18 Parallel waves in a ripple tank are diffracted as they pass through a gap in a barrier.

Three changes that can be made to this arrangement are listed.

1 Decrease the wavelength of the waves.

2 Increase the amplitude of the waves.

3 Decrease the size of the gap.

Which changes will cause the shape of the diffracted waves to be less curved?

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 and 3 only

22 Ultraviolet radiation and infrared radiation are both parts of the electromagnetic spectrum.

However, they differ in wavelength and frequency.

Which row describes how they differ?

	ultraviolet	infrared
A	longer wavelength than infrared	higher frequency than ultraviolet
B	longer wavelength than infrared	lower frequency than ultraviolet
C	shorter wavelength than infrared	higher frequency than ultraviolet
D	shorter wavelength than infrared	lower frequency than ultraviolet

23 A police car with its siren sounding is stationary in heavy traffic. A pedestrian notices that, although the loudness of the sound produced does **not** change, the pitch varies.

Which row describes the amplitude and the frequency of the sound?

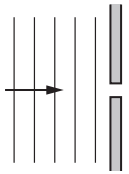
	amplitude	frequency
A	constant	constant
B	constant	varying
C	varying	constant
D	varying	varying

18 When water waves pass through a gap, they diffract.

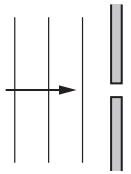
The diagrams show wavefronts approaching a gap.

In which diagram will the diffraction be least?

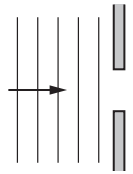
A



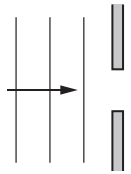
B



C



D



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]

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.

Use	**Region of e-m spectrum**
security marking	gamma rays
Bluetooth	ultraviolet
optical fibres	infrared
detection of cancer	radio waves

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]

(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.

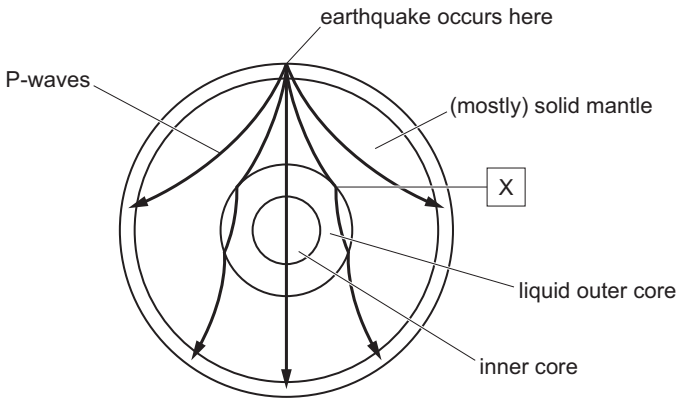


Fig. 5.2 (not to scale)

(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]

[Total: 10]

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.

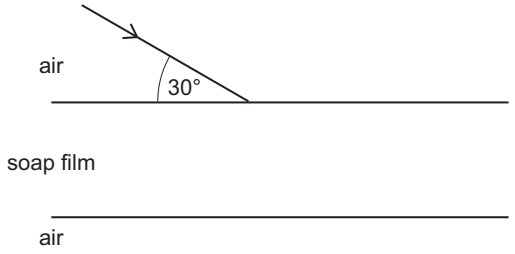


Fig. 5.1

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]

23 The element mercury exists as a solid, a liquid or a gas.

Which row gives a possible set of values of the speeds of sound through mercury?

	speed of sound in frozen mercury / m/s	speed of sound in liquid mercury / m/s	speed of sound in mercury vapour / m/s
A	250	1500	2500
B	250	2500	1500
C	1500	250	2500
D	2500	1500	250

4 A radio transmitter is a very tall, thin cylinder. It is prevented from falling over by wires which have one end fixed to the transmitter and the other end fixed in the ground. The ends of the wires in the ground are a long distance from the transmitter.

Fig. 4.1 shows the transmitter and two of the wires.

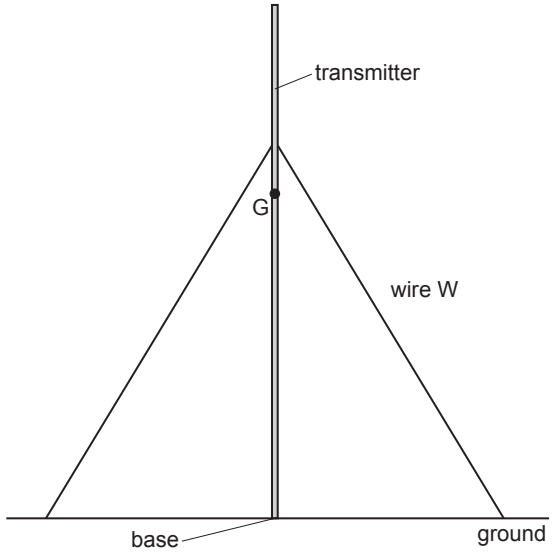


Fig. 4.1

(a) The centre of gravity G is shown on Fig. 4.1.

(i) State what is meant by centre of gravity.

.....

..... [1]

(ii) Explain why the radio transmitter without the wires is a very unstable structure.

.....

..... [1]

(b) Wire W is under tension and it exerts a force *T* on the transmitter.

(i) On Fig. 4.1, mark an arrow to show the force *T* exerted by wire W on the transmitter. [1]

(ii) The force *T* produces a moment on the transmitter about its base.

Describe how the moment produced by *T* is calculated and indicate on Fig. 4.1 what is meant by any other terms in the description.

.....

[3]

(c) The radio transmitter uses radio waves to transmit radio and television programmes.

State **one** other use of radio waves.

.....

..... [1]

[Total: 7]