2025 MCAS Sample Student Work and Scoring Guide

High School Introductory Physics
Question 38: Constructed-Response

Reporting Category: Waves
Practice Category: Mathematics and Data
Standard: HS.PHY.4.1 - Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling within various media. Recognize that electromagnetic waves can travel through empty space (without a medium) as compared to mechanical waves that require a medium.
Item Description: Calculate the period and wavelength of a sound wave and identify the wavelength of the sound wave in a model.

This item can be found in the released item sets on the MCAS Resource Center.

Scoring Guide

Select a score point in the table below to view the sample student response.

Score*	Description
3A	The response demonstrates a thorough understanding of the relationships among the frequency, period, wavelength, and speed of a wave. The response correctly identifies the wavelength of a sound wave. The response also correctly calculates the wavelength and the period of the sound wave produced by the red button.
3B	
2	The response demonstrates a partial understanding of the relationships among the frequency, period, wavelength, and speed of a wave.
1	The response demonstrates a minimal understanding of the relationships among the frequency, period, wavelength, and speed of a wave.
0	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

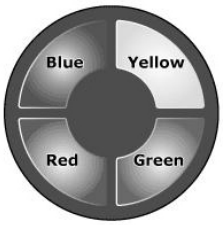
*Letters are used to distinguish between sample student responses that earned the same score (e.g., 3A and 3B).

Score Point 3A

One type of handheld electronic game is known as a random sequence game (RSG). The object of the game is to try to repeat a unique sequence of light and sound signals produced by the RSG. The player does this by pressing the game's four color buttons in the correct order.

The color buttons produce equally bright lights and equally loud sounds when pressed. Each color button, however, produces a different color of light and a different pitch of sound. The game is shown in the illustration.

Random Sequence Game



The table shows the frequency of the sound and the wavelength of the light that each button produces.

Sound Frequencies and Light Wavelengths Produced by RSG Buttons

	Sound Frequency	Light Wavelength

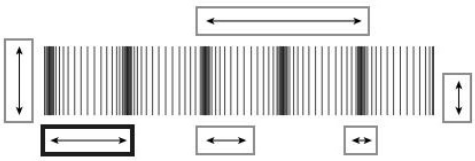
This question has three parts.

A student pressed the red color button on the RSG, which produced a sound wave that traveled at 343 m/s through air.

Part A

The student drew a diagram of the sound wave produced by the red button but did not label it.

Select the arrow that represents a wavelength of the sound.



Part B

Calculate the wavelength of the sound produced by the red button. Show your calculations and include units in your answer.

Wavelengths=Velocity/frequency

Wavelength= $\frac{343}{220} = 1.56 meters$

Part C

Calculate the period of the sound produced by the red button. Show your calculations and include units in your answer.

period= $\frac{1}{frequency}$

period= $\frac{1}{220} = .0045 \sec onds$

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Score Point 3B

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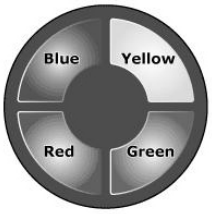
Random Sequence Game



The table shows the frequency of the sound and the wavelength of the light that each button produces.

Sound Frequencies and Light Wavelengths Produced by RSG Buttons

	Sound Frequency	Light Wavelength

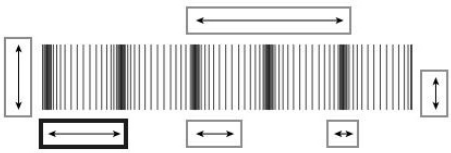
This question has three parts.

A student pressed the red color button on the RSG, which produced a sound wave that traveled at 343 m/s through air.

Part A

The student drew a diagram of the sound wave produced by the red button but did not label it.

Select the arrow that represents a wavelength of the sound.



Part B

Calculate the wavelength of the sound produced by the red button. Show your calculations and include units in your answer.

$$v = \lambda f$$
$$\lambda = \frac{v}{f}$$
$$\lambda = \frac{343}{220}$$
$$\lambda = 1.559m$$

Part C

Calculate the period of the sound produced by the red button. Show your calculations and include units in your answer.

$$T = \frac{1}{f}$$
$$T = \frac{1}{220}s$$

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Score Point 2

One type of handheld electronic game is known as a random sequence game (RSG). The object of the game is to try to repeat a unique sequence of light and sound signals produced by the RSG. The player does this by pressing the game's four color buttons in the correct order.

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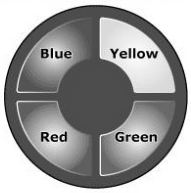
Random Sequence Game



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Sound Frequencies and Light Wavelengths Produced by RSG Buttons

	Sound Frequency	Light Wavelength

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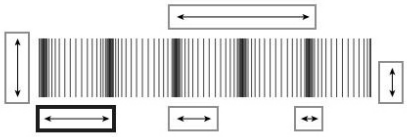
Part A

The student drew a diagram of the sound wave produced by the red button but did not label it.

Select the arrow that represents a wavelength of the sound.



Part B

Calculate the wavelength of the sound produced by the red button. Show your calculations and include units in your answer.

$v = 343$ meters per second squared

$f = 220Hz$

$\lambda = ?$

$\lambda = \frac{v}{f}$

$\lambda = \frac{343}{220}$

$\lambda \approx 1.559$

Part C

Calculate the period of the sound produced by the red button. Show your calculations and include units in your answer.

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

$T = \frac{1}{220}$

$\frac{1}{220} \approx 0.0045$

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Score Point 1

One type of handheld electronic game is known as a random sequence game (RSG). The object of the game is to try to repeat a unique sequence of light and sound signals produced by the RSG. The player does this by pressing the game's four color buttons in the correct order.

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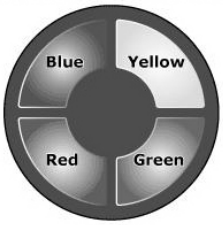

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Sound Frequencies and Light Wavelengths Produced by RSG Buttons

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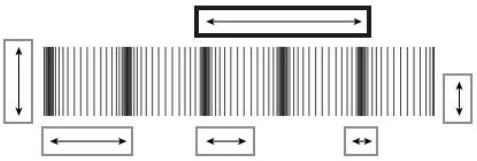
Part A

The student drew a diagram of the sound wave produced by the red button but did not label it.

Select the arrow that represents a wavelength of the sound.



Part B

Calculate the wavelength of the sound produced by the red button. Show your calculations and include units in your answer.

3 meters, I counted the dark lines, (troughs and crests) under the arrow

Part C

Calculate the period of the sound produced by the red button. Show your calculations and include units in your answer.

$T = \frac{1}{f},\ t = ?\ f = 220,\ \frac{1}{220} = 0.0045$ seconds

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Score Point 0

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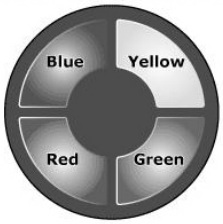
Random Sequence Game



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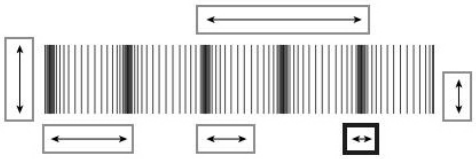
Select the arrow that represents a wavelength of the sound.



Part B

Calculate the wavelength of the sound produced by the red button. Show your calculations and include units in your answer.

The wavelength of the red button is 7.8×10^{-7}

Part C

Calculate the period of the sound produced by the red button. Show your calculations and include units in your answer.

The period of sound qould be 343meters per second

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