EXAM PAPERS PRACTICE

Chapter 14

Properties of waves

CIE IGCSE PHYSICS for board 0625 and 0972

(For exam 2025+)

Introduction

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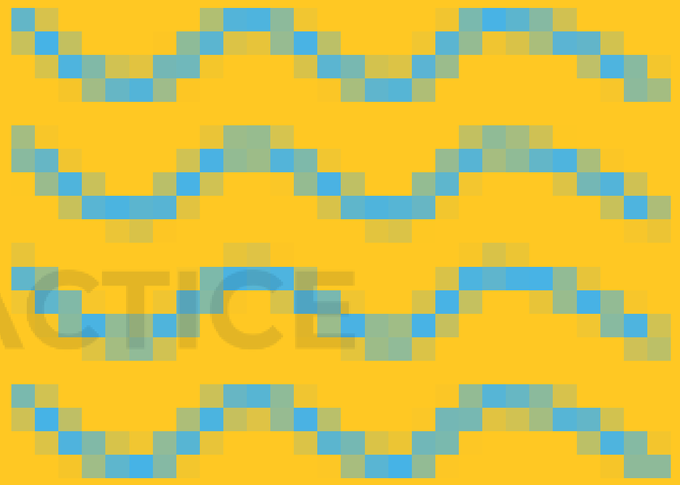
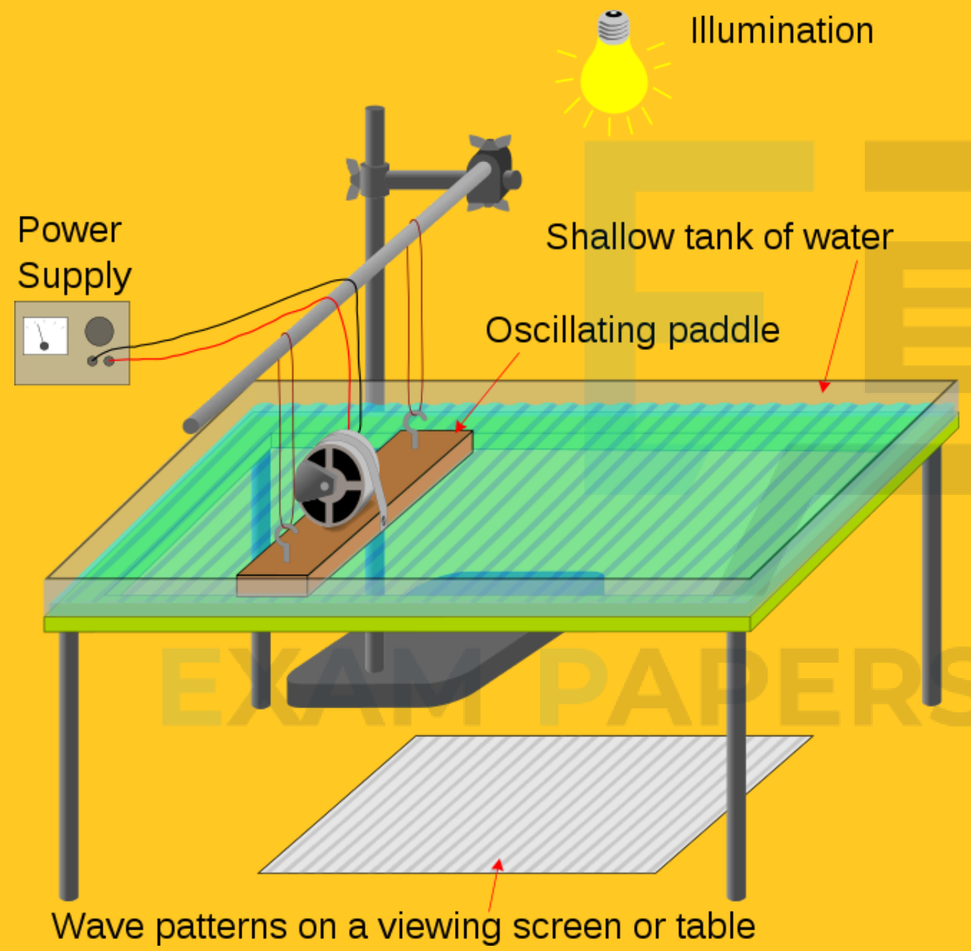
Physicists use waves as a model to describe the behavior of light, sound, and electromagnetic radiation.



Ripple tank

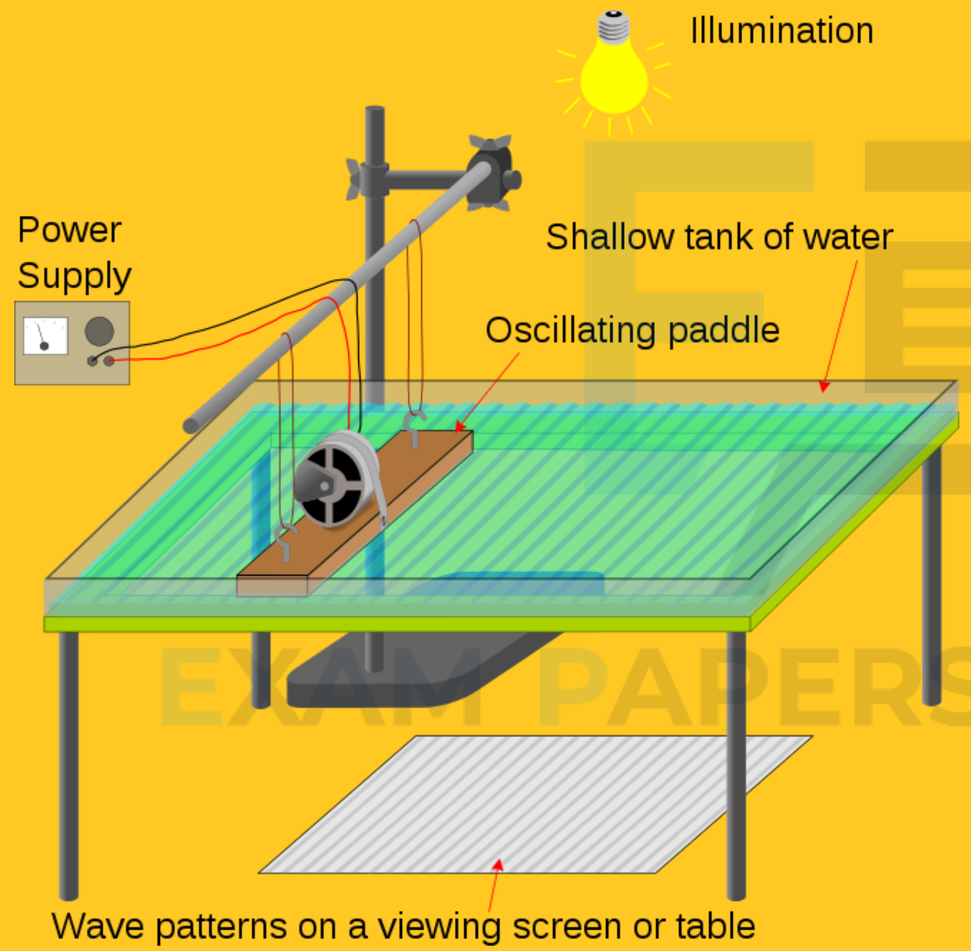


Various ripple patterns can be generated in different ways:

