The Doppler Effect

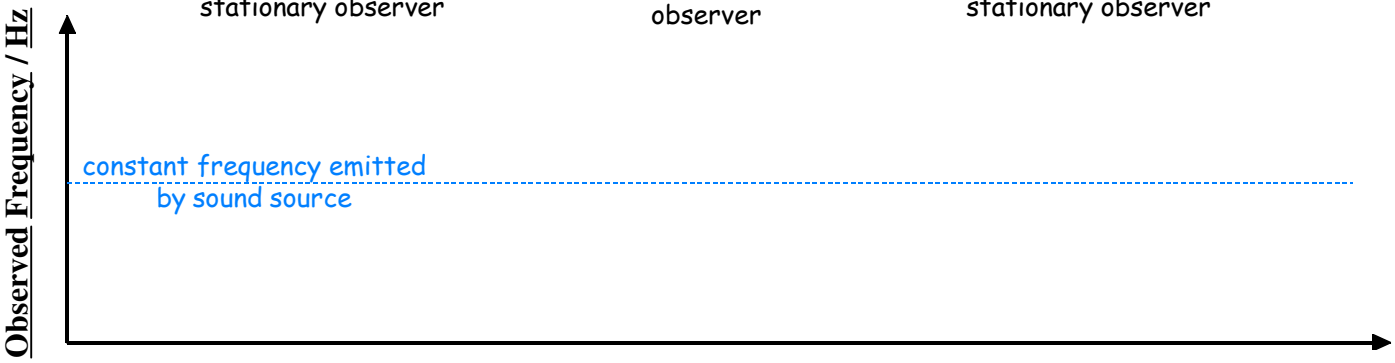
- **State that the Doppler effect is the change in frequency observed when a source of sound waves is moving relative to an observer (or vice versa).**

1) Moving Sound Source. Stationary Observer.

sound source moving towards stationary observer

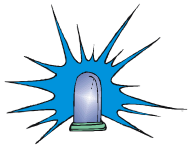
stationary observer

sound source moving away from stationary observer



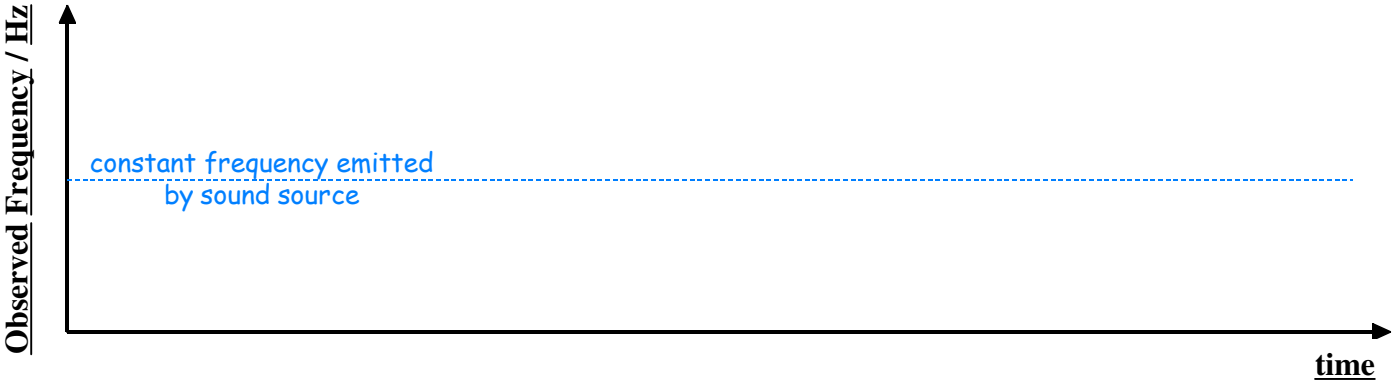
2) Moving Observer. Stationary Sound Source.

observer moving towards stationary sound source



stationary sound source

observer moving away from stationary sound source



State the equation which gives the frequency of sound heard by a **stationary observer** when a source of sound is moving **towards** them. Define all terms in the equation.

