Week 14

IGCSE Physics

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

IGCSE Physics Name: _____ Score: _____

1. A wave carries matter along with it from place to place.

   ☐ True ☐ False

2. A ray hits a plane mirror at 30° to the normal. At what angle to the normal does it reflect?

   ☐ 30° (angle of reflection = angle of incidence)

   ☐ 60°

   ☐ 90°

   ☐ 0°

3. A converging lens makes parallel rays of light:

   ☐ meet at the principal focus

   ☐ spread out as if from a point

   ☐ carry straight on unchanged

   ☐ stop completely

4. In a vacuum, how do the speeds of radio waves, light and gamma rays compare?

   ☐ they all travel at the same speed

   ☐ gamma rays are fastest

   ☐ radio waves are fastest

   ☐ visible light is fastest

5. Sound travels as a series of:

   ☐ compressions and rarefactions (a longitudinal wave)

   ☐ crests and troughs at right angles to travel

   ☐ electromagnetic waves

   ☐ still particles

6. A wave has frequency 5.0 Hz and wavelength 2.0 m. What is its speed, in m/s?

   _____ m/s

7. An image in a plane mirror is:

   ☐ virtual, the same size, and as far behind the mirror as the object is in front

   ☐ real and can be shown on a screen

☐ smaller than the object

☐ upside down

8. The distance from the lens to its principal focus is called the _____ length.

   _____

9. Sound can travel through a vacuum (empty space).

   ☐ True ☐ False

10. A sound wave travels at 330 m/s with a frequency of 110 Hz. What is its wavelength, in m?

    _____ m

IGCSE Physics

1. **False**

   A wave carries energy, not matter. A floating cork bobs up and down but does not travel with the wave.

2. **30° (angle of reflection = angle of incidence)**

   The law of reflection: the angle of reflection equals the angle of incidence, both measured from the normal.

3. **meet at the principal focus**

   A converging (convex) lens bends parallel rays inward so they meet at the principal focus.

4. **they all travel at the same speed**

   All electromagnetic waves travel at the same speed in a vacuum, 3.0×10^8 m/s.

5. **compressions and rarefactions (a longitudinal wave)**

   A vibrating source squeezes and stretches the air into compressions and rarefactions — a longitudinal wave.

6. **10 m/s**

   $v = f\lambda = 5.0 \times 2.0 = 10$ m/s.

7. **virtual, the same size, and as far behind the mirror as the object is in front**

   A plane mirror gives a virtual image, the same size, the same distance behind the mirror — it cannot be caught on a screen.

8. **focal**

   The focal length is the distance from the centre of the lens to the principal focus.

9. **False**

   Sound needs particles to pass the vibration along, so it cannot travel through a vacuum.

10. **3 m**

    Rearrange $v = f\lambda$: $\lambda = \dfrac{v}{f} = \dfrac{330}{110} = 3.0$ m.

IGCSE PHYSICS • EXERCISE SHEET

3.1 General properties of waves

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS wave 波 • transverse wave 横波 • longitudinal wave 纵波 • wavelength 波长 • amplitude 振幅

Objective

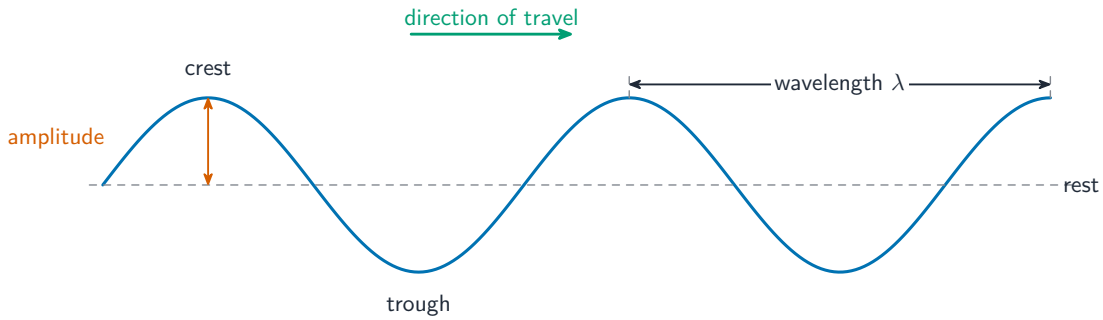
Build the skills to answer exam questions on the **general properties of waves** 波的性质 — the wave terms, the **wave equation** $v = f\lambda$, transverse vs longitudinal, and reflection/refraction/**diffraction** 衍射.

