6.1

On Fig. 6.1, draw **three** crests of the incident wave.

[3]

- (b) Tick **four** statements in the list below that are **false** for a sound wave that is audible to a healthy human ear.

The wave is longitudinal.

☐

The wave is transverse.

☐

The frequency of the wave is 1 Hz.

☐

The frequency of the wave is 1 kHz.

☐

The frequency of the wave is 1 MHz.

☐

The wave travels in a vacuum.

☐

The wave could travel in aluminium.

☐

[3]

- (c) State a typical value for the speed of a sound wave in water.

..... [1]

[Total: 7]

- 7 Fig. 7.1 shows red light travelling from air into a prism made of diamond. The path of the red light is incomplete.

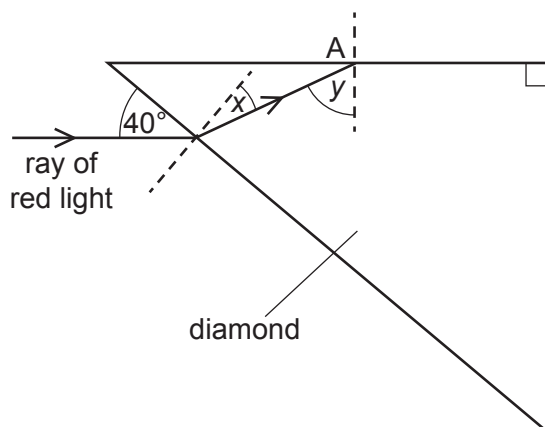


Fig. 7.1 (not to scale)

- (a) The refractive index of diamond is 2.42.

Calculate angle x .

angle $x = \dots\dots\dots$ [2]

- (b) Explain the term *total internal reflection*.

.....

 [3]

- (c) The angle y is greater than the critical angle of diamond.

On Fig. 7.1, draw the path of the red light through and out of the prism after point A. [2]

[Total: 7]

- 6 Fig. 6.1 shows a shallow tank viewed from above. The depth of the water is different in the two parts of the tank. Fig. 6.1 shows the crests and the troughs of a wave that pass from left to right.

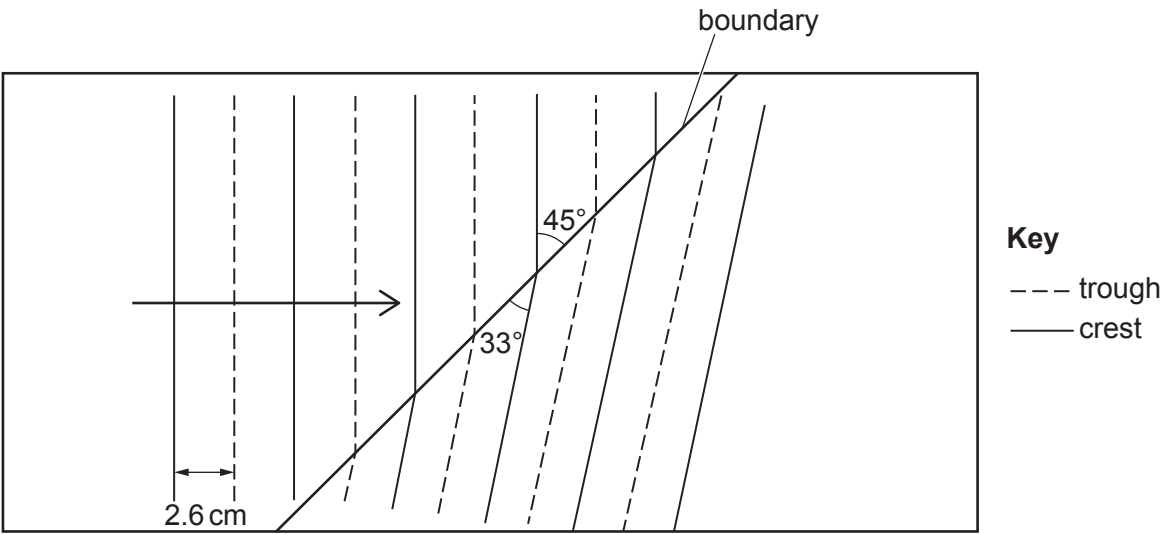


Fig. 6.1 (not to scale)

As the wave passes from one side to the other, the direction of the wavefronts changes.

- (a) Explain why the direction of the wavefronts changes in the way shown in Fig. 6.1.

.....

.....

.....

.....

..... [3]

- (b) The speed of the wave in the left-hand part of the tank is 0.39 m/s.

- (i) Using information from Fig. 6.1, determine the frequency of the wave.

frequency = ... [3]

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(ii) Determine the speed of the wave in the right-hand side of the tank.

speed = ... [3]

[Total: 9]

9 (a) (i) Describe what is observed during *total internal reflection*.

.....
..... [1]

(ii) State **two** conditions required for light to be totally internally reflected.

1.
.....
2.
..... [2]

(b) Describe and explain the action of optical fibres in communication technology. You may draw a diagram in your answer.

.....
.....
.....
..... [3]

[Total: 6]

6 Fig. 6.1 shows a transverse wave produced in a string.

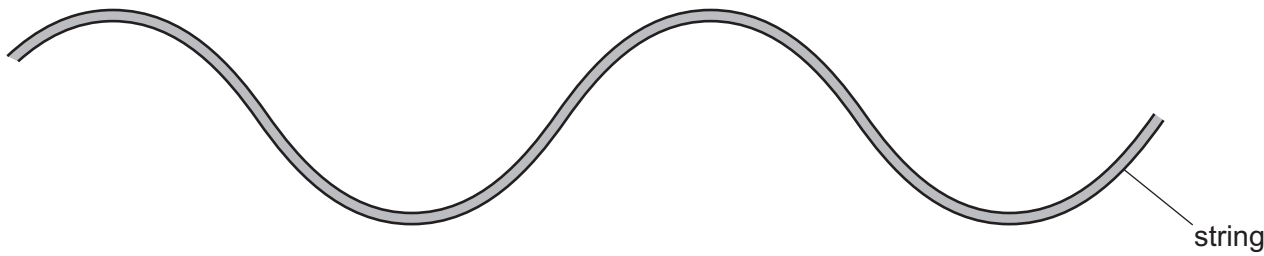


Fig. 6.1 (full size)

- (a) On Fig. 6.1:
- (i) draw labelled lines to show
 - 1. the amplitude of the wave
 - 2. the wavelength of the wave

[2]
 - (ii) label a trough with the letter T.

[1]
- (b) A person vibrates one end of the string vertically to produce the wave. He makes 15 complete oscillations in 60 s.
- Show that the speed of the wave is 2.0 cm/s.

[3]

- (c) State the difference between transverse waves and longitudinal waves. Use your ideas about the direction of oscillations.
- transverse waves
-
- longitudinal waves
-
- [2]

[Total: 8]

- 7 Fig. 7.1 shows a ray of light passing through an optical fibre.

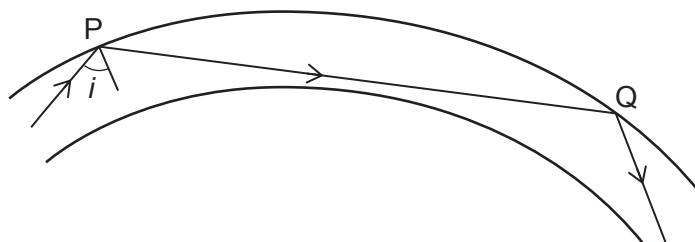


Fig. 7.1

The optical fibre is made of glass that has a refractive index of 1.4.

- (a) (i) No light refracts from the fibre at points P and Q.

State the name of the process that occurs at P and Q.

..... [1]

- (ii) Calculate the minimum value of angle i for there to be no refraction at point P.

angle = ... [2]

- (b) State and explain the use of optical fibres in medicine.

.....

 [3]

- (c) The ray of light shown in Fig. 7.1 is monochromatic light from a laser.

State what is meant by monochromatic light. Use **one** of the following quantities in your answer.

amplitude brightness frequency refractive index speed

.....
 [2]

[Total: 8]

- 6 (a)** Sound waves consist of compressions and rarefactions.

Explain the terms *compression* and *rarefaction*. Give your explanation in terms of the spacing of molecules and the pressure for sound waves in air.

compression

.....

rarefaction

.....

[3]

- (b)** A musical instrument emits a sound with a frequency of 4.4 kHz. The speed of sound in air is 340 m/s.

- (i)** Calculate the wavelength of the sound.

wavelength = ... [3]

- (ii)** The frequency of the sound emitted by the instrument is changed to 5.1 kHz and the amplitude of the sound is increased.

Without calculation, state what happens to

1. the speed of the sound

2. the wavelength of the sound

[2]

[Total: 8]

7 (a) State **two** uses for infrared radiation.

1.
-
2.
-
- [2]

(b) X-rays are used in hospitals to help treat patients.

Suggest and explain **three** precautions for the safe use of X-rays.

1.
-
2.
-
3.
-
- [3]

(c) (i) State the speed in a vacuum of

1. microwaves [1]
2. X-rays [1]

(ii) State a possible frequency for an ultrasound wave.

..... [1]

[Total: 8]

- 6** Fig. 6.1 shows a scale drawing of plane wavefronts approaching a gap in a barrier.

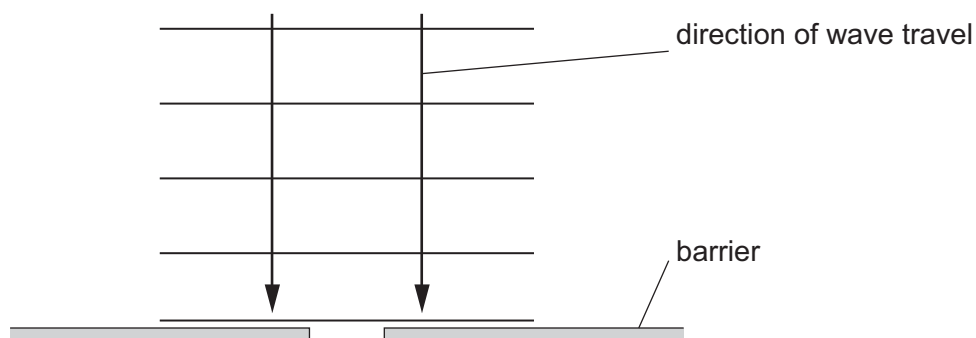


Fig. 6.1

- (a) On Fig. 6.1, draw the pattern of the wavefronts after the wave has passed through the gap. [2]
- (b) The wave approaching the barrier has a wavelength of 2.5 cm and a speed of 20 cm/s.
Calculate the frequency of the wave.

frequency = ... [2]

- (c) State what happens, if anything, to the frequency of the wave as it passes through the gap.

..... [1]

(d) Explain, in terms of diffraction, why a car radio may pick up low frequency radio signals but not pick up high frequency radio signals when the car is travelling behind a hill.

.....

.....

..... [2]

[Total: 7]

- 5 (a) State the name of the reflection of a sound wave or ultrasound wave.

..... [1]

- (b) Fig. 5.1 shows an ultrasound wave being used to scan an internal organ of a human body.

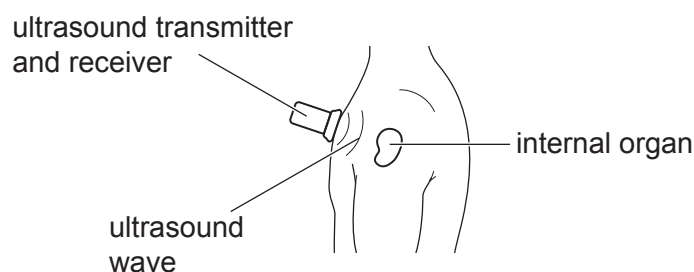


Fig. 5.1

The ultrasound wave has a frequency of 2.0 MHz and passes through human tissue at a speed of 1500 m/s.
Calculate the wavelength of the ultrasound wave in human tissue.

wavelength = ... [3]

- (c) Fig. 5.2 shows crests of a wave from a point source S approaching a straight barrier.

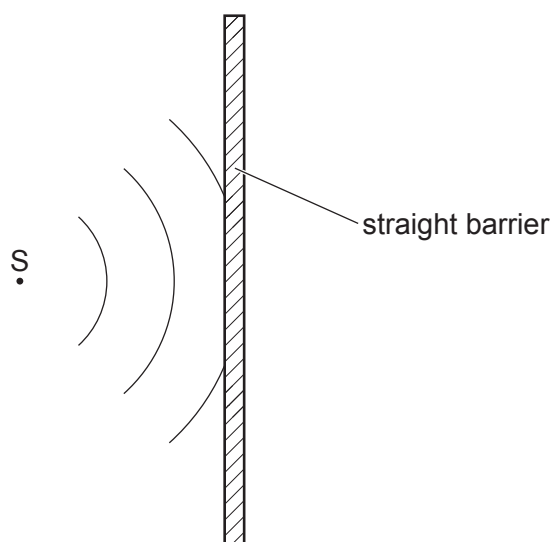


Fig. 5.2

- (i) On Fig. 5.2, indicate and label **one** wavelength.
(ii) On Fig. 5.2, draw **three** crests of the wave reflected from the barrier.

[3]

[Total: 7]

- 6 (a) Fig. 6.1 is a full scale diagram showing a converging lens, the two principal focuses F_1 and F_2 and an object PO.

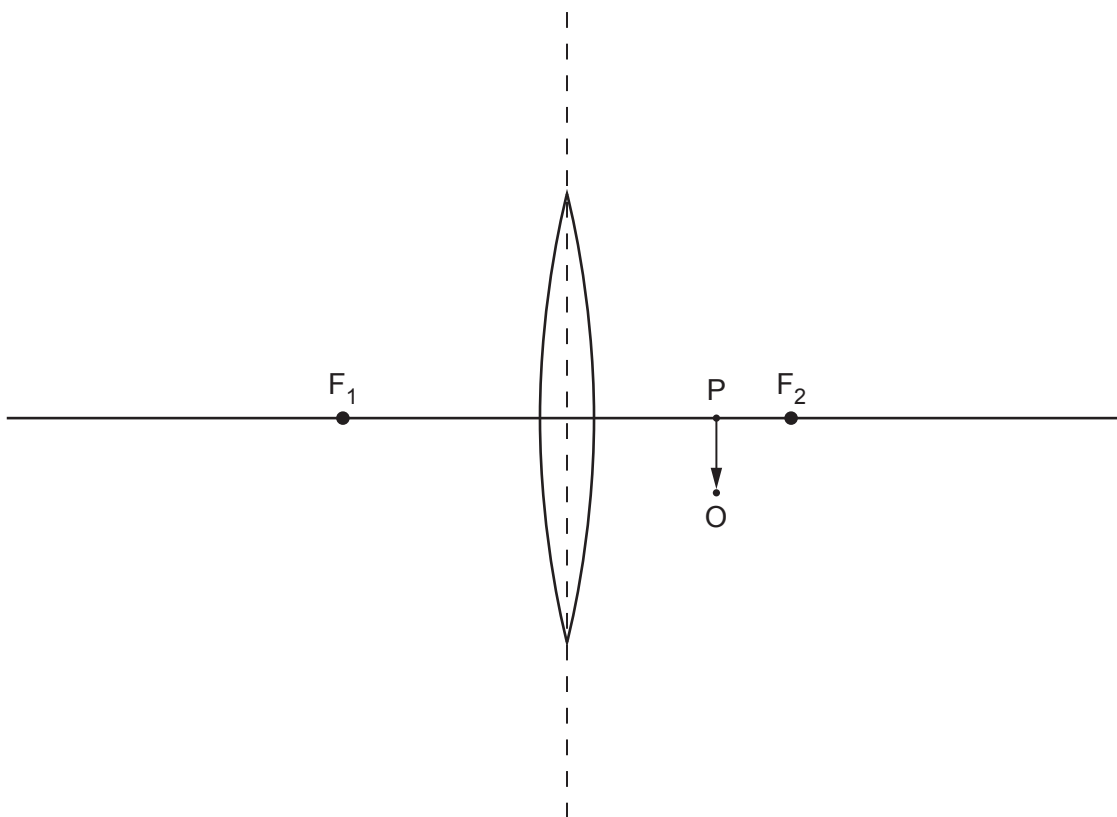


Fig. 6.1

On Fig. 6.1, draw two rays from point O of the object to determine the position of the image. Label the image IJ. Measure the length of the image.

image length = ... [3]

- (b) Ring **three** descriptions of the image.

diminished	magnified	real	same size	
same way up as object	upside down compared to object	virtual		[3]

(c) Fig. 6.2 shows three rays of green light passing through glass blocks.

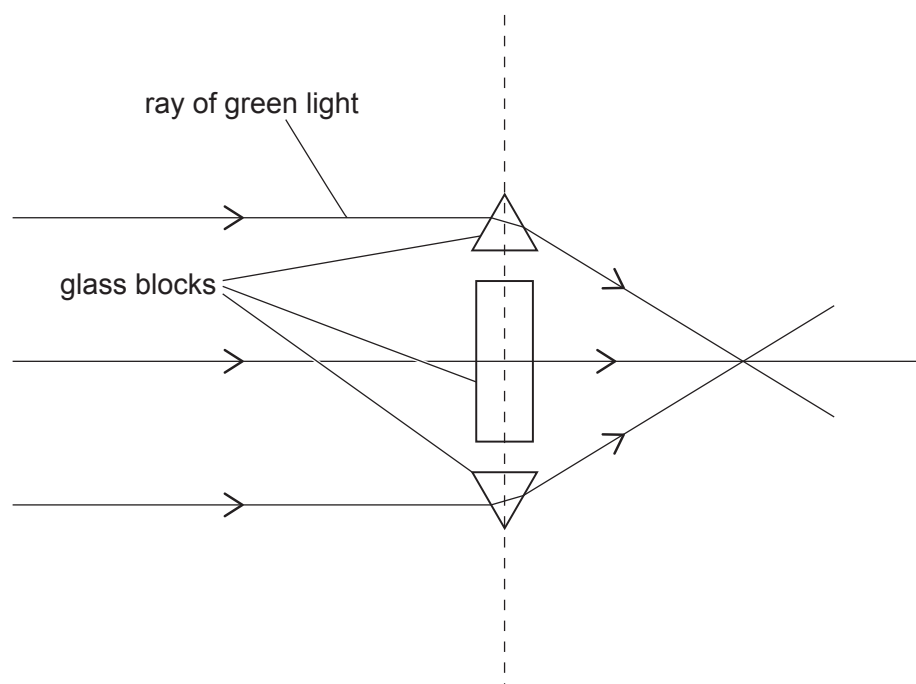


Fig. 6.2

Three rays of red light approach the glass blocks on the same paths as the rays of green light.

On Fig. 6.2, draw the paths of these rays of red light to the right of the glass blocks. [2]

[Total: 8]

- 6** Fig. 6.1 is a full-scale diagram that represents a sound wave travelling in air.

