13. A policeman blows a whistle with a frequency of 500 Hz. A car approaches him with a velocity of 15 ms^{-1}. The change in frequency as heard by the driver of the car as he passes the policeman is (Given, speed sound in air is 300 ms^{-1})

a. 25 Hz b. 50 Hz c. 100 Hz d. 150 Hz

14. The frequency of the sound of a car horn as perceived by an observer towards whom the car is moving, differs from a frequency of the horn by 2.5%. The velocity of sound in air is 320 m/sec, the velocity of the car is

a. 6 m/sec b. 7.5 m/sec c. 8 m/sec d. 800 m/sec

15. 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

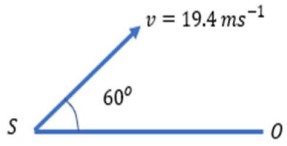
16. When both source and observer approach each other with a velocity equal to the half the velocity of sound the change in frequency of sound as detected by the listener is

a. 25% b. 50% c. 150% d. 200%

17. When both source and listener move in same direction with a speed equal to half the speed of a sound, the change in frequency of the sound is

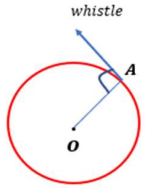
a. 0% b. 25 % c. 50% d. 100 %

18. A source of sound S emitting waves of frequency 100 Hz and an observer O are located at some distance from each other. The source is moving with a speed of 19.4 ms^{-1} at an angle of 60° with the source observer line as shown in the figure. The observer is at rest. The apparent frequency observed by the observer (velocity of sound in air 330 ms^{-1}) is:



a. 97 Hz b. 100 Hz c. 103 Hz d. 106 Hz

19. 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

20. An observer and a sounding source are moving in same direction. The observer is moving with velocity a and source velocity $b > a$. If actual frequency of source is n, the frequency heard by observer is

a. n b. less than n c. more than n d. infinite

21. A passenger is sitting on a fast-moving train. The engine of this train blows a whistle of frequency f. If the apparent frequency of sound heard by the passenger is f, then: a

a. $f' > f$ b. $f' < f$ c. $f' = f$ d. $f' \geq f$

22. A racing car moving towards a cliff, sounds its horn. The driver observes that the sound reflected from the cliff has a pitch one octave higher than the actual sound of the horn. If v is the velocity of sound, then the velocity of the car is

a. $\frac{v}{3}$ b. $\frac{v}{4}$ c. $\frac{v}{\sqrt{2}}$ d. $\frac{v}{2}$

23. The frequency of the sound of a car horn as perceived by an observer towards whom the car is moving, differs from a frequency of the horn by 2.5%. The velocity of sound in air is 320 m/sec, the velocity of the car is

a 8 m/sec b. 800 m/sec c. 7.5 m/sec d. 6 m/sec

24. A source of sound produces n waves/sec. An observer is receding with a velocity equal to velocity of sound. The observer receives

a n waves/sec b. $2n$ waves/sec c. 0 waves/sec d. ∞ waves /sec

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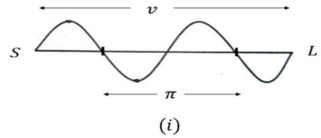
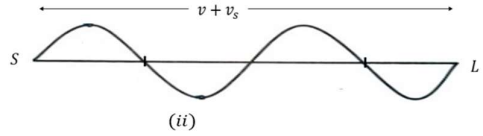
1. (a) What is Doppler's effect? Show that Doppler's effect in sound is asymmetric.
   (b) Find out the expression for apparent frequency heard by the observer.
   (c) The speed of observer is 30 m/s towards the stationary source emitting sound of real frequency 500 Hz. Calculate the apparent frequency. (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. In what situations, Doppler's effect is not applicable?
   (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.
3. 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*]
4. 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*] [3]
5. In the given figure, figure (i) represents a situation that both source of sound (S) and listener (L) are at rest positions. Figure (ii) represents relative motion between moving source and stationary listener.



(i)



(ii)

   i. Does the pitch of sound changes to the listener in second case? Justify. [1]
   ii. Develop an expression to support your answer in (i). [3]