You must be able to:

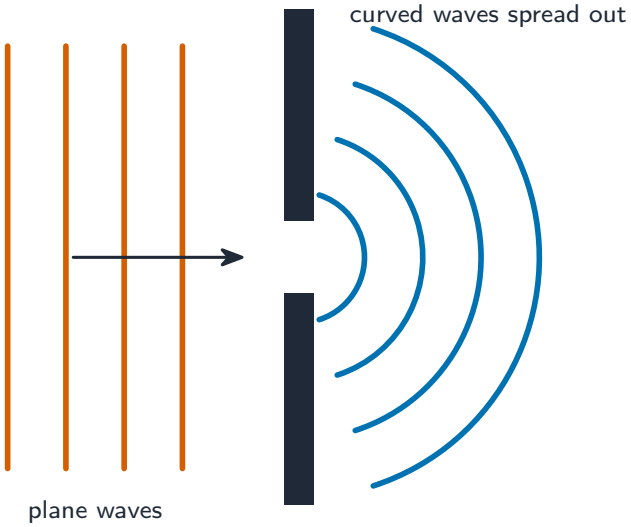
- use $v = f\lambda$ and define wavelength, frequency, amplitude
- distinguish transverse and longitudinal waves
- describe reflection, refraction and diffraction

1 Worked examples

The wave equation



Wavelength = crest-to-crest distance; amplitude = rest-to-crest height; $v = f\lambda$



Diffraction is strongest when the gap is about one wavelength wide

Sound $v = 340$ **m/s,** $f = 170$ **Hz:** $\lambda = \dfrac{v}{f} = \dfrac{340}{170} = 2.0$ m.

2 Practice

2.1 A wave has frequency 50 Hz and wavelength 0.40 m. Find its speed. [2]

2.2 State the difference between a transverse and a longitudinal wave. [1]

3 Exam-style questions

3.1 The number of complete waves passing a point each second is the: [1]

- **A** wavelength
- **B** amplitude
- **C** frequency
- **D** wave speed

3.2 Water waves of wavelength 0.020 m travel at 0.30 m/s.

(a) Find their frequency. [2]

(b) State and explain what happens to the waves as they pass through a gap about 0.02 m wide. [2]

3.3 A radio wave has a speed of 3.0×10^8 m/s and a frequency of 1.0×10^8 Hz. Find its wavelength. [2]

Solutions

2.1 $v = f\lambda = 50 \times 0.40 = 20$ m/s.

2.2 in a transverse wave the particles vibrate at right angles to the travel direction; in a longitudinal wave they vibrate along it.

3.1 C. Frequency is the number of waves per second.

3.2 (a) $f = \dfrac{v}{\lambda} = \dfrac{0.30}{0.020} = 15$ Hz.
(b) the waves spread out (diffract); because the gap is about the same size as the wavelength.

3.3 $\lambda = \dfrac{v}{f} = \dfrac{3.0 \times 10^8}{1.0 \times 10^8} = 3.0$ m.

