Signals Through Noise

Use scientific ideas and test results to evaluate a signal.

8.PS4.3 "Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the technician's two test results, circle the two ways noise changes signals, and write 1 beside the receiver's threshold rule and 2 beside the step that makes clean pulses. Use your marks to connect the test results to how each signal works.

A Noisy Cable at the Museum

1. At a crowded science museum, a guide speaks into a microphone while visitors listen through headsets down the hall. The microphone changes sound waves into a changing electrical signal. In an analog system, the signal's voltage follows the sound's changing shape, so the receiver uses those voltage changes to rebuild the sound. A digital system first measures the sound at many moments and turns each measurement into a number. Those numbers become a code of 0s and 1s, sent through a cable as a series of high and low electrical pulses.

2. The cable runs past a motor that adds unwanted electrical noise. On an analog line, that noise changes the signal's voltage; the headset may reproduce the change as a hiss. On a digital line, noise can also change a pulse's height or shape. But a receiver does not need its exact shape. It reads a pulse above a set threshold as high and one below it as low. If the noise is small enough, the code stays the same. A device along the cable can send fresh, clean pulses based on the code it reads.

3. During a test, the museum technician turns the motor on and compares what visitors hear. The analog headset has more hiss, while the digital headset still plays clear speech. The technician also checks the digital receiver: it reads the same 0s and 1s with the motor on as with it off. These observations support a claim about reliability, not perfect sound. Digital measurements can leave out details of the original sound, and strong noise can push a pulse across the threshold, causing an incorrect bit. Sending clean pulses cannot fix a bit read incorrectly.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why does the motor's noise cause hiss in the analog headset? Connect the way analog signals carry sound to the test result.

2. How does the receiver's threshold rule help explain what the technician found when checking the digital code?

3. The cable continues beyond the motor. How could the device that sends fresh pulses help keep the digital message reliable farther down the cable?

4. Why should the museum claim that digital transmission is more reliable, rather than perfect? Use two limits from the passage.

3 YOUR TURN

Your own words

A school robot receives commands through a cable that passes a noisy motor. Write a short recommendation for sending its commands as digital pulses instead of an analog signal. Use at least two scientific or technical details from the passage to explain your choice, and include one limit of digital transmission.

ANSWER KEY

Signals Through Noise

GRADE 8 · 8.PS4.3

PART 1 · READ AND MARK

Underline the technician's two test results, circle the two ways noise changes signals, and write 1 beside the receiver's threshold rule and 2 beside the step that makes clean pulses. Use your marks to connect the test results to how each signal works. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why does the motor's noise cause hiss in the analog headset? Connect the way analog signals carry sound to the test result.	**The analog receiver uses changes in voltage to rebuild sound. The motor changes that voltage, and the technician hears more hiss in the analog headset.**
2	How does the receiver's threshold rule help explain what the technician found when checking the digital code?	**The receiver reads pulses as high or low without needing their exact shape. If the motor's noise does not push pulses across the threshold, it reads the same 0s and 1s.**
3	The cable continues beyond the motor. How could the device that sends fresh pulses help keep the digital message reliable farther down the cable?	**The device uses the code it reads to send clean pulses, replacing pulses whose shapes may have been changed by noise.**
4	Why should the museum claim that digital transmission is more reliable, rather than perfect? Use two limits from the passage.	**Digital measurements can leave out details of the original sound. Strong noise can also push a pulse across the threshold and cause a wrong bit that fresh pulses cannot fix.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I recommend sending the robot's commands as digital pulses. The motor could change an analog signal's voltage, changing the information the robot receives. A digital receiver can read a pulse as high or low even if noise changes its shape, and a device along the cable can send fresh pulses. Digital transmission is not perfect: strong noise could push a pulse across the threshold and make the robot read the wrong bit.

Accept answers that connect a test observation or technical feature to how the signal carries information. For the open task, look for two accurate details applied to the robot and one accurate limit.