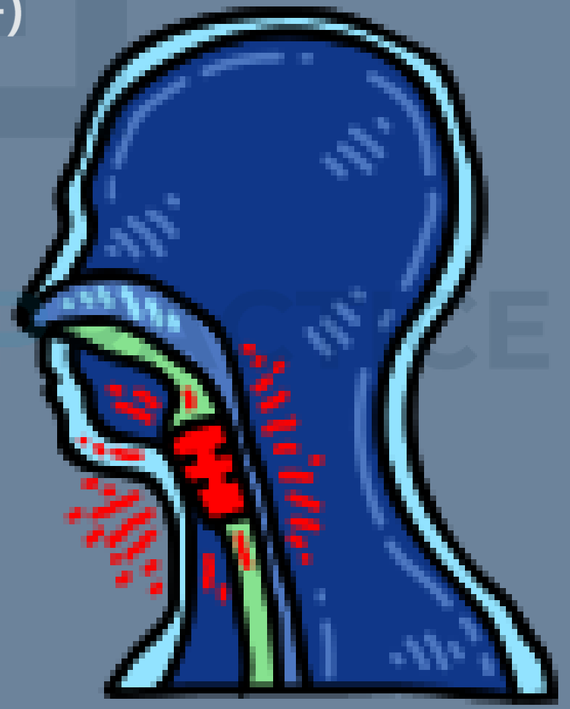
EXAM PAPERS PRACTICE

CHAPTER 12

SOUND

CIE IGCSE PHYSICS for board 0625 and 0972

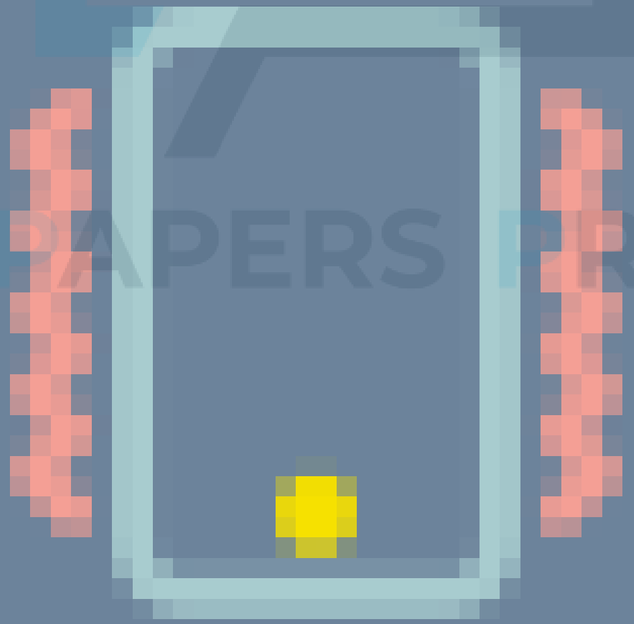
(For exams 2025+)



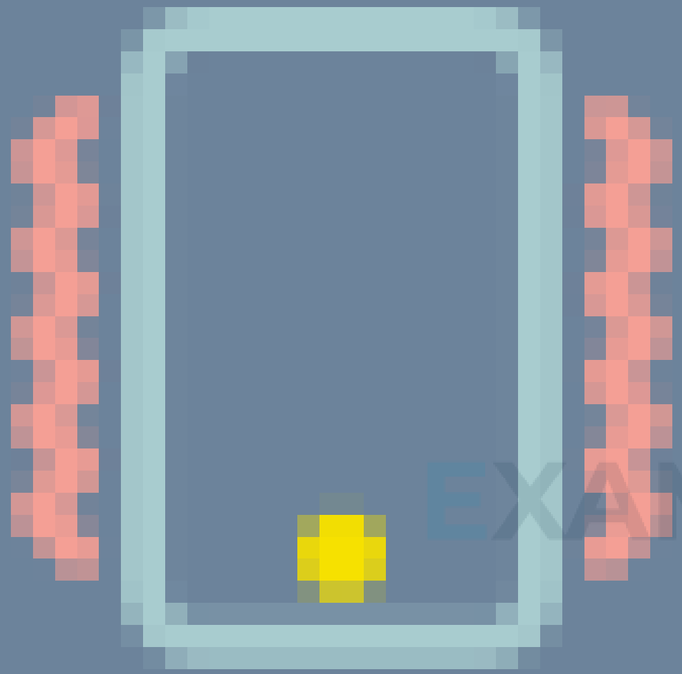
12.1 Making sounds

Sound originates from

VIBRATIONS.