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

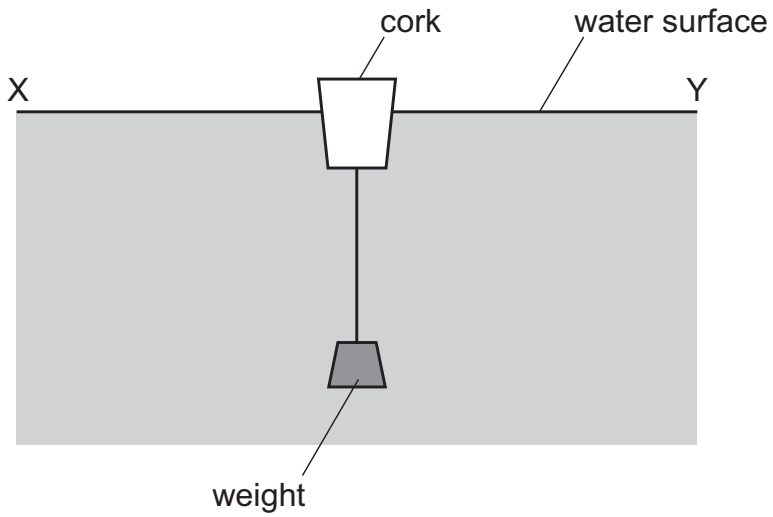
17 An earthquake-monitoring station records the arrival of 16 complete wavelengths of an earthquake wave in a time of 20 s.

The speed of the earthquake wave is 6.0 km / s.

What is the wavelength of the earthquake wave?

A 1.3×10^{-4} m **B** 2.1×10^{-4} m **C** 4.8×10^{3} m **D** 7.5×10^{3} m

17 The diagram shows a cork with a weight attached so that the cork floats upright in water.



Transverse waves travel across the water from X to Y.

In which direction do the waves make the cork move?

A → ← right and left

B ↑↓ up and down

C → only to the right

D ← only to the left

16 Which statement about waves is correct?

A Waves do not transfer either energy or matter.

B Waves transfer both energy and matter.

C Waves transfer energy without transferring matter.

D Waves transfer matter without transferring energy.

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.

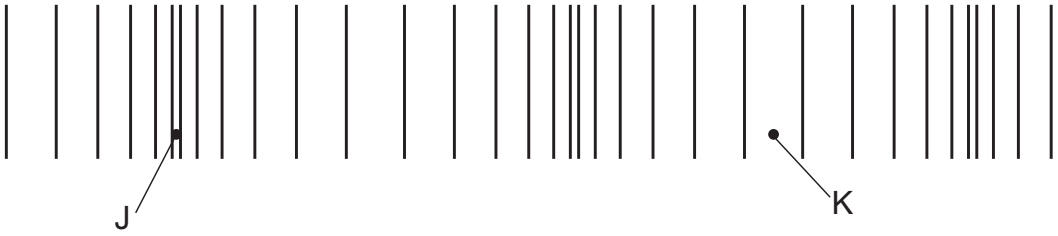


Fig. 5.1

(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.

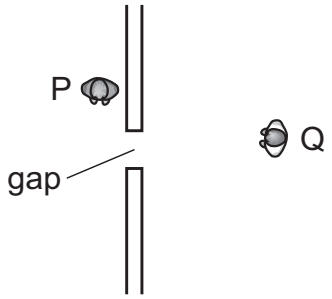
As the wave passes a certain point, the ground completes 5 oscillations.

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

ime = ... [3]

[Total: 8]

17 Two men, P and Q, stand close to a gap in a wall, as shown. Man P cannot see man Q but man P can hear man Q speaking.



Which statement explains this?

A Light waves do not diffract at all because they are electromagnetic waves.

B Light waves have a range of frequencies but sound has just one frequency.

C Sound waves are of a higher frequency than light waves.

D Sound waves diffract a lot because their wavelength is a similar size to the width of the gap.

18 Which quantities relating to a wave on the surface of water can **both** be measured in metres?

A amplitude and frequency

B amplitude and wavelength

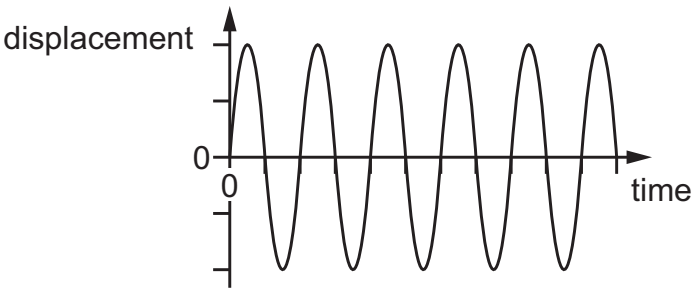
C amplitude and wave speed

D frequency and wavelength

17 The diagrams show graphs of displacement against time for four waves. All the graphs are drawn to the same scale.

Which wave has the largest amplitude and the highest frequency?