a. Straight ripples

b. Circular ripples

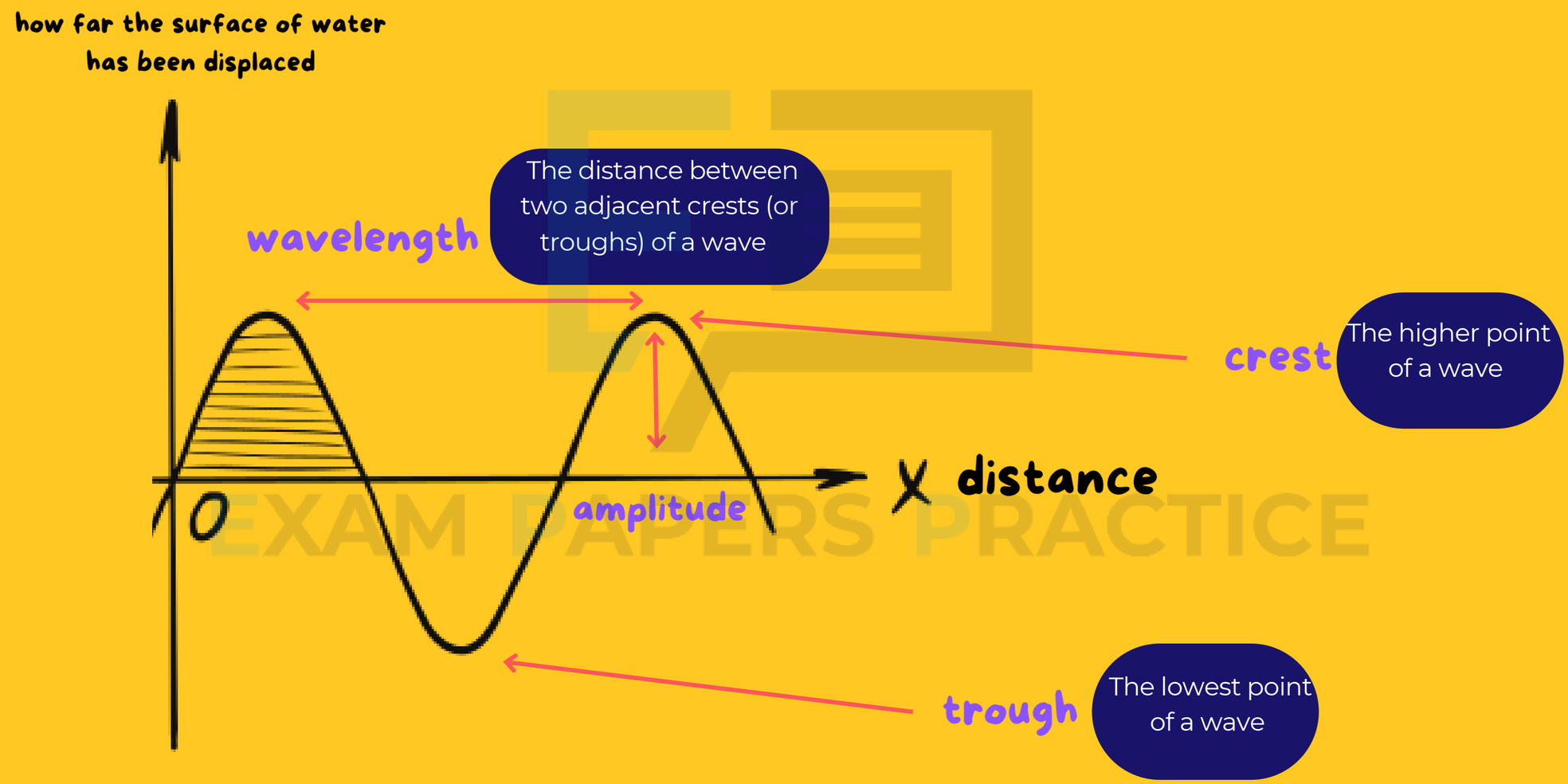
Ripple tank



How are ripples produced?

a.	Ripples are created by vertical vibrations.
b.	A vibrating bar or dipper moves water molecules up and down.
c.	This movement then affects neighboring water molecules.
d.	While waves transfer energy, water molecules return to their original positions after the wave passes, demonstrating that waves transfer energy but not matter.

Wavelength, Amplitude



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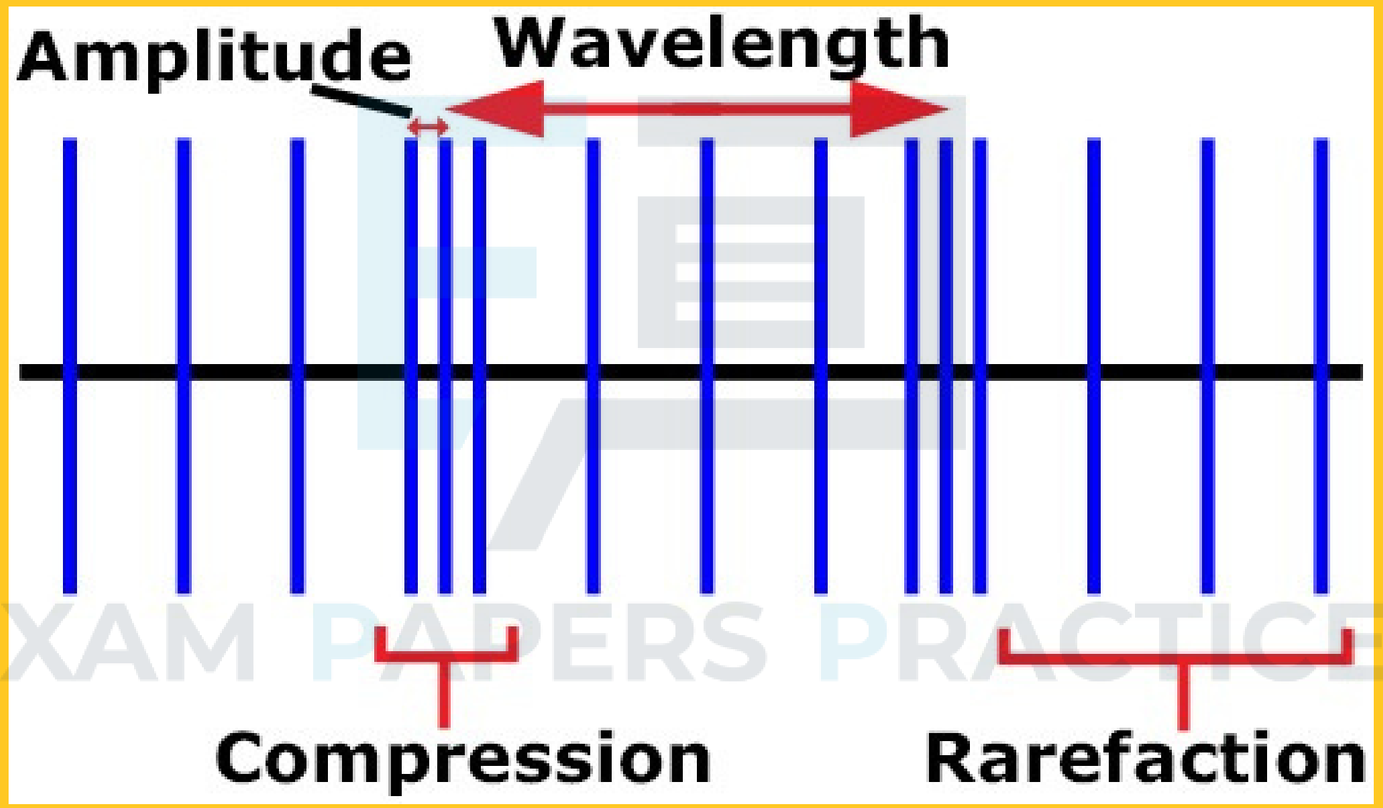
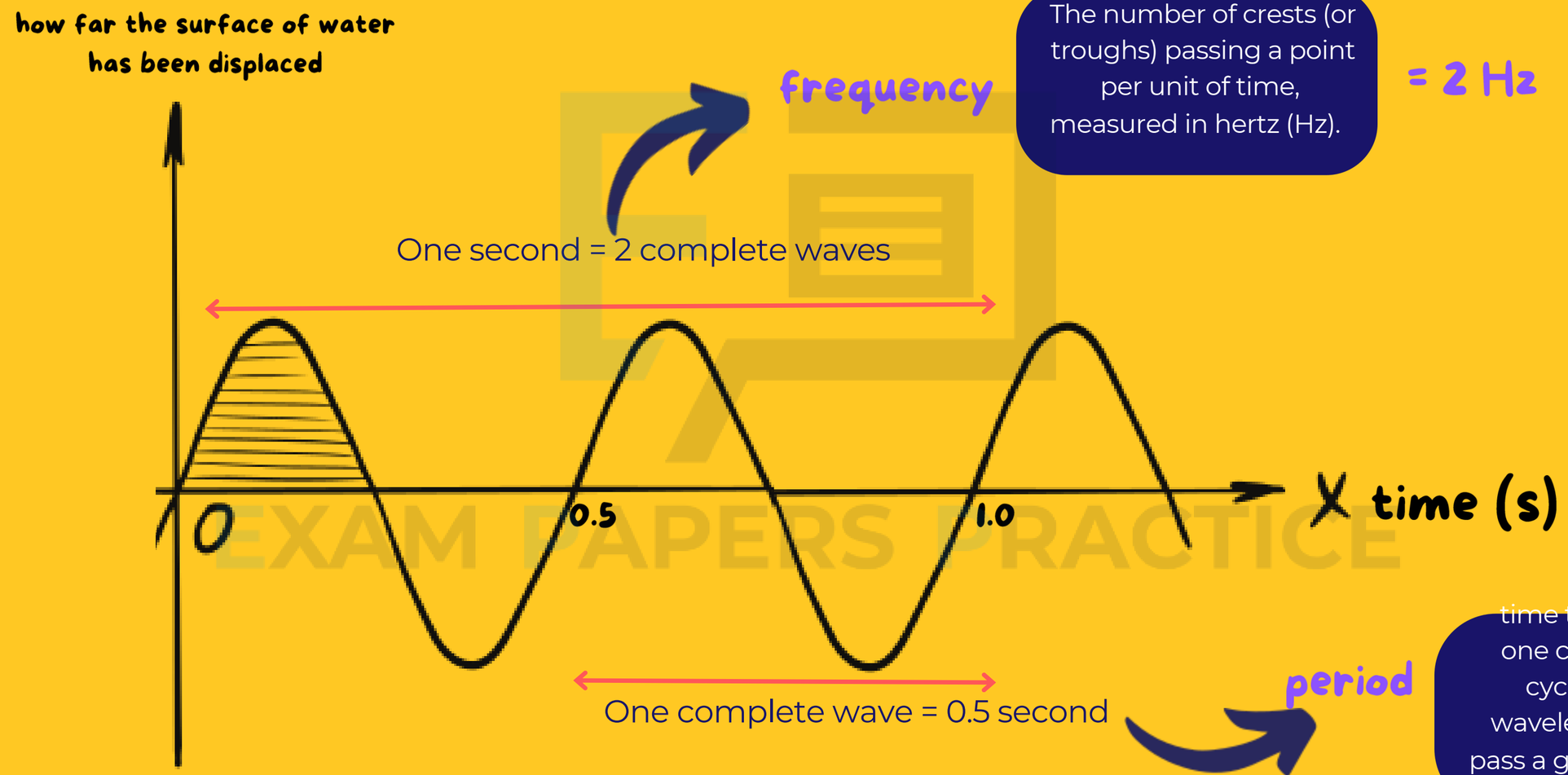