12.1 Making sounds



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12.1 Making sounds

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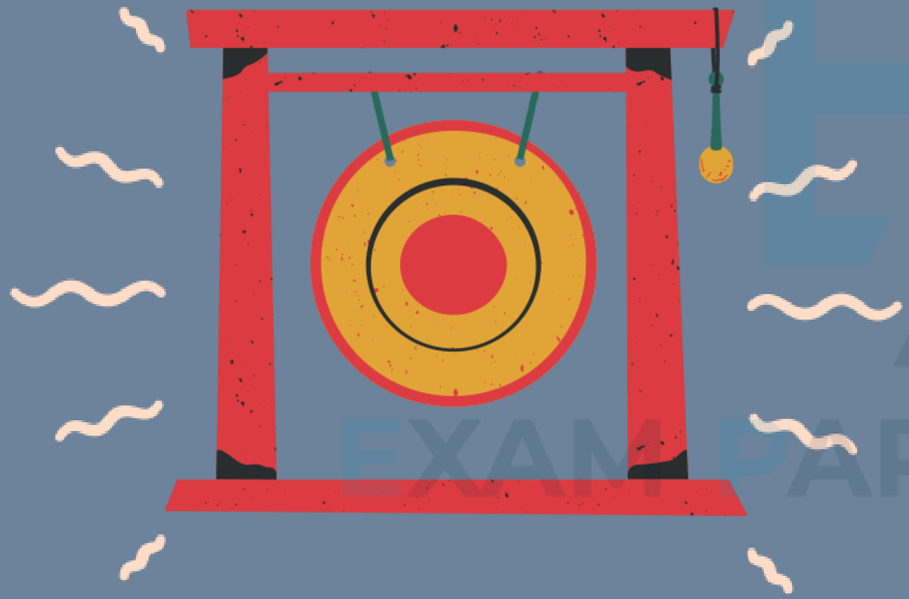
Examples of how sound is produced:



Hitting the gong with a hammer causes it to vibrate

Vocal folds in the human throat vibrate to create a speech

12.1 Making sounds

Important: The air particles themselves do not move

Musical Instruments

String Instruments

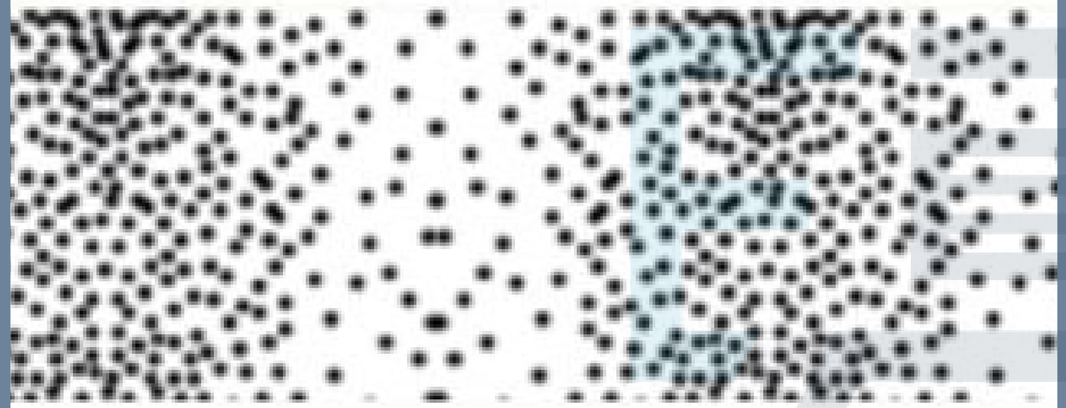
a. String instruments produce sound by plucking or bowing strings, causing them to vibrate. b. The body of the instrument and the air inside also vibrate, contributing to its unique sound characteristics. c. This explains why instruments like the oud and violin can produce the same note but sound distinctly different.

Wind Instruments

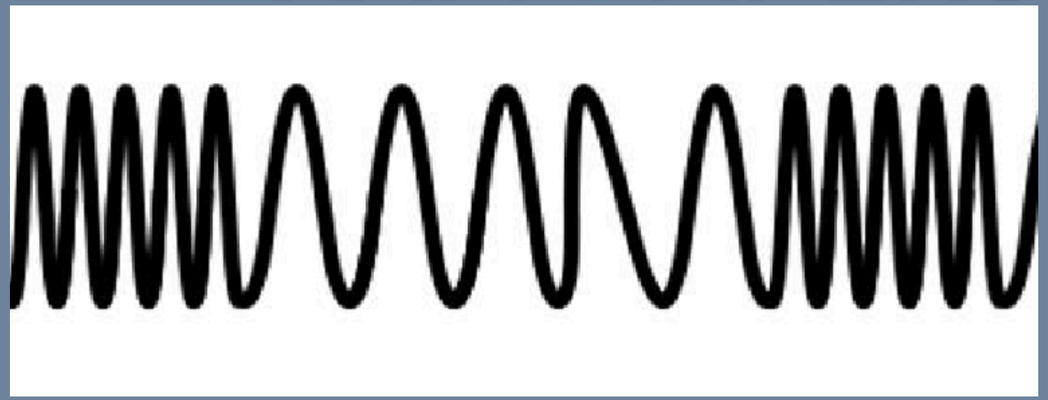
a. Wind instruments generate sound by blowing air into them, causing the column of air inside to vibrate. b. Players manipulate the pitch by covering and uncovering holes to alter the length of the vibrating air column. c. This variation in column length directly affects the pitch of the notes produced.

