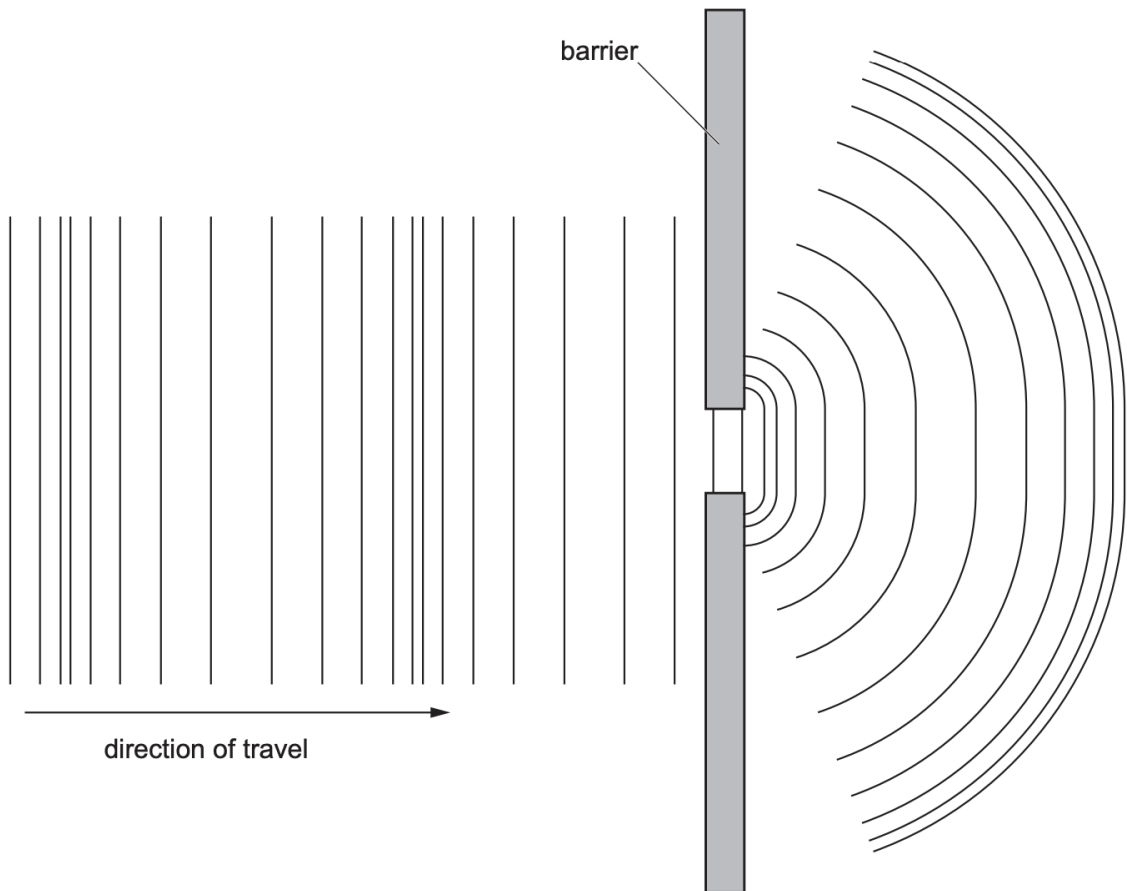


1.

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



Describe 2 ways in which a diagram representing a wave with greater frequency differs from the one shown.

- compressions / rarefactions closer // more compressions / rarefactions (in same distance)
- less diffraction / spreading out
- (because of) smaller wavelength or ratio wavelength / gap width smaller

2.

Fig. 5.1 shows a wave on the sea approaching a harbour.