A



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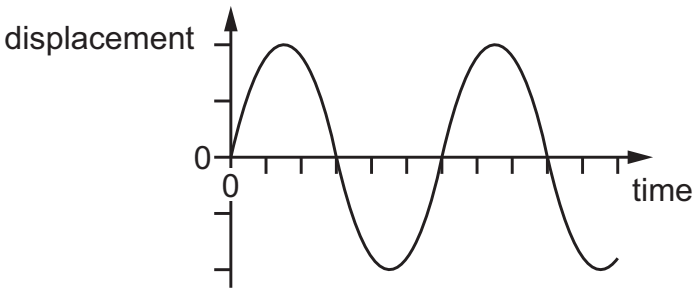

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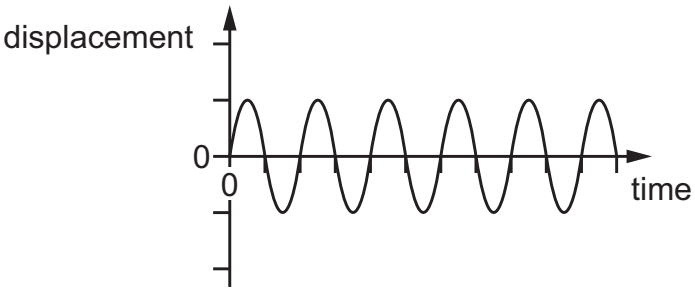
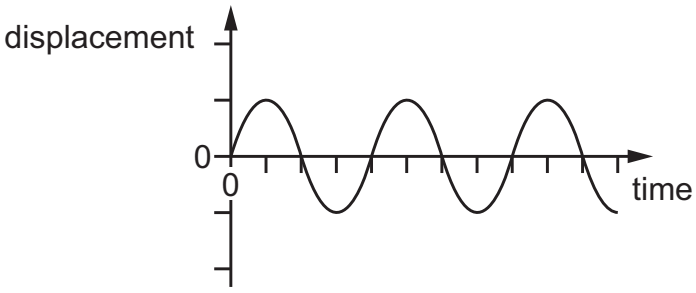


D



IGCSE PHYSICS • EXERCISE SHEET

3.2 Light

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS reflection 反射 • normal 法线 • total internal reflection 全反射 • refractive index 折射率 • converging lens 凸透镜

Objective

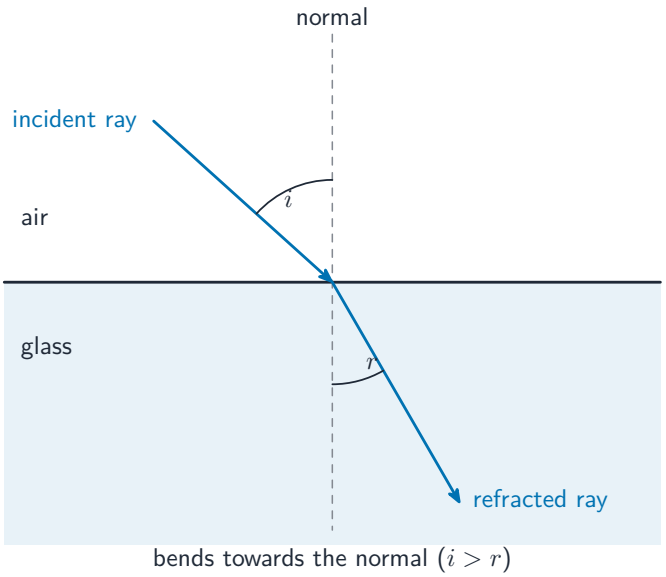
Build the skills to answer exam questions on **light** 光 — **reflection** 反射, **refraction** 折射 and the **refractive index** 折射率, **total internal reflection** 全反射, and lenses.