12.2 How does sound travel?

Air particles view

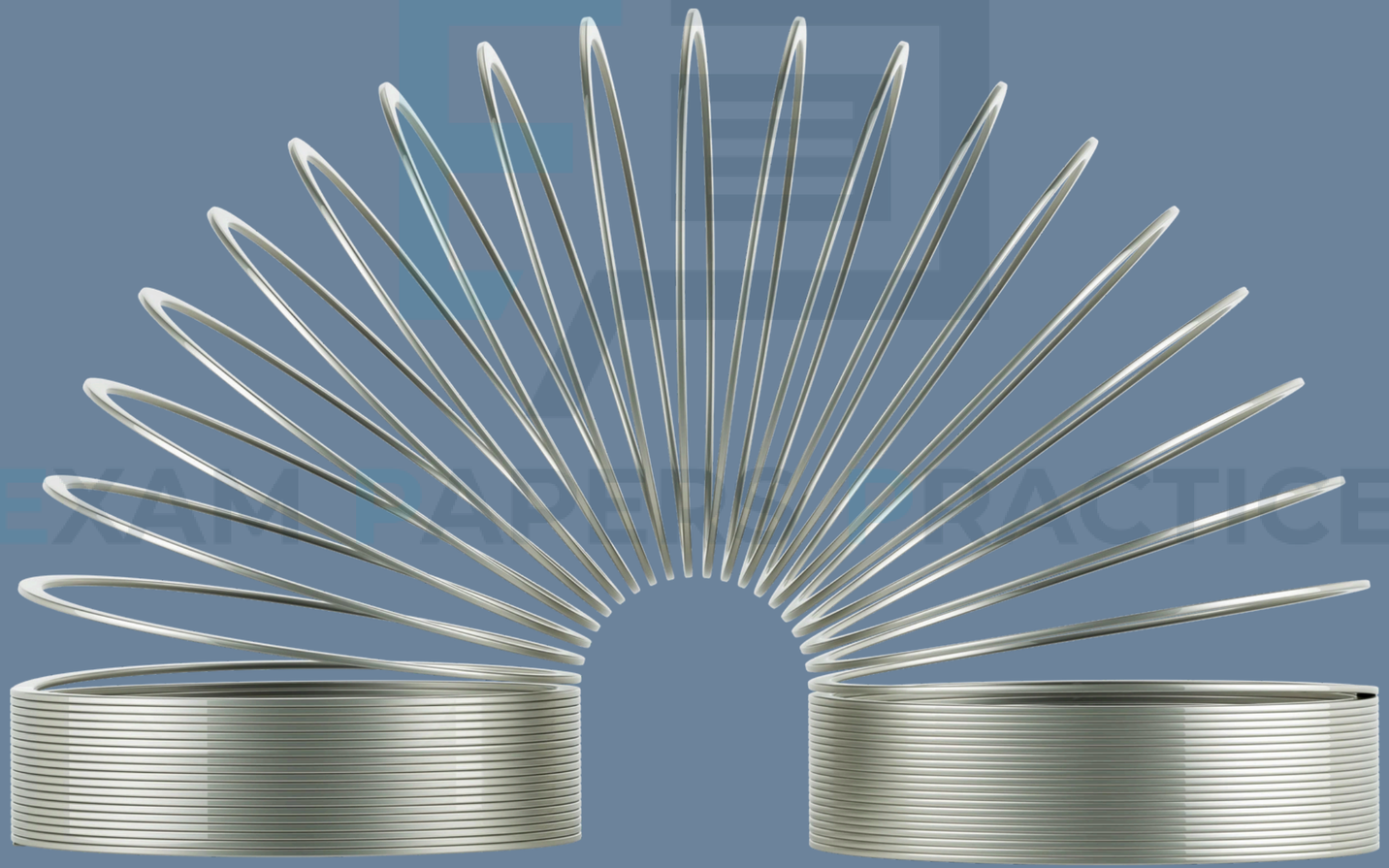


Spring view



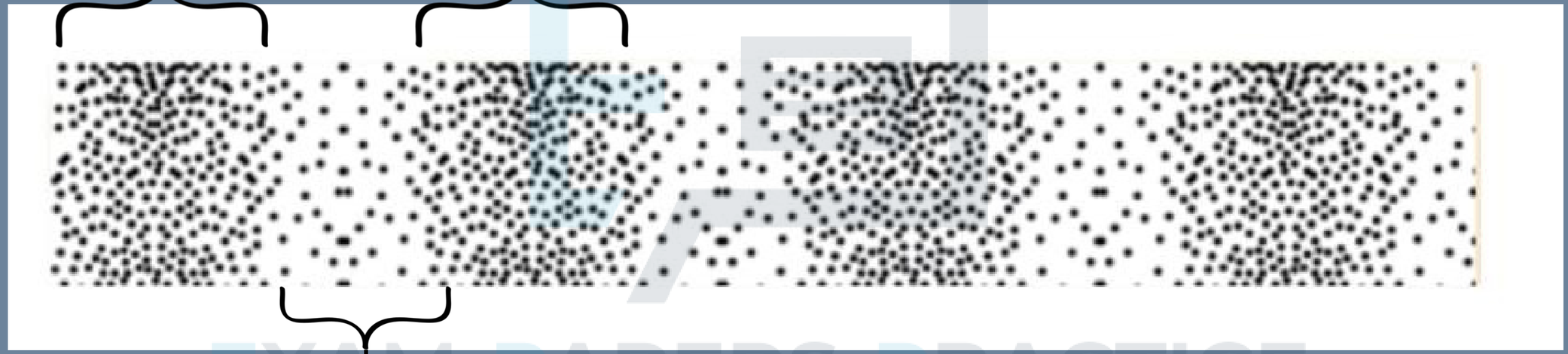
The origin of sound vibrates, causing the surrounding air particles to oscillate back and forth in the direction of the sound's propagation.

12.2 How does sound travel?



Compression

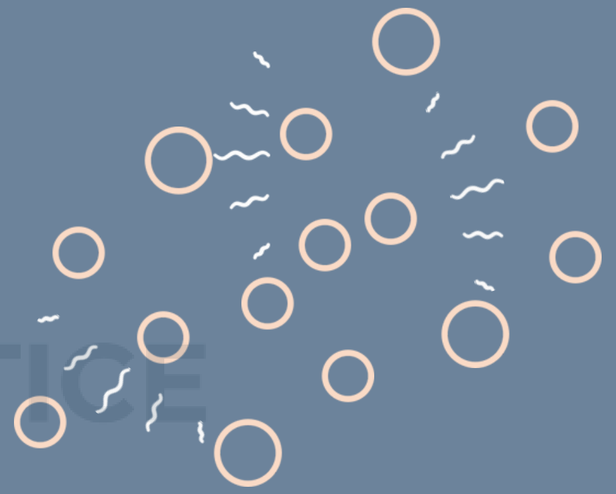
A region of a sound wave where the particles are pushed together.



Rarefaction

A region of a sound wave where the particles are further apart.

Sound waves are vibration caused by particles moving back and forth. Sound needs a mediumto travel through.



Solid

Liquid

Gas particles

Bell inside a vacuum experiment

1. When the battery is connected, the bell is visible and audible.