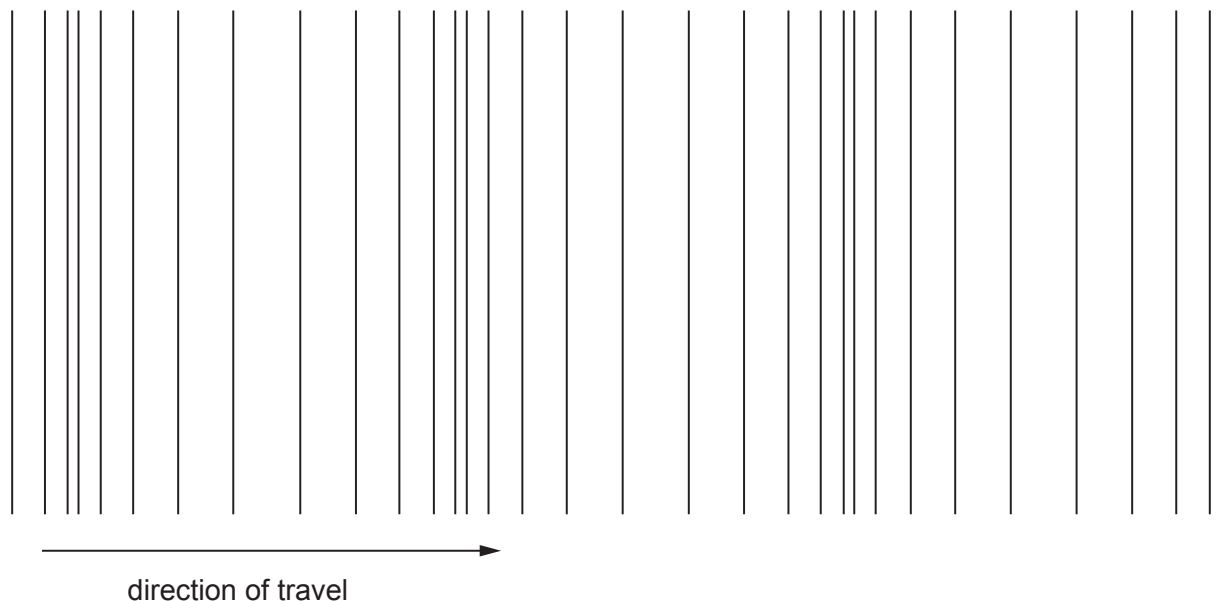


Fig. 6.1

- (a) On Fig. 6.1, mark **two** points, each at the centre of a different compression. Label both of the points C. [1]
- (b) The speed of sound in air is 330 m/s.

Measure the diagram and determine the frequency of the sound.

frequency = ... [3]

(c) The wave reaches a barrier. Fig. 6.2 shows the wave passing through a gap in the barrier.

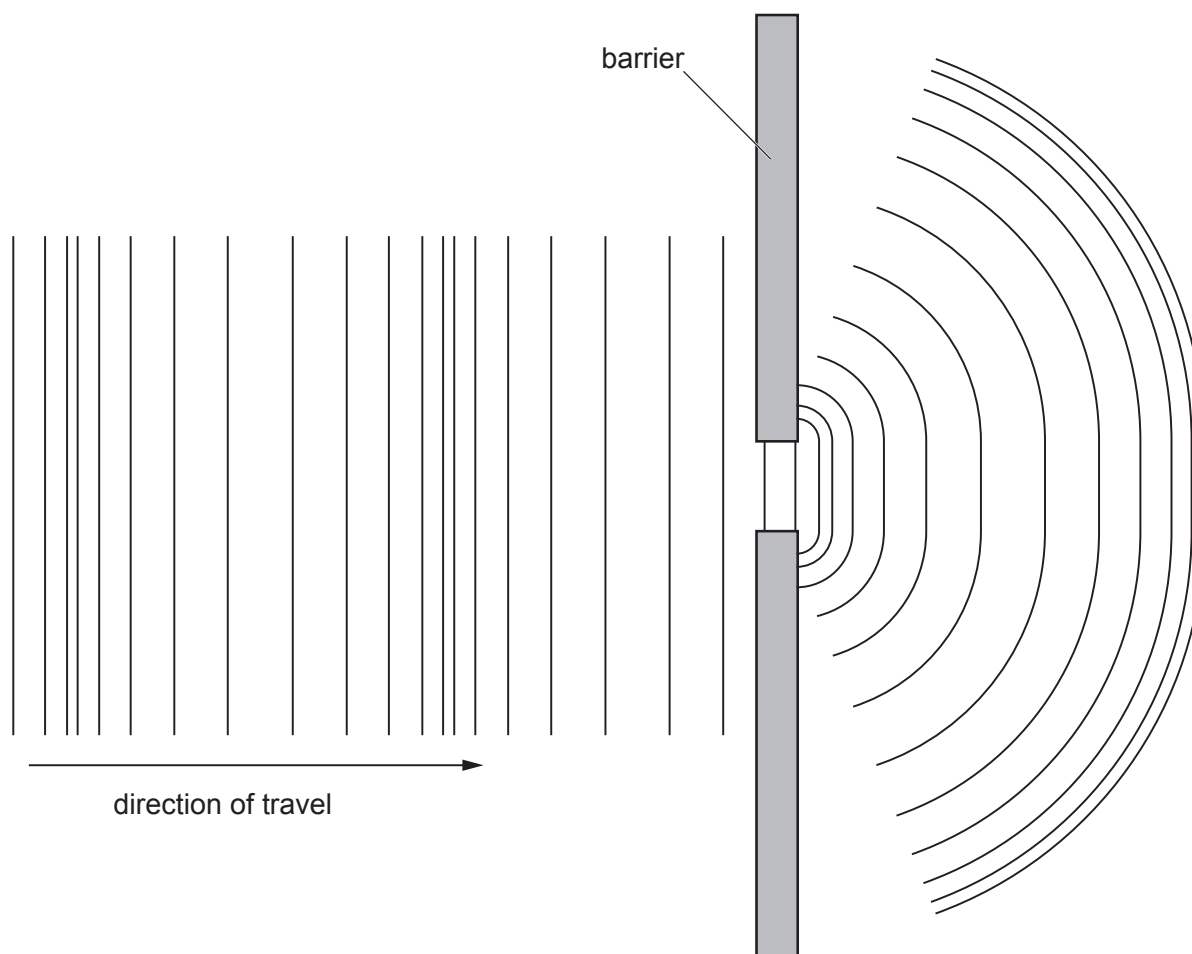


Fig. 6.2

The frequency of the wave is increased to a value many times greater than the value obtained in (b).

Describe and explain **two** ways in which a diagram representing the wave with the greater frequency differs from Fig. 6.2.

1.

.....

2.

.....

[3]

[Total: 7]

- 6 (a)** Fig. 6.1 shows a ray of green light passing through a prism.

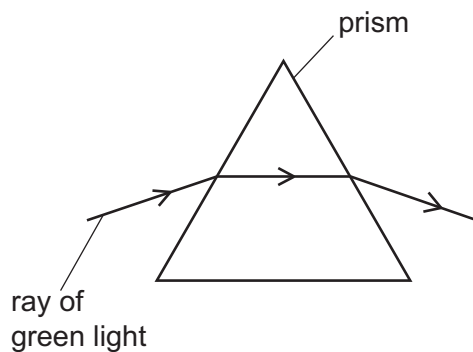


Fig. 6.1

A ray of blue light is directed towards the prism on the same path as the ray of green light.

On Fig. 6.1, draw the path of the blue light through and out of the prism. [3]

- (b)** The wavelength of the blue light in air is $4.8 \times 10^{-7} \text{ m}$.

Calculate the frequency of the blue light.

frequency = ... [3]

[Total: 6]

- 5 (a) Fig. 5.1 shows a wave on the sea approaching a harbour.

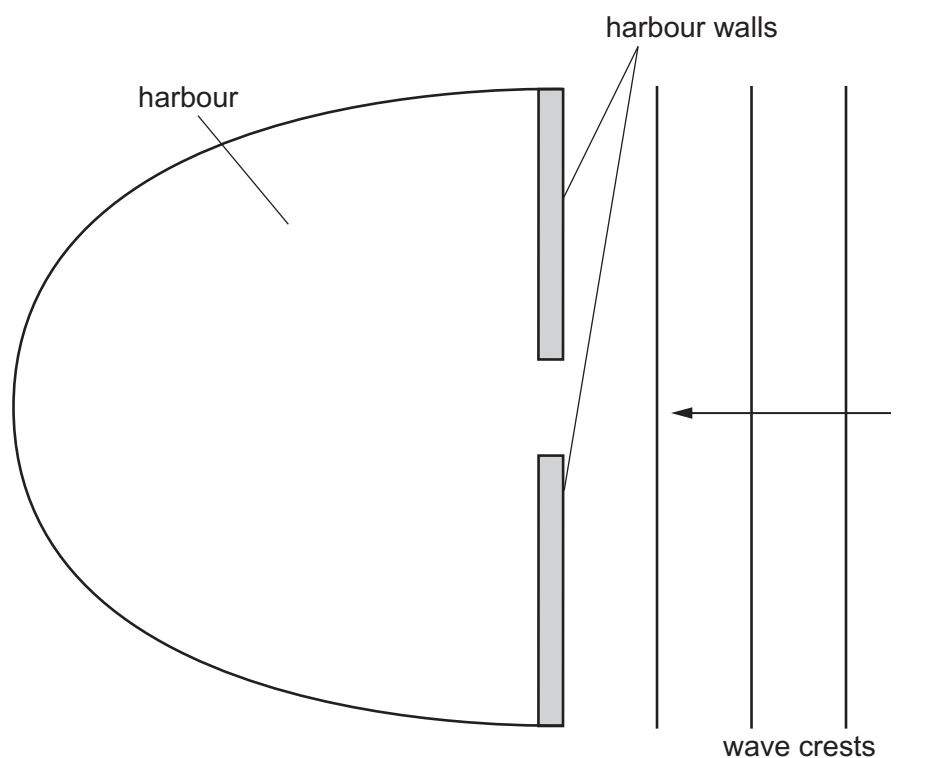


Fig. 5.1

- (i) On Fig. 5.1, draw **three** wave crests in the harbour. [2]
- (ii) Another harbour has a much wider gap between its walls.

Describe and explain how the pattern of wave crests in this harbour is different from the pattern you have drawn in (i).

description

.....

explanation

..... [2]

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- (b)** A sound wave of frequency 850 Hz travels through sea water. The speed of sound in sea water is 1500 m/s.

Calculate the wavelength of this sound wave in sea water.

wavelength = ... [2]

[Total: 6]

- 6 Fig. 6.1 is a full-scale diagram of a lens and an object O.

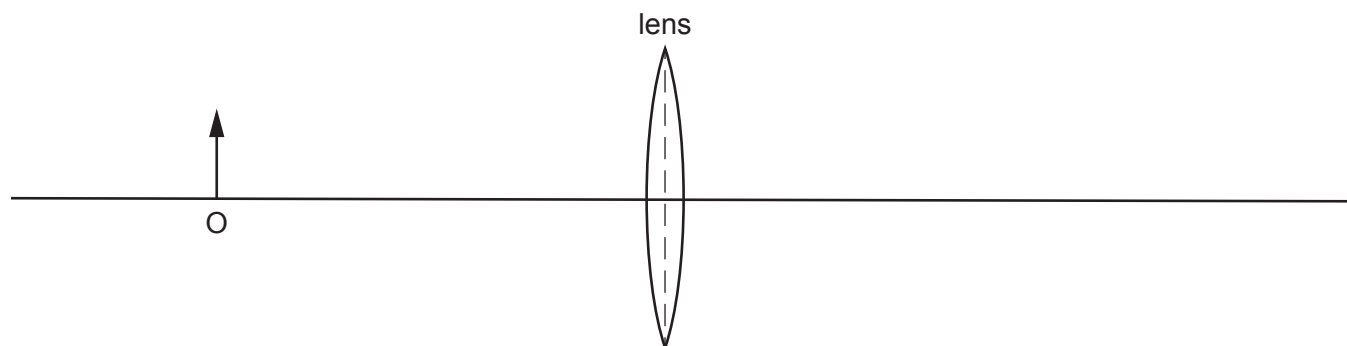


Fig. 6.1

- (a) The focal length of the lens is 3.5 cm.

On Fig. 6.1, mark and label with the letter F the positions of the **two** principal focuses. [1]

- (b) On Fig. 6.1, draw **three** rays to locate the image. Draw an arrow to represent the image and label the image I. [3]

- (c) State **three** properties of the image I.

..... [2]

- (d) A student incorrectly states that this lens is being used as a magnifying glass.

- (i) State how the image produced by a magnifying glass is different from the image I.

..... [1]

- (ii) The student moves the object O to a position P so that the lens shown in Fig. 6.1 acts as a magnifying glass.

On Fig. 6.1, mark a possible position for P. [1]

[Total: 8]

- 5 (a) Explain, in terms of the behaviour of light rays, what is meant by *principal focus* for a thin converging lens.

.....

 [2]

- (b) State what is meant by *focal length*.

.....
 [1]

- (c) A lens is used to produce a focused image of an object on a translucent screen. Fig. 5.1 shows the object O and its image I.

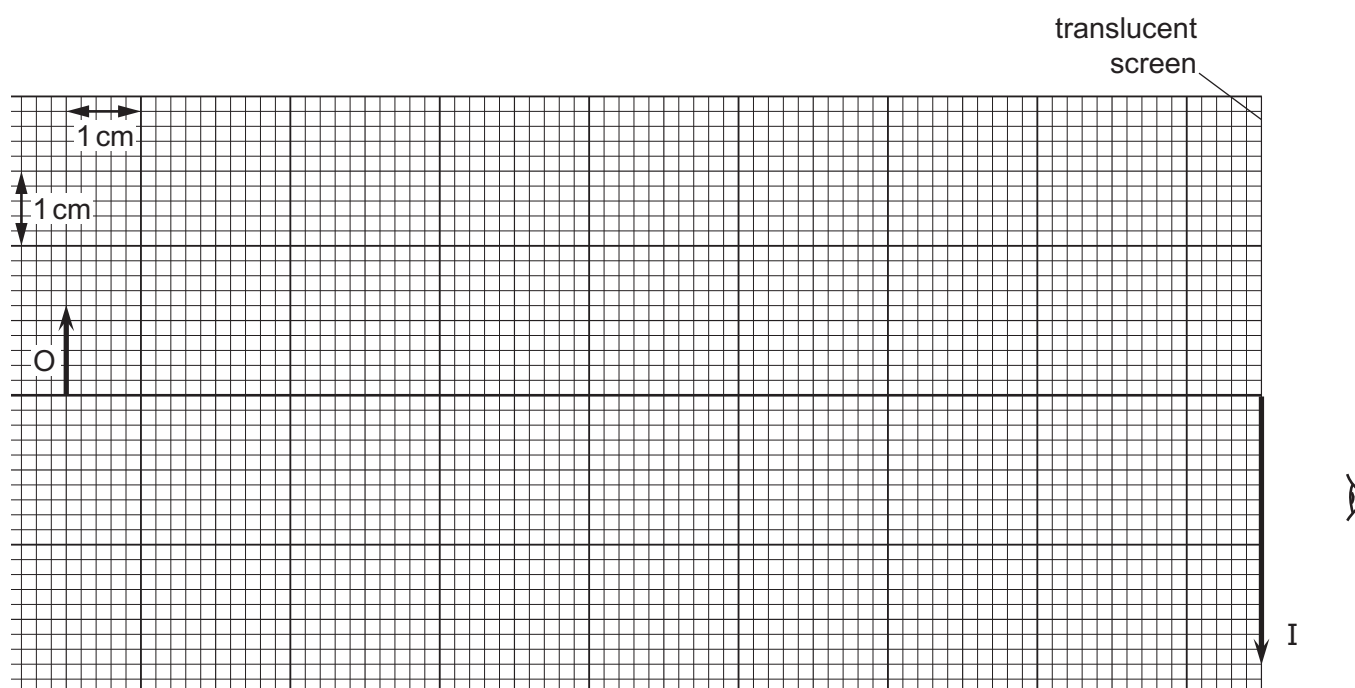


Fig. 5.1

- (i) Consider the straight ray that passes from the tip of O to the tip of I and find the position of the lens. Mark the position of the lens by drawing a vertical line labelled L from the top of the grid to the bottom. [1]
- (ii) On Fig. 5.1, draw a ray that passes through one of the principal focuses and determine the focal length of the lens.

focal length = ... [2]

- (iii) Object O is a printed document that includes a large letter R on the side facing the lens. The top edge of the document corresponds to the tip of O. Fig. 5.2 shows the printed document.

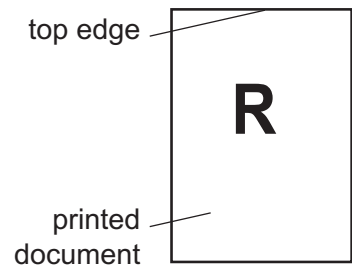


Fig. 5.2



Fig. 5.3

On Fig. 5.3, mark a tick in **one** of the boxes (☒) to indicate how the image on the translucent screen appears to someone who is looking at the screen from point P. Explain why the image has this appearance.

.....

.....

..... [2]

[Total: 8]

- 6 X-rays are electromagnetic waves. Fig. 6.1 shows the position of X-rays in the electromagnetic spectrum arranged according to increasing wavelength.

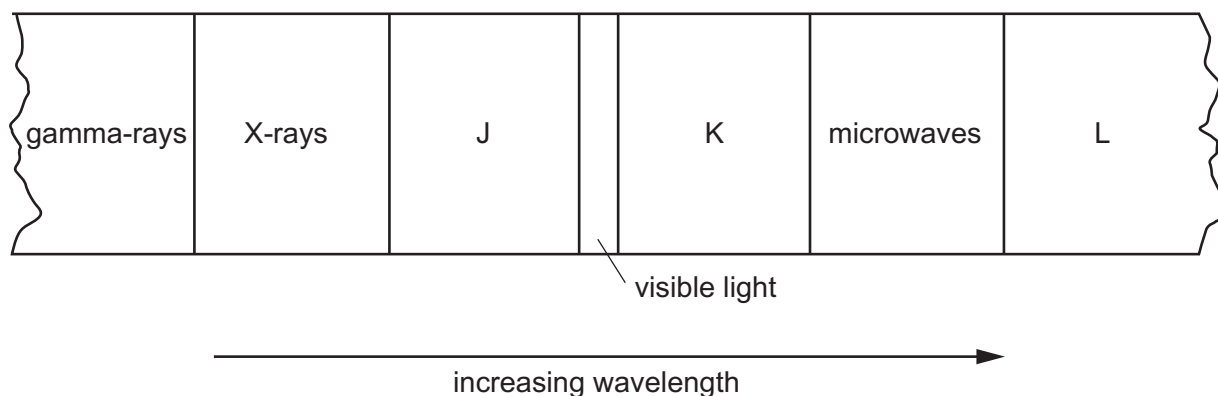


Fig. 6.1

- (a) Three components of the spectrum are unnamed but labelled J, K and L.

- (i) State the names of these three components.

J

K

L

[2]

- (ii) State which of these three components has the lowest frequency.

..... [1]

- (b) Calculate the frequency of X-rays that have a wavelength of $1.2 \times 10^{-9} \text{ m}$ in a vacuum.

frequency = ... [3]

- (c) (i) Describe **one** medical use of X-rays.

.....

.....

.....

.....

..... [3]

(ii) State **one** reason why it is necessary to take safety precautions when X-rays are used.

.....
..... [1]

[Total: 10]

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6 Fig. 6.1 shows particles of a material in which a sound wave is travelling.



