2024 MCAS Sample Student Work and Scoring Guide

High School Introductory Physics
Question 20: Constructed-Response

Reporting Category: Waves
Practice Category: None
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: Identify sound waves as a type of mechanical wave, describe how one type of electromagnetic wave can be used, explain why electromagnetic waves must be used in space, and describe a difference between mechanical and electromagnetic waves.

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Scoring Guide

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

Score*	Description
4A	The response demonstrates a thorough understanding of mechanical and electromagnetic waves. The response correctly identifies the mechanical wave used for communication. The response correctly identifies and clearly describes one electromagnetic wave used for communication. The response correctly identifies that electromagnetic waves should be used to send a signal from Earth to Mars and clearly explains the answer. The response also clearly describes one difference between mechanical and electromagnetic waves.
4B	
3	The response demonstrates a general understanding of mechanical and electromagnetic waves.
2	The response demonstrates a limited understanding of mechanical and electromagnetic waves.
1	The response demonstrates a minimal understanding of mechanical and electromagnetic waves.
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., 4A and 4B).

Score Point 4A

This question has four parts.

Mechanical and electromagnetic waves are used in different forms of communication.

Part A

Identify the mechanical wave commonly used for communication between people near each other.

1401

Sound waves are longitudinal mechanical waves used for communication between people near eachother.

Part B

Identify one electromagnetic wave used for communication on Earth and describe how it is used.

1303

Radio waves are transverse electromagnetic waves used for communication on Earth that are transmitted from places like celluar towers that people can pick up or tune into on something like a radio.

Part C

Identify which type of wave, mechanical or electromagnetic, should be used to send a signal from Earth to a rover on the surface of Mars. Explain your answer.

1325

Electromagnetic waves should be used to send a signal from Earth to Mars because unlike mechanical waves, electromagnetic waves can travel through vacuums such as outer space.

Part D

Describe one difference between mechanical and electromagnetic waves **not** identified in your explanation for Part C.

1392

Electromagnetic waves are always transverse waves. Mechanical waves can be transverse or longitudinal waves.

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Score Point 4B

This question has four parts.

Mechanical and electromagnetic waves are used in different forms of communication.

Part A

Identify the mechanical wave commonly used for communication between people near each other.

1402

A mechanical wave used to communicate is sound waves. For example a alarm is used to communicate.

Part B

Identify one electromagnetic wave used for communication on Earth and describe how it is used.

1341

An electromagnetic wave used to communicate is light waves. light waves can be used to communicate between ships. They flash light at eachother and decode them

Part C

Identify which type of wave, mechanical or electromagnetic, should be used to send a signal from Earth to a rover on the surface of Mars. Explain your answer.

1373

Electromagnetic because it does not require a median. In Space there would be nothing for a mechanical wave to travel through.

Part D

Describe one difference between mechanical and electromagnetic waves **not** identified in your explanation for Part C.

1401

One difference between the two is electromagnetic waves are faster traveling then mechanical waves.

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Score Point 3

This question has four parts.

Mechanical and electromagnetic waves are used in different forms of communication.

Part A

Identify the mechanical wave commonly used for communication between people near each other.

1401

The mechanical wave commonly used for communication between people near each other are sound waves.

Part B

Identify one electromagnetic wave used for communication on Earth and describe how it is used.

1358

One electromagnetic wave used for communicating here on earth are microwaves which help us communicate with cell phones and other technology.

Part C

Identify which type of wave, mechanical or electromagnetic, should be used to send a signal from Earth to a rover on the surface of Mars. Explain your answer.

1224

An electromagnetic wave should be used because, in order to get from earth to Mars the wave would have to travel through space, which is a vaccum, and mechanical waves can't travel through a vaccum, they need a medium. As a result, only an electromagnetic wave could be used.

Part D

Describe one difference between mechanical and electromagnetic waves **not** identified in your explanation for Part C.

1283

One difference between electromagnetic and Mechanical waves not mentioned it part C is that mechanical waves can be made by objects (such as sound) but electromagnetic ones can not (or require something more complex).

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Score Point 2

This question has four parts.

Mechanical and electromagnetic waves are used in different forms of communication.

Part A

Identify the mechanical wave commonly used for communication between people near each other.

1489

sound waves

Part B

Identify one electromagnetic wave used for communication on Earth and describe how it is used.

1485

Telephone waves

Part C

Identify which type of wave, mechanical or electromagnetic, should be used to send a signal from Earth to a rover on the surface of Mars. Explain your answer.

1430

Electromagnetic , because it can travel without a medium through space

Part D

Describe one difference between mechanical and electromagnetic waves **not** identified in your explanation for Part C.

1449

We can sence mechanical , not electromagnetic waves

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Score Point 1

This question has four parts.

Mechanical and electromagnetic waves are used in different forms of communication.

Part A

Identify the mechanical wave commonly used for communication between people near each other.

1490

Sound wave

Part B

Identify one electromagnetic wave used for communication on Earth and describe how it is used.

1487

cellular wave

Part C

Identify which type of wave, mechanical or electromagnetic, should be used to send a signal from Earth to a rover on the surface of Mars. Explain your answer.

1424

You would use a cellular wave because a sound wave wouldn't send far enough.

Part D

Describe one difference between mechanical and electromagnetic waves **not** identified in your explanation for Part C.

1450

A difference is that a mechanical wave is manmade.

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Score Point 0

This question has four parts.

Mechanical and electromagnetic waves are used in different forms of communication.

Part A

Identify the mechanical wave commonly used for communication between people near each other.

1493

A Phone

Part B

Identify one electromagnetic wave used for communication on Earth and describe how it is used.

1452

A Radio tower - it sends out signals to all over

Part C

Identify which type of wave, mechanical or electromagnetic, should be used to send a signal from Earth to a rover on the surface of Mars. Explain your answer.

1424

Electromagnetic waves because it has a better frequency than mechanical wave

Part D

Describe one difference between mechanical and electromagnetic waves **not** identified in your explanation for Part C.

1432

Electromagntic waves are longitudinal and Mechanical and transverse.

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