2. Vibrations from the bell travel through the air inside the jar, through the glass, and then through the air to reach your ear.
3. When the pump removes the air from the jar, the bell continues to vibrate visibly but cannot be heard.

12.3 The Speed of Sound

After seeing a lightning strike, it might take us a while to hear the thunderclap.

The reason is because the lightning might be far away and it takes time for the sound of the thunderclap to travel.

12.3 The Speed of Sound

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SPEED OF SOUND IN:

AIR = 330 M/S - 350 M/S

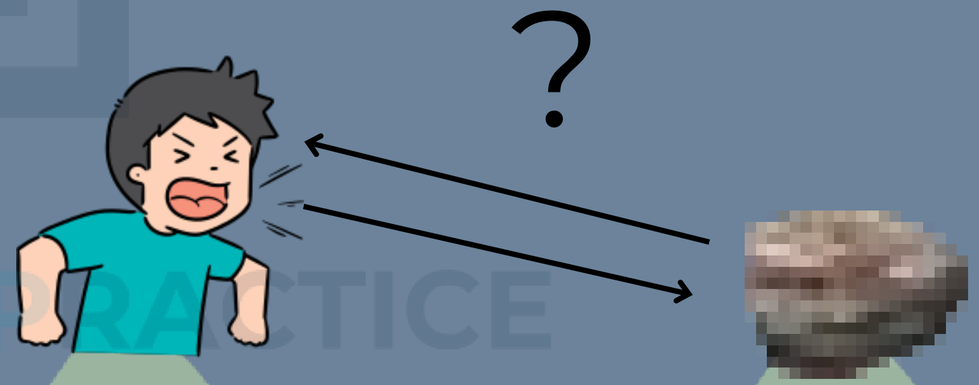
LIQUID = 1500 M/S

SOLID = DEPENDS ON THE MATERIALS

humidity of the air.