Fig. 6.1 (not to scale)

- (a) On Fig. 6.1, mark:
- (i) the centre of a compression with the letter C [1]
 - (ii) the centre of a rarefaction with the letter R [1]
 - (iii) one wavelength with a double-ended arrow. [1]
- (b) Circle **one** value from the list which is the speed of sound in water.
- 15 m/s 150 m/s 1500 m/s 15 000 m/s 150 000 m/s 1 500 000 m/s [1]
- (c) The wavelength of a sound wave in water is 12 cm.
- Calculate the frequency of this sound wave using your value from (b).

frequency = ... [3]

- (d) State and explain whether the sound in (c) is ultrasound.
- statement
- explanation
-
-
- [2]

[Total: 9]

- 7 Fig. 7.1 shows a ray of light approaching face AB of a glass prism of refractive index 1.5.

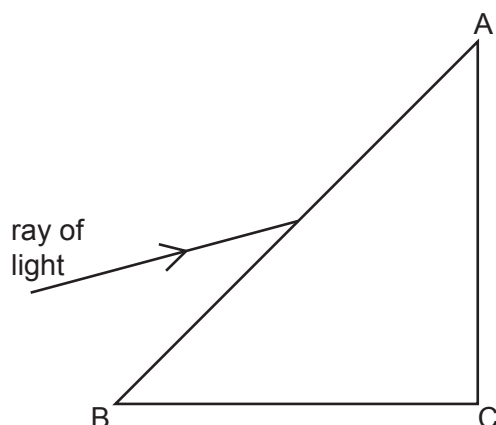


Fig. 7.1

- (a) (i) On Fig. 7.1, accurately draw the path of the ray within the prism from face AB to face AC. You will need to make a measurement from Fig. 7.1 and carry out a calculation.

[4]

- (ii) Determine the angle of incidence of this ray when it strikes face AC.

angle = ... [1]

- (b) Without further measurement or calculation, sketch on Fig. 7.1 the approximate path of the ray after passing through the face AC. [1]

- (c) Fig. 7.2 shows a ray of light travelling within an optical fibre.

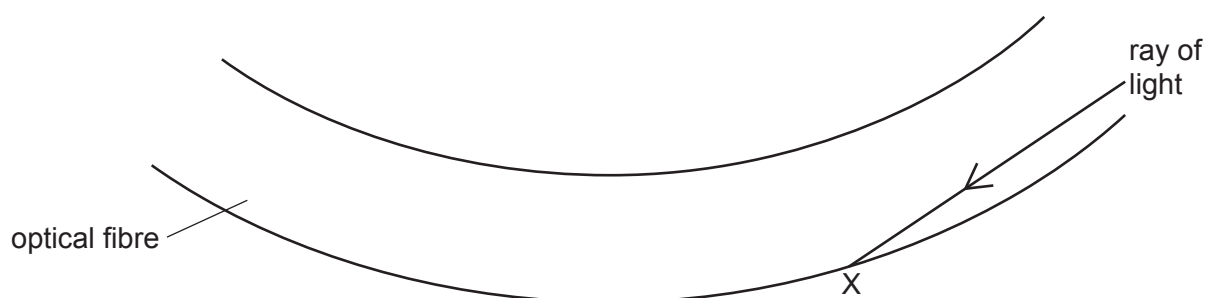


Fig. 7.2

- (i) Complete the path of the ray of light to the left-hand end of the fibre. [2]

- (ii) Name the process taking place at X. [1]

[Total: 9]

- 6 (a) Describe an experiment to determine the speed of sound in air. State the apparatus you need, details of how to take measurements and how to calculate the speed of sound in air.

You may use the space below to draw a **labelled** diagram as part of your answer.

.....

.....

.....

.....

.....

.....

.....

..... [5]

- (b) Sound waves from a television are diffracted through doorways. Light waves from a television are **not** diffracted through doorways.

Suggest why light waves and sound waves behave differently in this situation.

.....

.....

..... [2]

- 7 (a) Fig. 7.1 shows a ray of green light emerging from one face of a glass prism.

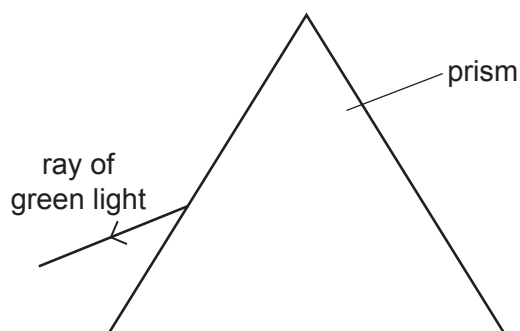


Fig. 7.1

- (i) On Fig. 7.1, draw the path of the green light entering and passing through the prism. [2]

- (ii) The green light is monochromatic. State, in terms of a **wave property**, what is meant by monochromatic light.

..... [1]

- (b) (i) State the speed of light in air.

..... [1]

- (ii) The wavelength of green light in air is $5.2 \times 10^{-7} \text{ m}$.

Calculate the frequency of green light.

frequency = ... [2]

- (iii) The refractive index of glass for green light is 1.52.

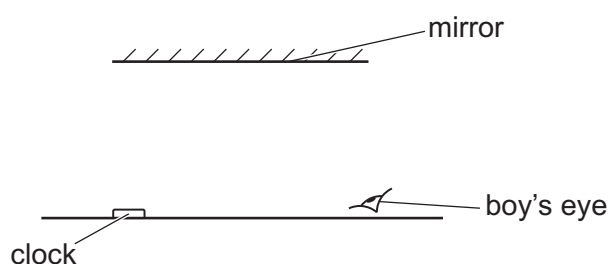
Calculate the speed of green light in glass.

speed = ... [2]

[Total: 8]

84. Question part 1/2 | 0625 Feb-March 2022 P4 V2 Q5

- 5 A boy looks at the image of a clock in a plane mirror. Fig. 5.1 shows the mirror, the clock and the position of one of the boy's eyes.

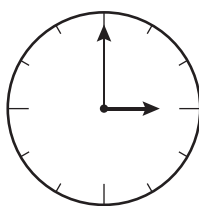
**Fig. 5.1**

- (a) (i) On Fig. 5.1, draw a ray of light from the clock, reflected to the boy's eye. [2]
 (ii) On Fig. 5.1, mark with an X the position of the image of the clock. [1]
 (iii) State whether the image formed by the mirror is virtual or real.

Explain your answer.

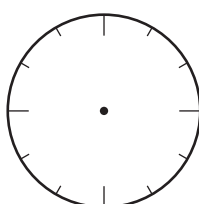
..... [1]

- (iv) Fig. 5.2 shows the image of the clock seen by the boy.

**Fig. 5.2**

The boy now looks directly at the clock.

On Fig. 5.3, draw what the boy sees.

**Fig. 5.3**

[1]

(b) (i) The clock is illuminated by a source of monochromatic green light.

State the meaning of monochromatic.

..... [1]

(ii) The green light has a wavelength of 5.6×10^{-7} m.

Calculate the frequency of this green light.

frequency = ... [3]

[Total: 9]

- 7 Fig. 7.1 is a full-scale diagram of a small nail N in front of a thin converging lens. The line L represents the lens.

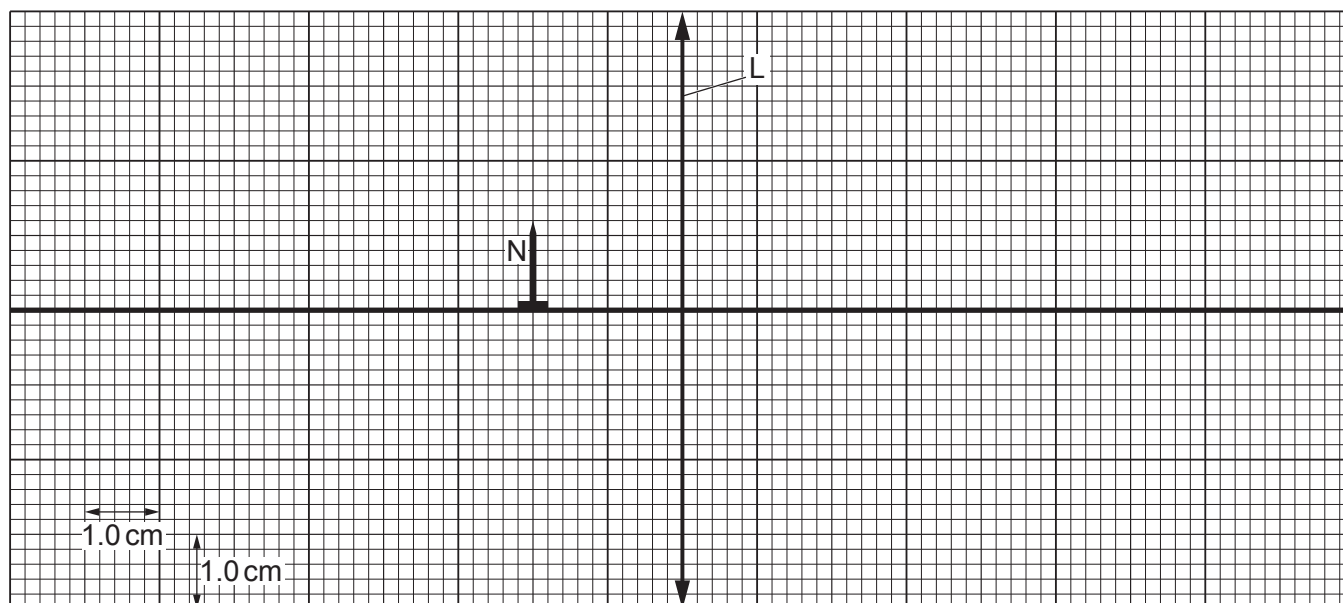


Fig. 7.1 (full scale)

The focal length of the lens is 3.0 cm.

- (a) Rays of light, parallel to XY, are travelling towards the lens.

Describe what happens to the light after it passes through the lens.

.....

.....

.....

..... [3]

- (b) On Fig. 7.1, mark and label with an F each of the **two** principal focuses of the lens. [1]

- (c) The small nail N, of height 1.2 cm, is positioned 2.0 cm to the left of the lens.

- (i) By drawing on Fig. 7.1, find the position of the image I of N and add image I to the diagram. [3]

- (ii) State and explain whether I is a real or a virtual image.

.....

..... [1]

- (iii) State the name given to a lens when it is used in this way.

..... [1]

[Total: 9]

5 Sound waves are longitudinal and electromagnetic waves are transverse.

(a) A sound wave used for a medical examination has a frequency of 1.5 MHz.

(i) State and explain what type of sound wave this is.

.....
..... [2]

(ii) The wave travels through soft human tissue at a speed of 1.3 km/s.

Calculate the wavelength of the wave in soft human tissue.

wavelength = ... [3]

(b) Describe **one** use of X-rays in medicine.

.....
..... [2]

[Total: 7]

- 6 Fig. 6.1 is a full-size ray diagram showing the formation of an image by a thin glass lens.

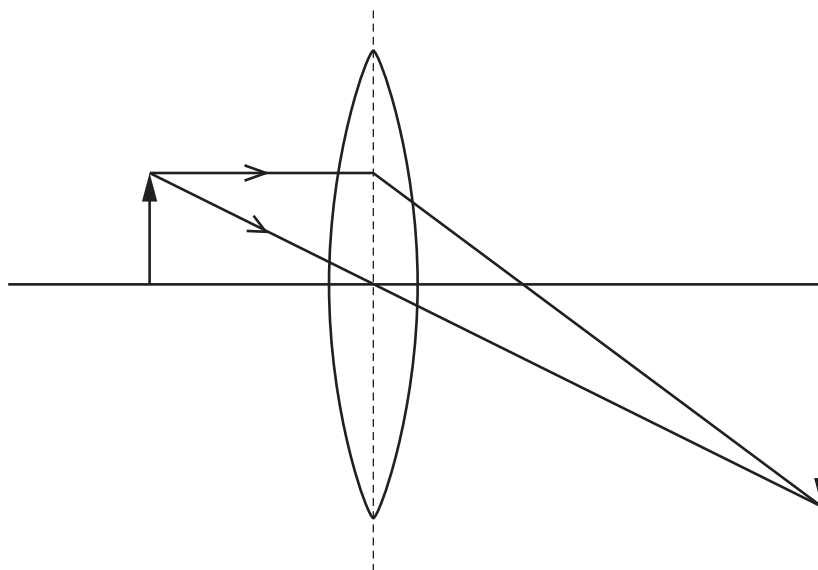


Fig. 6.1 (full size)

- (a) Determine the focal length of the lens.

focal length = ... [1]

- (b) Circle **three** items in the list which describe the nature of the image formed.

enlarged

same size

diminished

inverted

upright

real

virtual

[3]

- (c) State **one** feature of a virtual image.

..... [1]

[Total: 5]

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- 6 (a) (i) Fig. 6.1 shows crests of a plane water wave approaching a barrier with a gap.

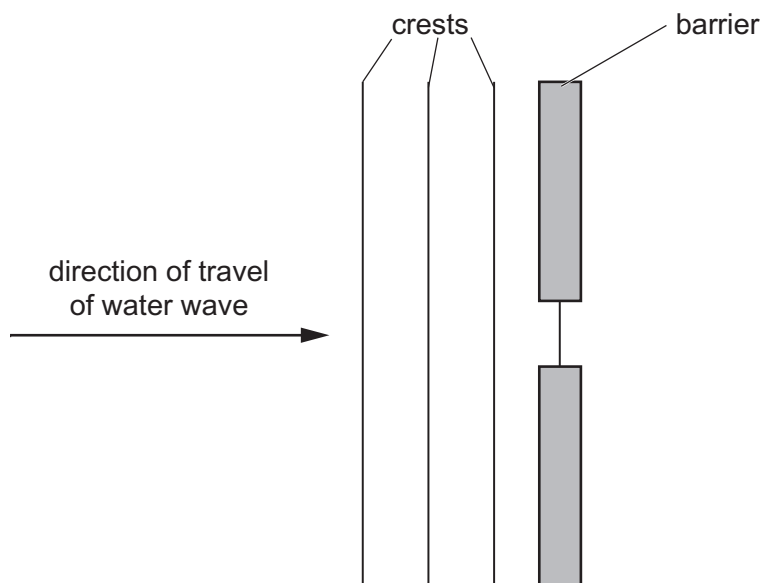


Fig. 6.1

On Fig. 6.1, draw **three** crests of the water wave to the right of the barrier. [2]

- (ii) Fig. 6.2 shows crests of a plane water wave in deep water approaching a region of shallow water.

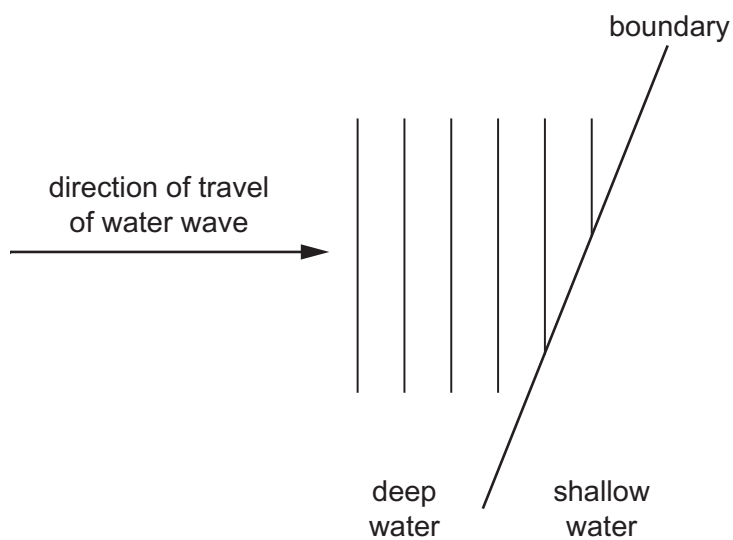


Fig. 6.2

The water wave moves more slowly in shallow water.

On Fig. 6.2, draw:

1. **three** crests of the water wave in the shallow water [2]
2. the direction of travel of the wave in the shallow water. [1]

(b) State **two** ways in which transverse waves differ from longitudinal waves.

1.

.....

2.

.....

[2]

(c) (i) State a typical value of the speed of sound in water.

..... [1]

(ii) Explain why sound travels faster in water than in air.

..... [1]

[Total: 9]

- 7 (a) Fig. 7.1 shows a plan view of a room. There is a plane mirror on one wall and a picture across the whole of wall AB.

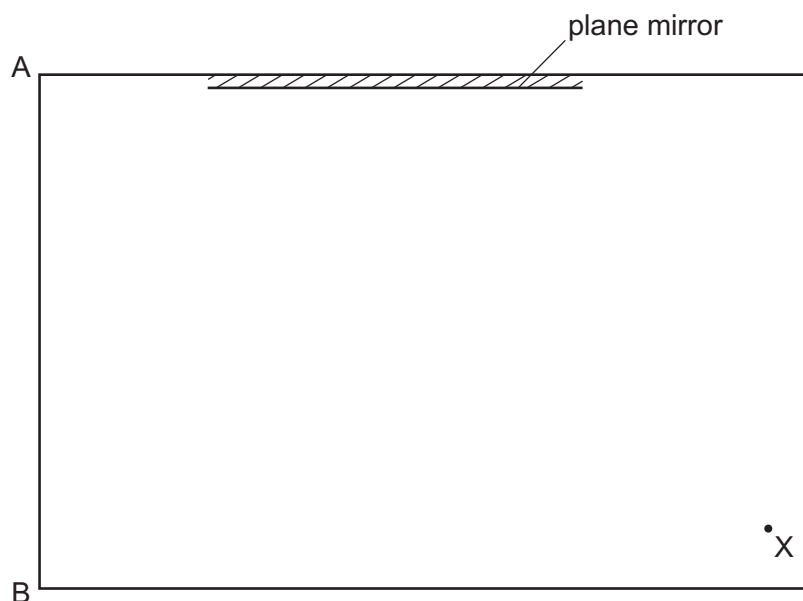


Fig. 7.1 (plan view)

A person is standing at point X and is looking at the mirror. The person cannot see all of the picture on wall AB reflected in the mirror.

There is a point P on wall AB which is the closest point to A that the person can see reflected in the mirror.

On Fig. 7.1, draw a reflected ray and an incident ray to show the position of the point P. [2]

- (b) State **two** properties of the image formed by the mirror.

1.

2.

[2]

- (c) Visible light is an electromagnetic wave.

State the name of **one** region of the electromagnetic spectrum in which the waves have:

- (i) shorter wavelengths than visible light

..... [1]

- (ii) longer wavelengths than visible light.

..... [1]

[Total: 6]

6 The red light produced by a laser is monochromatic.

(a) State what is meant by monochromatic.

.....
..... [1]

(b) The red light from the laser hits the curved surface of a semicircular transparent plastic block at point P and passes into the plastic.

The red light travels through the plastic and hits the straight edge of the block at its midpoint M. Fig. 6.1 shows that some of the light is reflected and that some light travels in the air along the straight edge of the plastic block.

