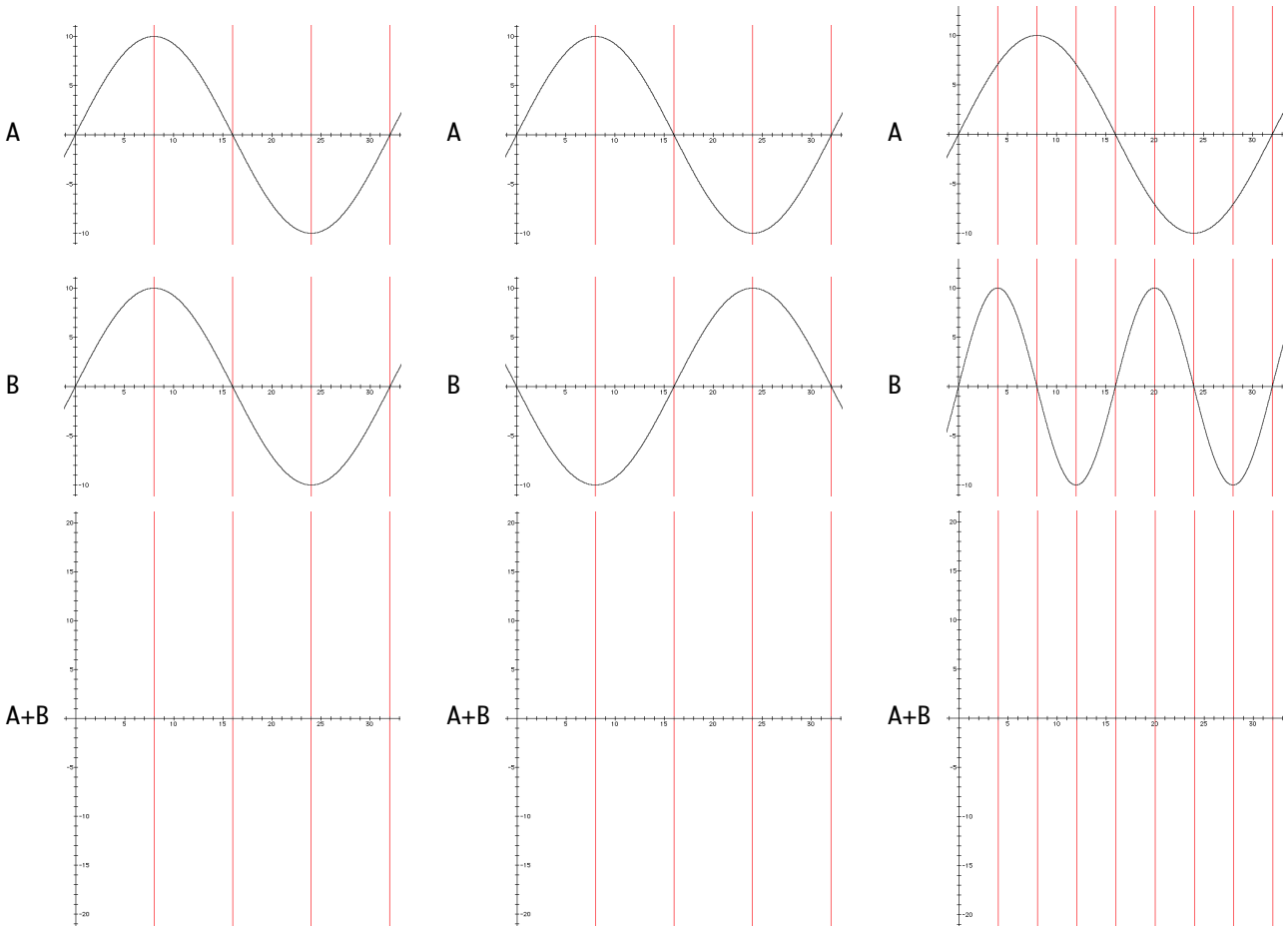
Physics

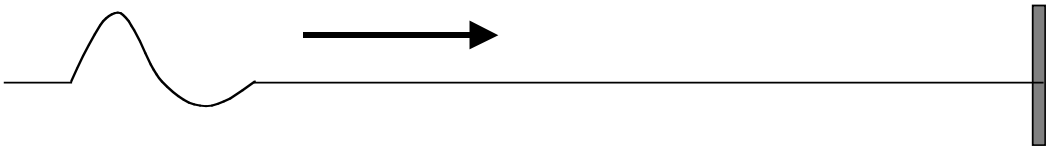
Sound Wave Homework

1. Gusts of wind make the Sears Tower in Chicago sway back and forth at a frequency of 0.1 Hz. What is the period of this vibration?
2. A bird flaps its wings 5 times every second. What is the frequency of its wing beats? What is their period?
3. If a single train of freight cars, each 10 meters long, rolls by you at the rate of three cars each second, how fast is the train going?
4. If a series of water waves oscillates a cork between 2 meters above sea level and 2 meters below sea level three times every second, and the distance between wave crests is 2 meters, then what is their frequency? What is their wavelength? What is their wave speed? What is their amplitude? What is their period?
5. Are the vibrations of a guitar string transverse or longitudinal waves? Explain why.
6. As you tighten a guitar string, the pitch gets higher. What happens to the wave speed?
7. Are sound waves transverse or longitudinal? Explain why.
8. Do the air molecules travel from the source of a sound to the listener? Explain your answer.
9. Use the superposition principle to "add up" each pair of waves below to show how they would combine:

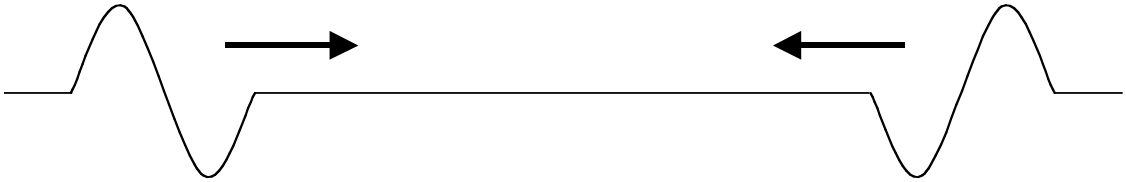


10. **Clearly** identify **each** area where the wave pairs above interfere constructively, each area where they interfere destructively, and each area where they cancel each other completely (e.g., shade the different regions in each A+B graph above using green for constructive interference, blue for destructive interference, and red for complete cancellation.)

11. Suppose the pulse below is traveling to the right on a tightly drawn wire tied to a post. Draw a picture of the pulse after it reflects off the post on the right and starts traveling to the left.



12. In a standing wave, which areas experience the most constructive interference, nodes or antinodes? Which experience the most destructive interference? Where is the amplitude the greatest?
13. Suppose there's a standing wave caused by the reflection of sound between opposite walls in a room. What direction do the air molecules move in at a node in this standing wave? How about at an antinode?