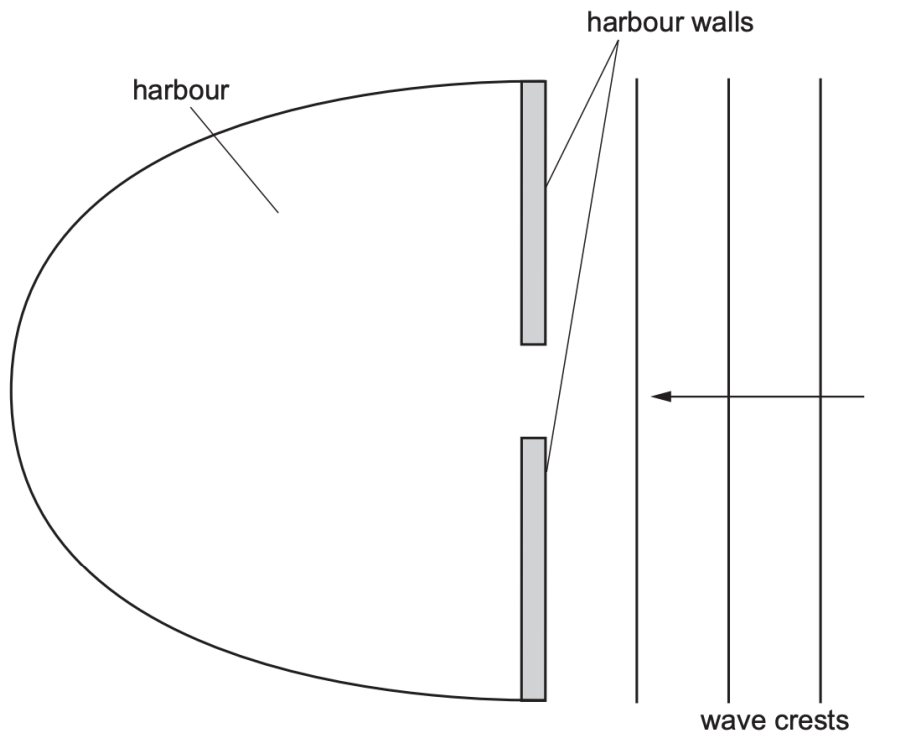


Fig. 5.1

(i) On Fig. 5.1, draw **three** wave crests in the harbour.

[2]

- part of a circle, at least quarter of a circle, centred on centre of gap B1
- waves same wavelength as incident waves

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).

- waves pass through gap remaining straight
- less / no diffraction occurs

3. Define principal focus

point) where parallel rays (of light) meet / are focussed (after passing through lens) OR (point) through which rays (of light) that emerge parallel pass (before reaching lens)

4. Define focal length

distance between principal focus / focal point and optical centre

5.

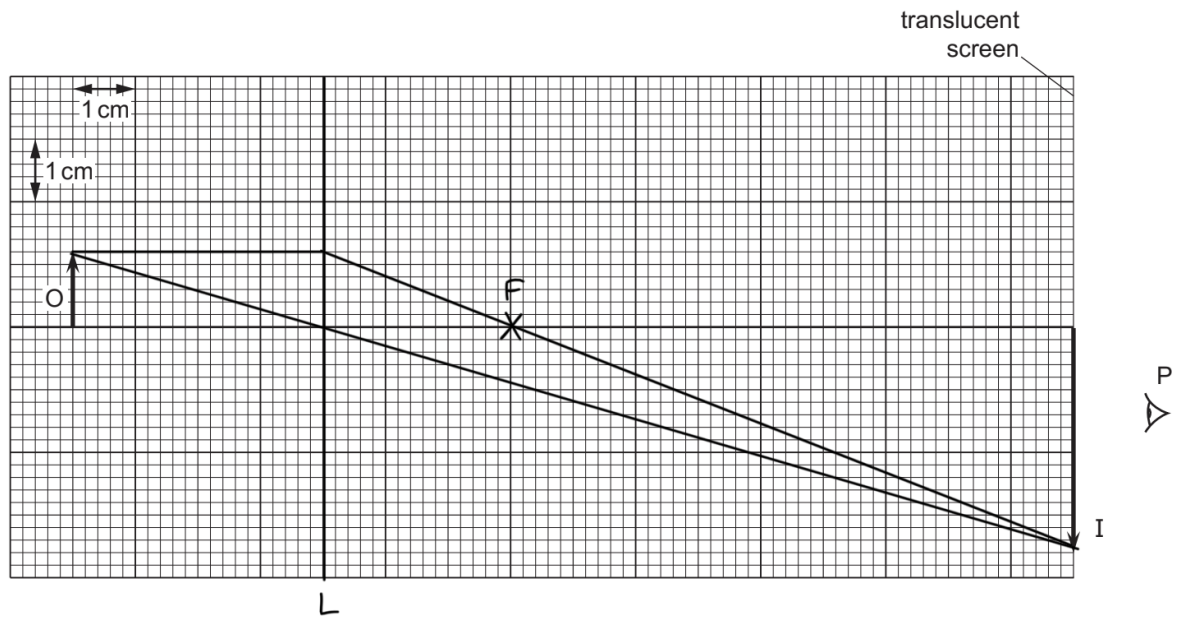


Fig. 5.1

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.