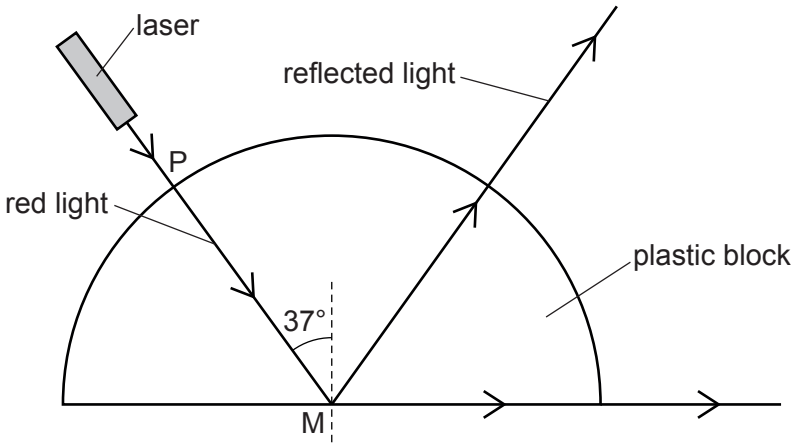


Fig. 6.1

The speed of light in air is $3.0 \times 10^8 \text{ m/s}$.

(i) Explain why the red light does **not** change direction as it enters the plastic block.

.....
.....
..... [2]

(ii) At M, the angle between the red light in the plastic and the normal is 37°.

Calculate the speed of the red light in the plastic.

speed = ... [4]

- (iii) In the plastic, blue light travels slightly slower than red light and so the critical angle for blue light is smaller than the critical angle for red light.

The laser that emits red light is replaced by one that emits blue light. Now blue light enters the block at P and hits the straight edge at M.

Explain what happens to the blue light after it hits the straight edge at M.

.....

.....

.....

..... [3]

[Total: 10]

- 6 (a)** Fig. 6.1 shows a converging lens and an object OX. The focuses of the lens are labelled F.

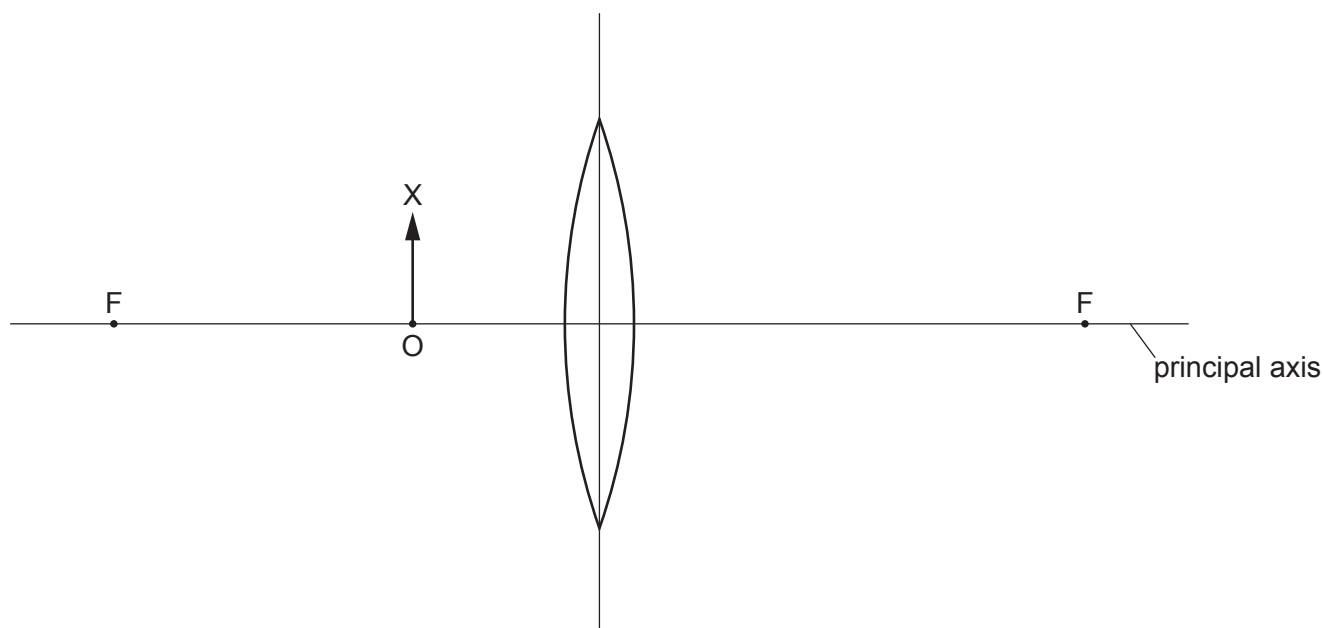


Fig. 6.1

- (i)** On Fig. 6.1, carefully draw **two** rays from X which locate the image of the object. Draw the image and label it IY.

Measure the distance from IY along the principal axis to the centre line of the lens.

distance = ... [4]

- (ii)** State **two** reasons why the image IY is virtual.

1.

2. [2]

(b) Fig. 6.2 shows a ray of green light passing into, through and out of a glass prism.

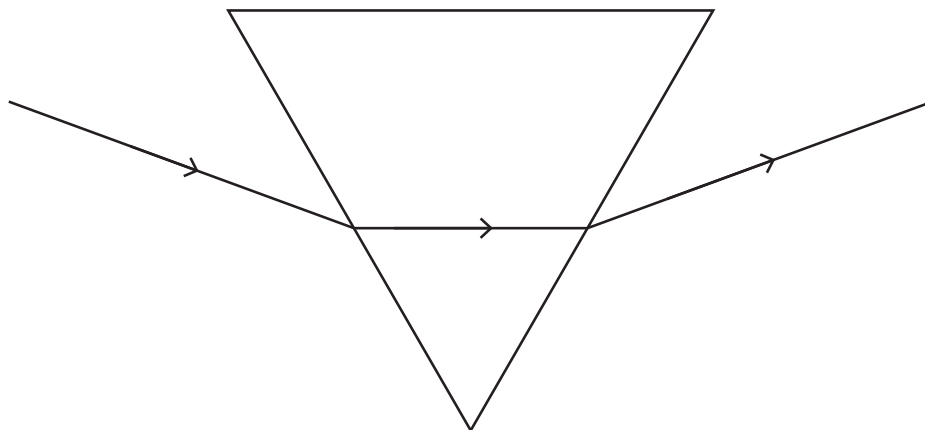


Fig. 6.2

A ray of blue light is incident on the prism on the same path as the incident ray of green light.

On Fig. 6.2, draw the path of the blue light through and out of the prism.

[3]

[Total: 9]

- 6 Fig. 6.1 shows wave crests and the direction of travel for a water wave approaching a barrier in a large ripple tank.

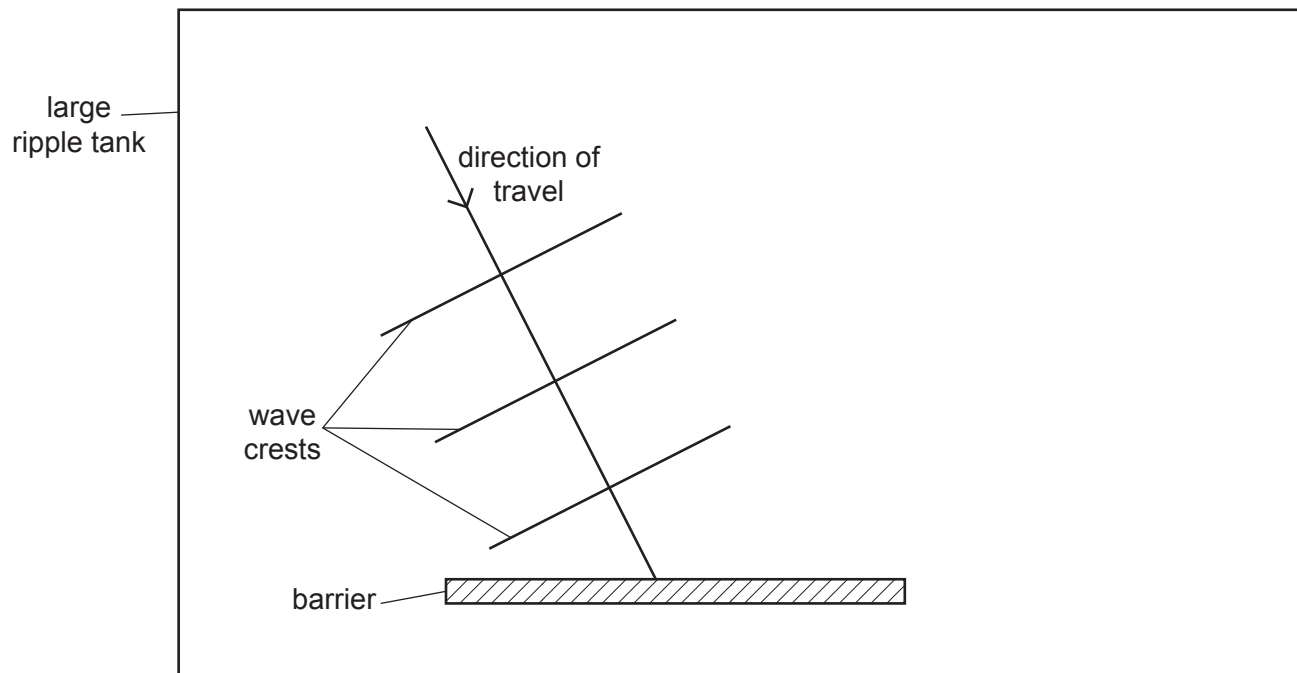


Fig. 6.1

The wavelength of the wave is 1.6 cm.

(a) On Fig. 6.1, draw:

- (i) the direction of travel of the reflected wave [1]
- (ii) **three** successive reflected wave crests. [2]

(b) Fig. 6.2 shows an identical wave approaching a barrier with a gap of 1.3 cm.

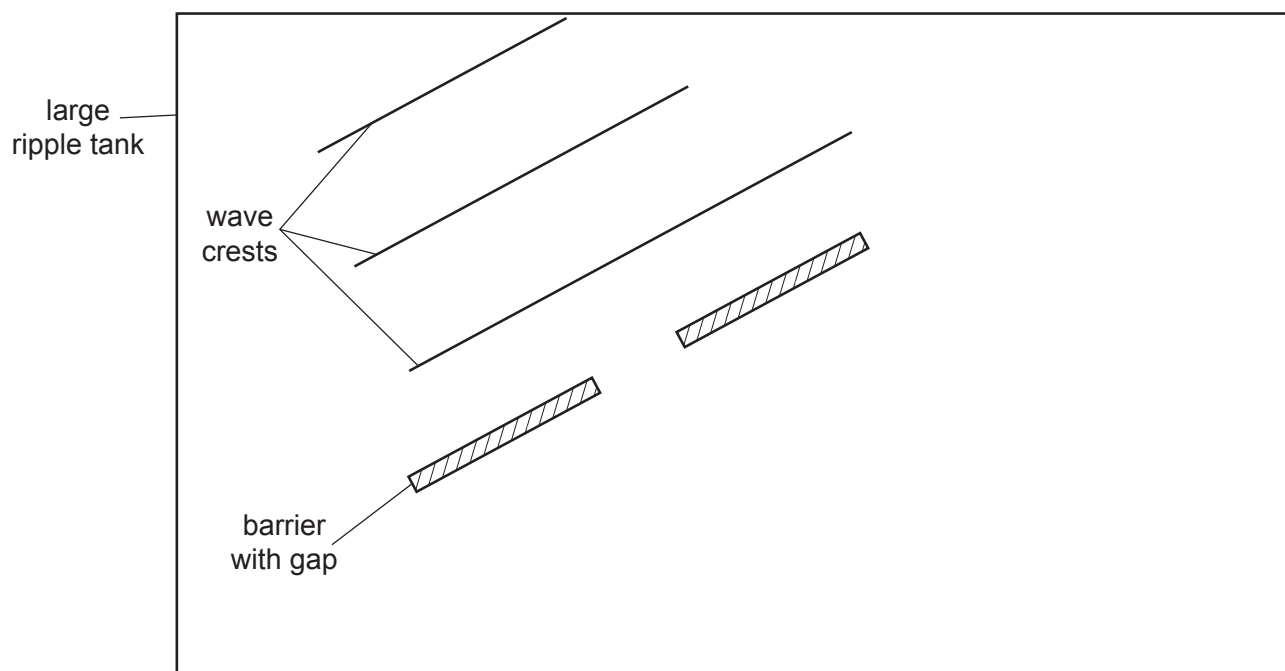


Fig. 6.2

On Fig. 6.2, draw **three** successive wave crests after they pass through the gap in the barrier. [3]

(c) The frequency of the wave is 4.0 Hz.

Calculate the speed of the wave.

speed = ... [2]

[Total: 8]

- 7 (a) State what is meant by total internal reflection.

.....
..... [2]

- (b) Fig. 7.1 shows a ray of light from a light source in a tank containing a liquid.

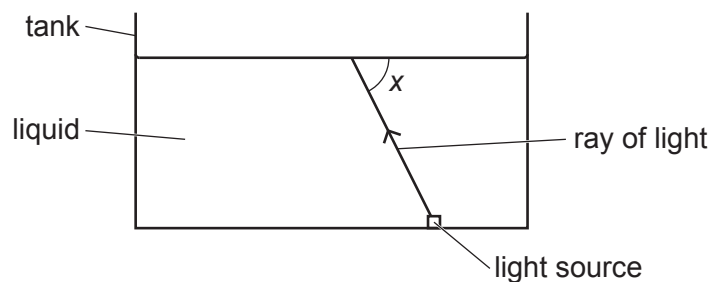


Fig. 7.1

The ray of light strikes the surface of the liquid at an angle x .

- (i) The refractive index of the liquid is 1.5.

Calculate the largest value of x for which total internal reflection can occur.

$x =$ [3]

- (ii) The speed of light in air is $3.0 \times 10^8 \text{ m/s}$.

Calculate the speed of light in the liquid.

speed = ... [2]

[Total: 7]

- 5 (a) Fig. 5.1 shows a semicircular transparent plastic block.

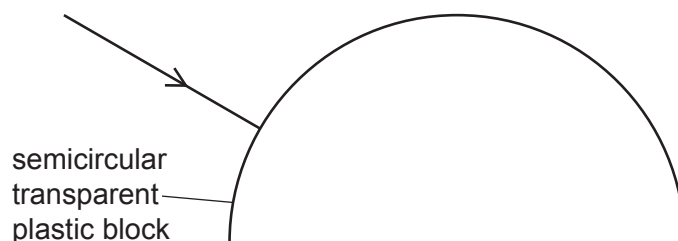


Fig. 5.1

A ray of light is incident normally on the curved surface of the block. The refractive index of the plastic is 1.5.

- (i) Calculate the critical angle for the plastic.

critical angle = ... [2]

- (ii) On Fig. 5.1, draw the path of the ray in the block and after the ray emerges from the block. [2]

- (b) Fig. 5.2 is a full-scale diagram of a lens and an object O.

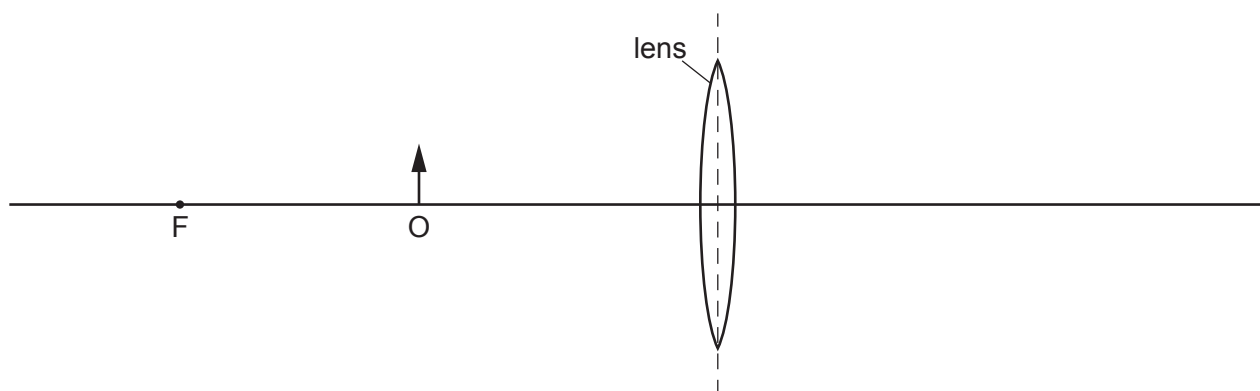


Fig. 5.2

The point marked F shows the position of a principal focus of the lens.

- (i) Determine the focal length of the lens.

focal length = ... [1]

- (ii) On Fig. 5.2, draw **two** rays from the object to locate the image. Label the image I. [3]

- (c) Fig. 5.3 shows a simplified diagram of an eye with rays from a distant object and the path of the rays inside the eye of a person with short sight.

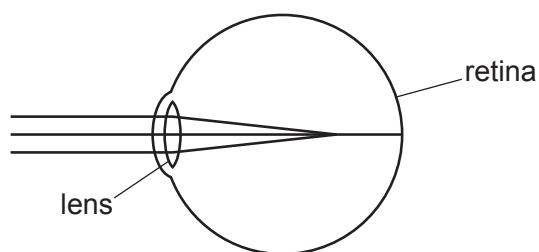


Fig. 5.3

On Fig. 5.4, draw an additional lens outside the eye to correct short-sightedness and show the path of the rays inside the eye.

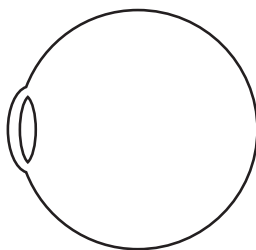


Fig. 5.4

[2]

[Total: 10]

6 (a) Sound waves have compressions and rarefactions.

Explain what is meant by compression and rarefaction.

compression
.....
rarefaction
..... [2]

(b) We can see light from the Sun but we cannot hear any sound from it.

State the reason for this.

.....
..... [1]

(c) During a thunderstorm, an observer sees the lightning almost immediately but hears the sound of the thunder several seconds later. The thunder and lightning are produced at the same time.

The sound of the thunder is heard 9.0 s after the lightning is seen. The speed of sound in air is 340 m/s.

Calculate the distance from the thunderstorm to the observer.

distance = ... [2]

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(d) In a lightning strike, there is a current of $3.0 \times 10^4 \text{ A}$ for 48 ms.

Calculate the charge that flows.

charge = ... [3]

[Total: 8]

- 5 Fig. 5.1 shows a block ABCD made of glass that has a refractive index of 1.5. The block has one curved side AB and three straight sides, BC, CD and DA.

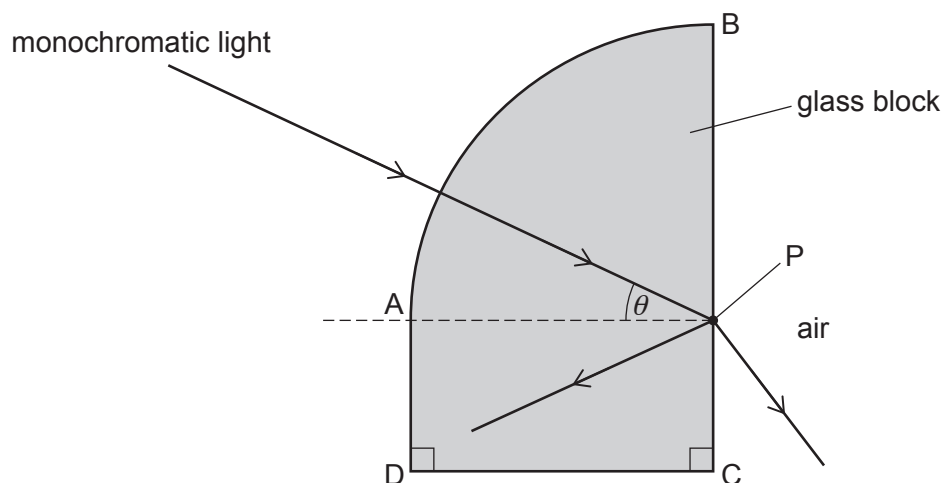


Fig. 5.1

There are right angles at C and D. The curved side AB is one quarter of the circumference of a circle that has its centre at point P.