Frequency, period



Introduction | Wavelength, Amplitude | Frequency, Period | Wave Speed, Energy | Transverse, Longitudinal

Frequency, period formula

"Frequency = $\frac{1}{\text{Period}}$"

	Sea Waves	A high pitch sound
Frequency / Hz	1 / 10	1000
Period / s	10	1 / 1000

Wave speed

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The wave speed is the rate at which the crest of a wave travels.

a.	Ripple -Few centimeters per second
b.	Sound Waves -330 m/s
c.	Light Waves -300000000 m/s

Wave and energy

The speed of the wave is equivalent to the speed at which the wave transfers energy from place to place. The bigger the amplitude, the more energy the wave transfers. A wave transfers energy without transferring matter.

Earthquake

Caused by a transfer of energy by waves

Two types of waves in an earthquake

- Primary seismic waves (fast-moving)
- Secondary seismic waves (slow-moving)

Introduction | Wavelength, Amplitude | Frequency, Period | Wave Speed, Energy | Transverse, Longitudinal

Types of waves

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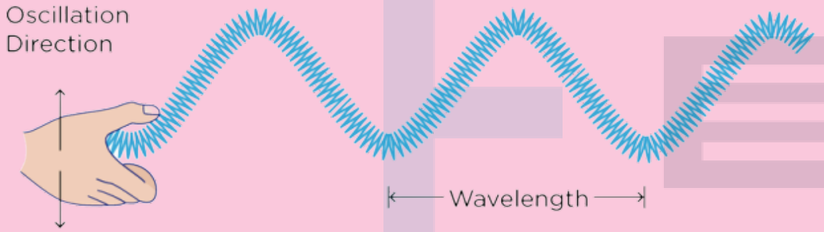
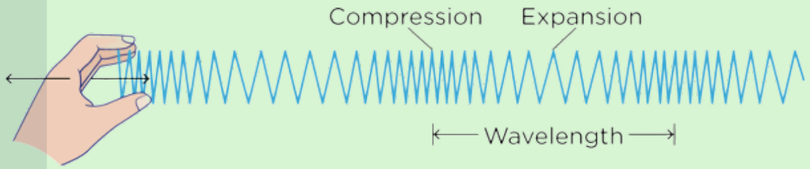
Type	Transverse Wave	Longitudinal Wave
Diagram		
Definition	A wave in which the oscillations or vibrations are perpendicular to the direction the wave travels.	A wave in which the oscillations or vibrations are parallel to the direction the wave travels.
Examples	Ripples onwater Lightand all other electromagnetic waves Secondaryseismic waves (S-waves)	Sound Primary seismic waves (P-waves)

Introduction
Wavelength, Amplitude
Frequency, Period
Wave Speed, Energy
Transverse, Longitudinal

Formula relating

Speed, frequency and wavelength

speed = frequency x wavelength

$v = f\lambda$

Worked Example

a frequency of 300 MHz. What is the speed of these signals?

Worked Example

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$v = f\lambda$

$= 300000000 \times 1.8$

$= 540000000$ m/s

Worked Example

significant figures.

Worked Example

significant figures.

$v = f\lambda$

$340 = 4320\lambda$

$\lambda = 340 / 4320$

$= 0.079m$

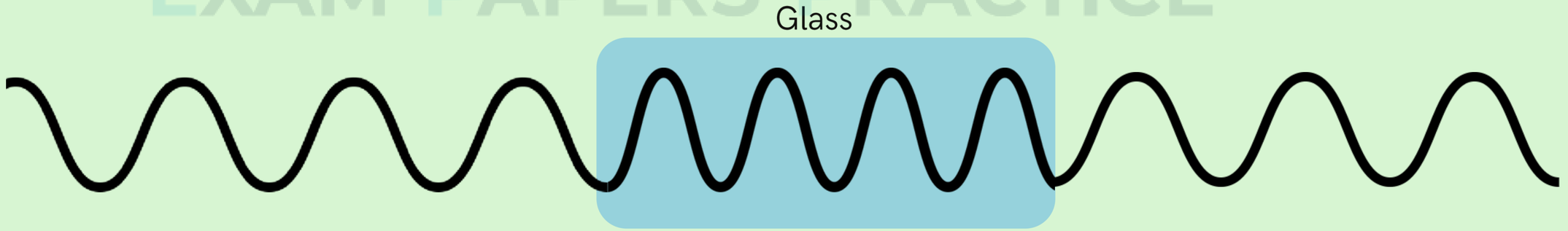
14.2 Speed, Frequency & Wavelength

Eg.

Light moves slower in glass compared to air.