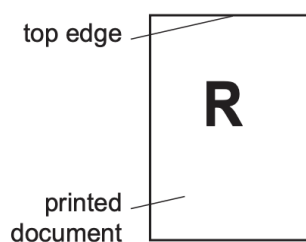


Fig. 5.2



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.

Answer:



Reason: reversed/ inverted

6. Describe one medical use of X-rays.

- stated medical use: used to detect broken bones
- statement of what happens to X-rays: X-rays pass through soft tissue
- AND not through bone // absorbed by bone
- stated consequence: picture/ shadow/ photograph produced

7. **State one reason why it is necessary to take safety precautions when X-rays are used.**
can cause burns / (cell) mutation / cell damage / tumours / cancer / damages DNA etc.

NOTE: Speed of sound in water = 1500 m/s

8. **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.**
- method of producing sound, e.g. clap for echo method
 - apparatus used, e.g. stopwatch, long tape, trundle wheel, wall if using echo method
 - detail of measurement of distance, e.g. measure distance between person and wall
 - detail of measurement of time OR appropriate time measured, e.g. start stopwatch when clap heard and stop when echo heard / measure time taken between clap and hearing echo
 - $\text{speed} = 2 \times \text{distance from student clapping to wall} / \text{time for echo method}$
9. **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.**
- wavelength of light is much smaller than width of doorway
 - wavelength of sound is similar to width of doorway, which results in greater diffraction

NOTE: Sound waves have a much longer wavelength than light waves and so diffract around the obstruction.

10. **Why an image is virtual**

- Cannot be projected on a screen
- Light doesn't pass through the image / actual rays don't meet at image

NOTE

Monochromatic light: light of a single frequency

Compression: region where particles are closer together than normal OR region where there is a greater pressure than normal

Rarefaction: region where particles are further / far apart than normal OR region where there is a lower pressure than normal

11. **Why we can see light from the sun but not hear any sound from it**

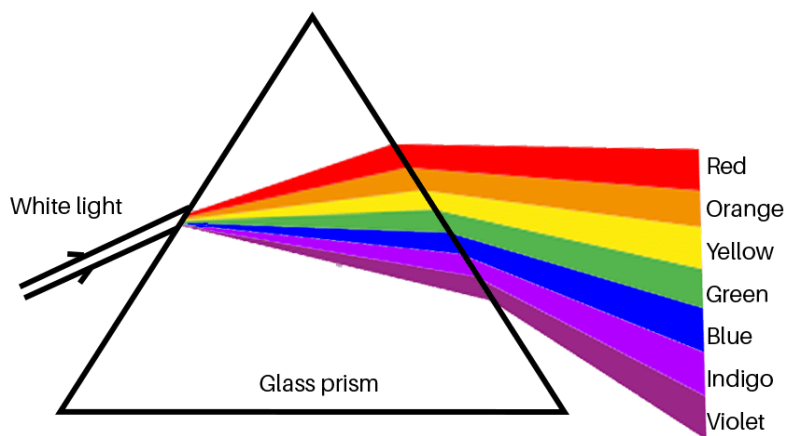
Light does not need any medium to travel through, but sound does (there is no medium between sun & earth)

12. A loudspeaker produces a sound wave in air of frequency 15000 Hz. How cone of loudspeaker produces sound

- cone vibrates
- alternating current (a.c.) (in coil /wire) or alternating magnetic field
- neighbouring air vibrates or vibrations passed on
- producing compressions and rarefactions / vibrations parallel to energy transfer
- vibrating at 15 000 Hz

NOTE: During diffraction through a gap, wave fronts are vertical inside the gap. They only diffract outside.

Refractive index = $\sin i / \sin r$



13. 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.