14. Suppose two wave pulses approach each other as shown below. Draw a picture of what the medium will look like at the instant when the two pulses are right on top of one another (one second from now). Draw another picture of what the medium will look like two seconds from now. Where is the wave energy of the two pulses "stored" at the instant when they're right on top of one another?



15. Suppose that a 70 cm guitar string vibrates with a fundamental frequency of 50 Hz. What is the wavelength? What is the wave speed? What would the wave speed of the second harmonic be? What would its frequency be? What about its wavelength?
16. Which of the following frequencies are possible for standing waves in the string in **Question #15**: 25 Hz, 75 Hz, 100 Hz and/or 150 Hz?
17. Suppose the string in **Question #15** is plucked so that only the 2^{nd} and 3^{rd} harmonics are present. What is the pitch of the sound it would make? Would this sound be generally louder or softer than that of the fundamental?
18. Draw a picture of a standing wave in a string with 4 nodes. How many wavelengths is this? Which harmonic does this represent?
19. What is the frequency of the tone two octaves above 264 Hz?
20. Which pair of frequencies sound better when played simultaneously, 40 Hz & 60 Hz or 40 Hz & 44 Hz?
21. Calculate the beat frequency for each pair of frequencies in **Question #20**.
22. How many times each second do the peaks in each pair of frequencies in **Question #20** line up perfectly?
23. What kind of object can produce a standing wave with more nodes than antinodes? How about one with more antinodes than nodes?
24. What kind of object can produce a standing wave with the same number of nodes and antinodes?
25. Repeat **Question #18** (all parts) for a standing wave in a tube with both ends open.
26. Repeat **Question #18** (all parts) for a standing wave in a tube with one end closed.
27. Calculate the velocity of sound through air at 30°C.
28. When a noisy object is moving toward you, how are the following variables affected by the object's motion: sound wave speed, pitch, amplitude, wavelength, period and frequency?
29. Finish the **Shock Waves** practice sheet (the one with the circles on it).