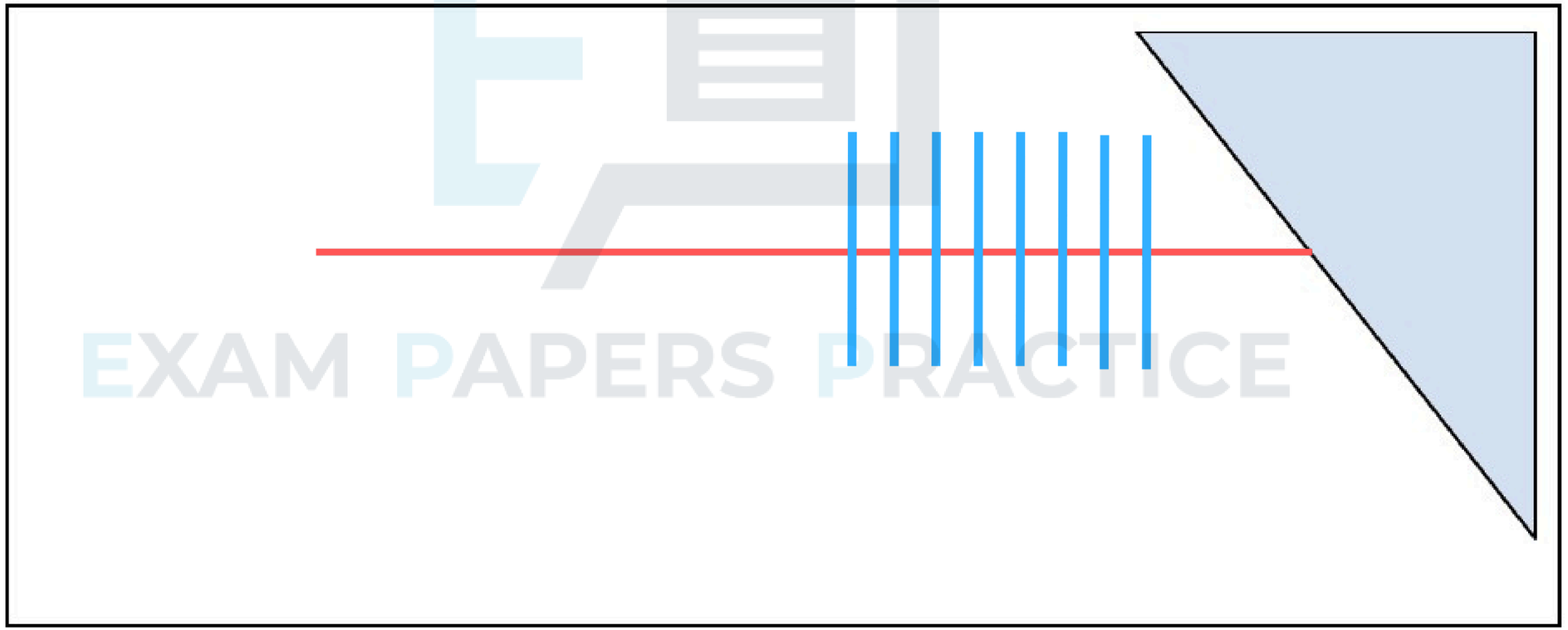
Sound travels faster in steel than in air.

Despite changes in wave speed, the frequency of the waves remains constant. The wavelength of the waves is what changes.



Reflection of ripples

1. The diagram above provides a top-down view of the ripples.
2. The line depicted represents the crests of the ripples, known as **wavefronts**.

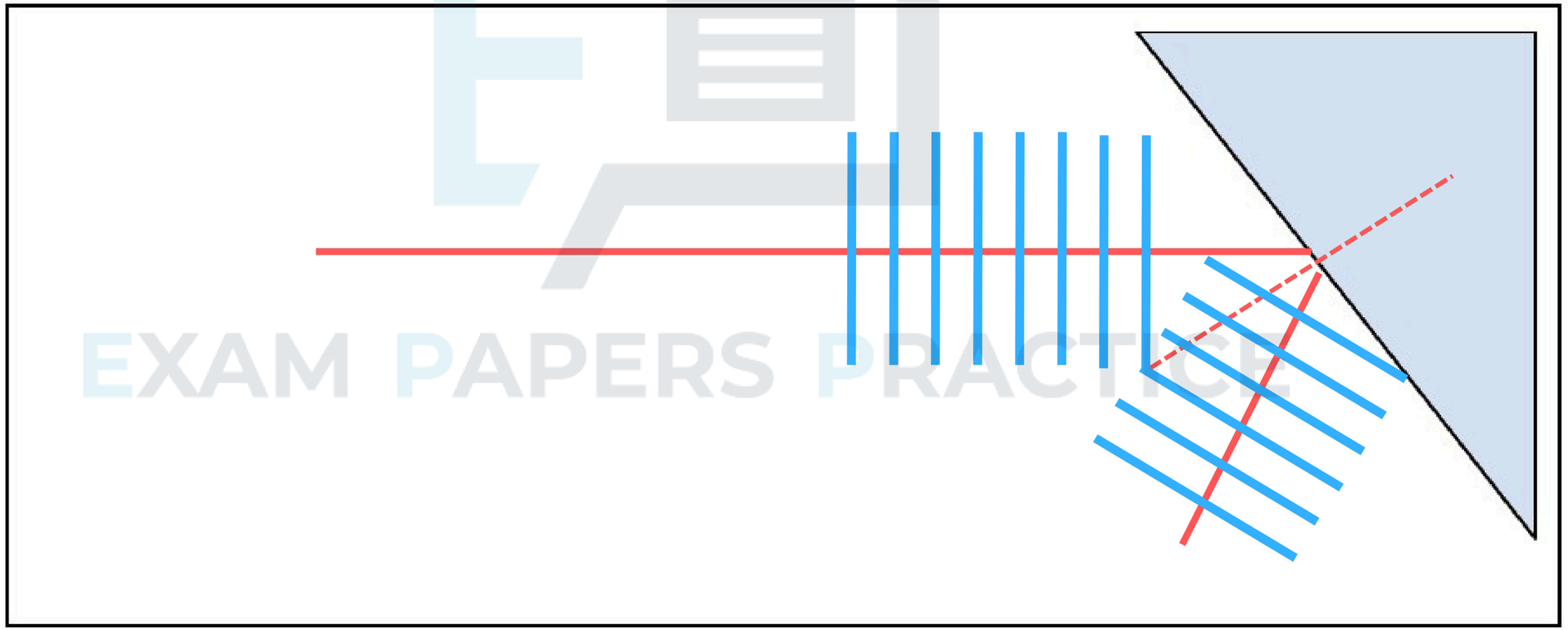


Reflection of ripples

The diagram above below shows an overview head of the ripples.

