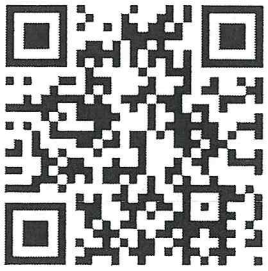
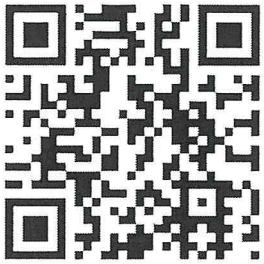
The Doppler Effect

Doppler Effect Examples & Video Explanations



Conceptual Physics: The Doppler effect
http://www.youtube.com/watch?v=m3MkZjlacaI



Fire Engine siren demonstrates the Doppler Effect
http://www.youtube.com/watch?v=imoxDcn2Sgo

Supersonic Flight, Sonic Booms
http://www.youtube.com/watch?v=gWGLAAYdbbc

Doppler Shift Examples

Name: _____ Date: _____

1. A car drives past you while honking its horn. The horn emits a frequency of 512 Hz and is moving at 25 km/h. The air temperature was measured to be 23°C. Calculate the perceived frequency as it approaches you and after it passes you.

2. A train moving towards you at 180 km/h and is blowing its whistle. It is -10°C outside and you perceive the frequency of the whistle to be 400 Hz. Calculate the frequency the horn is actually emitting.

3. A fancy car passes by you emitting a sound from a whistle with a frequency of 700 Hz. As it passes by you, you notice the frequency drop to 680 Hz. It is 32°C outside. Calculate the speed of the car.

4. A train is moving at 230 km/h and is blowing its whistle with a frequency of 650 Hz. You perceive a frequency of 800 Hz. Calculate the air temperature.

Doppler Effect Problems

Potentially useful equations:

$$f = \frac{1}{T} \qquad v = f\lambda \qquad v_s = 332 + 0.6T \qquad f_2 = \frac{f_1 v_s}{v_s \pm v_o}$$

Show all of your work in your solutions.

1. Explain why the Doppler Effect occurs only if the sound-emitting object is moving relative to the listener. Explain and use the equation to help you explain your answer.

2. A siren emits a sound at 1700 Hz. Assume a speed of sound of 332 m/s. What frequency would the stationary observer hear if the car with the siren is travelling at
   a) 25 m/s toward the observer?
   b) 25 m/s away from the observer?
   c) 140 km/h toward the observer?

3. Repeat question 2, but use an air temperature of 35°C.

4. How fast is a car moving and in what direction if the frequency of the horn drops from 900 Hz to 875 Hz, as heard by a stationary listener? The air temperature is 0°C.

5. A siren moving at 20 m/s emits a sound at 1200 Hz. A stationary observer perceives a frequency of 1130 Hz. The observer looks down at her thermometer. What would the temperature read?

6. As a racing car zooms by you, its pitch (frequency) decreases by 20%. If the speed of sound is 345 m/s, how fast is the car travelling?

Numerical Answers:

1. answers may vary.
2. a) 1838 Hz b) 1581 Hz c) 1926 Hz
3. a) 1830 Hz b) 1588 Hz c) 1910 Hz
4. 9.5 m/s (away)
5. -15°C
6. 86 m/s

Doppler Effect Problems (Good ones!)

Name: _____ Date: _____

1. A vehicle is travelling at Mach 0.05 in an air temperature of 30°C. The perceived frequency of sound that an observer hears as the vehicle approaches them is 400 Hz. Calculate frequency of sound is the vehicle emitting?

2. A car is approaching you on a cool day (temperature of 15°C). The person in the car is trying to annoy you by emitting a frequency of 1000 Hz. You perceive a frequency of 1090 Hz. Calculate the speed at which the car is approaching you.

3. A person is running really fast (v_o=5 m/s) with a tuning fork that is emitting a frequency of 256 Hz. The person you are running away from perceives a frequency of 252 Hz. Calculate the temperature of the air in which this is occurring?