

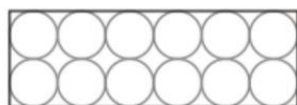
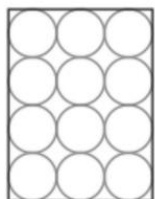
ACT Activities

Examples align with Arts, A/V Technology, & Communications course standards

Career Cluster: Arts, A/V Technology, & Communications Mathematics in *Digital Arts and Design III* – Addresses standard 11

Question

A graphic designer at a bottling company is tasked with designing efficient packaging for soda cans. Two options are being considered. Which of the two arrangements has less unused space in the package and how does the arrangement compare with the alternative? The radius of a soda can is approximately 3.2 cm.



Package A

Package B

- A. Package A; Package A has 16.7% less unused space than Package B.
- B. Package B; Package B has 16.7% less unused space than Package A.
- C. Package B; Package B has 8.3% less unused space than Package A.
- D. Neither; The two packages have equal unused space.

Source: Adapted from Zordak, S. E. (n.d.). Soda Cans. Retrieved February 24, 2016, from <http://illuminations.nctm.org/Lesson.aspx?id=2363>

Career Cluster: Arts, A/V Technology, & Communications Science in A/V Production I – Addresses Standard 15

Passage I

Natural Science: This passage is adapted from the chapter “The Wave Theory of Sound” in *Acoustics: An Introduction to Its Physical Principles and Applications* by Allan Pierce. (Acoustical Society of America).

5 *Acoustics* is the science of sound, including its production, transmission, and effects. In present usage, the term *sound* implies not only phenomena in air responsible for the sensation of hearing but also whatever else is governed by analogous physical principles. Thus, disturbances with frequencies too low (*infrasound*) or too high (*ultrasound*) to be heard by a normal person are also regarded as sound. One may speak of

10 underwater sound, sound in solids, or structure-borne sound. Acoustics is distinguished from optics in that sound is a mechanical, rather than an electromagnetic, wave motion.

15 The broad scope of acoustics as an area of interest and endeavor can be ascribed to a variety of reasons. First, there is the ubiquitous nature of mechanical radiation, generated by natural causes and by human activity. Then, there is the existence of the sensation of hearing, of the human vocal

20 ability, of communication via sound, along with the variety of psychological influences sound has on those who hear it. Such areas as speech, music, sound recording and reproduction, telephony, sound reinforcement, audiology, architectural

25 acoustics, and noise control have strong association with the sensation of hearing. That sound is a means of transmitting information, irrespective of our natural ability to hear, is also a significant factor, especially in underwater

30 acoustics. A variety of applications, in basic research and in technology, exploit the fact that the transmission of sound is affected by, and consequently gives information concerning, the medium through which it passes and intervening

35 bodies and inhomogeneities. The physical effects of sound on substances and bodies with which it interacts present other areas of concern and of technical application.

A Little History

40 The speculation that sound is a wave phenomenon grew out of observations of water waves. The rudimentary notion of a *wave* is an oscillatory *disturbance* that moves away from some source and transports no discernible amount of
45 matter over large distances of *propagation*. The possibility that sound exhibits analogous behavior was emphasized, for example, by the Greek philosopher Chrysippus (c. 240 B.C.), by the Roman architect and engineer Vitruvius (c. 25 B.C.), and
50 by the Roman philosopher Boethius (A.D. 480-524). The wave interpretation was also consistent with Aristotle's (384-322 B.C.) statement to the effect that air motion is generated by a source, "thrusting forward in like manner the adjoining air, to that
55 the sound travels unaltered in quality as far as the disturbance of the air manages to reach."

A pertinent experimental result, inferred with reasonable conclusiveness by the early seventeenth century, with antecedents dating back
60 to Pythagoras (c. 550 B.C.) and perhaps further, is that the air motion generated by a vibrating body sounding a single musical note is also vibratory and of the same frequency as the body. The history of this is intertwined with the development
65 of the laws for the natural frequencies of vibrating strings and of the physical interpretation of

musical consonances. Principal roles were played by Marin Mersenne (1588-1648), a French natural philosopher often referred to as the "father of
70 acoustics," and by Galileo Galilei (1564-1642), whose *Mathematical Discourses Concerning Two New Sciences* (1638) contained the most lucid statement and discussion given up until then of the frequency equivalence.

75 Mersenne's description in his *Harmonic universelle* (1636) of the first absolute determination of the frequency of an audible tone (at 84 Hz) implies that he already demonstrated that the absolute-frequency ratio of two vibrating
80 strings, radiating a musical tone and its octave, is as 1:2. The perceived harmony (consonance) of two such notes would be explained if the ratio of the air oscillation frequencies is also 1:2, which in turn is consistent with the source-air-motion-
85 frequency-equivalence hypothesis.

The analogy with water waves was strengthened by the belief that air motion associated with musical sounds is oscillatory and by the observation that sound travels with a finite
90 speed. Another matter of common knowledge was that sound bends around corners, which suggested diffraction, a phenomenon often observed in water waves. Also, Robert Boyle's (1640) classic experiment on the sound radiation

95 by a ticking watch in a partially evacuated glass vessel provided evidence that air is necessary,

either for the production or transmission of sound.

Questions

1. One of the author's main points about sound in the passage is that:
 - A. When analyzing the scope of acoustics, both the sensation of hearing and the scientific principles governing the phenomena are factors to consider.
 - B. The idea that sound is actually a wave is speculation only.
 - C. The phenomena of sound may best be explained with an analogy to water waves.
 - D. During the course of history, scientists noted similarities between the physical qualities of sound with those of water waves.
2. According to the explanation provided in Paragraph 4 (lines 57-74), use of the phrase "the most lucid statement and discussion" in line 72-73 most likely means that:
 - F. Galileo's writings disagreed most strongly with Pythagoras' experimental results.
 - G. Galileo's writings provided the strongest explanation of the frequency equivalence during his lifetime.
 - H. Both Mersenne and Galileo played key roles in explaining the frequency equivalence.
 - J. Galileo's writings, while contributing to discussion, were too convoluted to make a strong argument.

Source: Pierce, A. D. (n.d.). Chapter 1: The Wave Theory of Sound. In *Acoustics: An Introduction to Its Physical Principles and Applications*. Acoustical Society of America. Retrieved February 24, 2016, from <http://asa.aip.org/pierce.html>.