You must be able to:

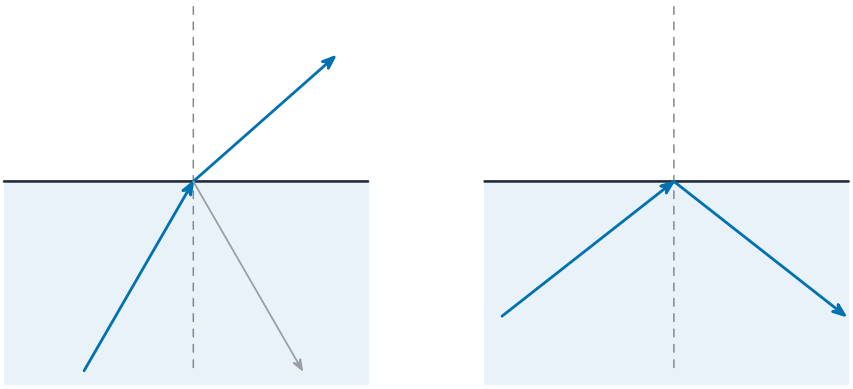
- use the law of reflection (angle i = angle r)
- use $n = \dfrac{\sin i}{\sin r}$ and $n = \dfrac{1}{\sin c}$
- describe converging lenses and total internal reflection

1 Worked examples

■ Refraction & TIR



Entering glass the light slows and bends towards the normal, so $i > r$



angle $<$ critical:
light refracts out

angle $>$ critical:
total internal reflection

Above the critical angle the light is totally internally reflected; $n = \dfrac{1}{\sin c}$

$i = 60°$, $r = 35°$ $(\sin 60 = 0.87,\ \sin 35 = 0.57)$**:** $n = \dfrac{0.87}{0.57} = 1.5.$

2 Practice

2.1 State the law of reflection. [1]

2.2 Light enters glass with $\sin i = 0.80$ and $\sin r = 0.50$. Find the refractive index. [2]

3 Exam-style questions

3.1 When light passes from air into glass it: [1]

- **A** speeds up and bends away from the normal
- **B** slows down and bends towards the normal
- **C** slows down and bends away from the normal
- **D** does not change direction

3.2 A glass has a refractive index of 1.5.

(a) Find the critical angle for the glass. [3]

(b) State one use of total internal reflection. [1]

3.3 Describe what a converging lens does to parallel rays of light, and name the point where they meet. [2]

Solutions

2.1 the angle of incidence equals the angle of reflection (both measured from the normal).

2.2 $n = \dfrac{\sin i}{\sin r} = \dfrac{0.80}{0.50} = 1.6$.

3.1 B. Light slows down and bends towards the normal entering glass.

3.2 (a) $\sin c = \dfrac{1}{n} = \dfrac{1}{1.5} = 0.667$; $c = 41.8°$.
(b) in optical fibres (carrying light/data signals).

3.3 it bends the parallel rays inwards so they meet at a single point; this point is the principal focus.

IGCSE PHYSICS • EXERCISE SHEET

3.3 Electromagnetic spectrum

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS electromagnetic spectrum 电磁波谱 • spectrum 光谱 • microwaves 微波 • radio waves 无线电波 • infrared 红外线

Objective

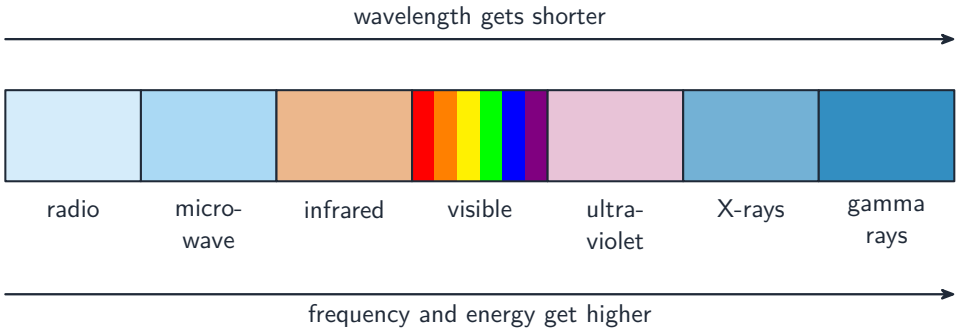
Build the skills to answer exam questions on the **electromagnetic spectrum** 电磁波谱 — the order of the regions, their uses, and their dangers.

