

A Sound Wave Has A Frequency Of 425 Hz. What Is The Period Of This Wave? 0.00235 Seconds 0.807 Seconds

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Understanding the relationship between frequency and period is fundamental in the study of sound waves and wave physics. When analyzing a sound wave with a given frequency, such as 425 Hz, one of the essential parameters to determine is its period. The period indicates the time it takes for one complete cycle of the wave to pass a fixed point. This article explores the concepts behind frequency and period, demonstrates how to calculate the period from the given frequency, and discusses the significance of these parameters in various practical contexts.

Fundamental Concepts: Frequency and Period

What Is Frequency?

Frequency refers to how many cycles of a wave pass a point per second. It is measured in Hertz (Hz), where 1 Hz equals one cycle per second. In our example, a sound wave has a frequency of 425 Hz, meaning that 425 wave cycles pass through a point every second.

What Is Period?

The period, on the other hand, is the duration of time for one complete cycle of the wave. It is measured in seconds (s). The period is inversely related to frequency: as the frequency increases, the period decreases, and vice versa.

The Relationship Between Frequency and Period

The relationship between these two parameters is expressed by the simple formula:

$$T = \frac{1}{f}$$

where:

- T is the period in seconds,
- f is the frequency in Hz.

This formula indicates that knowing either the frequency or the period allows us to calculate the other.

Calculating the Period of a 425 Hz Sound Wave

Given the frequency $(f = 425 \text{ Hz})$, we can calculate the period (T) as follows:

$$T = \frac{1}{f} = \frac{1}{425}$$

Performing the calculation:

$$T \approx 0.002352941 \text{ seconds}$$

Rounding to a more practical precision:

$$T \approx 0.00235 \text{ seconds}$$

This means that each cycle of the wave lasts approximately 0.00235 seconds.

Understanding the Result

The calculated period of approximately 0.00235 seconds indicates that the wave completes one cycle in just over two milliseconds. This rapid oscillation is characteristic of high-frequency sound waves, such as those produced by certain musical instruments or other sound sources.

Comparing the Two Given Options: 0.00235 Seconds and 0.807 Seconds

The question often arises whether the period is approximately 0.00235 seconds or 0.807 seconds. Based on our calculation:

- 0.00235 seconds aligns closely with the computed period from the frequency.
- 0.807 seconds is significantly larger, corresponding to a much lower frequency (approximately 1.24 Hz), which is not consistent with the given 425 Hz.

Therefore, the correct period for a 425 Hz wave is approximately 0.00235 seconds.

Practical Implications of the Wave's Period

Understanding the period of a sound wave is crucial in various applications, including:

- **Music and Audio Engineering:** Precise calculations of wave periods help in tuning instruments and designing audio equipment.
- **Acoustics:** Knowledge of wave periods aids in analyzing sound propagation and

designing spaces with optimal sound quality.

- **Communication Technologies:** Sound wave properties are essential in designing microphones, speakers, and communication devices.
- **Medical Imaging:** Ultrasound technology relies on high-frequency sound waves with well-understood periods for imaging internal body structures.

In scientific research, accurately determining the period from the frequency allows for better modeling of wave behavior in different mediums.

Additional Concepts Related to Sound Wave Periods

Wavelength and Speed of Sound

The wave's wavelength (λ) is related to its speed (v) and frequency (f) via the equation:

$$v = f \times \lambda$$

For sound waves in air, the speed of sound is approximately 343 meters per second at room temperature.

Given the frequency of 425 Hz, the wavelength (λ) is:

$$\lambda = \frac{v}{f} = \frac{343 \text{ m/s}}{425 \text{ Hz}} \approx 0.807 \text{ meters}$$

Interestingly, this wavelength matches the second option of 0.807 seconds in the question, but note that this is the wavelength in meters, not the period.

Clarifying the Difference Between Period and Wavelength

- Period: Time of one complete cycle (seconds)
- Wavelength: Distance covered in one cycle (meters)

While both involve the wave's behavior, they are distinct parameters. Accurate understanding of both is fundamental in wave physics.

