SCIENCE FOUNDATIONS

Sound

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you explain why you hear thunder after the lightning, why a guitar string sounds higher when you tighten it, and why you cannot hear anything in the vacuum of space. You see the lightning first because light travels far faster than sound, so the thunder arrives late. A guitarist tightens a string to make it vibrate faster and sound higher. Knowing sound tells you that it needs something to travel through, and that pitch and loudness come from how the air is shaking.



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Rule

Sound: sound is a longitudinal wave, which means the air shakes back and forth in the same direction the sound travels. Sound needs a medium, something to travel through, like air, water, or a solid, and it cannot travel through a vacuum, which has no medium.

Frequency, measured in hertz (Hz), is how fast something vibrates: higher frequency means higher pitch, and larger amplitude, a bigger shake, means a louder sound. An echo is sound reflected, bounced back, off a surface. Sound travels faster in solids than in gases, and at about 343 metres per second in air.

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Worked examples

EXAMPLE 1

Q Why can astronauts not hear each other in space without radios?



SOLUTION

Recall what sound needs: a medium to travel through.

Space is a vacuum, with no medium.

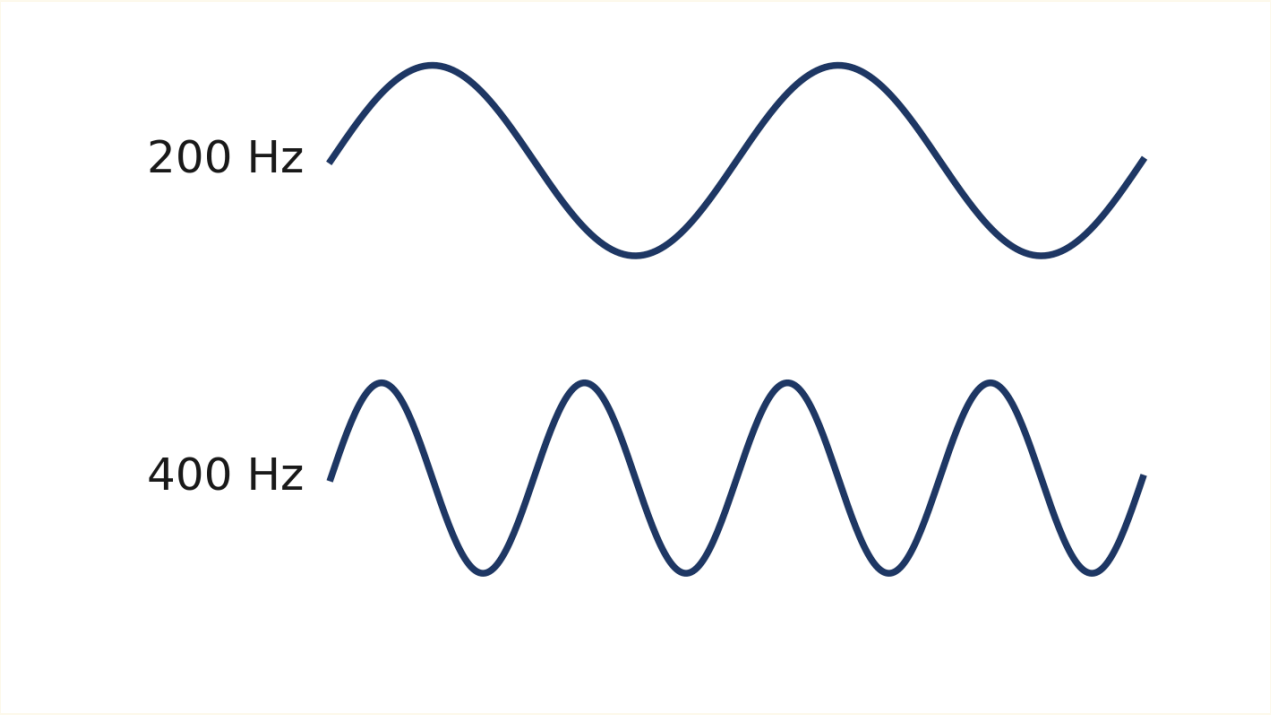
Conclude: sound cannot travel, so radios are needed.

The result is no medium in space, so no sound travel.

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EXAMPLE 2

Q Which is higher pitched: a 200 Hz note or a 400 Hz note?



SOLUTION

Recall the rule: higher frequency means higher pitch.

Compare: 400 is higher than 200.

Conclude: the 400 Hz note is higher pitched.

The result is 400 Hz note.

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Practice questions

1

Why would a shout on the Moon not reach a listener standing nearby without a radio?

A Sound needs a medium, and the Moon has no air

B Sound travels faster where there is no air

C The gravity of the Moon stops sound

D Sound needs light to travel

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2 Why do you see lightning before you hear the thunder?

- **A** Light travels much faster than sound
- **B** Sound travels faster than light
- **C** Thunder is made after the lightning stops
- **D** Lightning makes no sound until it hits the ground

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3 Which is higher pitched: a 250 Hz note or a 500 Hz note?

- **A** The 500 Hz note
- **B** The 250 Hz note
- **C** They have the same pitch
- **D** Pitch does not depend on frequency

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4 A guitarist tightens a string. What happens to the pitch of the note it plays?

- **A** It sounds higher
- **B** It sounds lower
- **C** It stays the same
- **D** It gets louder

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5 Is sound a transverse or a longitudinal wave?

- **A** Longitudinal
- **B** Transverse

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6

Does sound travel faster in solids or in gases?

A Solids

B Gases

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7

What does larger amplitude mean for loudness?

A Louder sound

B Quieter sound

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8

What is an echo?

A Reflected sound

B Absorbed sound

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9

What vibrates to make sound?

A A vibrating object

B A vacuum

C A radio wave

D A mirror

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10

What is the speed of sound in air?

A 343 m/s

B 150 m/s

C 1500 m/s

D 3 m/s

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ANSWER KEY

1. Sound needs a medium, and the Moon has no air

2. Light travels much faster than sound

3. The 500 Hz note

4. It sounds higher

5. Longitudinal

6. Solids

7. Louder sound

8. Reflected sound

9. A vibrating object

10. 343 m/s

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