A ray of monochromatic light enters the block through the curved side AB and strikes side BC at P. Some light emerges into the air and some is reflected.

- (a) State what is meant by monochromatic.

.....
 [1]

- (b) Explain why the ray of light does **not** change direction when it enters the block through side AB.

.....

 [2]

- (c) Show that the critical angle c for glass of refractive index 1.5 is 42° .

(d) Fig. 5.1 shows that the angle between the ray of light and line AP is θ , where line AP is at right angles to side BC.

Angle θ increases to 45° .

(i) State and explain what happens to the light that strikes P.

.....

.....

..... [2]

(ii) When $\theta = 45^\circ$, the reflected light strikes side CD.

Describe what happens when this reflected light strikes side CD.

.....

..... [1]

[Total: 8]

6 A mobile phone (cell phone) network uses microwaves of frequency $1.9 \times 10^9 \text{ Hz}$ to transmit and receive signals.

The speed of microwaves in air is $3.0 \times 10^8 \text{ m/s}$.

(a) Calculate the wavelength of these microwaves in air.

wavelength = ... [2]

(b) State **two** reasons why microwaves are used for mobile phone (cell phone) signals.

- 1
-
- 2
-
- [2]

(c) All mobile phone (cell phone) networks use digital signals to communicate with the phone.

(i) Describe, with the aid of a diagram, how a digital signal differs from an analogue signal.

-
-
-
- [3]

(ii) State **two** advantages of using digital signals rather than analogue signals.

- 1
-
- 2
-
- [2]

6 Two types of seismic waves are P-waves and S-waves.

(a) State the types of wave that P-waves and S-waves can be modelled as.

P-waves

S-waves

[2]

(b) The velocity of a P-wave in the Earth’s solid crust is 7.2 km/s and its frequency is 4.5 Hz.

Calculate the wavelength of this P-wave.

wavelength = ... [3]

[Total: 5]

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- 7 Fig. 7.1 shows a container of oil.

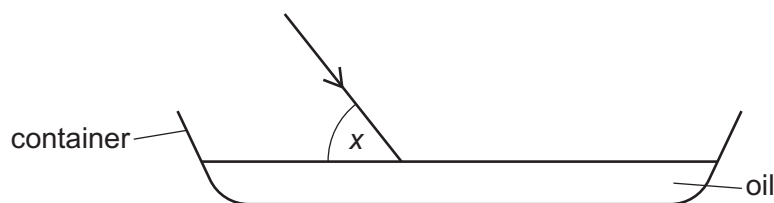


Fig. 7.1

A ray of light shines on the surface of the oil. The refractive index of the oil is 1.47.

- (a) On Fig. 7.1, draw the normal at the point where the ray enters the oil. [1]

- (b) The angle x is 56° .

Calculate the value of the angle of refraction.

angle of refraction = ... [3]

- (c) State the approximate speed of light in air.

..... [1]

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(d) Calculate the speed of light in the oil.

Give your answer to three significant figures.

speed = ... [2]

[Total: 7]

- 4 (a) Fig. 4.1 is an incomplete ray diagram showing an object O, a converging lens and the principal axis. The focal points of the lens are each labelled F.

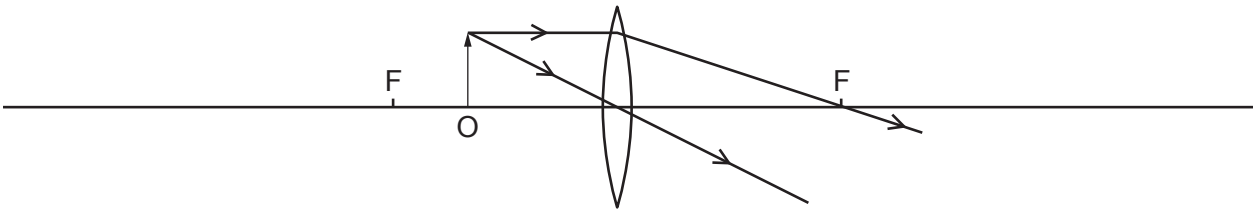


Fig. 4.1

- (i) Complete the ray diagram to draw the image formed by the lens. Label your image I. [3]
- (ii) Circle **three** descriptions in the list which describe the image formed in (i).

diminished enlarged inverted same size
real upright virtual

[3]

- (b) (i) State the name for the defect of vision that can be corrected by a converging lens.

..... [1]

- (ii) Describe how a converging lens corrects the defect in (i).
You may find it helpful to sketch a ray diagram.

.....
.....
..... [2]

[Total: 9]

5 (a) Two types of electromagnetic radiation are used in glass optical fibres for high-speed broadband.

(i) State the type of electromagnetic radiation, other than visible light, which is used in glass optical fibres.

..... [1]

(ii) Give **two** reasons why these two types of electromagnetic radiation are used in glass optical fibres for high-speed broadband.

1

.....

2

.....

[2]

(b) (i) The critical angle of the glass in an optical fibre is 45° .

Calculate the refractive index of the glass.

refractive index = ... [2]

(ii) Fig. 5.1 shows an optical fibre made of the glass described in (i).

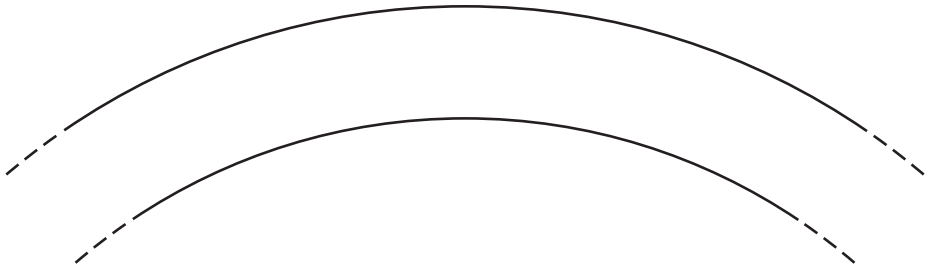


Fig. 5.1

On Fig. 5.1, draw carefully a ray of light in the fibre undergoing total internal reflection. [2]

[Total: 7]

- 6** A page of printed text is placed 18 cm from a converging lens of focal length 35 cm.

Fig. 6.1 is a scale diagram of the arrangement with each of the two principal focuses (focal points) of the lens labelled F.

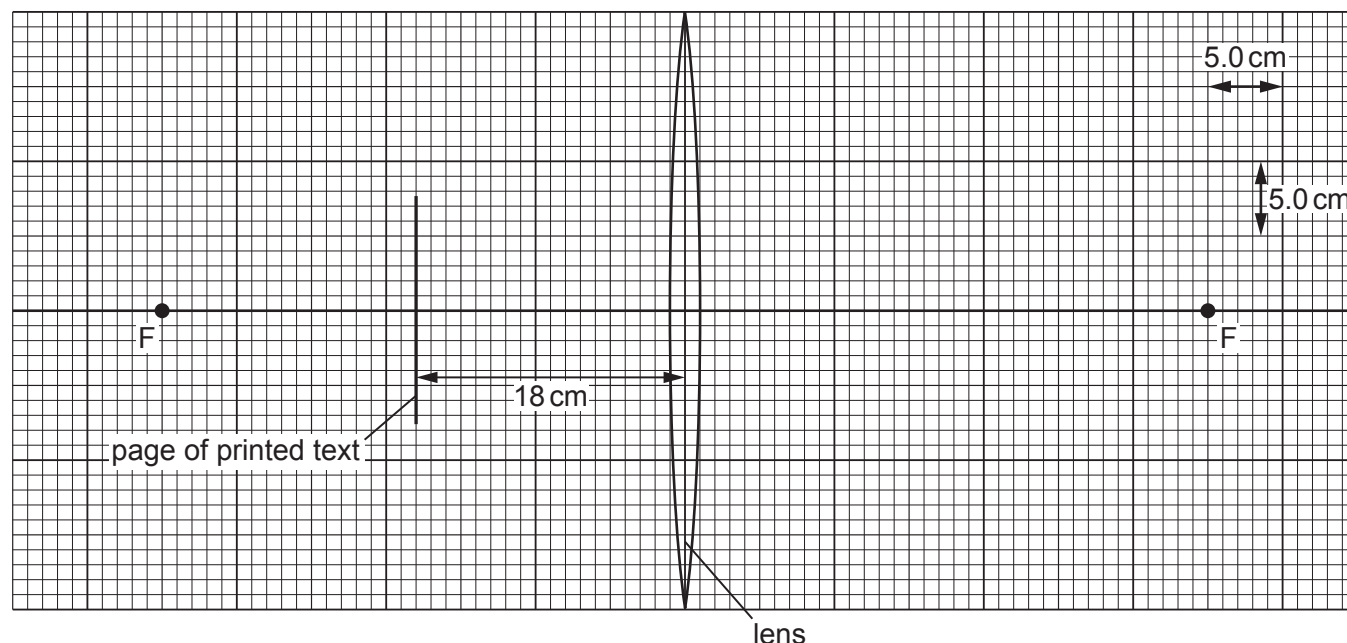


Fig. 6.1

- (a) A length of 1.0 cm on the scale diagram represents an actual length of 5.0 cm.
- (i) By drawing on Fig. 6.1, locate the image of the page produced by the lens and label it I. [3]
- (ii) Using Fig. 6.1, determine the actual distance of image I from the lens.

actual distance from lens = ... [2]

- (b) Converging lenses can be used as magnifying glasses.

State whether the image produced when a lens is used as a magnifying glass is real or virtual. Explain why.

.....
 [1]

- (c) Suggest how someone who is long-sighted may benefit from using a converging lens.

.....

 [2]

[Total: 8]

- 5 Fig. 5.1 shows a road junction, a moving car and a stationary truck. The road has high walls on each side.

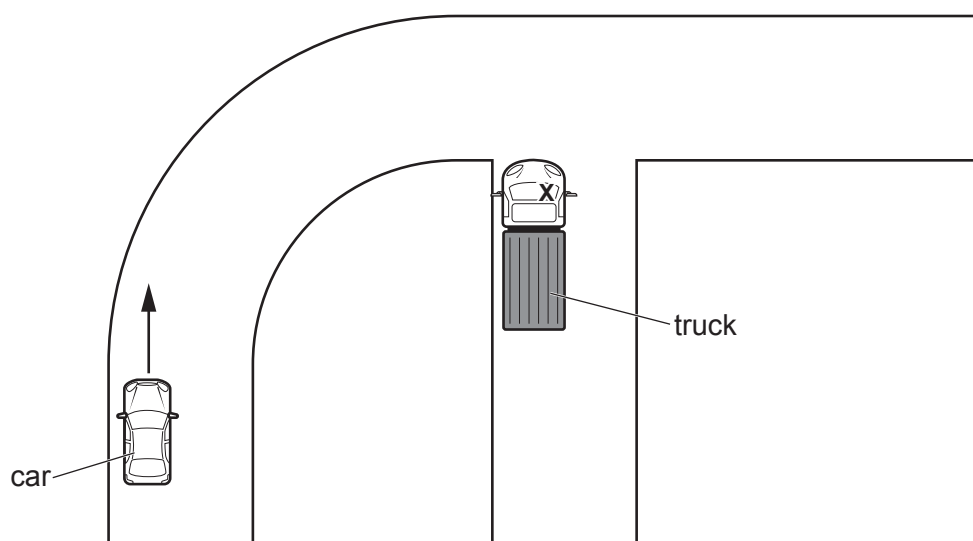


Fig. 5.1

- (a) The driver of the truck is at position X. The car moves around the corner.

On Fig. 5.1, label a point Y on the road where the truck driver first sees the car. [1]

- (b) A plane mirror is placed at the road junction as shown in Fig. 5.2.

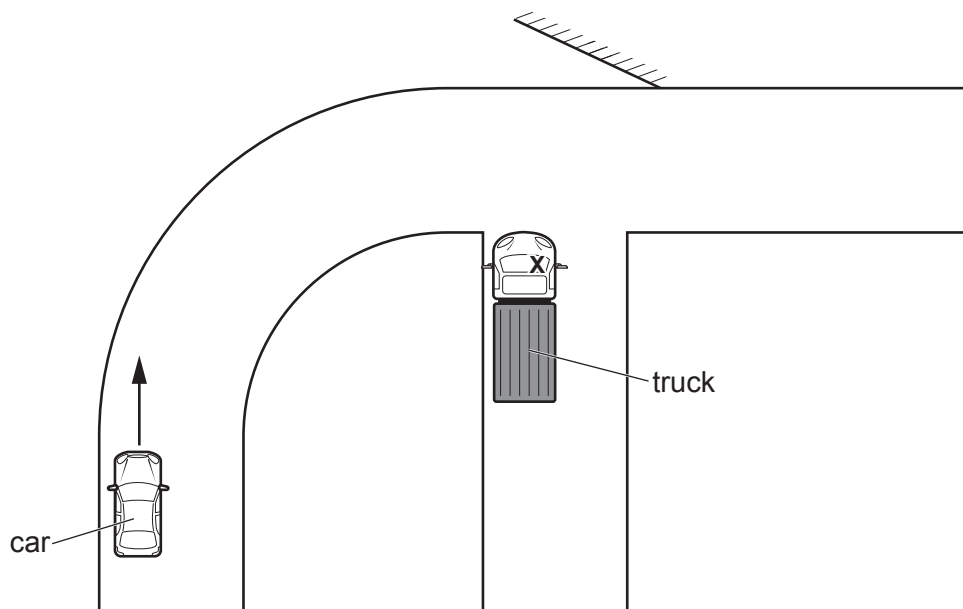


Fig. 5.2

Show how this mirror allows the driver of the truck to see the car when it is at the position shown in Fig. 5.2. [2]

- (c) The truck driver wears spectacles to correct long-sightedness. Fig. 5.3 shows how a blurred image of an object O forms on the retina. Any effect of the cornea on the rays of light can be ignored.

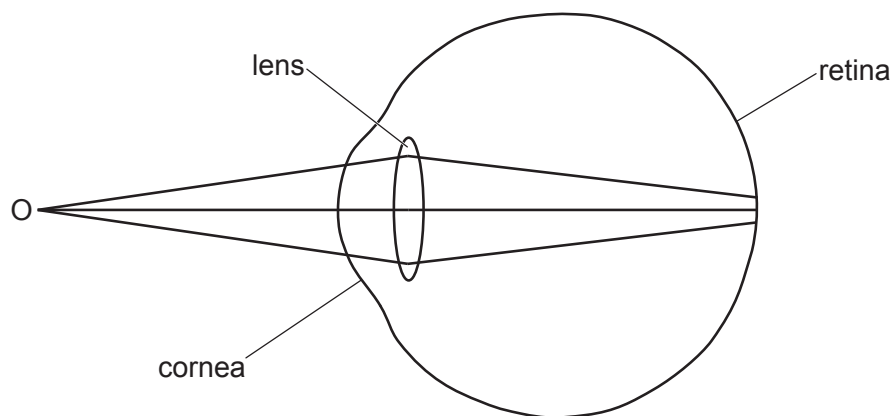


Fig. 5.3

On Fig. 5.4, show how long-sightedness is corrected by:

- adding a suitable lens in front of the eye
- continuing the path of the **three** rays of light until they meet to form an image.

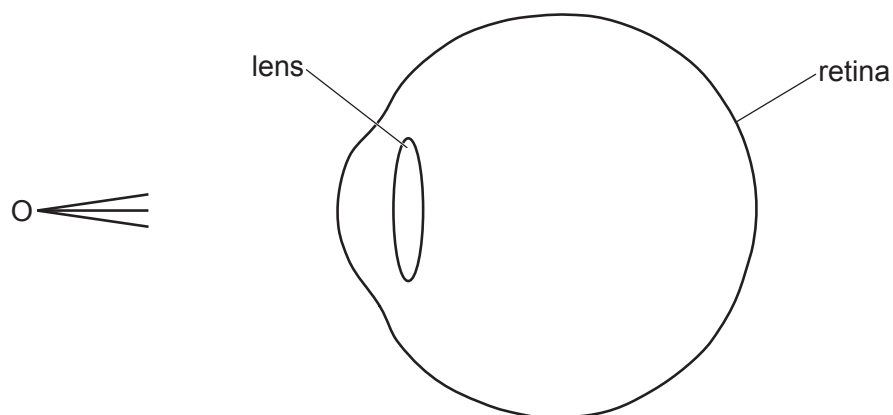


Fig. 5.4

[4]

[Total: 7]

- 7 Fig. 7.1 shows some uses of electromagnetic radiation and different regions of the electromagnetic spectrum.

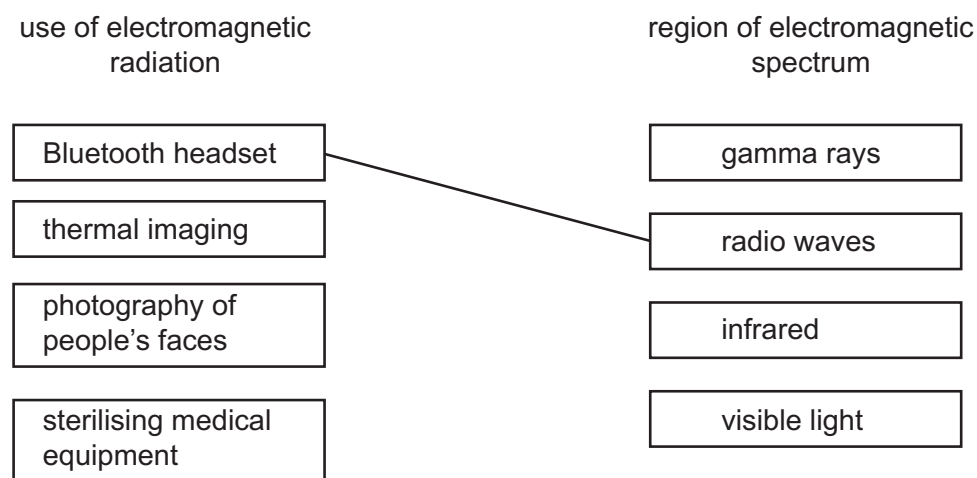


Fig. 7.1

- (a) Draw a line from each use to the correct region of the spectrum. Each region of the spectrum is used once. One line has been completed for you. [2]

- (b) State the speed of electromagnetic waves in a vacuum.

speed = ... [1]

- (c) A Bluetooth headset can be used to listen to music on a mobile (cell) phone without the need for wires to connect the headset to the phone.

- (i) The headset uses frequencies in the range 2.40–2.48 GHz.

Calculate the wavelength of the radio waves when the frequency is in the middle of the frequency range.

wavelength = ... [3]

- (ii) Suggest why a Bluetooth headset only works well over short distances.

.....
 [1]

[Total: 7]

- 5 (a) Fig. 5.1 is a scale diagram of wavefronts of red light approaching a gap in a barrier.