Calculate the frequency of sound heard by a stationary observer when an ambulance (siren emitting sound of frequency 12 000 Hz) moves towards them at 8.0 m s^{-1}.	A police car travels towards a stationary observer at 10 m s^{-1}. The frequency of sound emitted by the police car siren is 15 000 Hz. Calculate the frequency of sound heard by the observer.
Calculate the frequency of sound emitted by a fire engine which is travelling towards a stationary observer at 7.5 m s^{-1} if the observer hears sound of frequency 14 200 Hz.	A stationary observer hears sound of frequency 900 Hz being emitted from the siren of an emergency vehicle which is approaching him at 9.5 m s^{-1}. Calculate the actual frequency of the sound emitted from the siren.

State the equation which gives the frequency of sound heard by a **stationary observer** when a source of sound is moving **away from** them. Define all terms in the equation.

Calculate the frequency of sound heard by a stationary observer when a car (horn emitting sound of frequency 12 500 Hz) moves away from them at 6.5 m s^{-1}.	A bus travels away from a stationary observer at 5.5 m s^{-1}. The frequency of sound emitted by the bus horn is 14 400 Hz. Calculate the frequency of sound heard by the observer.
Calculate the frequency of sound emitted by an ambulance siren when the ambulance is travelling away from a stationary observer at 8.2 m s^{-1}, if the observer hears sound of frequency 11 500 Hz.	A stationary observer hears sound of frequency 1 600 Hz being emitted from the siren of a police motor cycle which is moving away from her at 10.2 m s^{-1}. Calculate the actual frequency of the sound emitted from the motor cycle siren.

State the equation which gives the frequency of sound heard by a **moving observer** when they are travelling **<u>towards</u>** a **stationary** source of sound. Define all terms in the equation.

Calculate the frequency of sound heard by an observer who is moving towards a stationary sound source at 8.4 m s^{-1}. (The source is a siren emitting sound of frequency 13 400 Hz).	A motor cyclist travels towards a stationary sound source at 12 m s^{-1}. The frequency of sound emitted by the stationary source is 12 750 Hz. Calculate the frequency of sound heard by the motor cyclist.
Calculate the frequency of sound heard by a car driver who is travelling towards a stationary source of sound at 8.2 m s^{-1}. The source emits a sound signal of frequency 11 900 Hz.	A speed skater hears sound of frequency 980 Hz being emitted from a stationary direction buzzer when she is approaching it at 12.6 m s^{-1}. Calculate the actual frequency of the sound emitted from the direction buzzer.

State the equation which gives the frequency of sound heard by a **moving observer** when they are travelling **away from** a **stationary** source of sound. Define all terms in the equation.

Calculate the frequency of sound heard by an observer who is moving away from a stationary sound source at 9.4 m s^{-1}. (The source is a horn emitting sound of frequency 16 800 Hz).	A scooter rider travels away from a stationary sound source at 11.5 m s^{-1}. The frequency of sound emitted by the stationary source is 17 525 Hz. Calculate the frequency of the sound heard by the scooter rider.
Calculate the frequency of sound heard by a jockey whose horse is travelling away from a stationary source of sound at 11.5 m s^{-1}. The source emits a sound of frequency 18 750 Hz.	A ski jumper hears sound of frequency 15 780 Hz being emitted from a stationary starting buzzer when she moves away from the buzzer down a slope at 18.5 m s^{-1}. Calculate the actual frequency of the sound emitted from the stationary starting buzzer.

The alarm of a parked car emits sound waves of frequency 560 Hz. What frequency of sound would you hear if you drove towards the stationary car at 12.0 m s^{-1}?	As Fred drives away from the chip shop at 10 m s^{-1}, he toots his car horn which emits sound of frequency 520 Hz. What frequency of horn sound is heard by customers in the chip shop?	If a motorcyclist travels towards a stationary sound source at 13.5 m s^{-1}, what frequency of sound will she hear if the source frequency is 525 Hz?
A train travels past a stationary observer at 100 m s^{-1}. The train emits a sound of frequency 2 000 Hz. Calculate the minimum and maximum frequencies the stationary observer will hear.		
A train moving at 85 m s^{-1} sounds its horn (frequency 1800 Hz). Determine the minimum an maximum horn frequencies the train passengers will hear.		
A scooter is being driven towards a stationary observer. The horn of the scooter is emitting sound waves of frequency 460 Hz. The apparent frequency heard by the observer is 475 Hz. Determine the speed of the car.		