

Standard: 4.6 - Describe the apparent change in frequency of waves due to the motion of a source or a receiver (the Doppler effect).

1. A student conducted two investigations using a toy car and microphones, as shown below.

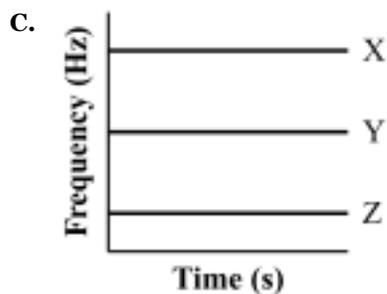
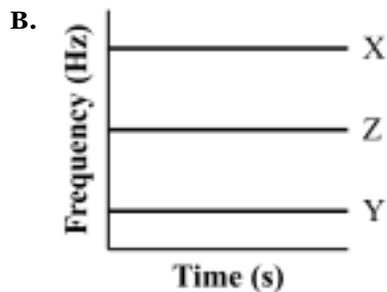
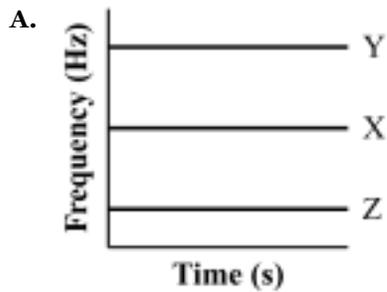
Investigation 1



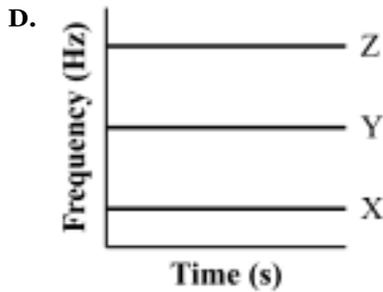
Investigation 2



The toy car contained a buzzer. The microphones were used to record the frequency of sound. In investigation 1, the buzzer frequency was measured while the toy car was at rest. In investigation 2, the toy car was in motion and the observed frequency was measured in front of and behind the car. Which of the following graphs represents the frequency recorded by each microphone?



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2. A person is driving north in a car at a constant speed. A police officer is driving south toward him at a constant speed. The police officer uses a radar unit to measure the speed of the person's car. The radar unit sends out waves of a certain frequency toward the person's car. The waves reflect off the person's car and travel back to the radar unit in the police car.

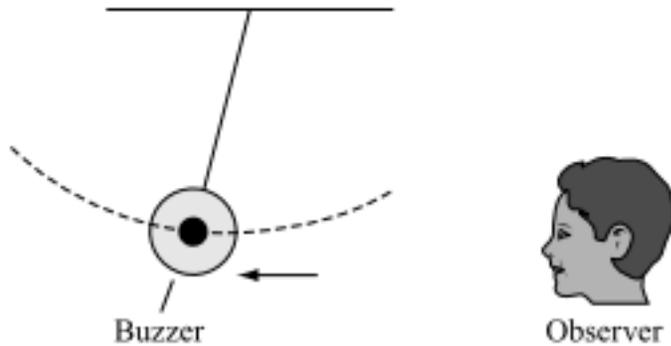
What happens to the frequency of the waves detected by the radar unit?

- A. The frequency is lower as the person's car approaches.
 - B. The frequency is higher as the person's car approaches.
 - C. The frequency remains the same but with increased energy as the person's car approaches.
 - D. The frequency remains the same but with decreased energy as the person's car approaches.
3. Which of the following observed properties of a wave is changed by the Doppler effect?
- A. amplitude
 - B. direction
 - C. frequency
 - D. speed
4. The siren of a fire truck emits a certain pitch, which is heard by a nearby observer. In which of the following situations would the observer perceive the lowest frequency of sound?
- A. The observer and fire truck are both stationary.
 - B. The observer walks at 3 m/s toward the stationary fire truck.
 - C. The observer is stationary while the fire truck drives toward the observer at 15 m/s.
 - D. The observer is stationary while the fire truck drives away from the observer at 15 m/s.

<http://youtu.be/imoxDcn2Sgo>

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5. A loud buzzer is swinging like a pendulum. An observer is near one end of the buzzer's path, as shown below.



Which of the following describes and explains what the observer hears as the buzzer moves away from him?

- A. a lower-pitched buzz than the buzzer's normal sound because the sound waves are arriving less frequently
- B. a higher-pitched buzz than the buzzer's normal sound because the sound waves are arriving more frequently
- C. a lower-pitched buzz than the buzzer's normal sound because the velocity of the sound waves is reduced by the velocity of the swinging buzzer
- D. a higher-pitched buzz than the buzzer's normal sound because the velocity of the sound waves is increased by the velocity of the swinging buzzer

6. A car with its horn sounding approaches a group of students. Assume the car's horn produces sound waves with a constant frequency.

Which of the following statements **best** explains why the students hear a higher pitch as the car approaches than when it is stopped?

- A. The sound waves increase in speed as the car approaches the students.
- B. The sound waves decrease in speed as the car approaches the students.
- C. The sound waves are heard at a lower frequency as the car approaches the students.
- D. The sound waves are heard at a higher frequency as the car approaches the students.

7. Which of the following observations is a result of the Doppler effect?

- A. Noise from across a lake is louder at night than during the day.
- B. A person walking notices that the pitch of a car's engine decreases as the car passes by.
- C. Beats are produced when two tuning forks with different frequencies are heard together.
- D. A person hears the sound from a radio more clearly in certain areas of a room than in others.