1 (a) A tiger's roar includes sounds at frequencies below the range of human hearing known as infrasound.

Infrasound of wavelength 45 m travels at 330 m s^{-1} in air.

Calculate the frequency of this infrasound.

(2)

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Frequency = ...

(b) The roar of a tiger in a zoo can be heard by visitors at the entrance, even though the tiger can not be seen because there is a hill in the way.

Name and explain this effect.

(2)

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2 Waves may be transverse or longitudinal.

(a) The table shows three types of wave. Complete the table by putting tick(s) in the box(es) to show which waves are longitudinal.

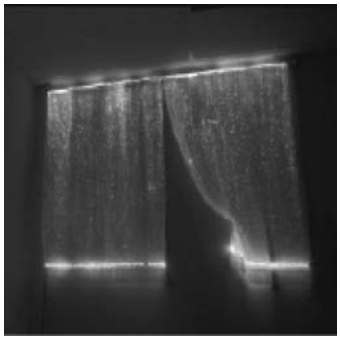
(1)

Type of wave	Longitudinal
Radio waves	
Ultrasound	
Visible light	

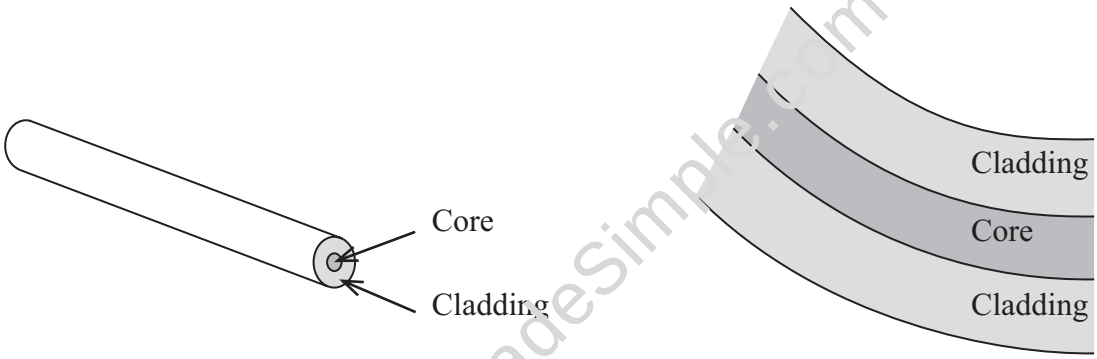
(b) Some waves can be plane polarised. Explain why longitudinal waves cannot be plane polarised.

(2)

3 Optical fibres have many uses in medicine and communications. They can also be incorporated into items such as the curtains shown in the photograph.



Some optical fibres are made from a central core of transparent material surrounded by a material of a different refractive index as a cladding.



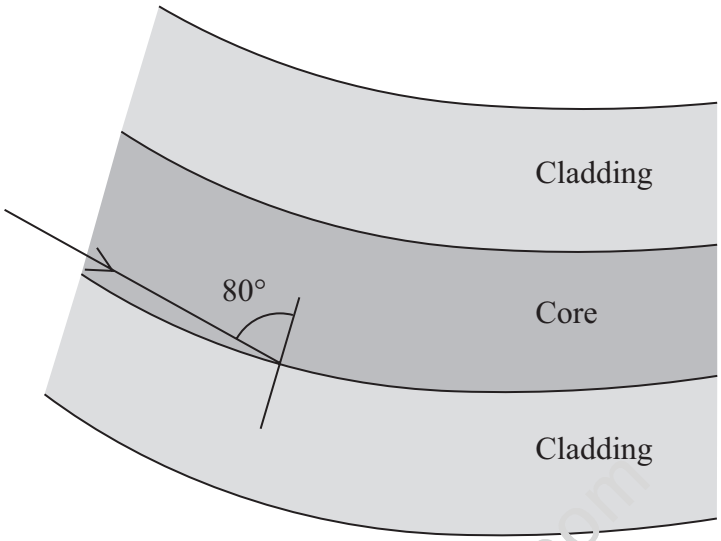
speed of light in the core = 1.96×10^8 m s^{-1}
speed of light in the cladding = 2.03×10^8 m s^{-1}

(a) Calculate the critical angle for the core-cladding boundary.

(3)

Critical angle = ...

(b) The diagram below shows a ray of light inside the core of a fibre. The ray is incident on the core-cladding boundary at an angle of 80°.



State what happens to this ray of light when it is incident on the core-cladding boundary as shown.

(1)

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(c) The light source for these curtains is at the top.

Suggest why the bottom of the curtain is much brighter than the rest of the curtain.