You must be able to:

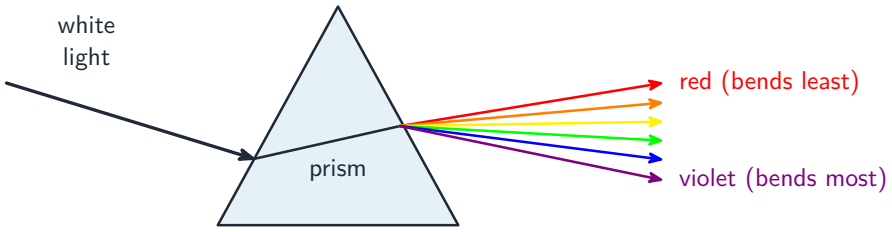
- list the regions in order of wavelength/frequency
- give a use for each region
- state the dangers of the higher-frequency regions

1 Worked examples

The EM spectrum



From radio to gamma rays: wavelength falls, frequency and energy rise



A prism disperses white light into the visible spectrum

- **order:** radio, microwave, infrared, visible, ultraviolet, X-ray, gamma.
- all travel at 3.0×10^8 m/s in a vacuum.
- **uses:** microwave (phones/cooking), infrared (remote controls/thermal imaging), UV (sterilising), X-ray (scans), gamma (sterilising/cancer treatment).

2 Practice

2.1 Name the region of the EM spectrum used for mobile phone signals. [1]

2.2 State which has the higher frequency: ultraviolet or infrared. [1]

3 Exam-style questions

3.1 Which travels fastest in a vacuum? [1]

- **A** radio waves
- **B** visible light
- **C** gamma rays
- **D** they all travel at the same speed

3.2 Going from radio waves towards gamma rays:

(a) State what happens to the frequency and to the wavelength. [2]

(b) State one danger of too much ultraviolet radiation. [1]

3.3 Give a use for (a) infrared and (b) X-rays. [2]

Solutions

2.1 microwaves.

2.2 ultraviolet.

3.1 D. All electromagnetic waves travel at the same speed in a vacuum.

3.2 (a) the frequency increases and the wavelength decreases.
(b) it can cause skin cancer (or eye damage).

3.3 (a) infrared — remote controls / thermal imaging / grills.
(b) X-rays — medical or security scans.

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

22 Visible light, X-rays and microwaves are all components of the electromagnetic spectrum.

Which statement about the waves is correct?

A In a vacuum, microwaves travel faster than visible light and have a shorter wavelength than visible light.

B In a vacuum, microwaves travel at the same speed as visible light and have a shorter wavelength than visible light.

C In a vacuum, X-rays travel faster than visible light and have a shorter wavelength than visible light.

D In a vacuum, X-rays travel at the same speed as visible light and have a shorter wavelength than visible light.

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.