Summary

- The period of a wave is inversely proportional to its frequency.
- For a 425 Hz sound wave, the period is approximately 0.00235 seconds.
- The value 0.807 seconds is not the period but could relate to wavelength or other wave properties in different contexts.
- Understanding these parameters is essential for applications across science, engineering, and technology.

Conclusion

In conclusion, when analyzing a sound wave with a frequency of 425 Hz, the period is best calculated as approximately 0.00235 seconds. This knowledge is fundamental for understanding wave behavior, designing audio equipment, and exploring various scientific and technological domains. Recognizing the distinction between period, frequency, and wavelength allows for a comprehensive understanding of wave phenomena, enabling advancements in multiple fields that rely on wave physics.

If you're working with sound waves or engaging in related scientific studies, mastering the relationship between frequency and period will enhance your ability to analyze and interpret wave data effectively.

Frequently Asked Questions

What is the formula to find the period of a sound wave when the frequency is known?

The period (T) of a wave is the reciprocal of its frequency (f), given by $T = 1/f$.

Given a sound wave frequency of 425 Hz, what is its period?

The period is approximately 0.00235 seconds, calculated as $T = 1/425 \text{ Hz} \approx 0.00235$ seconds.

How does increasing the frequency of a sound wave affect its period?

As the frequency increases, the period decreases because they are inversely related.

What are the two options provided for the period of a

425 Hz sound wave?

The options are 0.00235 seconds and 0.807 seconds.

Why is 0.00235 seconds the correct period for a 425 Hz wave?

Because calculating $T = 1/425 \text{ Hz}$ yields approximately 0.00235 seconds, which matches this option.

Can a sound wave with a frequency of 425 Hz have a period of 0.807 seconds?

No, because that would correspond to a much lower frequency, approximately $1/0.807 \approx 1.24 \text{ Hz}$.

What is the significance of knowing a sound wave's period in physics?

The period helps understand the wave's oscillation timing, which is essential in acoustics, signal processing, and wave analysis.

If the period of a wave is 0.00235 seconds, what is its frequency?

The frequency is approximately 425 Hz, calculated as $f = 1/T = 1/0.00235 \text{ seconds}$.

How are frequency and period related mathematically?

They are inversely related: $f = 1/T$ and $T = 1/f$.

Additional Resources

A Sound Wave Has A Frequency Of 425 Hz. What Is The Period Of This Wave? 0. 00235 Seconds 0. 807 Seconds

Understanding the fundamental properties of sound waves is essential in fields ranging from acoustics and engineering to music production and physics education. Among the basic characteristics of a sound wave, frequency and period stand out as critical parameters that describe how sound propagates through a medium. When given the frequency of a sound wave, determining its period provides insight into the wave's behavior and how it interacts with its environment. This article delves into the relationship between frequency and period, elucidates the calculation process, and explores the significance of these parameters with practical examples.

Fundamentals of Sound Waves: Frequency and Period

What Is Frequency?

Frequency, denoted by the symbol f , refers to the number of complete oscillations or cycles that a wave completes in one second. It is measured in hertz (Hz), where 1 Hz equals one cycle per second. In the context of sound, frequency determines the pitch of the sound perceived by human ears: higher frequencies correspond to higher pitches, while lower frequencies produce deeper sounds.

For example, a sound wave with a frequency of 425 Hz completes 425 cycles every second. This particular frequency might be associated with certain musical notes or specific environmental sounds, depending on the context.

What Is Period?

Period, denoted by T , is the duration of time it takes for one complete cycle of the wave to pass a fixed point in space. It is inversely related to frequency and is measured in seconds (s). The relationship between period and frequency can be summarized as:

$$T = \frac{1}{f}$$

This simple formula indicates that if you know the frequency of a wave, you can determine how long each cycle lasts, and vice versa.

