Doppler Effect - Worksheet

10 Practice Problems

Organic Chemistry Tutor

1. An ambulance truck emits a sound with a frequency of 800 Hz. (a) What is the frequency detected by a stationary observer if the ambulance truck is moving 30 m/s toward the observer? (b) What frequency will be detected if the ambulance truck is moving 30 m/s away from the observer? (The speed of sound in air at 20° C is 343 m/s)

3. A police car is moving west at 20 m/s toward a driver who is moving east at 25 m/s. The police car emits a frequency of 900 Hz. What frequency is detected by the driver? (The speed of sound in air at 20° C is 343 m/s)

2. A stationary ambulance truck emits a frequency of 1200 Hz. Calculate the frequency detected by the observer if (a) the observer is driving toward the ambulance truck at 25 m/s and if (b) the observer is driving away from the ambulance truck at 25 m/s. (The speed of sound in air at 20° C is 343 m/s)

4. The siren of an ambulance truck emits a frequency of 1700 Hz. A stationary observer detects a frequency of 1825 Hz. (a) Is the ambulance truck moving toward or away from the observer? (b) How fast is the ambulance truck moving?

5. A whale emits a frequency of 420 Hz in the ocean. An observer in a submarine moving toward the whale at 15 m/s detects a frequency of 427.33 Hz when the whale is approaching the submarine at 12 m/s. Calculate the speed of sound in seawater.

7. A train is moving toward a stationary observer at 40 m/s as it emits a sound with a frequency of 600 Hz. The air temperature is currently 10° C. The observer hears a different frequency from the train as it approaches compared to after it passes by. What is the difference of the two frequencies detected by the observer?

6. Jared hears a frequency of 1593 Hz and Rachel detects a frequency of 1417 Hz from a moving ambulance truck. (a) Is the truck moving toward Rachel or Jared? (b) What is the frequency emitted by the ambulance truck? (c) How fast is it moving?

8. An ambulance truck is moving at 20 m/s toward a driver who, in turn, is moving at 370 m/s (in a special vehicle) away from the ambulance truck. The ambulance truck emits a siren of 1000 Hz. What frequency is detected by the observer?

9. A stationary source emits a 4500 Hz sound wave directed at an object moving toward the source at 21 m/s. What is the frequency of the reflected wave?

10. A stationary policeman uses his radar gun to direct a sound wave of 6000 Hz at a moving vehicle. The speed limit is 40 m/s. The radar gun detects a reflected wave of 8544 Hz. (a) Is the driver moving toward or away from the policeman? (b) Is the driver speeding?

Answers:

1a. 877 Hz
1b. 736 Hz

2a. 1287 Hz
2b. 1113 Hz

3. 1025 Hz

4a. The source is moving toward the observer. The observed frequency is greater than the source frequency.
4b. 23.5 m/s

5. 1559 m/s

6a. The truck is moving toward Jared because he detects a higher frequency than Rachel.
6b. 1500 Hz
6c. 20 m/s

7. 144 Hz

8. He detects nothing. He is moving faster than the speed of sound. Since he is moving away from the source, the sound will never catch up to him to reach his ears.

9. 5087 Hz

10a. The driver is moving toward the policeman because the frequency of the reflected wave is greater than the frequency of the source wave.

10b. The driver is moving at 60 m/s. He is speeding, driving well above the speed limit of 40 m/s.