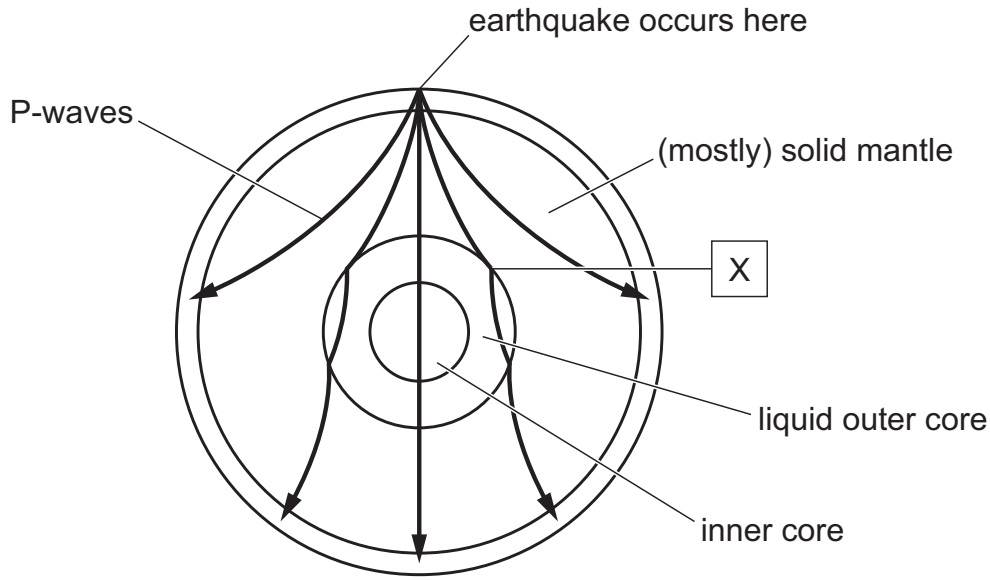


Fig. 5.2 (not to scale)

(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]

Name:

IGCSE Physics: **s25 21**

22 Satellites are sometimes used to receive and re-transmit television signals.

Which row shows the type of satellite and the electromagnetic waves used?

	type of satellite	electromagnetic waves used
A	low orbit	infrared
B	low orbit	microwaves
C	geostationary	infrared
D	geostationary	microwaves

IGCSE Physics: **s24 21**

21 Which region of the electromagnetic spectrum is used for detecting fake bank notes?

A radio

B microwaves

C ultraviolet

D X-rays

IGCSE Physics: **w23 21**

22 A radio transmitter broadcasts at a frequency of 200 kHz.

What is the wavelength of these radio waves?

A 6.7×10^{-4} m **B** 1.5 m **C** 1.5×10^{3} m **D** 1.5×10^{6} m

IGCSE Physics: **s23 21**

21 Visible light has wavelengths in the range 4.0×10^{-7} m to 7.0×10^{-7} m.

What is the range of the frequencies of visible light?

A 0.12 Hz to 0.21 Hz

B 120 Hz to 210 Hz

C 4.3×10^{11} Hz to 7.5×10^{11} Hz

D 4.3×10^{14} Hz to 7.5×10^{14} Hz

6 A mobile phone (cell phone) network uses microwaves of frequency 1.9×10^9 Hz to transmit and receive signals.

The speed of microwaves in air is 3.0×10^8 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]

[Total: 9]

IGCSE PHYSICS • EXERCISE SHEET

3.4 Sound

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS longitudinal wave 纵波 • echo 回声 • compression 压缩 • rarefaction 稀疏 • sound 声音

Objective

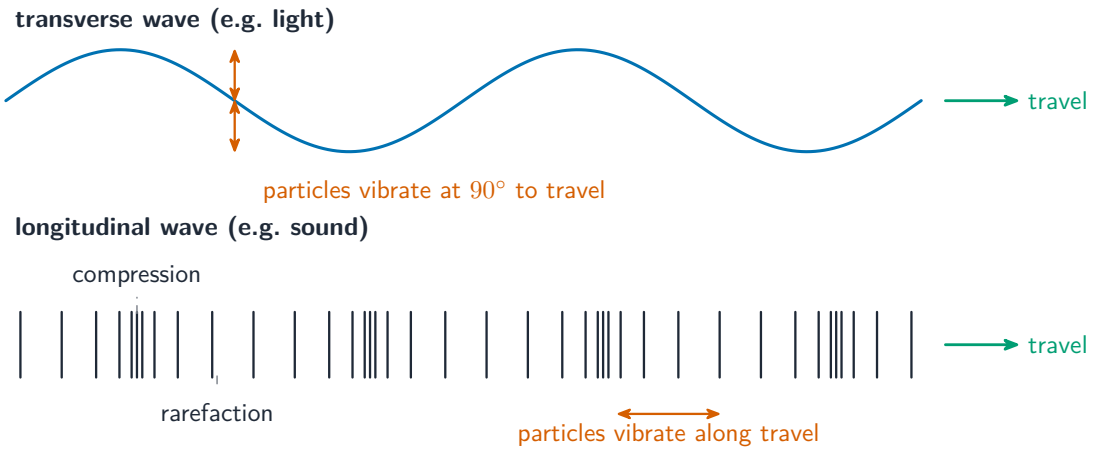
Build the skills to answer exam questions on **sound** 声音 — sound as a **longitudinal wave** 纵波, the need for a medium, the range of human hearing, and **echoes** 回声.