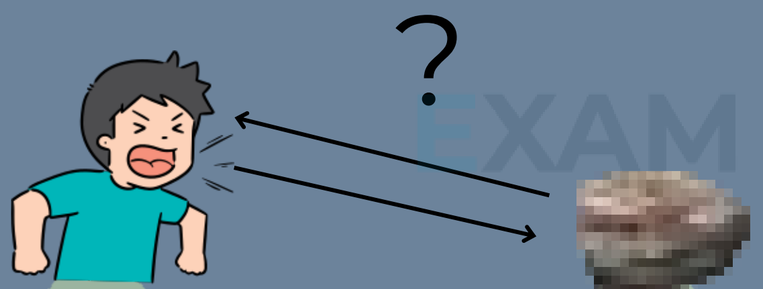
WORKED EXAMPLE

A child yells in a canyon and hears the echo after 1.8 seconds. How far away is the canyon wall from the child? Assume the speed of sound in air is 343 m/s.



WORKED EXAMPLE

ANSWER



Calculate the total distance the sound has travelled:

distance = speed * time
= 343 * 1.8
= 617.4 m

Divide the answer by two to find the distance between the boy and the rock:

617.4 / 2 = 308.7m
Answer: 308.7m

WORKED EXAMPLE

A hiker sees a lightning strike on a mountain peak, and then hears the thunder 3.5 seconds later. How far is the spectator? The speed of sound in air is 330 m/s.

WORKED EXAMPLE

ANSWER

distance = speed * time

= 330 * 3.5

= 1155 m

ANSWER = 1155m

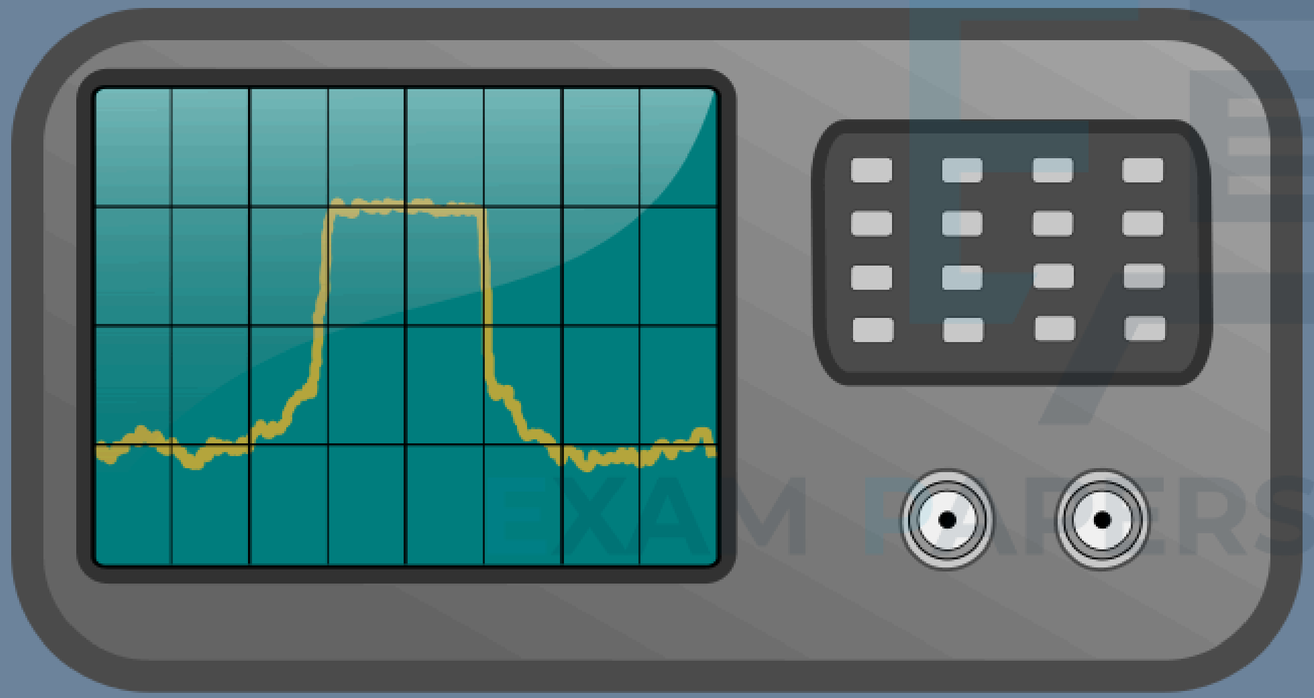
WORKED EXAMPLE

Sound travels at 1500 m/s in fresh water and at 1530 m/s in salt water. Explain the difference in speeds?

ANSWER

Salt water is denser.