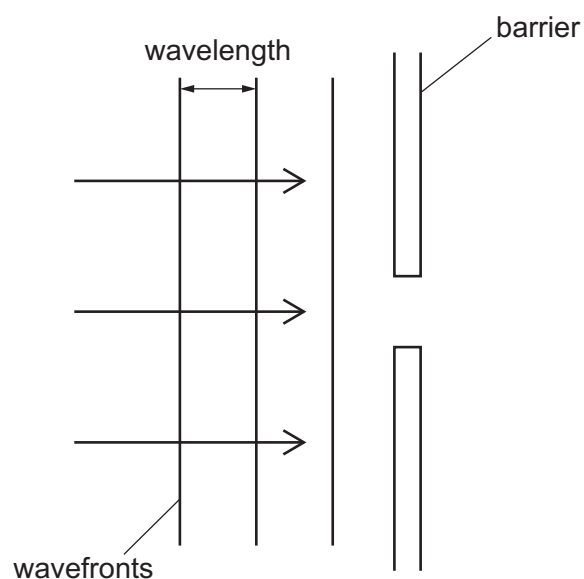


Fig. 5.1

On Fig. 5.1, draw **three** wavefronts after the wave has passed through the gap. [3]

- (b) Fig. 5.2 shows the same barrier and gap. A wave of blue light approaches this barrier.

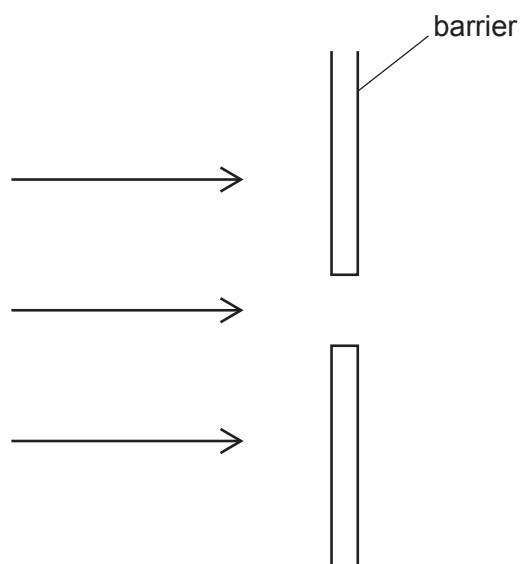


Fig. 5.2

On Fig. 5.2:

- draw **three** wavefronts of this wave before it reaches the barrier
- draw **three** wavefronts after the wave passes through the gap.

[3]

[Total: 6]

- 6 (a)** Fig. 6.1 shows a converging lens and its principal axis. The points F_1 and F_2 are each a principal focus of the lens.

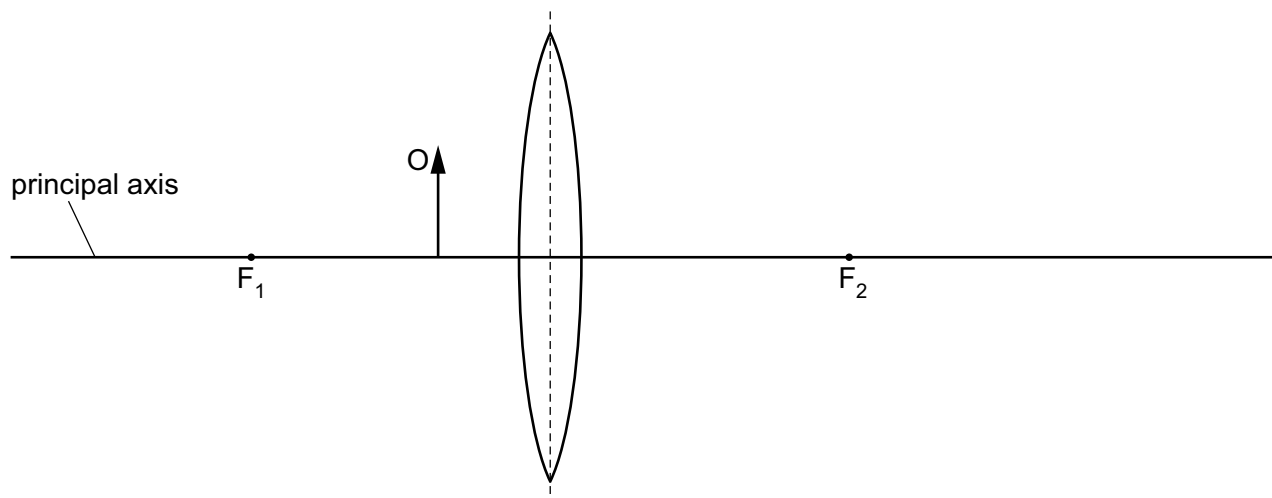


Fig. 6.1

An object O is placed between F_1 and the lens.

- (i) On Fig. 6.1, draw two rays from the top of the object O to locate the image. Label the image I . [3]
- (ii) The object O is moved to the left along the principal axis so that it is further from the lens than F_1 .

Fig. 6.2 is a diagram of the new arrangement with the new image shown.

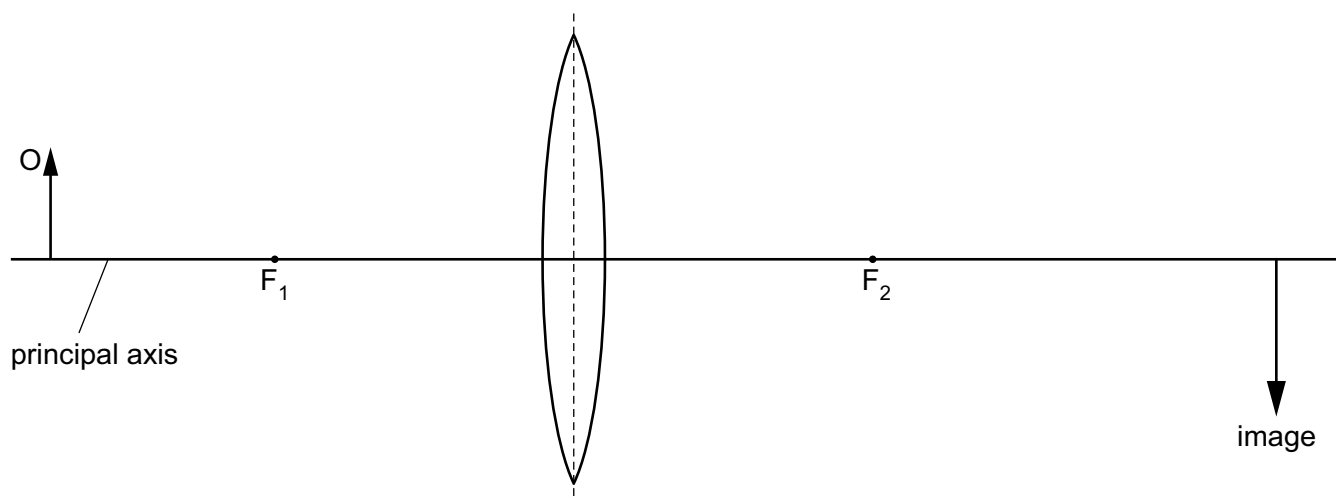


Fig. 6.2

Underline **three** of the terms below that describe the image shown in Fig. 6.2.

diminished enlarged inverted real same size upright virtual

[2]

(b) Fig. 6.3 shows yellow light passing through a glass prism.

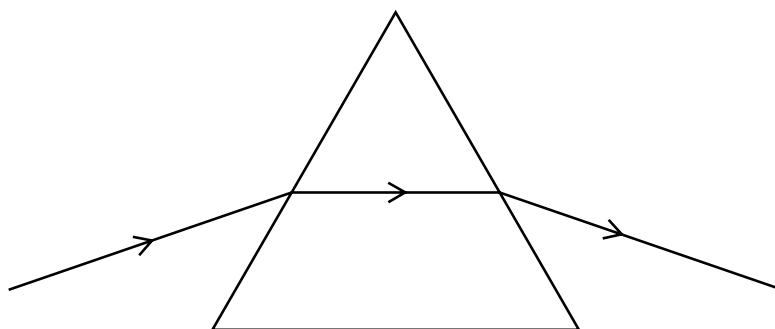


Fig. 6.3

Blue light enters the prism along the same path as the yellow light.

On Fig. 6.3, draw the path of the blue light as it enters, passes through and leaves the prism.
[2]

[Total: 7]

- 7 (a) State a typical value for the speed of sound in air.

speed = ... [1]

- (b) A sound wave in air has a wavelength of 22 mm.

Using your value for the speed of sound in (a), calculate the frequency of the sound wave.

frequency = ... [2]

- (c) Fig. 7.1 shows a solid block made from hot liquid metal. As the liquid cooled, a bubble formed **inside** the block. The bubble is **not** visible from outside the block.

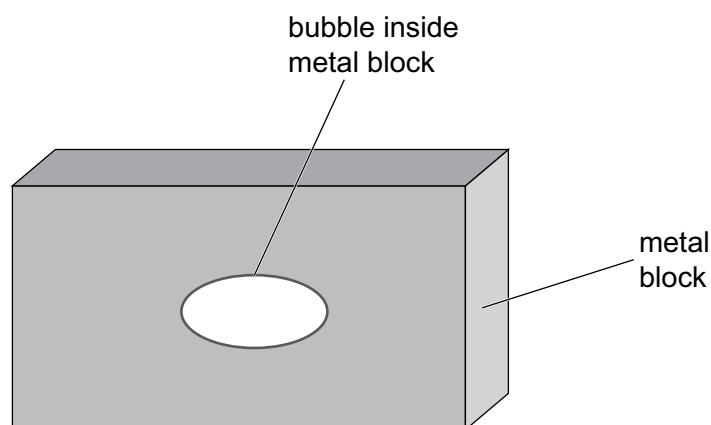


Fig. 7.1

Describe and explain how to use ultrasound to determine the size and position of the bubble inside the metal block. You may draw on the diagram.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 7]

5 (a) (i) Table 5.1 shows applications of regions of the electromagnetic spectrum.

Complete the second column of the table with the region of the electromagnetic spectrum used for each application.

Choose from the regions in this list:

gamma rays infrared microwaves radio waves ultraviolet

Each region may be used once, more than once or not at all.

Table 5.1

application	region of electromagnetic spectrum
cancer treatment	gamma rays
Bluetooth data connection	
optical fibres	
security marking	
sterilising food	
wireless internet	

[3]

(ii) State the approximate speed of radio waves in air.

speed = ... m/s [1]

(b) Fig. 5.1 shows successive crests of a wave after a plane wave has passed through a gap.

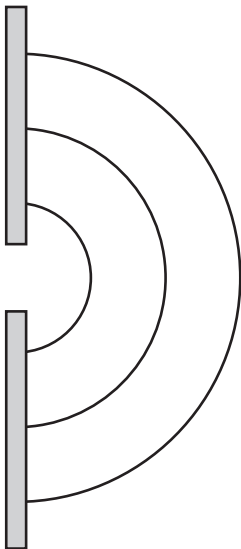


Fig. 5.1

(i) On Fig. 5.1 draw **three** successive crests before the wave reaches the gap. [2]

- (ii) Fig. 5.2 shows a much wider gap. A plane wave of the same wavelength as in (b)(i) is incident on the gap from the left side of the barrier.



Fig. 5.2

On Fig. 5.2, draw **three** successive crests of the wave after the wave has passed through the gap. [2]

[Total: 8]

- 6 Fig. 6.1 shows a full-scale diagram of an object O and its image I produced by a converging lens. The lens and its position on the principal axis are not shown.



Fig. 6.1

- (a) On Fig. 6.1, draw:

- a single ray to locate the position of the centre of the converging lens
- a line to represent the position of the lens and label the line L.

[2]

- (b) Determine the focal length of the lens by drawing another ray on Fig. 6.1.

focal length = ... [2]

- (c) The object is moved 2.0 cm closer to the lens.

State **two** changes to the characteristics of the image.

1

2

[2]

[Total: 6]

- 4 The lens in a magnifying glass is a converging lens.
- (a) Fig. 4.1 shows the lens of the magnifying glass, its two focal points, F_1 and F_2 , and its principal axis.

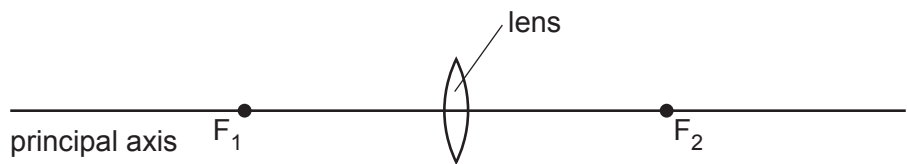


Fig. 4.1

- (i) State what is meant by 'focal point'.
-
-
- [2]

- (ii) A student using the magnifying glass sees a magnified image of an object.

On Fig. 4.1, mark:

- a point X on the principal axis for a possible position of the object
 - a point E for a possible position of the student's eye.
- [1]

- (iii) Underline **two** words in the list that describe the image produced in (a)(ii).

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

[1]

- (b) The refractive index of the glass used to make the lens is 1.5.

- (i) The speed of light in air is $3.0 \times 10^8 \text{ m/s}$.

Calculate the speed of light in the glass.

speed in glass = ... [2]

Topical questions | 131 questions

(ii) State what happens to the wavelength of light as it passes into the lens.

..... [1]

State the name of the problem and explain how a converging lens is used to correct it. You may draw a diagram.

name of problem:

.....

.....

.....

.....

[3]

[Total: 10]

5 (a) Describe how a longitudinal wave differs from a transverse wave.

.....

.....

..... [2]

(b) Fig. 5.1 represents a seismic wave produced by an earthquake.

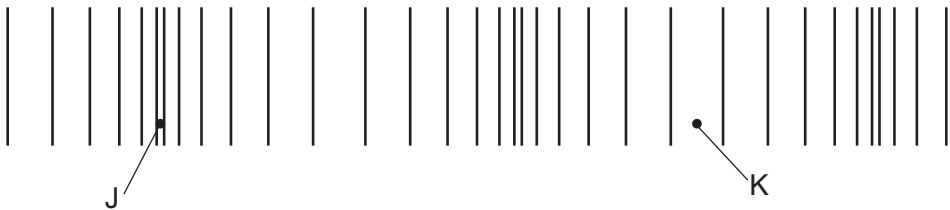


Fig. 5.1

(i) State whether this seismic wave is a P-wave (primary) or an S-wave (secondary). Justify your choice.

.....

..... [1]

(ii) The wave represented in Fig. 5.1 has a wavelength of 1.2×10^4 m.

Calculate the actual distance between point J and point K.

distance = ... [2]

(iii) The wave in (ii) travels through the ground at a speed of 4600 m/s.

As the wave passes a certain point, the ground completes 5 oscillations.

Calculate the time that it takes for the wave to pass. Show your working.

time = ... [3]

5 Fig. 5.1 shows a ray of yellow light incident on a glass prism ABC.

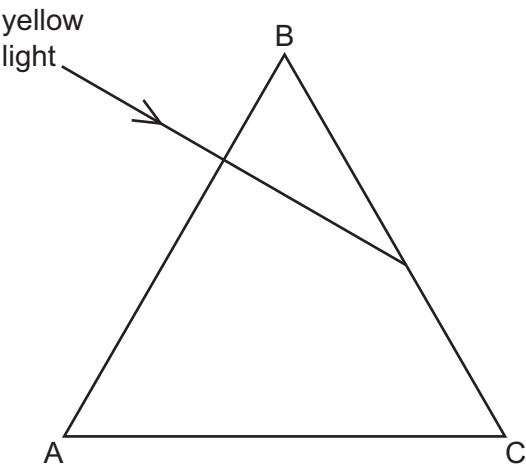


Fig. 5.1

(a) Explain why the ray does **not** change direction when it enters the prism at face AB.

.....
..... [1]

(b) The critical angle for the glass is 42° .

(i) Calculate the refractive index of the glass.

Show your working.

refractive index = ... [2]

(ii) On Fig. 5.1, continue the path of the light through the prism and after it leaves the prism. [3]

(c) Internet data can be transferred using infrared waves in optical fibres.

State **two** advantages of using optical fibres to transmit data.

1
2 [2]

- 6 (a) A sound wave travels through air. Fig. 6.1 shows a pressure–time graph for the air at one place.

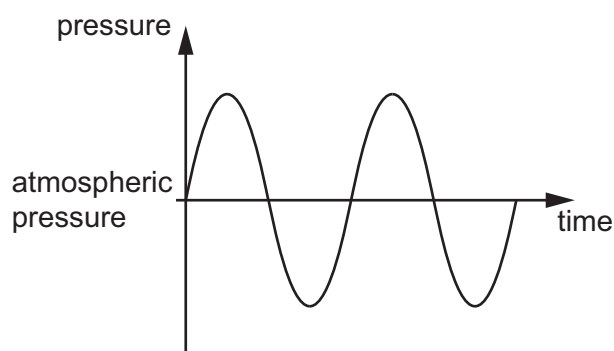


Fig. 6.1

- (i) On Fig. 6.1:

- label **one** point C to indicate a compression
- label **one** point R to indicate a rarefaction.

[2]

- (ii) Explain why this graph **cannot** be used to find the wavelength of the sound wave.

.....
..... [1]

- (iii) The sound becomes louder and of lower pitch.

State what happens to:

the amplitude of the sound

.....

the frequency of the sound.

.....

[1]



- (b) A sound of frequency 13 kHz is transmitted through water.
The speed of sound in water is 1500 m/s.

Calculate the wavelength of this sound in water.

wavelength = ... [3]

- (c) State the approximate speed of sound in air.

speed = ... [1]

[Total: 8]

6 Fig. 6.1 shows a thin converging lens used to produce a magnified image of an object AB.

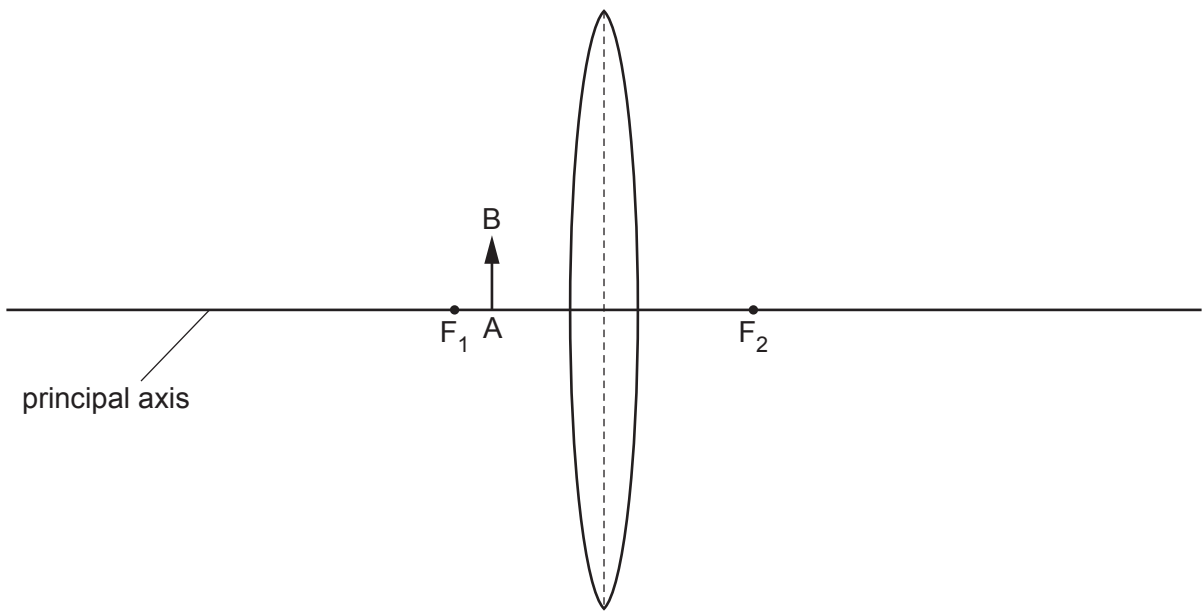


Fig. 6.1

(a) Explain the meaning of the terms principal focus and focal length.

principal focus
.....
focal length
.....

