Use the information about the properties of light and sound waves and your knowledge of science to answer the questions.

Properties of Light and Sound Waves

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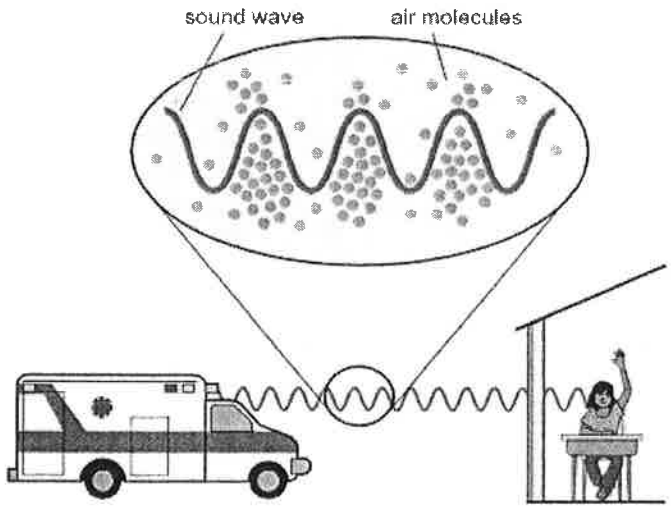
A group of students is learning about the sounds and lights used by emergency vehicles. An ambulance and a fire truck are in the school parking lot. The students can hear the sound made by the sirens of each vehicle, but do not see the flashing lights until they can see each vehicle. This is because the walls of the school affect sound waves and light waves differently. Figure 1 shows a model of a sound wave traveling through the air. The sound wave causes the air molecules to vibrate. This movement of the air molecules, along with a transfer of energy, results in the sound wave traveling through the air.

Figure 1. Sound Wave from an Emergency Vehicle



Different types of materials can affect how sound waves travel. Table 1 shows how different materials affect the speed of sound waves.

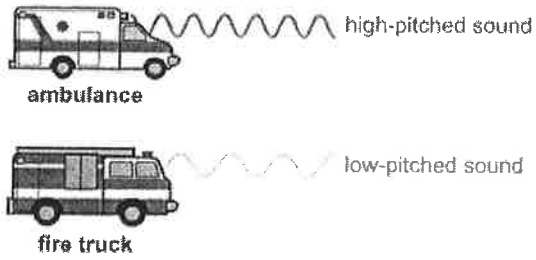
Table 1. Speed of Sound in Different Materials

Material	Speed of Sound (m/s)
air at 20°C	343
water at 20°C	1,482
brick	3,650
aluminum	5,100

Source: Brooks/Cole.

The students observe that the pitches of the sounds from the fire truck and the ambulance siren are different. The siren for each vehicle has a different pitch, as shown in Figure 2. The ambulance siren has sound waves with a higher pitch than sound waves from the fire truck siren.

Figure 2. Pitches of Emergency Sirens



Q1: Based on the information in Figure 1 and Table 1, which statement **best** compares a sound wave in a vacuum to a sound wave in air?

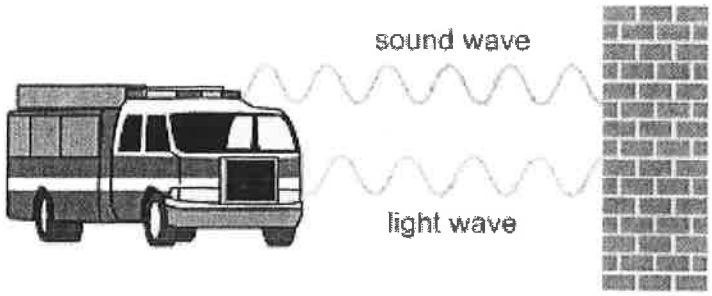
(A) A sound wave in a vacuum travels much faster than a sound wave in air because there are no molecules to slow it down.

(B) A sound wave in air travels much slower than a sound wave in a vacuum because of the number of molecules in air.

(C) A sound wave cannot travel in a vacuum because there are no molecules to transfer the energy.

(D) A sound wave travels at the same speed in a vacuum as a sound wave in air does.

Q2: The diagram shows sound and light waves from an emergency vehicle traveling toward a brick wall. The brick wall has both smooth and rough surfaces.



Select the correct answer from **each** drop-down menu to complete the sentences about how each wave is affected by the brick wall.

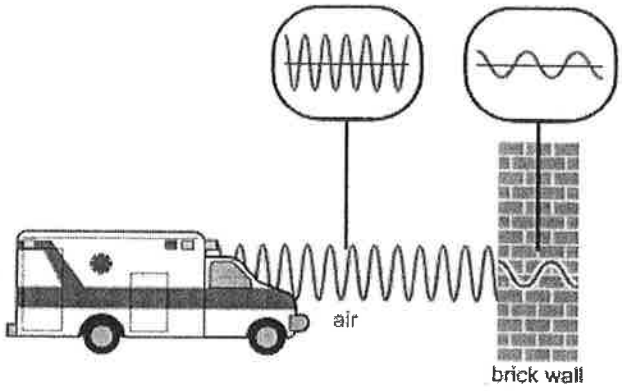
The sound waves from the siren will [a] the smooth surface of the wall. The light waves from the emergency vehicle will [b] the smooth surface of the wall. Rougher sections of the wall surface will cause the [c] from the emergency vehicle to scatter.

a.
- only reflect off
- only pass through
- pass through and reflect off

b.
- only reflect off
- only pass through
- pass through and reflect off

c.
- sound waves
- light waves
- sound and light waves

Q3: The diagram shows how a sound wave from an emergency vehicle changes as it moves through air and then through a brick wall.



Which statement **best** describes how the amplitude and energy of a sound wave are affected as the wave travels through air and as the wave travels through a brick wall?

(A) The sound wave has less energy and a larger amplitude when traveling through a brick wall than when traveling through air.

(B) The sound wave has more energy and a smaller amplitude when traveling through a brick wall than when traveling through air.

(C) The sound wave has more energy and a larger amplitude when traveling through a brick wall than when traveling through air.

(D) The sound wave has less energy and a smaller amplitude when traveling through a brick wall than when traveling through air.

Q4: Part A

Based on Figure 2, which statement **best** describes how the pitch and the frequency of sound waves are related?

(A) Sound waves with a higher frequency have a higher pitch.

(B) Sound waves with a lower frequency have a higher pitch.

(C) Sound waves with a higher frequency have a lower pitch.

(D) Sound waves with higher and lower frequencies can have the same pitch.

Part B

Which evidence from Figure 2 **best** supports the answer to Part A?

(A) The ambulance sound waves have fewer waves and a longer wavelength.

(B) The fire truck sound waves have fewer waves and a shorter wavelength.

(C) The ambulance sound waves have more waves and a shorter wavelength.

(D) The fire truck sound waves have more waves and a longer wavelength.