12.4 Seeing sounds



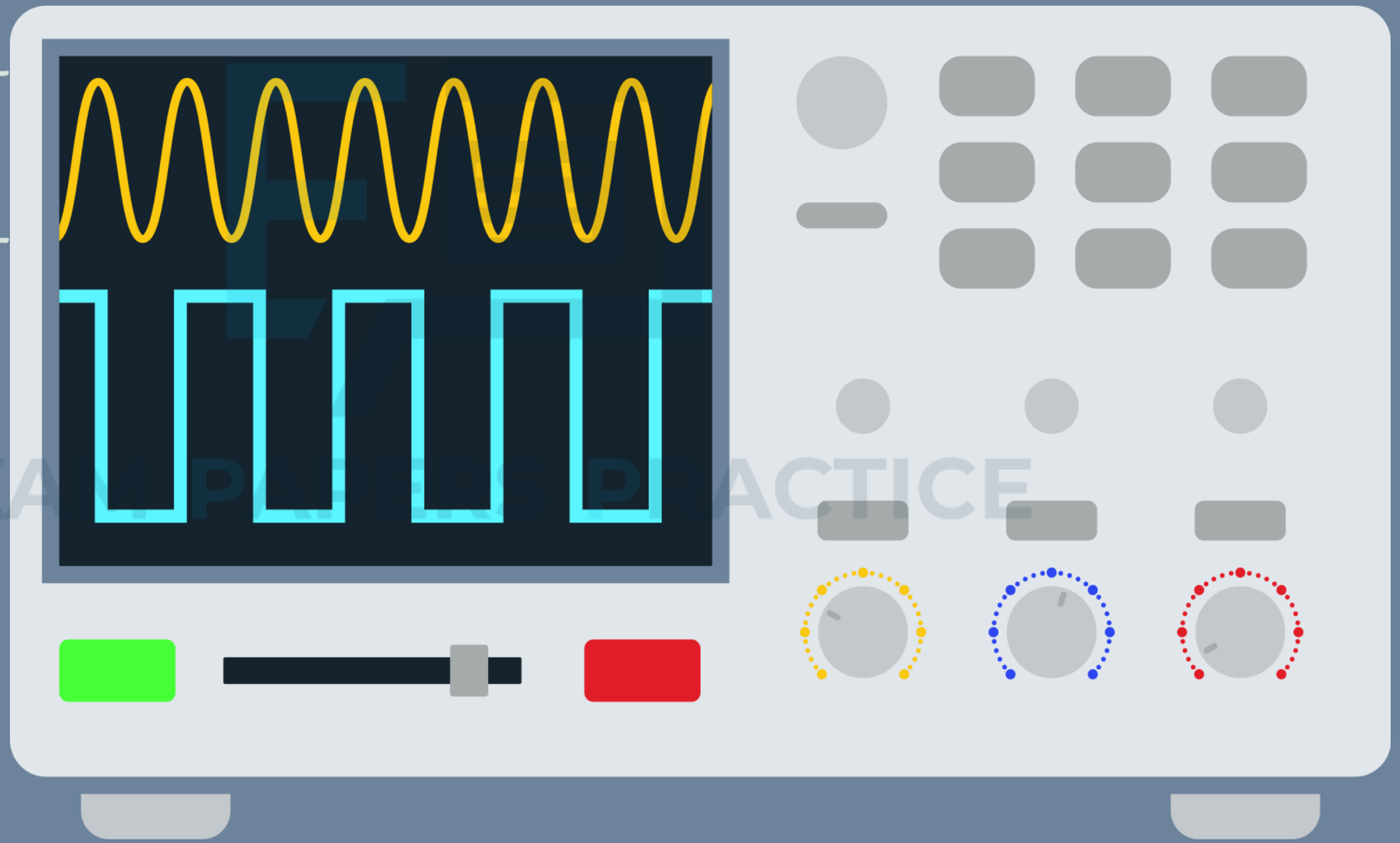
- A cathode ray oscilloscopeand microphonecan be used to represent sounds on a display screen.
- The microphone picks up the sound and converts it to an electrical signal.
- The oscilloscope converts this to a line which represents the vibrations that make up the sound wave.

12.4 Seeing sounds

"The oscilloscope is used to observe 2 important things about the wave."

1. (Loudness) Amplitude

the maximum displacement or distance moved by a point on a vibrating body or wave from its equilibrium position.