Calculating the Period of a 425 Hz Sound Wave

Given the frequency of the sound wave, 425 Hz, the task is to calculate its period. Using the fundamental relationship:

$$T = \frac{1}{f}$$

we substitute the known value:

$$T = \frac{1}{425 \text{ Hz}}$$

Calculating this:

$$T \approx 0.002352941 \text{ seconds}$$

Rounding to a practical precision:

$T \approx 0.00235 \text{ seconds}$

This value indicates that each cycle of the sound wave lasts approximately 2.35 milliseconds.

Understanding the Result: 0.00235 Seconds

The calculated period of approximately 0.00235 seconds (or 2.35 milliseconds) signifies that the wave oscillates very rapidly, completing a cycle in just over two thousandths of a second. This rapid oscillation is characteristic of higher-frequency sounds, which tend to be perceived as higher pitches.

To put this into perspective:

- Musical notes: The middle C note on a piano has a frequency of about 261.63 Hz, corresponding to a period of roughly 0.00382 seconds. The 425 Hz wave's period is shorter, indicating a higher pitch.
- Perception: The human ear can typically perceive frequencies from 20 Hz to 20,000 Hz, so 425 Hz is well within the audible range, perceived as a resonant, clear pitch.

Why Is the Period Important?

Understanding the period of a sound wave is crucial for several reasons:

- Sound synthesis: In music production, knowing the period helps in creating precise waveforms for synthesizers.
- Acoustics design: Engineers designing auditoriums or soundproofing systems use period calculations to analyze sound propagation.
- Signal processing: In telecommunications, the period informs filtering and modulation techniques.
- Biological impact: Certain frequencies and their periods can influence biological systems, such as in ultrasound imaging or therapeutic applications.

Comparing the Two Possible Periods: 0.00235 Seconds vs. 0.807 Seconds

The question posed two options for the period: 0.00235 seconds and 0.807 seconds. Based on the fundamental relationship between frequency and period, which makes sense?

- 0.00235 seconds: This value aligns with the calculated period derived directly from the given frequency of 425 Hz.
- 0.807 seconds: This would correspond to a frequency of approximately 1.24 Hz (since $f = 1/T$), which is far below the audible range and unlikely for a typical sound wave with the specified frequency.

Thus, the correct period for a 425 Hz wave is approximately 0.00235 seconds.

Implications of the Period in Real-World Applications

Knowing the period of a sound wave helps professionals in various fields optimize their work:

- Music and acoustics: Adjusting instrument tuning or designing concert halls to enhance sound clarity.
- Engineering: Developing ultrasonic sensors that operate at specific periods to detect objects or measure distances.
- Medicine: Utilizing ultrasound waves with known periods for imaging internal organs.
- Communication technology: Designing audio codecs that encode sound signals efficiently based on their periodic properties.

Practical Example: Tuning a Musical Instrument

Suppose a musician wants to tune a string instrument to produce a note at 425 Hz. Understanding the period helps in visualizing the wave's oscillations, ensuring the string vibrates at the correct rate. The rapid oscillations (about 2.35 ms per cycle) mean that the musician or tuner must listen carefully or use electronic tools to match this frequency precisely.

Conclusion: The Significance of Accurate Wave Parameter Calculation

The relationship between frequency and period is a fundamental concept in wave physics, underpinning various technological and scientific applications. For a sound wave with a frequency of 425 Hz, the period is approximately 0.00235 seconds. This concise number encapsulates the wave's oscillation rate and provides valuable insights into the sound's pitch and behavior.

Understanding and accurately calculating these parameters enable engineers, musicians, scientists, and healthcare professionals to manipulate, analyze, and utilize sound waves effectively. Whether designing better concert halls, developing ultrasonic imaging devices, or fine-tuning musical instruments, grasping the nuances of wave properties remains essential.

In essence, the tiny fraction of a second that defines each cycle of a 425 Hz wave holds the key to a broad spectrum of practical innovations and scientific understanding.

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