- larger frequency results in smaller speed in glass
- for larger frequency, more refraction / closer to normal / larger refractive index
- violet light has larger frequency
- violet light has larger refractive index
- violet light has a smaller speed (in glass)

14. difference between longitudinal and transverse wave (on basis of wave motion)

- Longitudinal: vibrations parallel to direction of wave (motion)
- Transverse: vibrations perpendicular to direction of wave (motion)

15. A wave of frequency 0.120 kHz travels through a rock. It then travels from the rock into the air. State and explain whether the wave will be audible to a healthy human ear.

- It will be audible because audible range 20 Hz – 20 kHz
- Frequency does not change in different medium

16.

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.

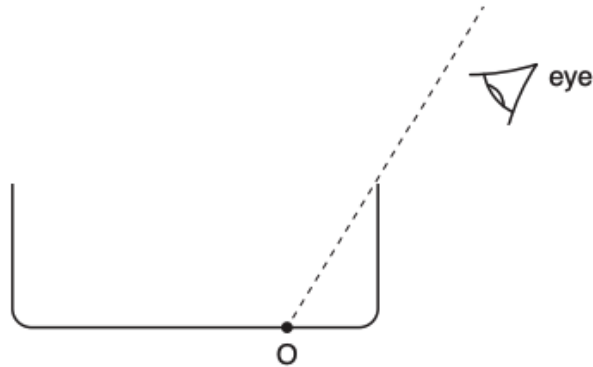


Fig. 6.1

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.

- Light from coin bends / changes direction / is refracted
- refracts / bends away from normal

17.

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



The loudness of the sound increases at the same pitch. State and explain any change there would be in the pattern of wavefronts shown.

- closer together at compression and further apart at rarefaction
- amplitude changes
- loudness does not affect wavelength

The wave passes into water. State & explain any change in pattern of wavefronts shown

- more spread out / further apart
- Velocity / speed greater in water than air
- So wavelength greater

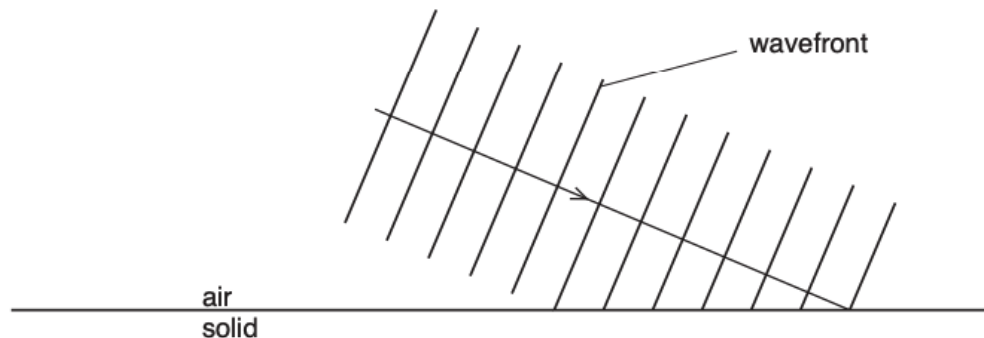
18. Images formed by lenses sometimes have coloured edges. Suggest a reason for this.

Different colours have different wavelengths / different frequencies / refracted by different amounts OR dispersion (in glass)

19.

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.



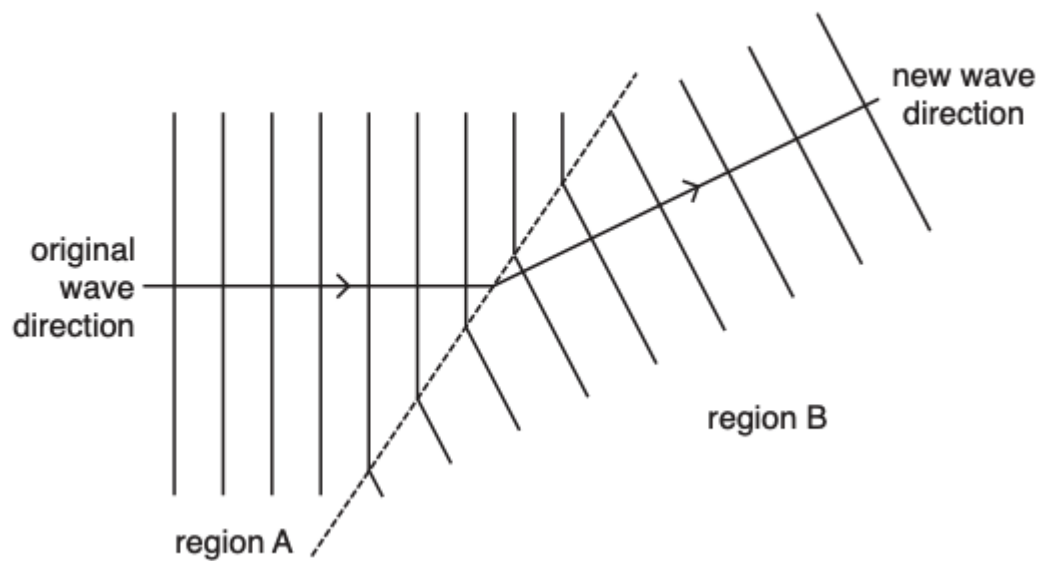
The light travels more slowly in the transparent solid.

