

## WAVES and SOUND Worksheet

- When an automobile moves towards a listener, the sound of its horn seems relatively
  - low pitched
  - high pitched
  - normal
- When the automobile moves away from the listener, its horn seems
  - low pitched
  - high pitched
  - normal
- The changed pitch of the Doppler effect is due to changes in
  - wave speed
  - wave frequency
- Circle the letter of each statement about the Doppler Effect that is true.
  - It occurs when a wave source moves towards an observer.
  - It occurs when an observer moves towards a wave source.
  - It occurs when a wave source moves away from an observer.
  - It occurs when an observer moves away from a wave source.
- True / False: A moving wave source does not affect the frequency of the wave encountered by the observer.
- True / False: A higher frequency results when a wave source moves towards an observer.
- Two fire trucks with sirens on speed towards and away from an observer as shown below.



- Which truck produces a higher than normal siren frequency?
  - Which truck produces a lower than normal siren frequency?
- What is the frequency heard by a person driving at 15 m/s toward a blowing factory whistle (800. Hz) if the speed of sound is 340.6 m/s?
  - From the previous problem, what frequency would he hear after passing the factory if he continues at the same speed?
  - A car approaching a stationary observer emits 450. Hz from its horn. If the observer detects a frequency of 470. Hz, how fast is the car moving? The speed of sound is 343 m/s.
  - While standing near a railroad crossing, a person hears a distant train horn. According to the train's engineer, the frequency emitted by the horn is 440 Hz. The train is traveling at 20.0 m/s and the speed of sound is 346 m/s.
    - What would be the frequency of the train's horn if the train were at rest?
    - What is the adjusted frequency that reaches the bystander as the train approaches the crossing?
    - What is the adjusted frequency that reaches the bystander once the train has passed the crossing?
  - Determine the speed of sound at 45.0 °C.
  - A burglar alarm is wailing with a frequency of 1200. hertz. What frequency does a cop hear who is driving towards the alarm at a speed of 40.0 m/s? The air temperature is 35.0 °C.

14. With reference to the previous problem, what frequency would the burglar hear, if he was running away from the alarm at a speed of 10 m/s?
15. A cop car's siren has a frequency of 700. Hz. If you are standing on the sidewalk as the cop car approaches you at a speed of 15.0 m/s, what frequency would you hear? The speed of sound is 343 m/s.
16. In the previous problem, what frequency would you hear if the cop were driving away from you at a speed of 25 m/s?
17. An alarm clock is dropped off the edge of a tall building. You, standing directly under it, hear a tone of 1350. Hz coming from the clock at the instant it hits the ground. Since you know the building is 25.0 m tall, you can find out what the frequency of the alarm would be if you had just held it in your hands. What would that frequency be? The speed of sound is 343 m/s.
18. Two identical cars are driving toward one another and sounding their horns. You're the driver of one of the cars. You measure your car's horn to be sounding at 512 Hz, but you measure the horn of the other car to be sounding at 600. Hz. The speed of sound is 345 m/s. If you are traveling at 26.8 m/s (60 mph), how fast is the other car traveling?
19. Out in the ocean, a wave crest 3.2 m high meets a wave trough from another direction which is 2.6 m deep. How high is the resulting wave?
20. A physics student sitting on the beach notices that a wave hits the beach every 5.0 seconds, and the waves seem to be about 15 m apart. What is the speed of these waves?
21. Sally and her lab partner held the ends of their spring 6.00 meters apart. There were 6 nodes in the standing wave produced. Sally moved her hand from the rest position back and forth along the floor 16 times in 4.00 s. Sketch the situation and determine the following:
- the wavelength of the wave Sally sent
  - the frequency of the wave produced
  - the speed of the wave

## ANSWERS

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|--------------|----------------|-----------------|---------------|-------------|
| 1) B         | 2) A           | 3) B            | 4) A, B, C, D | 5) false    |
| 6) true      | 7a) left truck | 7b) right truck | 8) 835 Hz     | 9) 765 Hz   |
| 10) 15 m/s   | 11a) 440 Hz    | 11b) 467 Hz     | 11c) 416 Hz   | 12) 358 m/s |
| 13) 1336 Hz  | 14) 1166 Hz    | 15) 732 Hz      | 16) 652 Hz    | 17) 1263 Hz |
| 18) 27.7 m/s | 19) 0.6 m, up  | 20) 3.0 m/s     | 21a) 2.40 m   | 21b) 4.0 Hz |
| 21c) 9.6 m/s |                |                 |               |             |