PHYSICS IN MOTION
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Unit 6C
The Doppler Effect
Practice Problems TEACHER

Work each of the following problems. SHOW ALL WORK.

1. **A siren emits a frequency of 2,000 Hz. If an observer hears a frequency of 1,800 Hz, is the siren moving toward or away from him?**

The siren is moving away because the observed frequency is less than the emitted frequency.

2. **A car horn emits a frequency of 400 Hz in 20 °C air, at which temperature the speed of sound is 343 m/s. If the car moves toward a stationary observer at 20 m/s, what is the observed frequency of the horn?**

$$f_{obs} = f_{source}\left(\frac{v \pm v_{obs}}{v \pm v_{source}}\right)$$

f_{source} = *400 Hz* v_{obs} = *0 m/s*

v = *343 m/s* v_{source} = *20 m/s*

$$f_{obs} = (400\ Hz)\left(\frac{343\ ^{m}/_{s} + 0}{343\ ^{m}/_{s} - 20\ ^{m}/_{s}}\right)$$
$$f_{obs} = (400\ Hz)\left(\frac{343\ ^{m}/_{s}}{323\ ^{m}/_{s}}\right)$$
$$f_{obs} = (400\ Hz)(1.06)$$
$$f_{obs} = 424\ Hz$$

3. **The frequency of a tornado siren is 1,000 Hz. If a cyclist moves toward the siren at 10 m/s in 15 °C air, at which temperature the speed of sound is 340 m/s, what frequency does the cyclist observe?**

$$f_{obs} = f_{source}\left(\frac{v \pm v_{obs}}{v \pm v_{source}}\right)$$

f_{source} = *1,000 Hz* v_{obs} = *10 m/s*

v = *340 m/s* v_{source} = *0 m/s*

$$f_{obs} = (1000\ Hz)\left(\frac{340\ ^{m}/_{s} + 10\ ^{m}/_{s}}{340\ ^{m}/_{s} - 0}\right)$$
$$f_{obs} = (1000\ Hz)\left(\frac{350\ ^{m}/_{s}}{340\ ^{m}/_{s}}\right)$$
$$f_{obs} = (1000\ Hz)(1.03)$$
$$f_{obs} = 1030\ Hz$$

questions continued on next page

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Work each of the following problems. SHOW ALL WORK.

4. **A tug boat horn emits a frequency of 250 Hz in 18 °C air, at which temperature the speed of sound is 342 m/s. If the tug boat moves away from a stationary observer at 15 m/s, what is the observed frequency of the horn?**

$$f_{obs} = f_{source}\left(\frac{v \pm v_{obs}}{v \pm v_{source}}\right)$$

f_{source} = *250 Hz* v_{obs} = *0 m/s*

v = *342 m/s* v_{source} = *15 m/s*

$$f_{obs} = (250\ Hz)\left(\frac{342\ ^{m}/_{s} + 0}{342\ ^{m}/_{s} + 15\ ^{m}/_{s}}\right)$$
$$f_{obs} = (250\ Hz)\left(\frac{342\ ^{m}/_{s}}{357\ ^{m}/_{s}}\right)$$
$$f_{obs} = (250\ Hz)(0.96)$$
$$f_{obs} = 240\ Hz$$

5. **A jogger runs at 9 m/s and is trailed by a bumblebee moving at 5 m/s and buzzing at a frequency of 270 Hz. What frequency does the jogger hear if the speed of sound in the air is 336 m/s?**

$$f_{obs} = f_{source}\left(\frac{v \pm v_{obs}}{v \pm v_{source}}\right)$$

f_{source} = *270 Hz* v_{obs} = *9 m/s*

v = *336 m/s* v_{source} = *5 m/s*

$$f_{obs} = (270\ Hz)\left(\frac{336\ ^{m}/_{s} - 9\ ^{m}/_{s}}{336\ ^{m}/_{s} - 5\ ^{m}/_{s}}\right)$$
$$f_{obs} = (270\ Hz)\left(\frac{327\ ^{m}/_{s}}{331\ ^{m}/_{s}}\right)$$
$$f_{obs} = (270\ Hz)(0.99)$$
$$f_{obs} = 267\ Hz$$