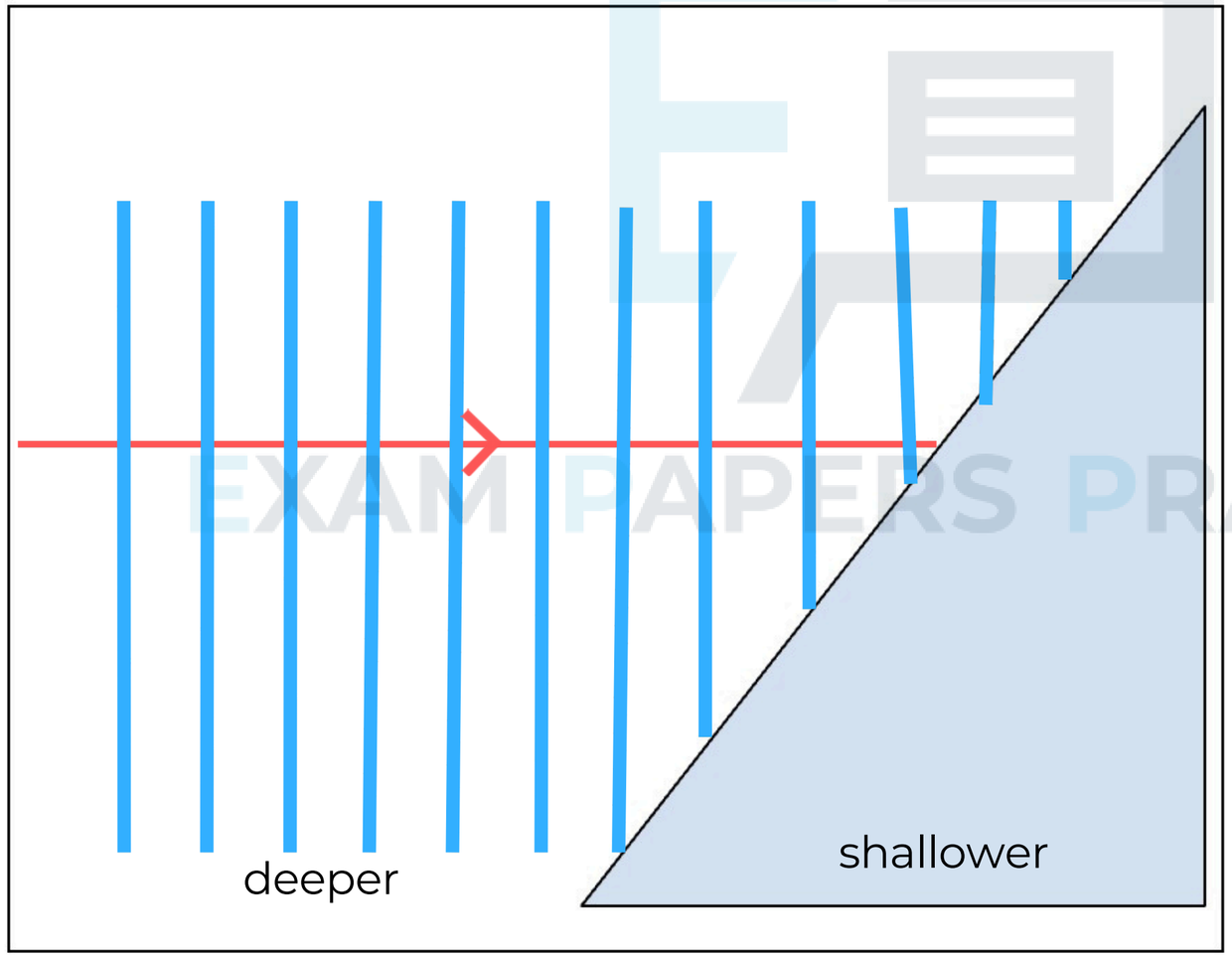
The line represents the tops of the ripples. These lines are known as wavefronts.

The separation of the wavefronts is equal to the wavelengths of the ripples.



Refraction of ripples

1. Refraction of light occurs when the speed of light changes as it moves from one medium to another.
2. The wavefront diagram below illustrates how the pattern of wavefronts changes when light travels through a shallower region.



a. The ripples move slower, resulting in a decrease in wavelength.

b. The rays illustrate how the ripples change direction, becoming closer to the normal as they slow down.

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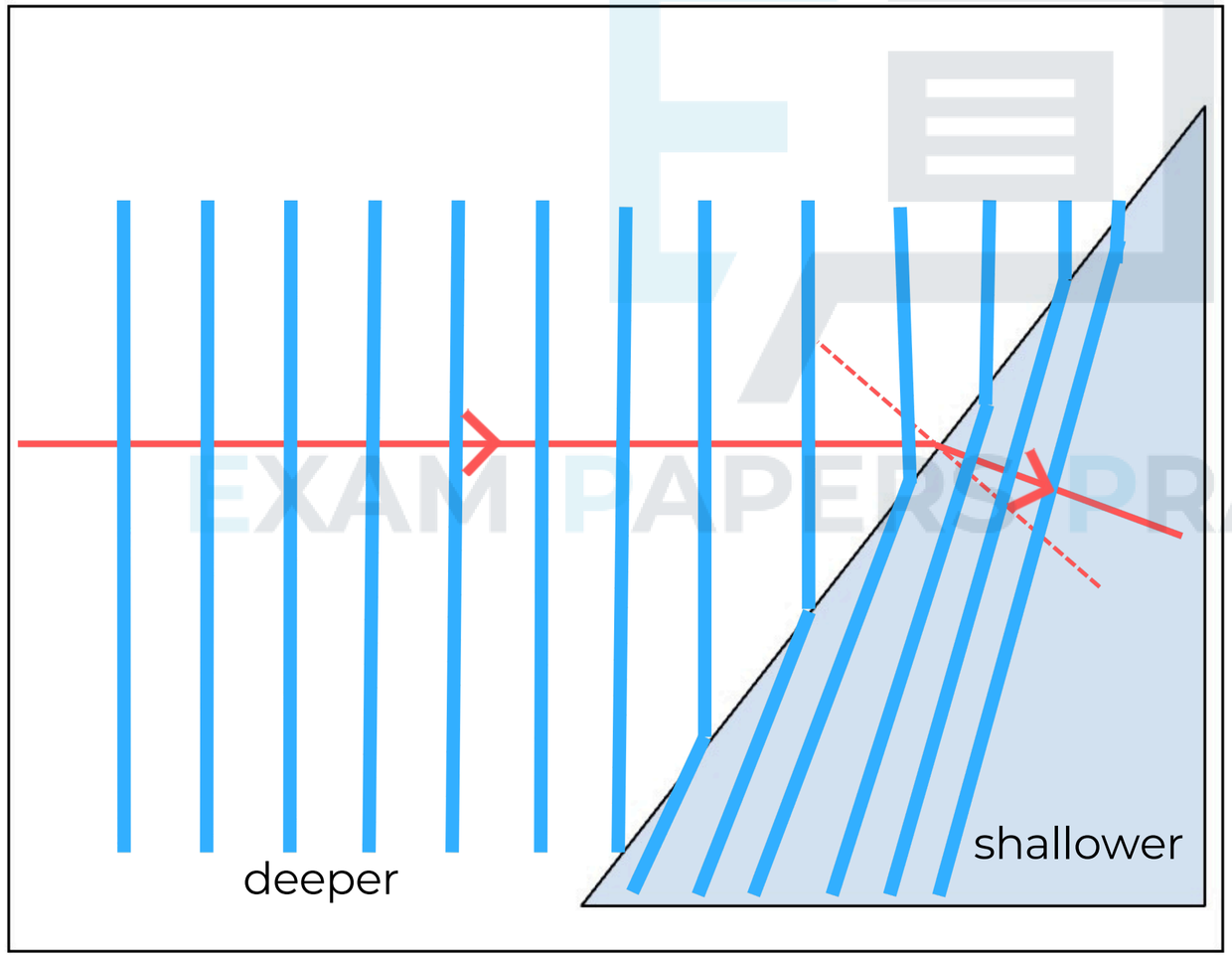