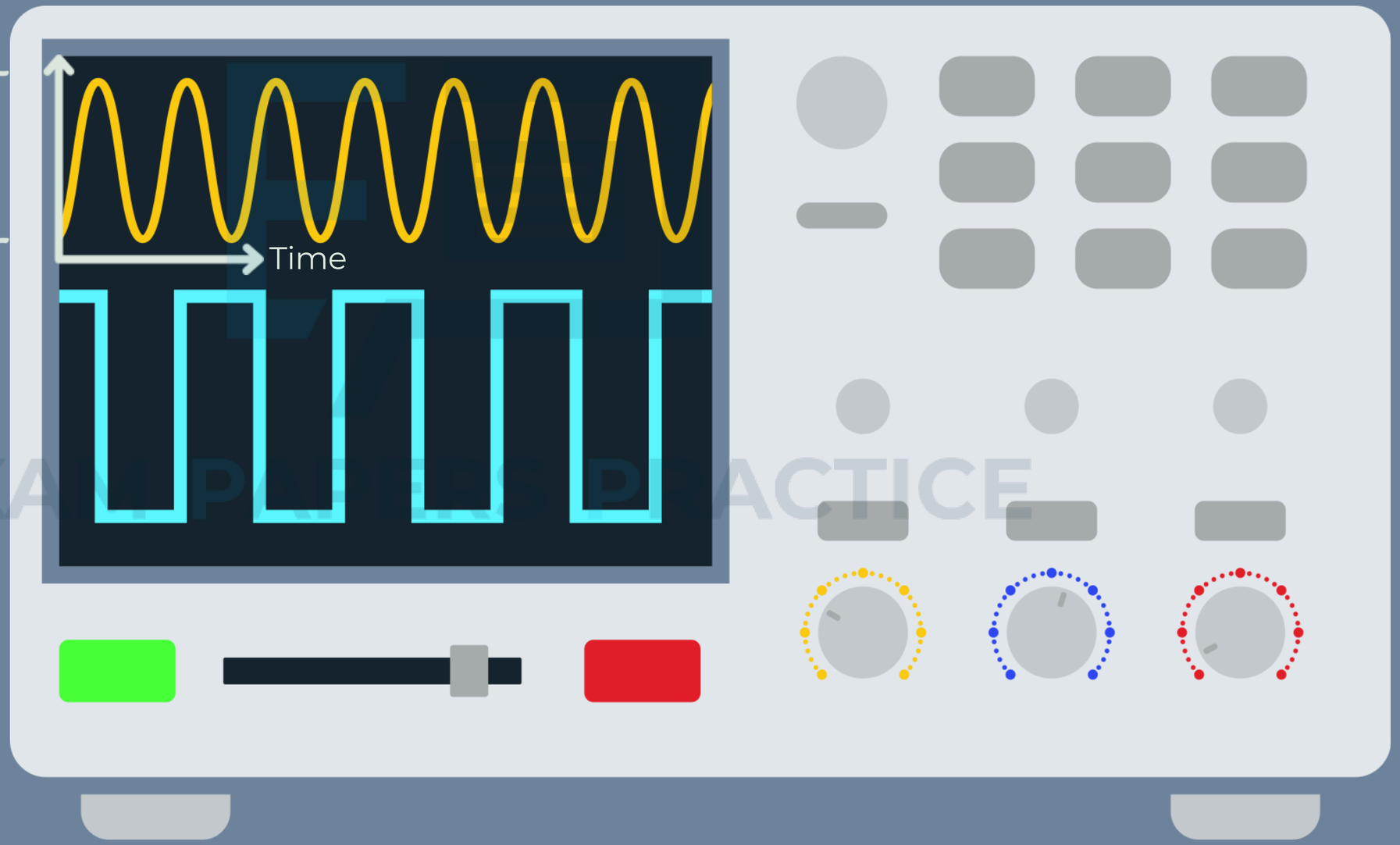
12.4 Seeing sounds

"The oscilloscope is used to observe 2 important things about the wave."

2 pitch

Frequency

the number of occurrences of a repeating event per unit of time, often measured in hertz (Hz), which is cycles per second.



12.5 Hearing sounds

YOUNG HUMANS CAN PERCEIVE SOUNDS RANGING FROM 20 HZ TO 20,000 HZ.

AS WE AGE, THE SENSORY CELLS IN THE EAR THAT DETECT VIBRATIONS DETERIORATE. ADDITIONALLY, THESE CELLS CAN BE DAMAGED BY REPEATED EXPOSURE TO VERY LOUD NOISES.

12.5 Hearing sounds

SOUNDS WITH FREQUENCIES HIGHER THAN 20,000 HZ ARE TOO HIGH-PITCHED TO BE HEARD BY THE HUMAN EAR AND ARE KNOWN AS ULTRASOUND.

MANY ANIMALS, SUCH AS DOLPHINS, CAN DETECT AND USE HIGH-FREQUENCY SOUNDS FOR COMMUNICATION.

12.6 Applications of ultrasound (1) - Sonar

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SONAR IS A METHOD USED TO MEASURE THE DEPTH OF WATER OR TO LOCATE AN UNDERWATER OBJECT.

HOW IT WORKS

- A PULSE OF ULTRASOUND IS EMITTED FROM A BOAT AND REFLECTS OFF THE SEABED.
- THE TIME IT TAKES FOR THE REFLECTED PULSE TO RETURN IS MEASURED.
- USING THE KNOWN SPEED OF SOUND IN WATER, THIS TIME MEASUREMENT IS USED TO CALCULATE THE DEPTH OF THE WATER.