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.

- one side of wavefront enters / hits solid first OR wavefronts don't hit the solid all at once
- this side slows down first OR this side is delayed relative to the other side
- angle of wavefront changes

20.

Fig. 6.1 shows a water wave in a ripple tank.



Suggest a cause for the change in direction of the wave.

Wave moves slower in region A/ faster in region B

21.

(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.

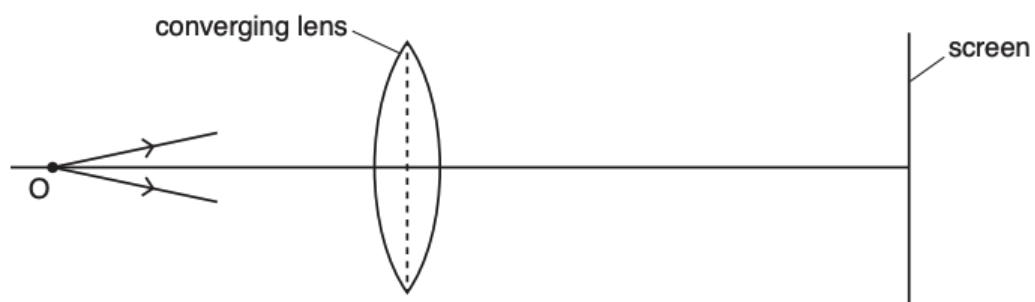


Fig. 7.1

[2]

- both rays straight to left of lens AND top ray bends clockwise AND bottom ray bends anti-clockwise
- both rays converge to meet on the centreline at the screen

- (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.

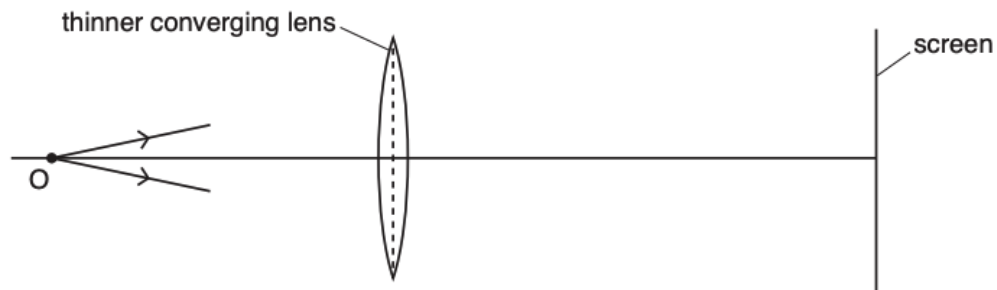


Fig. 7.2

[2]

- both rays straight to left of lens AND top ray bends clockwise less than in (a) AND bottom ray bends anti-clockwise less than in (a)
 - both rays converge and/would meet beyond screen
22. A converging lens is used as a magnifying glass. The focal length of the lens is 10cm.
- a. Describe the position of the object in relation to the lens: object closer to lens than one focal length
 - b. Describe the position of the image in relation to the lens and the object: (image) same side (of lens as object) OR image further from lens (than object)

23.

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.