You must be able to:

- describe sound as a longitudinal wave (compressions and rarefactions)
- state that sound needs a medium and give the hearing range
- find the speed of sound from an echo

1 Worked examples

■ Speed of sound from an echo



Sound is longitudinal: the air vibrates along the travel direction, making compressions and rarefactions

Clap 85 m from a wall, echo after 0.50 s: the sound goes there and back, $2 \times 85 = 170$ m, so $v = \dfrac{170}{0.50} = 340$ m/s.

2 Practice

2.1 State why sound cannot travel through a vacuum. [1]

2.2 State the approximate range of frequencies a human can hear. [1]

3 Exam-style questions

3.1 Sound is a: [1]

- **A** transverse wave that needs no medium
- **B** longitudinal wave that needs a medium
- **C** transverse wave that needs a medium
- **D** longitudinal wave that needs no medium

3.2 A person stands 660 m from a cliff and shouts. The echo returns 4.0 s later.

(a) Find the speed of sound. [3]

(b) State whether sound travels faster or slower in water than in air. [1]

3.3 Explain why you see lightning before you hear the thunder. [2]

Solutions

2.1 sound needs a medium (particles) to travel through, and a vacuum has none.

2.2 about 20 Hz to 20 000 Hz.

3.1 B. Sound is a longitudinal wave that needs a medium.

3.2 (a) distance there and back $= 2 \times 660 = 1320$ m; $v = \dfrac{1320}{4.0}$; $= 330$ m/s.
(b) faster in water.

3.3 light travels much faster than sound; so the light from the lightning reaches you almost at once, while the sound takes longer to arrive.

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

23 Sound travels through air as a series of compressions and rarefactions.

Which statement correctly compares a compression with a rarefaction?

A In a compression, the wavelength is longer than in a rarefaction.

B In a compression, the wavelength is shorter than in a rarefaction.

C In a compression, the density of the air is greater than in a rarefaction.

D In a compression, the density of the air is lower than in a rarefaction.

23 Both the amplitude and the frequency of a sound wave decrease.

What happens to the sound that is heard?

A The sound is louder and has a higher pitch.

B The sound is louder and has a lower pitch.

C The sound is quieter and has a higher pitch.

D The sound is quieter and has a lower pitch.

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]

IGCSE Physics: **s25 21**

23 A sound wave travels through the air and strikes a solid block of steel.

Some of the sound is reflected from the steel, and some is transmitted through the steel.

How does the speed and the wavelength of the sound in steel compare to the speed and the wavelength of the sound in air?

	speed in steel	wavelength in steel
A	less than in air	less than in air
B	less than in air	greater than in air
C	greater than in air	less than in air
D	greater than in air	greater than in air

IGCSE Physics: **s24 21**

22 A sound wave travels at 330 m / s. The distance between the centre of a compression and the centre of the nearest rarefaction in the sound wave is 2.5 cm.

What is the frequency of the sound wave?

A 66 Hz **B** 130 Hz **C** 6600 Hz **D** 13 000 Hz

23 Which waves are used in the medical scanning of soft tissue?

A gamma rays

B infrared

C microwaves

D ultrasound

IGCSE Physics: **s23 21**

22 Student X fires a starting pistol which produces smoke and sound. Student Y is standing 100 m away and sees the smoke the instant it is produced. The speed of sound in air is 340 m / s.

What is the time delay between student Y seeing the smoke and hearing the sound?

A 0.29 s **B** 0.59 s **C** 1.7 s **D** 3.4 s