12.6 Applications of ultrasound (1) - Sonar

WORKED EXAMPLE

A submarine uses sonar to detect a target underwater. If the sonar pulse travels at 1450 m/s and the time taken for the pulse to return after hitting the target is 4.5 seconds, what is the distance from the submarine to the target?

12.6 Applications of ultrasound (1) - Sonar

WORKED EXAMPLE

distance = speed * time

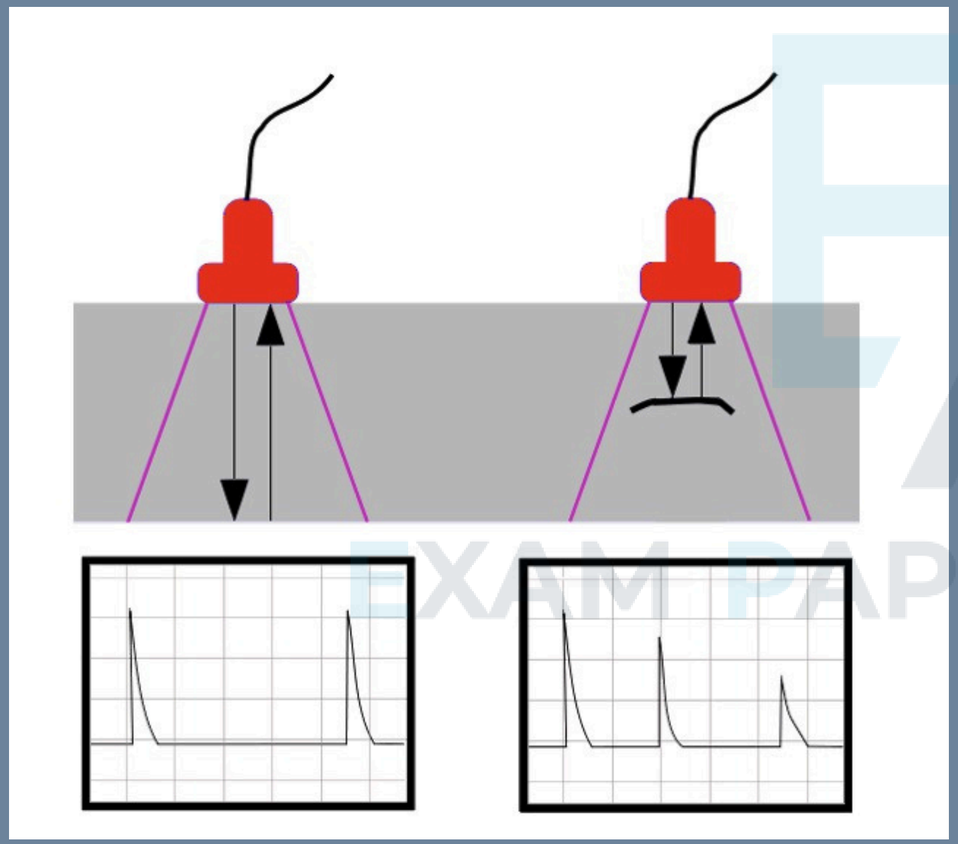
= 1450 * 4.5

= 6300 m

One way = distance of the target

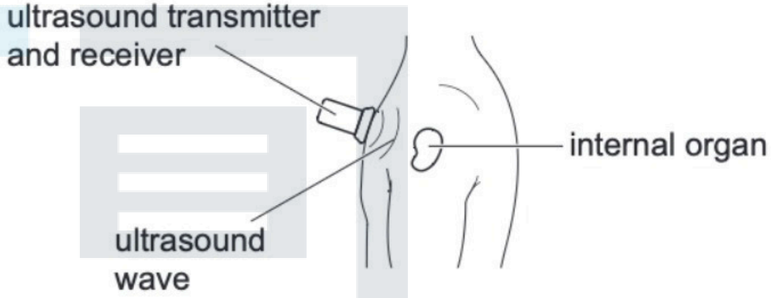
Answer = 6300 / 2 = 3150 m

12.6 Applications of ultrasound (2) -Material Testing



a. Ultrasound is directed through the material to identify any cracks or imperfections.
b. If there is a crack, the ultrasound will reflect back sooner than expected, indicating the presence of a flaw in the material.

1 The diagram shows an ultrasound wave being used to scan an internal organ of a human body.



The ultrasound wave has a frequency of 2.0 MHz and passes through human tissue at a speed of 1500 m / s.

Calculate the wavelength of the ultrasound wave in human tissue.

wavelength = ... [3]

[Total: 3]

Question	Answer	Marks
1	(λ =) 7.5×10^{-4} m OR ALLOW (λ =) v / f OR $v = f \lambda$ in any form (1) (λ =) $1.5 \times 10^{3} / 2 \times 10^{6}$ (1)	3

Mark scheme