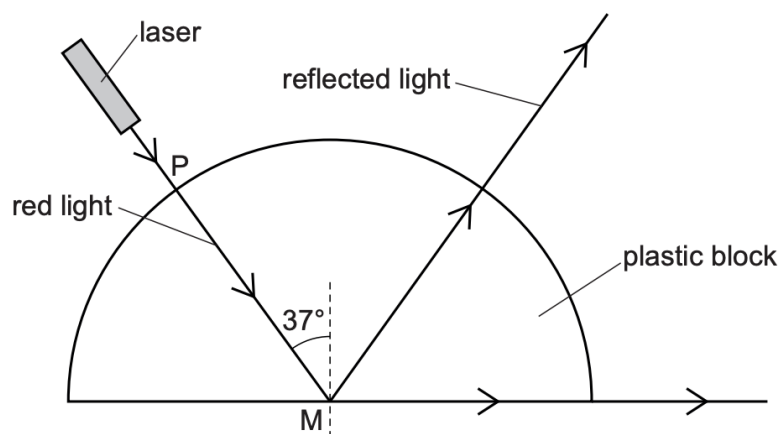


Fig. 6.1

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

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.

$$n = 1 / \sin(c) = 1 / \sin(37) = 1.7$$

$$1.7 = \text{speed of light in air} / \text{speed of light in plastic}$$

$$= 3 \times 10^8 / v$$

$$v = 3 \times 10^8 / 1.7 = 1.8 \times 10^8 \text{ m/s}$$

In the plastic, blue light travels slightly slower than red light, 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.

- critical angle (for blue light) $< 37^\circ$
- angle of incidence (of blue light) greater than its critical angle (in plastic)
- total internal reflection // all the (blue) light reflects // no (blue) light leaves the glass / refracts / travels in air along the straight edge

24. Differences between longitudinal and transverse waves

- particles (in transverse waves) vibrate perpendicular to direction of travel (of wave)
- OR particles in longitudinal waves vibrate parallel to direction of travel of wave

- longitudinal waves have compressions and rarefactions
- transverse waves have troughs and crests

25. Explain why sound travels faster in water than in air

- molecules closer together / water has greater density

26. Properties of image formed by a mirror

- virtual
- upright
- same size as object
- laterally inverted

NOTE: vibrations on a guitar string is a transverse wave, NOT a longitudinal wave.

NOTE: when asked to state features of virtual image, only say “can’t be projected on screen”
// “light rays do not meet/ pass through image”. DO NOT talk about it being upright, etc.

27.

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.

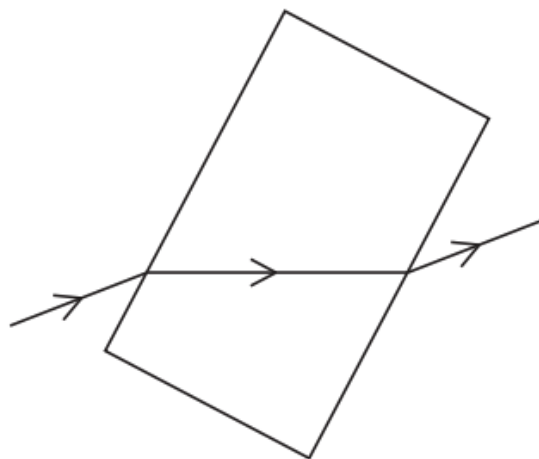


Fig. 7.3

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] |

7(b)(ii)	ray in rectangular block refracted down less than green ray
7(b)(iii)	ray leaving rectangular block parallel to incident ray

NOTE: In questions about TIR, where you have to state what is happening to the light, along with total internal reflection, also state that “all the light is reflected”.

28. Reasons why microwaves are used for mobile/cell phone signals

- (microwaves) only need short aerials / antennas
- (microwaves) penetrate (some) walls

29. Describe, with the aid of a diagram, how a digital signal differs from an analog signal

- labelled diagram of digital (signal) with blocks of high (1) and low (0) AND labelled diagram of analogue with continuously variable signal
- digital (signal) consists of two values
- analogue (signal) varies over a range (of values)

30. Advantages of using digital signal over analogue

- faster (data) transmission rate OR data can be compressed
- data / signal transmitted over long(er) distances (as signal can be regenerated)
- noise easily removed (from signal / data) OR signal can be regenerated

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

- Long-sightedness focuses the image behind the retina/ back of eye // produces blurry/fuzzy images of close objects
- Converging lens reduces focal length of eye

AND

- Converging lens gives sharp/ focussed image on retina/ back of eye // rays converge on retina