(2)

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4 A radio station broadcasts at a frequency of 198 kHz.

(a) Calculate the wavelength of these radio waves.

(3)

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Wavelength = ...

*(b) Obstacles such as buildings and hills can make it difficult to receive some radio signals with shorter wavelengths.

Explain why this is less of a problem for this radio station.

(3)

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5 (a) Light from the Sun is unpolarised.

Explain what is meant by unpolarised.

(2)

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*(b) When a ray of light from the Sun is incident on a block of ice, most of the light is refracted into the ice. Some of it is reflected. The light that is reflected is partially plane polarised.

Describe a test to confirm that the reflected ray is partially plane polarised.

(3)

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(c) Some skiers wear sunglasses with polarising lenses. These sunglasses reduce the amount of reflected light entering their eyes.

Suggest how these sunglasses work.

(2)

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6 If you look into a fish pond on a bright sunny day, you sometimes cannot see the fish because of the glare of light reflected off the surface. When the sunlight is reflected off the surface of the water it is partially plane-polarised.

(a) State the difference between plane-polarised and unpolarised light.

(1)

(b) Explain how Polaroid sunglasses can enable the fish to be seen.

(3)

(c) State why sound waves cannot be polarised.

(1)

***7** Ready-meals that can be heated in a microwave oven always have the instruction that the food should be stirred properly before eating. This is because 'hot and cold spots' within the oven lead to uneven heating of the food.

A microwave source within the oven emits coherent waves in all directions. The waves are reflected off the walls and so the microwaves arrive at one spot by several different routes. The waves interfere with each other and set up standing waves.

(a) Explain what is meant by the following words:

(2)

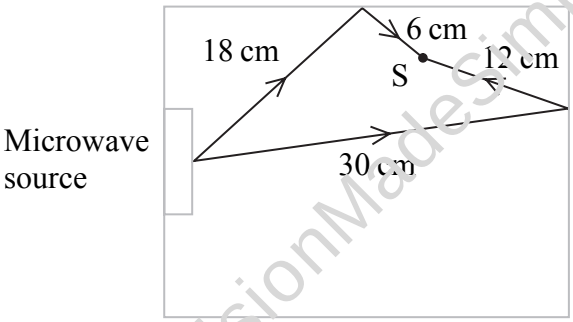
Coherent .....

.....

Standing wave .....

.....

(b) The diagram shows the path of two microwaves arriving at point S.



The wavelength of the microwaves is 12 cm.

Explain why S is a 'cold spot'. Assume that no other microwaves arrive at that point.

(4)

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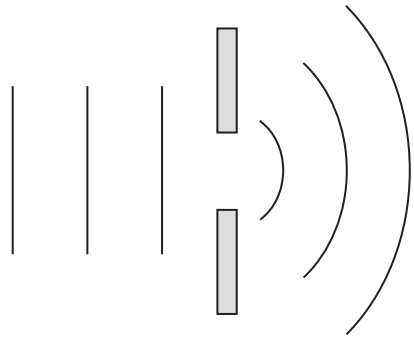
(c) Uneven heating can be reduced by placing the food on a rotating turntable. Explain why this will reduce the uneven heating of the food.

(2)

8 Wavefronts of light change shape when they pass around an edge or through a slit. This means that the light bends and the effect is called diffraction. The longer the wavelength of light, the more the light bends.

(a) The diagram on the left shows red light passing through a slit and undergoing diffraction.



Red light

Blue light

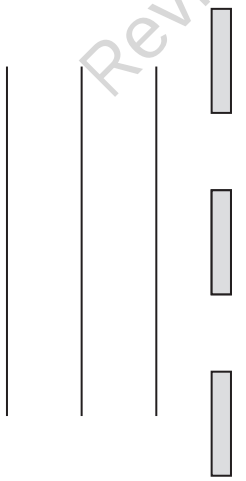
On the diagram on the right, show the same effect for blue light.

(2)

(b) If the red light passes through two slits that are close together, the waves spread out, overlap and add together to produce a pattern of light and dark bands.

Complete the diagram below to show how two overlapping waves produce the pattern of light and dark bands.

(4)



(c) (i) The spacing between two dark bands in the pattern produced is inversely proportional to the distance between the two slits. Red light is shone through two slits that are separated by 1.2 mm and the dark bands in the pattern are 0.60 mm apart.

Calculate how far apart the dark bands will be if the distance between the two slits is reduced to 0.40 mm.

(2)

Distance between dark bands = ...

(ii) Describe the effect on the pattern if the distance between the two slits is gradually increased to 1 cm.

(2)