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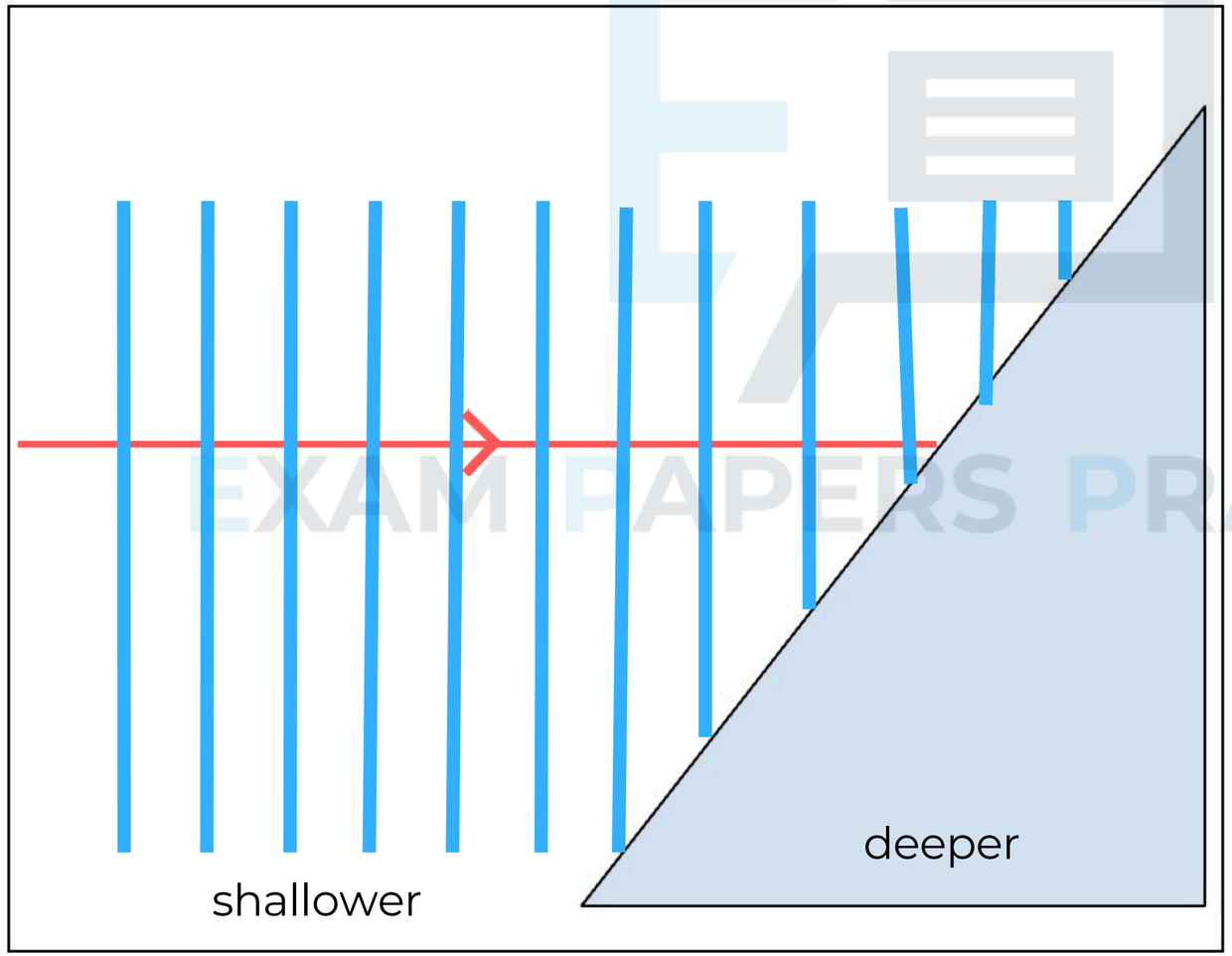

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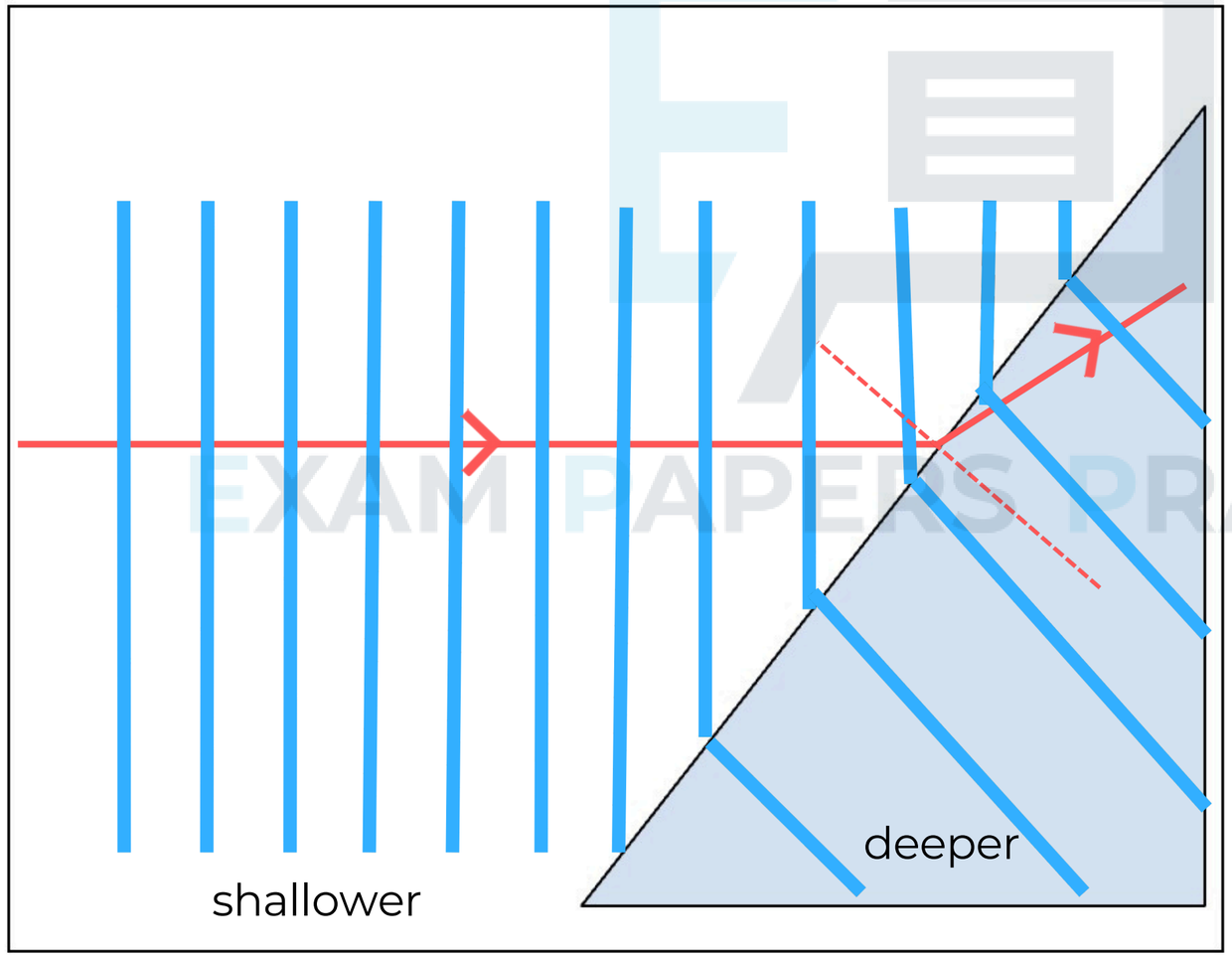

