Day 3 and 4: Doppler's Effect

1. Doppler shift in frequency is independent of
   a. the frequency of waves produced b. the speed of source
   c. the speed of observer d distance from source to observer
2. An observer moves towards a stationary source of sound with a velocity one-fifth of the velocity of sound. The percentage change in the apparent frequency is
   a.5% b. 10% c. 20% d. zero
3. A source of sound producing wavelength 50 cm is moving away from a stationary observer with $(1/5)^{th}$ speed of sound. Then what is the wavelength of sound received by the observer?
   a.55 cm b. 40 cm c. 60 cm d. 70 cm
4. A source of sound produces f waves/sec. An observer is receding with a velocity equal to velocity of sound. The observer receives
   a. $f\ waves/sec$ b. $2f\ waves/sec$ c. all waves in no time d. no waves
5. A source of sound and listener are moving along the same direction with same velocity. If the actual frequency of source is f, the frequency f' heard by the observer will be
   a. $f' = f$ b $f' > f$ c. $f' < f$ d. $f' \geq f$
6. A person blowing a whistle is moving in a circle around the observer O with speed 5 km/hr as shown in figure. If the frequency of sound emitted is 500 Hz, then apparent frequency observed by observer is
   a. 300 Hz b. 400 Hz c. 500 Hz d. 1000 Hz

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1. (a) What is Doppler's effect? Show that Doppler's effect in sound is asymmetric.
   (b) Find out the expression for apparent frequency heard by the observer.
   (c) The speed of observer is 30 m/s towards the stationary source emitting sound of real frequency 500 Hz. Calculate the apparent frequency. (Speed of sound=332m/s) (**Ans: 544.12 Hz**)
   (d) A passenger standing at the bus stand hears sound of low frequency if a bus is moving away from him. Why?
2. (a) Define doppler's effect. Write its applications and its limitations. Establish an expression of apparent frequency when both source and observer are moving along same direction.
   (b) Derive an expression for the change in frequency observed by a stationary observer when a moving source just crosses the observer.
   (c) A car, sounding a horn with note 500 Hz, approaches and then passes a stationary observer at a steady speed of 20m/s. Calculate the change in frequency heard by the observer. [velocity of sound is 330 m/s] (**Ans: 59 Hz**)
   (d)Whistle of an approaching train is shriller, why? Obtain an expression of apparent frequency heard by the observer in the given case.
   (e) In what situations, doppler's effect is not applicable?

Additional questions:

1. A source of sound generates sound waves which travel with a speed of 340 m/s. The frequency of source is 500 Hz. Find the frequency of sound heard if:
   i. The source is moving towards the stationary observer at 30 m/s
   ii. The observer is moving towards the stationary source at 30 m/s
   iii. Both source and observer move at 30 m/s and approach one another [***550 Hz, 545.45 Hz, 600 Hz***]
2. A car, sounding a horn and producing a note of 500 Hz, approaches and then passes a stationary observer at a steady speed of 20 m/s. Calculate the change in frequency heard by the observer. Velocity of sound= 340 m/s. [***59 Hz***]
3. A car travelling with a speed of 60 Km/Hr. sounds a horn of frequency 500 Hz. The sound is heard in another car travelling behind the first car in the same direction with a speed of 80 Km/Hr. What frequencies will the driver of the second car hear before and after overtaking the first car? Velocity of sound is 340 m/s. [***507.8Hz; 491.4Hz***]
4. An observer, travelling with constant velocity of 20 m/s, passes close to a stationary source of sound and notice that there is a change of frequency of 50 Hz as passes the source. What is the frequency of the source [$v = 340\ m/s$]. [***425 Hz***]
5. A car approaching towards a cliff at a speed of 20 m/s. The driver sounds a whistle of frequency 800 Hz. What will be the frequency of the echo as heard by the car driver? Velocity of sound=350 m/s [***896.97 Hz***]