[2]

(b) On Fig. 6.1, draw the magnified image of AB. Show your working.

[4]

[Total: 6]



X-ray scan of a hand

Fig. 8.1

- [1]

- [1]

- State the speed of X-rays in a vacuum.

..... [1]

- 1

2

3

[3]

[Total: 6]

5 A loudspeaker produces a sound wave in air. The distance between the centre of a compression and the centre of a neighbouring rarefaction is 0.10 m.

(a) Calculate the wavelength of the sound wave.

wavelength = ... [1]

(b) State a typical value for the speed of sound in air.

..... [1]

(c) (i) Calculate the frequency of the sound from the loudspeaker.

frequency = ... [2]

(ii) Explain whether the sound from the loudspeaker is audible to a human with normal hearing.

.....
..... [1]

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- (d) Another loudspeaker produces a sound of wavelength 0.40 m . Sound from the loudspeaker reaches a sound absorbing surface with a gap of width 0.80 m at the centre.

Fig. 5.1 shows the arrangement.

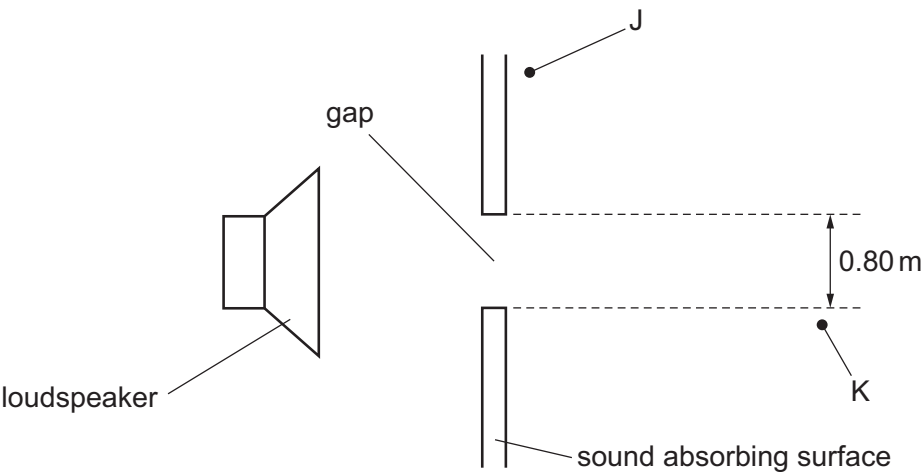


Fig. 5.1

Explain whether it is possible to detect sound from the loudspeaker at either point J or at point K.

point J

.....

.....

point K

.....

.....

[4]

[Total: 9]

6 A student plays the violin near the doorway to a large room. Fig. 6.1 shows a young teacher standing where he can hear the sound but cannot see the student.

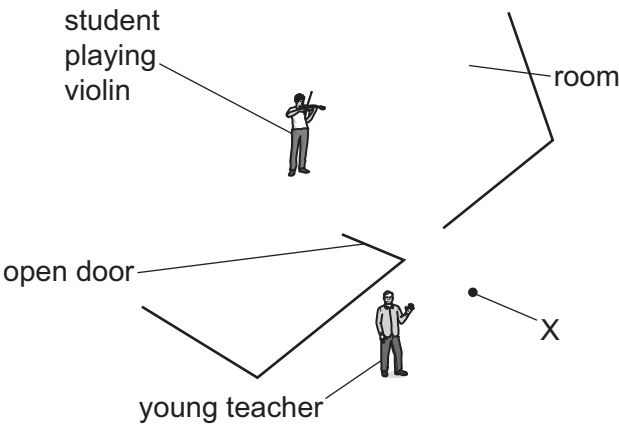


Fig. 6.1

(a) (i) State the wave effect that allows the young teacher to hear sounds from the violin at the position he is standing in Fig. 6.1.

..... [1]

(ii) Calculate the frequency of sound with a wavelength of 0.75 m.
The speed of sound in air is 340 m/s.

frequency = ... [2]

(iii) A violin produces sounds in the frequency range 200 Hz–3800 Hz. The width of the open doorway is 0.75 m.

Explain why the young teacher hears the frequency calculated in (a)(ii) clearly but finds a frequency of 3500 Hz much harder to hear.

.....
.....
..... [2]

(b) A plane mirror is placed at point X so that the teacher can see the student.
On Fig. 6.1:

- draw a light ray from the violin to point X and from point X to the teacher
- draw and label the mirror
- add an arrow to the ray to show how the teacher sees the student.

Use a ruler and sharp pencil for this drawing. [3]

- 8 A fisherman uses high frequency sound waves to locate fish in the sea. Fig. 8.1 shows the sound waves emitted from the boat.

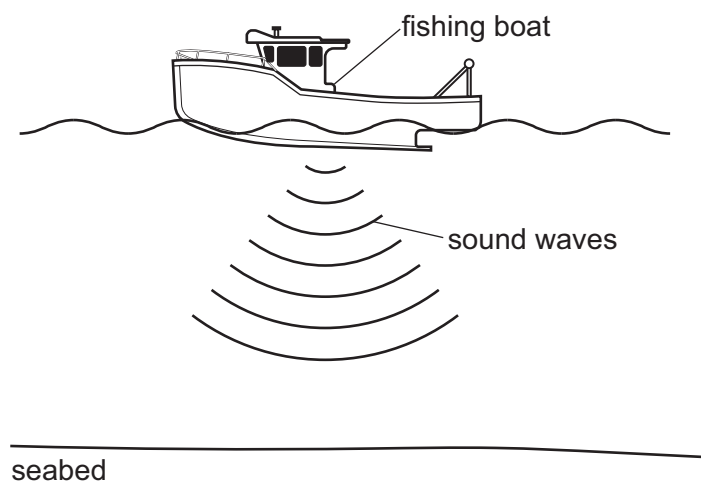


Fig. 8.1 (not to scale)

- (a) State the name of sound waves which have a frequency greater than 20 kHz.

..... [1]

- (b) High frequency sound waves travel from the boat through the sea water.
The speed of sound in water is 1500 m/s. The seabed is 22 m below the boat.

Calculate the time taken for the boat to receive the reflected wave from the seabed after the sound is emitted.

time = ... [3]

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(c) Fig. 8.2 shows a fish below the boat.

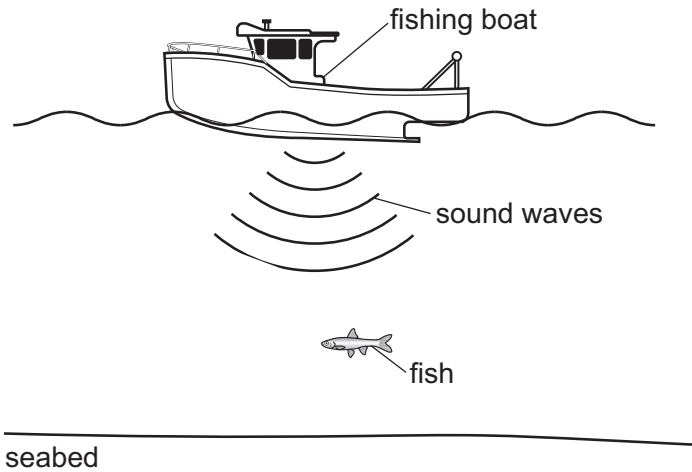


Fig. 8.2 (not to scale)

Describe and explain how the reflected sound wave received by the boat from the fish differs from the reflected sound wave received from the seabed.

.....

.....

..... [2]

[Total: 6]

- 4 (a) Fig. 4.1 shows a ray of light as it enters the side of a plastic block. The ray of light passes from air into the plastic.

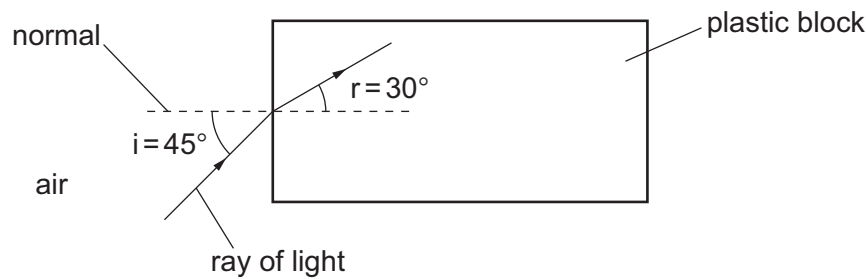


Fig. 4.1

- (i) State how the speed, wavelength and frequency of the wave in the plastic block compare with their values in the air.

speed:

wavelength:

frequency:

[2]

- (ii) Show that the refractive index of the plastic is 1.4.

Show your working.

[1]

- (iii) Calculate the critical angle for the plastic.

critical angle = ... [2]



(b) Fig. 4.2 shows the same plastic as in (a) used to make an optical fibre. A ray of light is passing along the fibre.

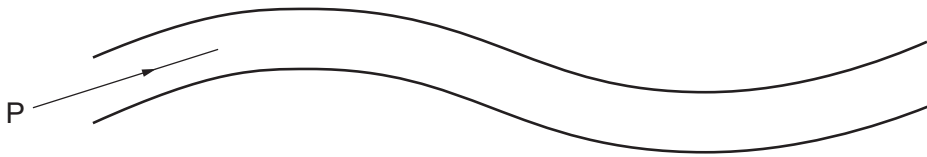


Fig. 4.2

(i) Carefully continue the ray of light P until it reaches the other end of the fibre. [2]

(ii) State **two** uses for optical fibres.

1

2

[2]

[Total: 9]

120. Question part 1/2 | 0625 Feb-March 2025 P4 V2 Q3

- 3 Fig. 3.1 shows a mains electric heater used to heat a small room.

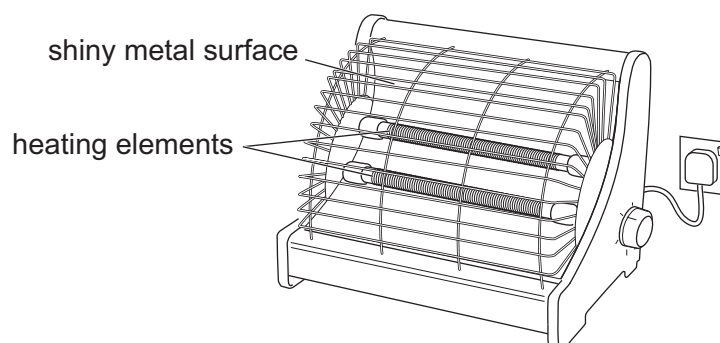


Fig. 3.1

- (a) State the region of the electromagnetic spectrum which radiates thermal energy from the heater.

..... [1]

- (b) Explain why the shiny metal surface behind the heating elements increases the thermal energy radiated into the room.

.....
.....
..... [2]

- (c) The metal outer casing of the heater is earthed. State why this is an important safety feature.

.....
..... [1]

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(d) The mains voltage is 230 V. The two identical heating elements are connected in parallel. Each heating element has a resistance of $89\,\Omega$.

(i) Calculate the current in **one** heating element.

current = ... [2]

(ii) Show that the electrical power of the heater is approximately 1200 W. State any equation you use in words or symbols.

[2]

(iii) The heater is 95% efficient at converting electrical work done to thermal energy.

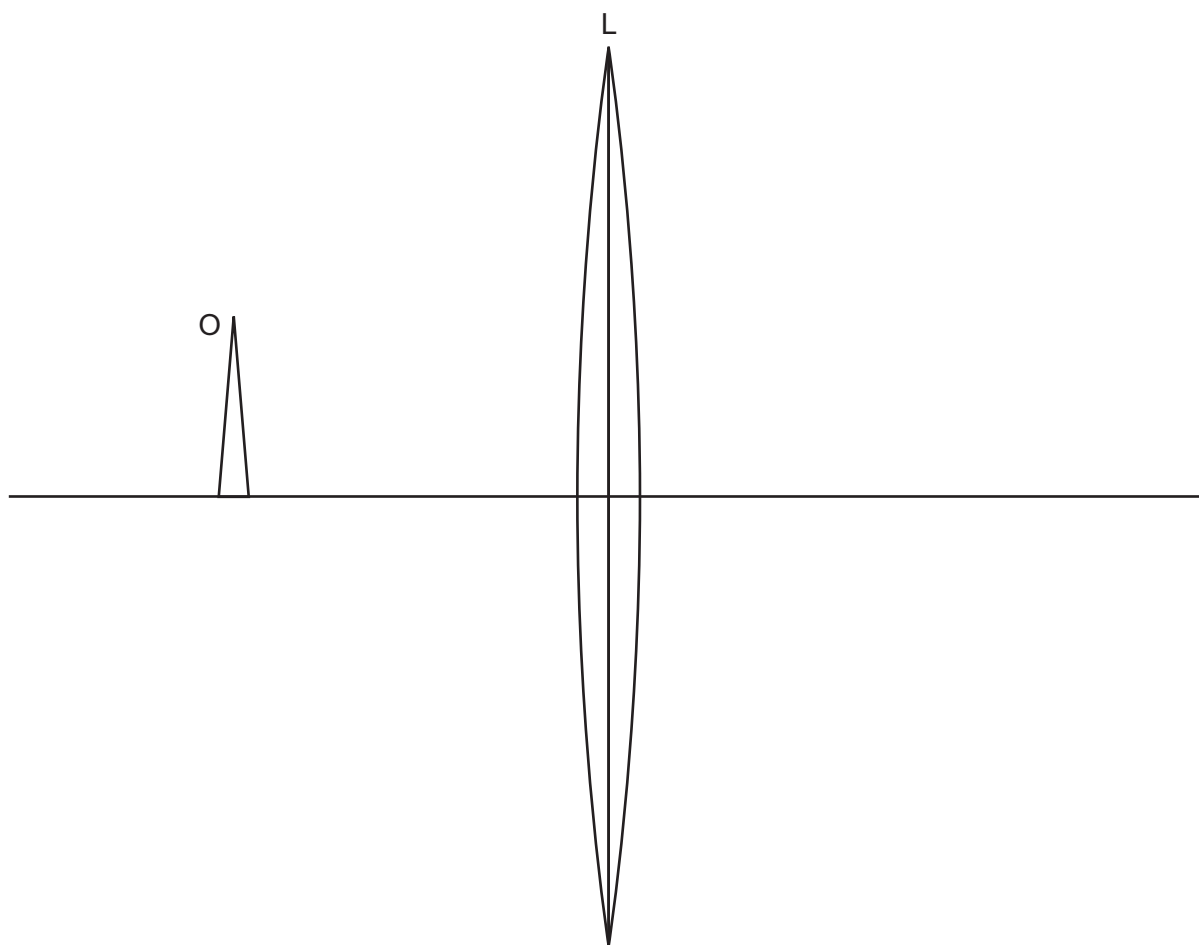
Calculate the thermal energy emitted by the heater in (d)(ii) in 60 s. Give your answer to **two** significant figures.

thermal energy = ... [3]

[Total: 11]

121. Question part 1/2 | 0625 Feb-March 2025 P4 V2 Q6

- 6 Fig. 6.1 shows an object O which is 5.0 cm away from the centre of a thin, converging lens L. The focal length of L is 3.0 cm. Fig. 6.1 is drawn to full scale.

**Fig. 6.1**

- (a) (i) On Fig. 6.1, label the principal axis with a P. [1]
- (ii) On Fig. 6.1, place a letter X at a focal point. [1]
- (iii) On Fig. 6.1, draw two rays from O to locate the tip of the image produced by the lens. [2]

121. Question part 2/2 | 0625 Feb-March 2025 P4 V2 Q6



(iv) In Table 6.1, place a tick in the right-hand column next to **all** the terms that describe the image in (a)(iii).

Table 6.1

diminished	
enlarged	
inverted	
real	
same size	
upright	
virtual	

[3]

(b) The object moves closer to L. The new distance between L and the object is less than the focal length of L.

Describe how the new image is different from the image in (a)(iv).

.....

.....

..... [2]

[Total: 9]

122. Question part 1/2 | 0625 Feb-March 2025 P4 V2 Q7

7 (a) Fig. 7.1 is a scale drawing of light waves approaching a narrow slit.

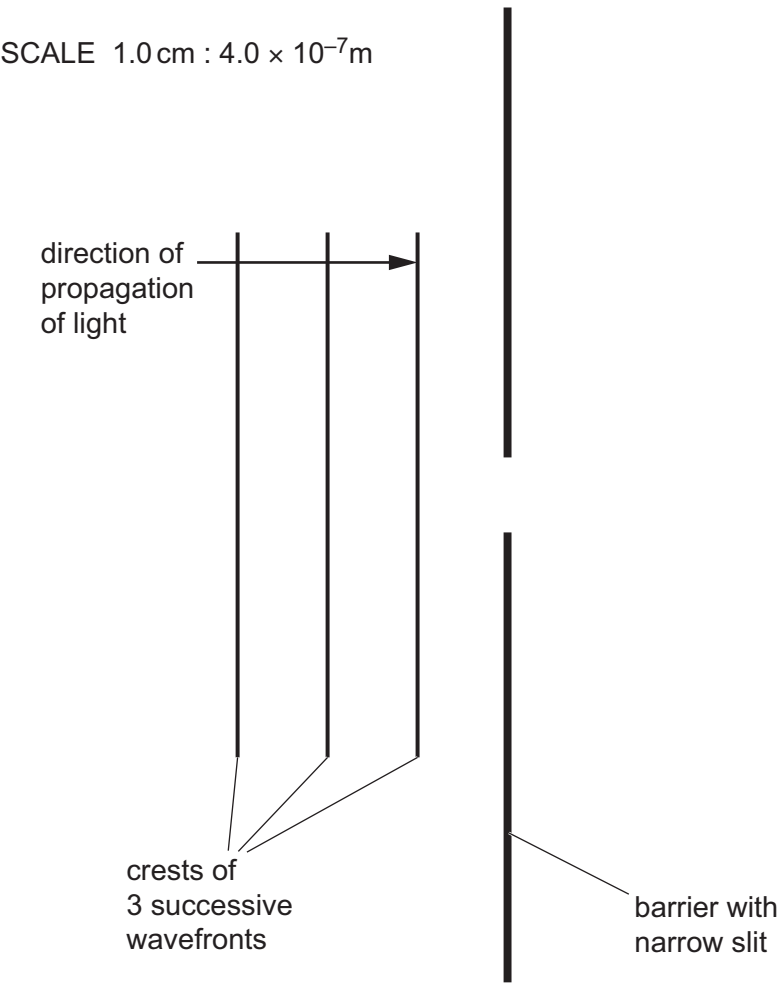


Fig. 7.1

(i) Name the wave effect produced by the narrow slit.