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Diffraction

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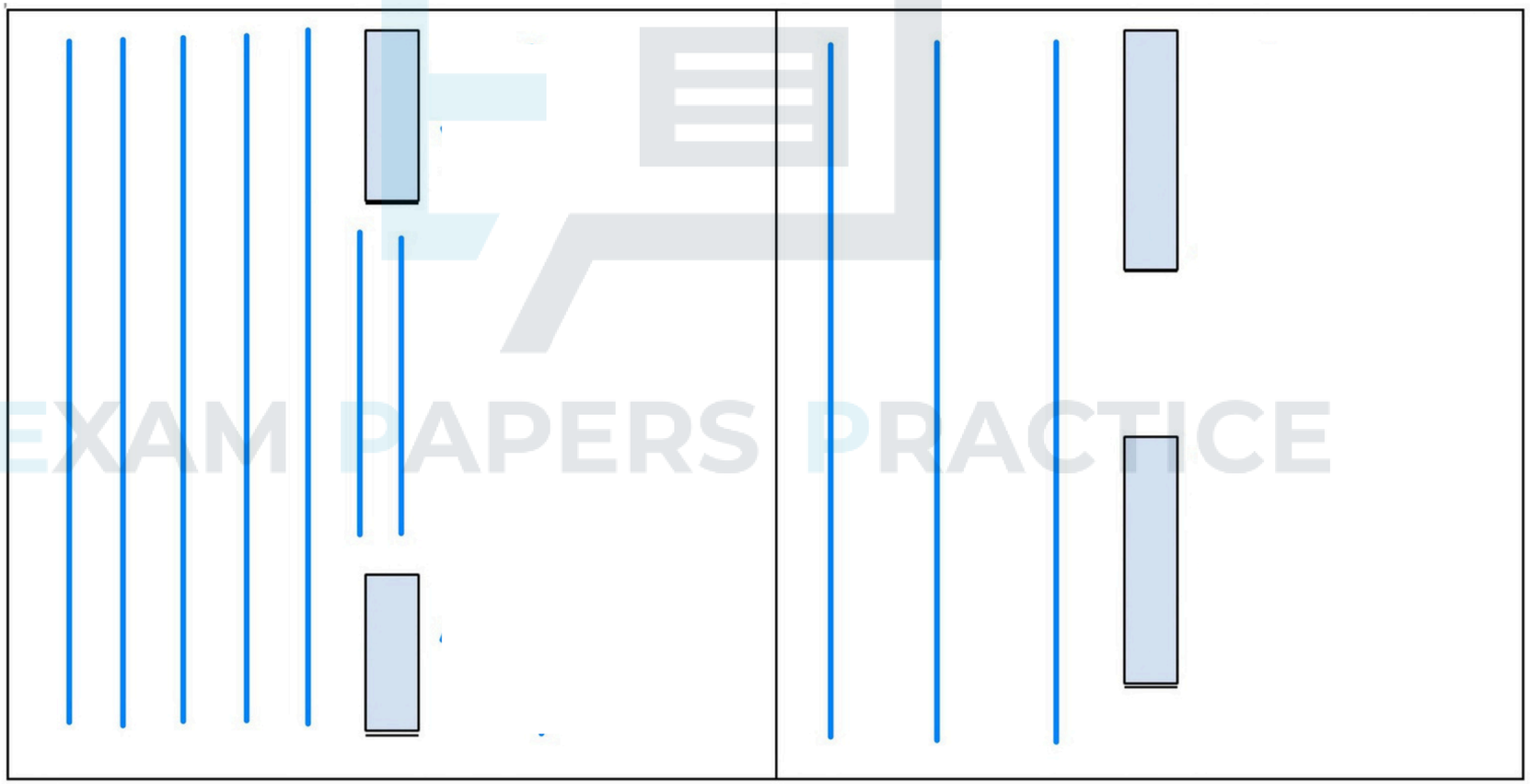
> When a wave spreads out as it travels through a gap or past the edge of an object

Diffraction - Passing through a gap

Observation:

[redacted]

undergoing diffraction.



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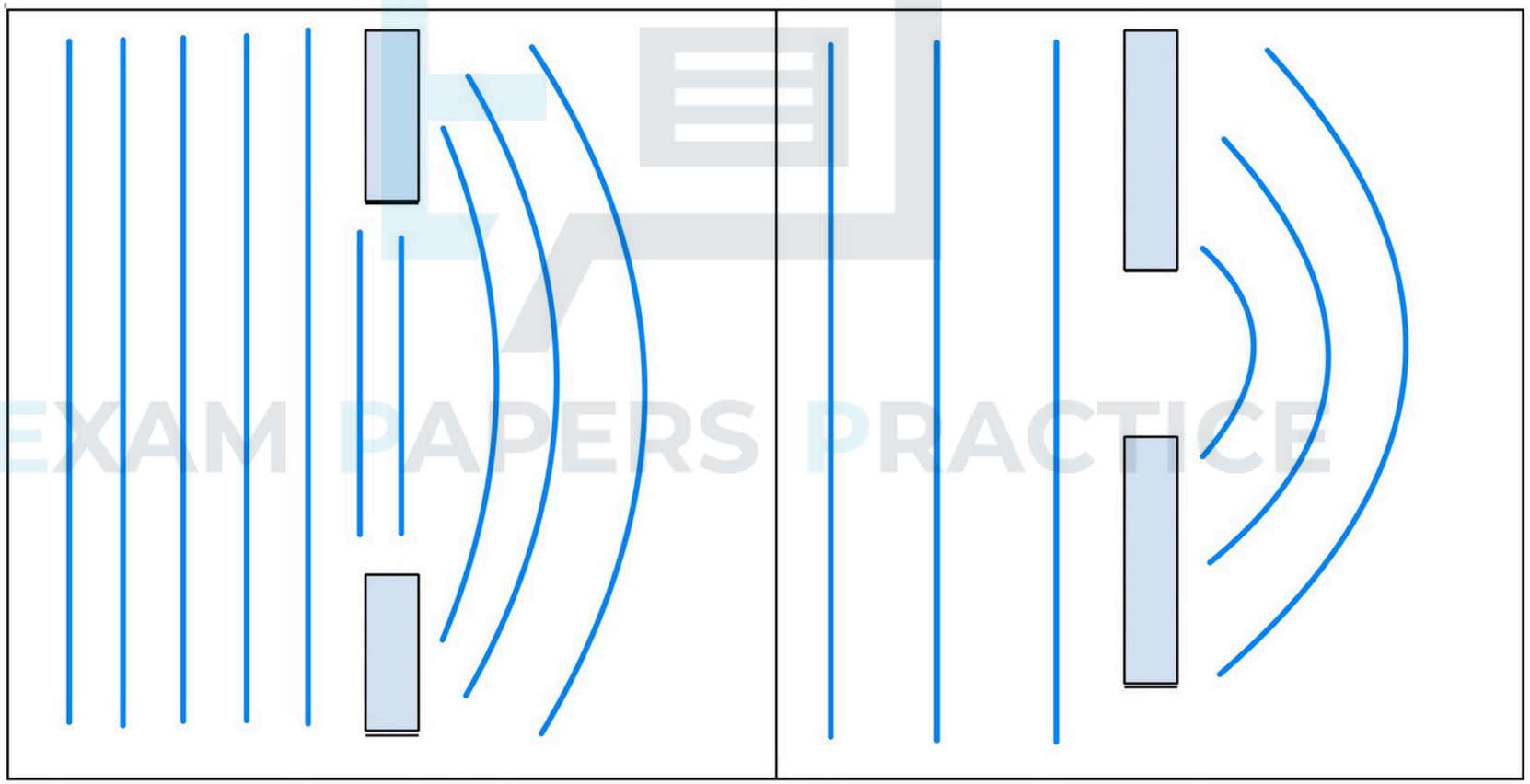
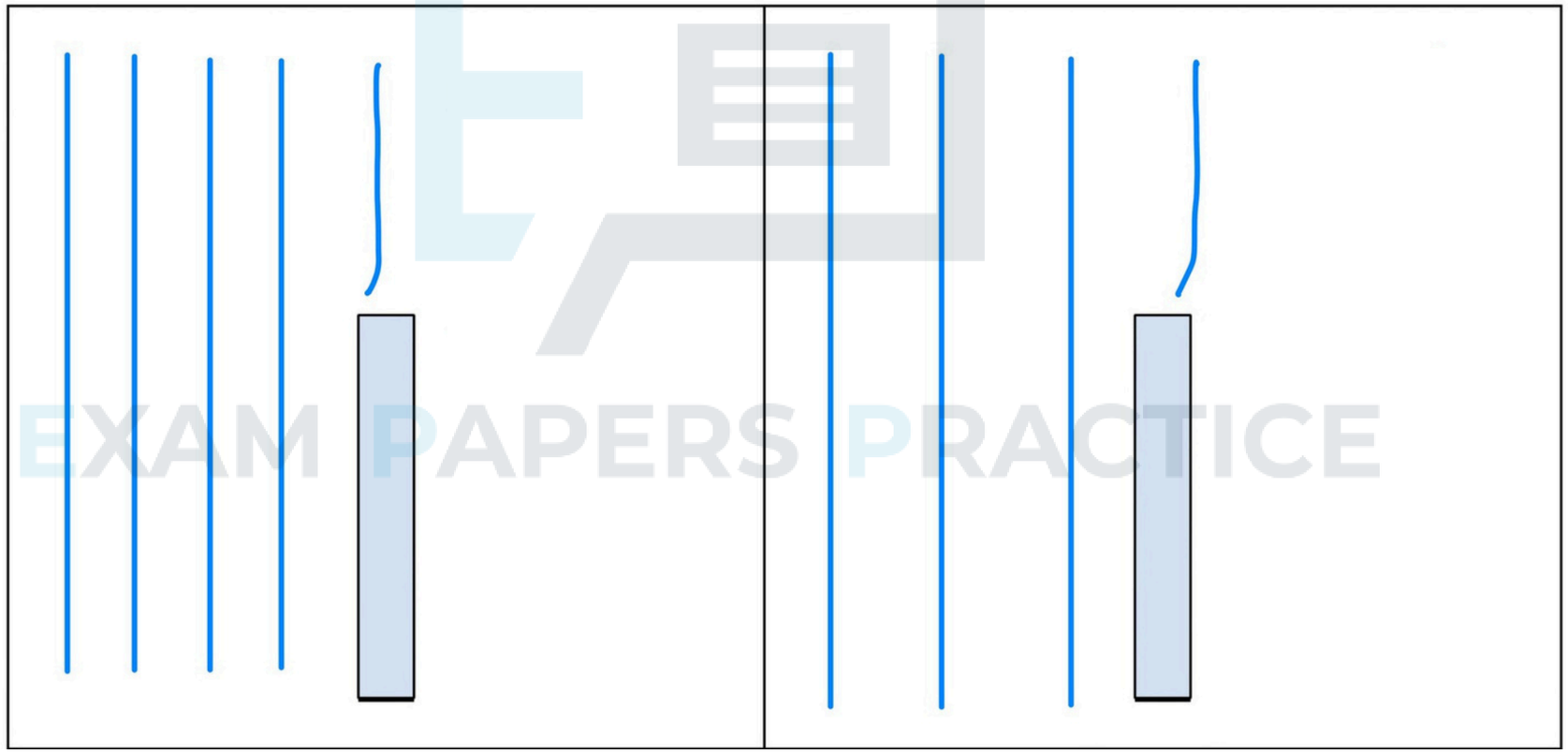


Diffraction - Passing through an edge

Observation:

Increasing the wavelength of waves increases the angle of diffraction.



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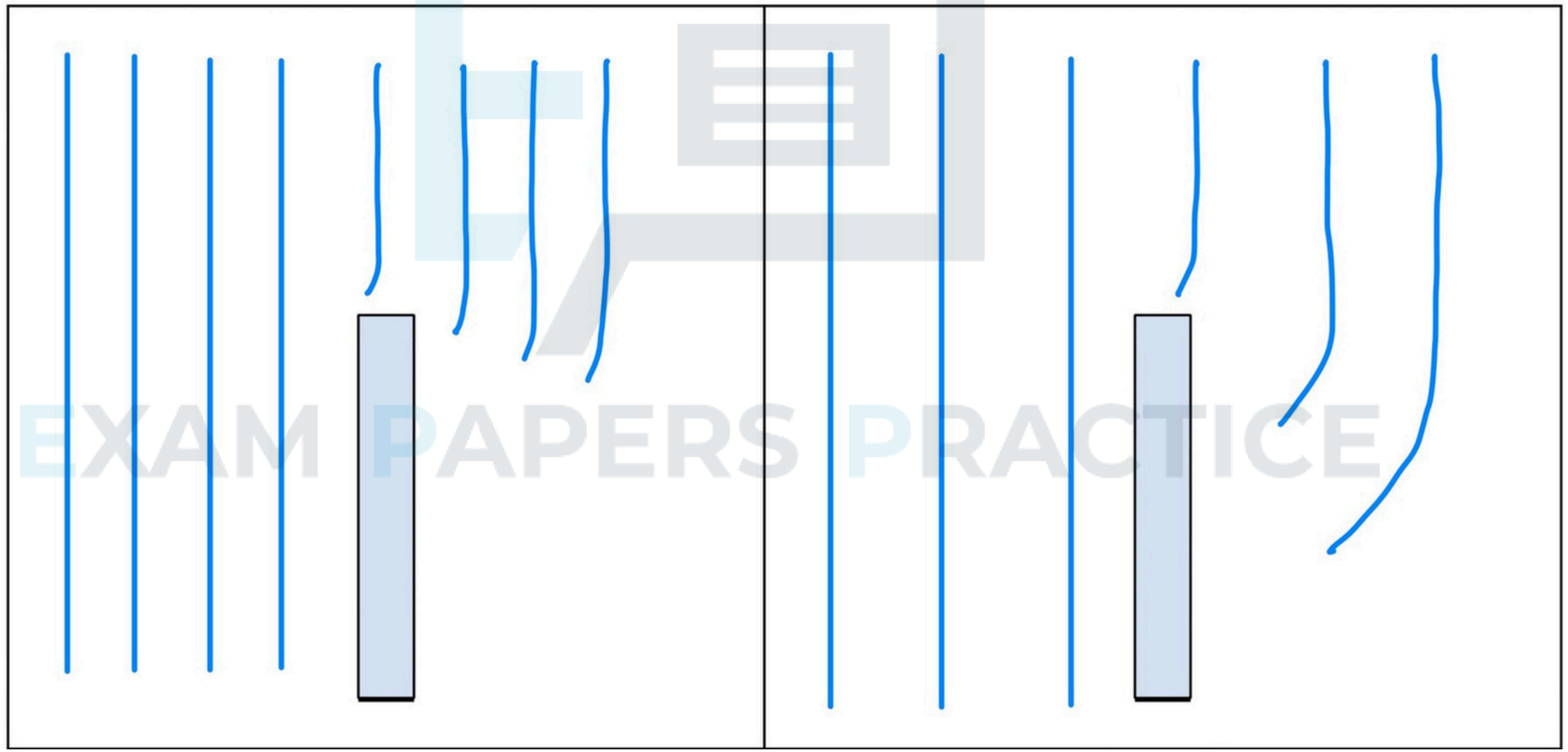

Examples of Diffraction

Sound

1. Sound waves exhibit diffraction when passing through doorways and open windows.
2. This phenomenon allows us to hear a person around a corner even when they are not visible.
3. This observation supports the concept that sound travels in wave form.

Light

1. Light waves are diffracted when they pass through very tiny gaps.
2. Example: Halo oflight
3. Explanation: Light is diffracted by tiny dropletsofwater in theair.

The following table shows some examples of waves

Which row correctly lists the nature of each of the wave types?

	sound waves	infrared waves	red light waves
A	transverse	longitudinal	transverse
B	longitudinal	transverse	transverse
C	longitudinal	longitudinal	transverse
D	transverse	transverse	longitudinal

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Water waves travel from deeper water to more shallow water. This causes them to refract.

Which wave property always remains the same when refraction occurs?

A Wavelength

B Frequency

C Amplitude

D Speed

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1 A clock is illuminated by a source of monochromatic green light.

State the meaning of monochromatic.

..... [1]

[Total: 1]

Question	Answer	Marks
1	(monochromatic light) is light of a single frequency	1

1 A clock is illuminated by a source of monochromatic green light.

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

Calculate the frequency of this green light.

frequency = ... [3]

[Total: 3]

Question	Answer	Marks
1	5.4×10^{14} Hz (3) OR ALLOW (speed of light =) 3×10^{8} (m / s) (1) (f =) v / λ in any form OR $3.0 \times 10^{8} / 5.6 \times 10^{-7}$ (1)	3