..... [1]

(ii) Using Fig. 7.1, determine the wavelength of the light. Give your answer to **two** significant figures.

wavelength = ... [2]

(iii) On Fig. 7.1, draw **three** wavefronts that have passed through the narrow slit. [3]

122. Question part 2/2 | 0625 Feb-March 2025 P4 V2 Q7



- (b) A foghorn emits a sound with frequency 380 Hz. The sound is heard by a ship 2.5 km away from the foghorn. The speed of sound in air is 330 m/s.
- (i) Show that the wavelength of the sound is approximately 0.9 m.
State any equation you use in words or symbols.

[2]

- (ii) Calculate the time it takes for sound to travel to the ship from the foghorn.

time = ... [2]

[Total: 10]

123. Question | 0625 May-June 2025 P4 V1 Q5

- 5 A ray of light is incident on a soap film. Fig. 5.1 shows a magnified image of a small part of the soap film. The ray of light is refracted as it enters the soap film.

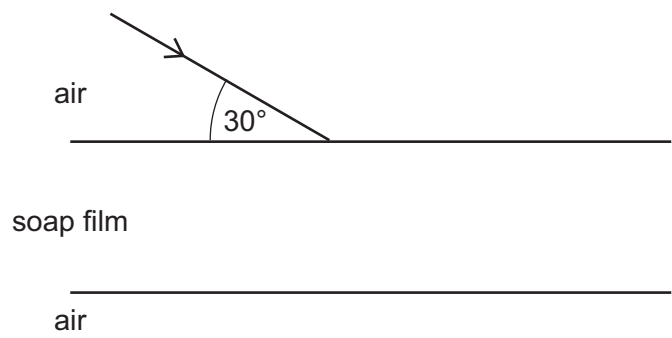


Fig. 5.1

The refractive index of the soap film is 1.28.

- (a) Define refractive index in terms of the speed of light.

.....
..... [1]

- (b) (i) Show that the angle of refraction as the light enters the soap film is approximately 43°.

[2]

- (ii) On Fig. 5.1, carefully draw the refracted light ray in the soap film and label the angle of refraction. [2]

- (c) The ray of light is monochromatic red light with a wavelength of 680 nm in air.

- (i) Define monochromatic.

.....
..... [1]

- (ii) Calculate the frequency of the light.

frequency = ... [3]

[Total: 9]

5 (a) Describe an experiment to determine the speed of sound in air.

State the apparatus required, the measurements taken and how to calculate the speed of sound in air from the measurements.

You may draw a **labelled** diagram as part of your answer.

.....

.....

.....

.....

.....

.....

.....

[4]

(b) Bluetooth is used to connect a mobile (cell) phone to headphones.

(i) State the name of the region of the electromagnetic spectrum used by Bluetooth.

..... [1]

(ii) State the speed of electromagnetic waves in air.

speed = ... [1]

124. Question part 2/2 | 0625 May-June 2025 P4 V2 Q5



(iii) The frequency of a Bluetooth network is 2.48 GHz.

Calculate the wavelength of the waves used in the Bluetooth network.

wavelength = ... [3]

[Total: 9]

- 6 (a) Fig. 6.1 is a full-size diagram of a lens and an image I of an object.

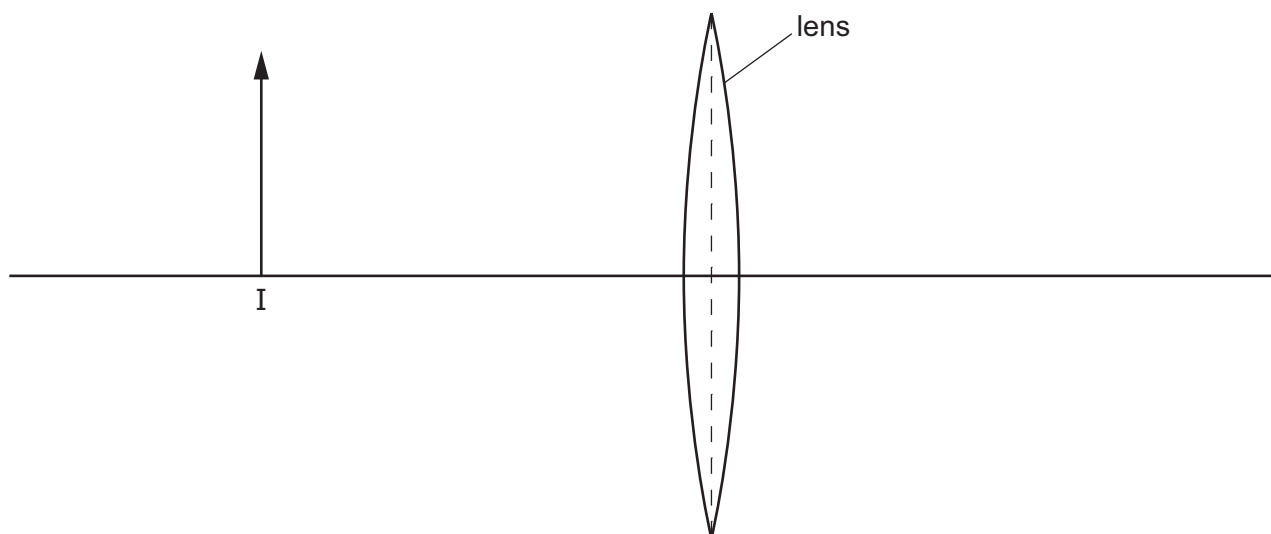


Fig. 6.1

The focal length of the lens is 3.0 cm.

- (i) On Fig. 6.1, mark **two** points with labels F, to show the positions of the principal focuses (focal points) of the lens. [1]
- (ii) On Fig. 6.1, draw **two** rays from the image I to locate the object. Draw the object and label it O. [3]
- (iii) The object is moved so that it is 6 cm to the left of the lens.

State **one** characteristic of the image formed when the object is in this position.

..... [1]

125. Question part 2/2 | 0625 May-June 2025 P4 V2 Q6



- (b) Fig. 6.2 shows a simplified diagram of an eye with rays from a near object. The eye needs correction for long-sightedness.

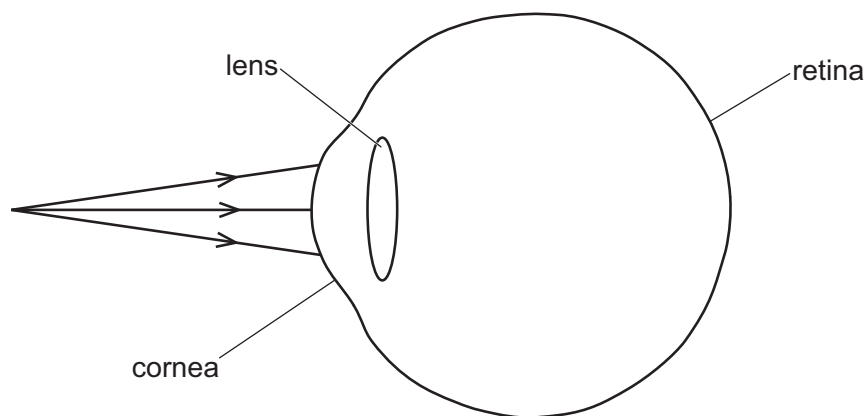
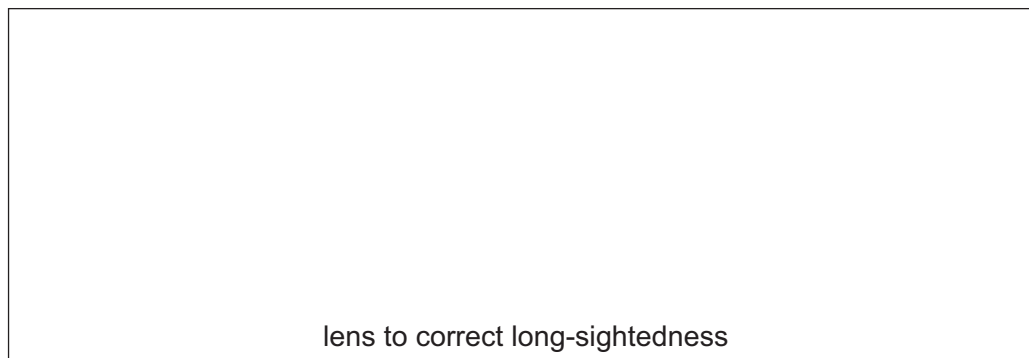


Fig. 6.2

- (i) On Fig. 6.2, draw the path of the rays inside the eye to show the effect of long-sightedness. [1]

- (ii) A lens is used to correct the long-sightedness.

Draw a lens suitable for this correction.



[1]

[Total: 7]

- 5 Fig. 5.1 shows four rays of red light, P, Q, R and S, coming from a spotlight in a swimming pool.

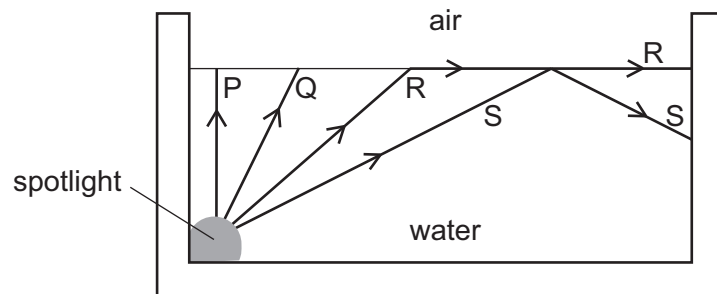


Fig. 5.1

- (a) Define, in words, refractive index for a ray of light travelling from air to water.

..... [1]

- (b) On Fig. 5.1, draw the path of rays P and Q at the water–air boundary.

[2]

- (c) The angle of incidence for ray R is 49° .

Calculate the refractive index of the water.

refractive index = ... [2]

- (d) Explain why ray S is totally internally reflected at the water surface.

.....
 [2]

[Total: 7]

127. Question | 0625 May-June 2025 P4 V3 Q6

6 Ultrasound is an example of a longitudinal wave.

(a) Define the term ultrasound.

..... [1]

(b) Describe what is meant by a longitudinal wave.

.....
..... [1]

(c) Ultrasound is used to locate objects below the surface of the sea.

(i) Describe how ultrasound is used to locate an object below the surface of the sea.

You may draw a labelled diagram as part of your answer.

.....
.....
.....
..... [3]

(ii) State **one** other use of ultrasound.

.....
..... [1]

[Total: 6]

5 A dolphin communicates with other dolphins underwater by emitting sounds in the range 7–15 kHz.

(a) State the value of the speed of sound in air and state how the speed of sound in water differs from the speed of sound in air.

speed of sound in air m/s

speed of sound in water
[1]

(b) State and explain if humans with normal hearing can hear all the sounds emitted by the dolphin.

statement

explanation
.....
[2]

(c) Complete Table 5.1 to describe differences in loudness and pitch of two different dolphin sounds.

Table 5.1

Frequency / kHz	amplitude	loudness	pitch
14	large		
8	small		

[2]

(d) Complete the sentences to describe how sound is transmitted through water.

Sound waves are made of vibrating which produce
compressions and rarefactions. A compression is a region of
and a rarefaction is a region of The sound waves travel
..... to the direction of the vibrations.

[3]

[Total: 8]

6 Fig. 6.1 shows part of an optical fibre used in high-speed broadband communication.

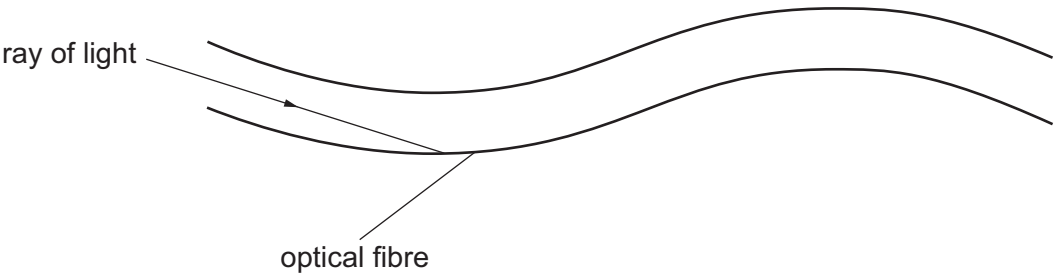


Fig. 6.1

(a) State **two** advantages of using optical fibres in high-speed data transmission compared to electrical signals sent on copper wires.

.....
..... [2]

(b) (i) The optical fibre is made of glass with a refractive index of 1.4.

Calculate the critical angle c .

$c =$ [3]

(ii) State the meaning of critical angle.

.....
..... [1]

(iii) On Fig. 6.1, label the angle of incidence of the ray of light as it hits the wall of the glass fibre. Draw the continuation of the ray until it leaves the glass fibre. [2]

[Total: 8]

130. Question | 0625 Oct-Nov 2025 P4 V2 Q6

6 (a) Fig. 6.1 shows successive crests of a water wave approaching a boundary.

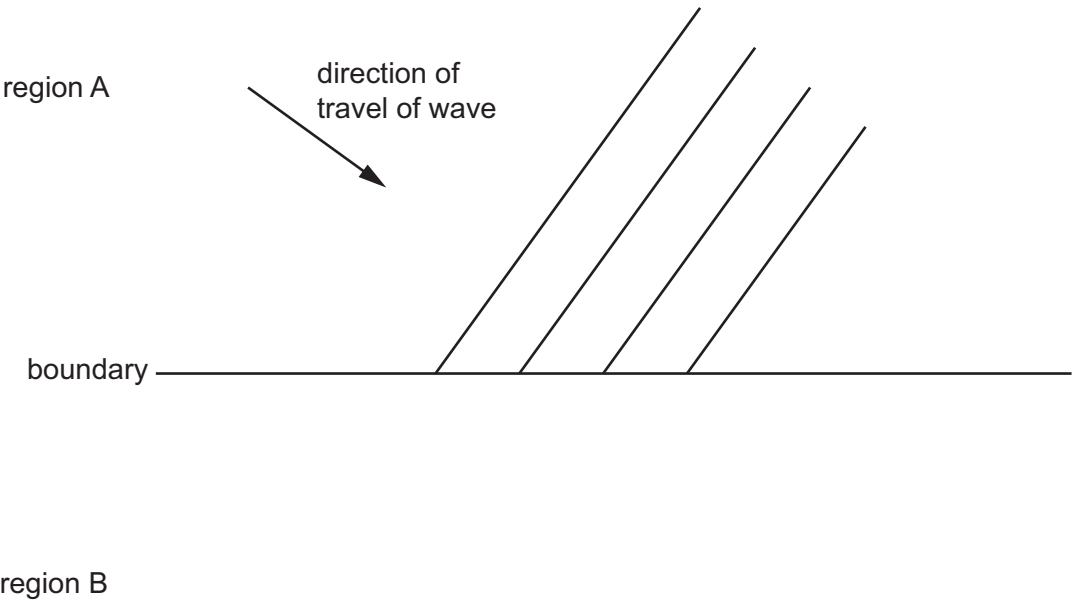


Fig. 6.1

(i) The speed of the waves in region B is lower than the speed of the waves in region A.

On Fig. 6.1, draw the crests of the waves in region B. [3]

(ii) State the wave effect that occurs as the wave crosses the boundary between region A and region B.

..... [1]

(b) (i) Light can be totally internally reflected when striking the boundary between two different regions.

State **two** conditions that are necessary for total internal reflection to occur.

1

.....

2

.....

[2]

(ii) State **two** advantages of using optical fibres for transmitting high speed broadband.

1

2

[2]

[Total: 8]

131. Question part 1/2 | 0625 Oct-Nov 2025 P4 V3 Q5

5 (a) (i) Electromagnetic waves have many uses.

On Fig. 5.1 draw **one** line from each use to the region of the electromagnetic (e-m) spectrum it uses.

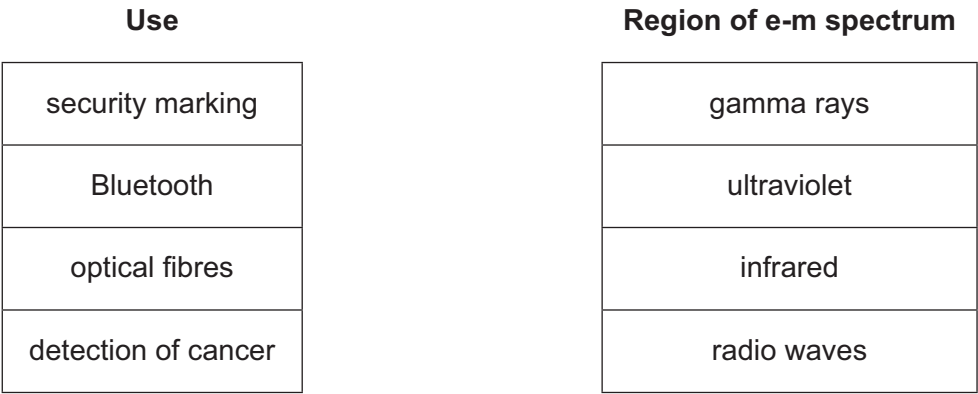


Fig. 5.1 [2]

(ii) State **one** advantage of using microwaves compared with radio waves to transmit mobile (cell) phone signals.

..... [1]

(b) Describe the difference between transverse waves and longitudinal waves.

..... [2]

131. Question part 2/2 | 0625 Oct-Nov 2025 P4 V3 Q5



- (c) Fig. 5.2 shows a simplified diagram of seismic P-waves travelling through the Earth. The paths of the waves are curved. Seismic waves are produced by rock movements in earthquakes.

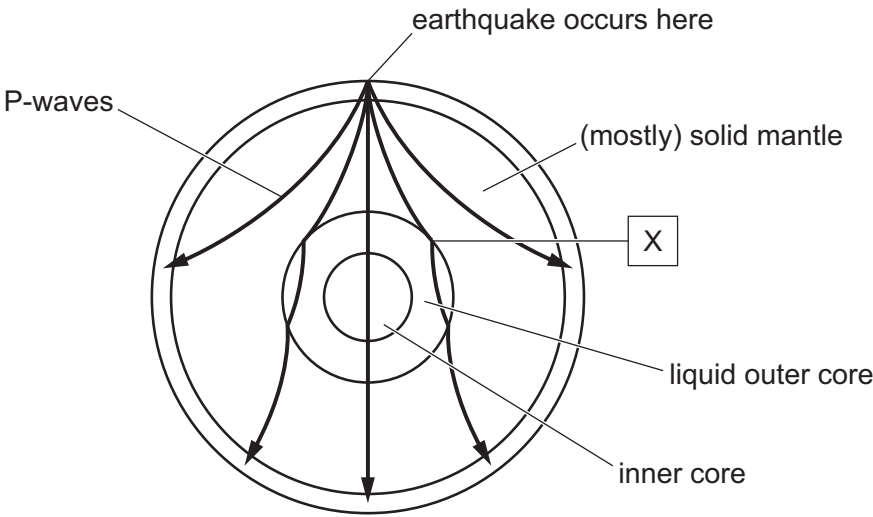


Fig. 5.2 (not to scale)

- (i) State the type of wave that P-waves can be modelled as.
- [1]
- (ii) At point X, the P-wave travels from the solid mantle to the liquid core. There is a sudden change in direction of the path of the wave.
- Explain the change in direction of the P-wave at point X.
-
-
- [2]
- (d) The Earth’s surface absorbs incoming radiation from the Sun and also emits thermal radiation from its surface.
- Over the past 50 years, scientists estimate that the average temperature of the Earth’s surface has increased by approximately 0.75 °C.
- Explain what is causing this average temperature rise.
-
-
-
- [2]