SOUND WAVE

1. A closed organ pipe 150 cm long gives 7 beats per second with an open organ pipe of length 350 cm, both vibrating in fundamental mode. The velocity of sound is _____ m/s.

2. In a closed organ pipe, the frequency of fundamental note is 30 Hz. A certain amount of water is now poured in the organ pipe so that the fundamental frequency is increased to 110 Hz. If the organ pipe has a cross-sectional area of 2 cm^2, the amount of water poured in the organ tube is _____ g.

(Take speed of sound in air is 330 m/s)

3. A point source is emitting sound waves of intensity 16×10^{-8} Wm^{-2} at the origin. The difference in intensity (magnitude only) at two points located at a distances of 2m and 4m from the origin respectively will be____ $\times 10^{-8}$ Wm^{-2}.

4. The fundamental frequency of a closed organ pipe is equal to the first overtone frequency of an open organ pipe. If length of the open pipe is 60 cm, the length of the closed pipe will be :

(1) 60 cm (2) 45 cm

(3) 30 cm (4) 15 cm

5. A sonometer wire of resonating length 90 cm has a fundamental frequency of 400 Hz when kept under some tension. The resonating length of the wire with fundamental frequency of 600 Hz under same tension _____ cm.

6. Two open organ pipes of length 60 cm and 90 cm resonate at 6^{th} and 5^{th} harmonics respectively. The difference of frequencies for the given modes is _____ Hz.

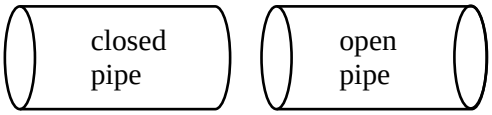
(Velocity of sound in air = 333 m/s)

7. A closed and an open organ pipe have same lengths. If the ratio of frequencies of their seventh overtones is $\left(\frac{a-1}{a}\right)$ then the value of a is _____.

SOLUTIONS

1. Ans. (294)

Sol.



$f_c = \frac{v}{4_1}$ $f_o = \frac{v}{2_2}$

$|f_c - f_0| = 7$

$\frac{v}{4 \cdot 150} - \frac{v}{2 \cdot 350} = 7$

$\frac{v}{600\ cm} - \frac{v}{700\ cm} = 7$

$\frac{v}{6m} - \frac{v}{7m} = 7$; $v\left(\frac{1}{42}\right) = 7$

$v = 42 \cdot 7 = 294$ m/s

2. Ans. (400)

Sol. $\frac{V}{4_1} = 30 \Rightarrow =_1 \frac{11}{4}m$

$\frac{V}{4_2} = 110 \Rightarrow {}_2 = \frac{3}{4}m$

$\Delta =$ 2m,

Change in volume = $A\Delta = 400\ cm^3$

M = 400 g ; $\left(\because \rho = 1g/cm^3\right)$

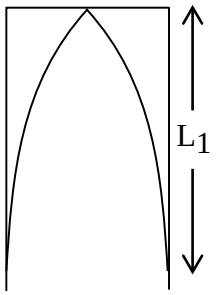
3. Ans. NTA (3)

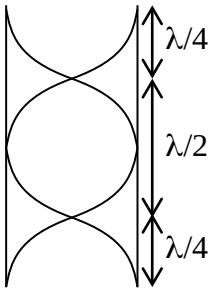
Allen (Bonus)

Sol. Question is wrong as data is incomplete.

4. Ans. (4)

Sol.





$\frac{\lambda}{4} = L_1$

$2\left(\frac{\lambda}{2}\right) = \lambda$

$v = f\lambda$

$f_2 = \frac{2v}{2L_2}$

$v = f_1(4L_1)$

$f_2 = \frac{v}{L_2}$

$f_1 = \frac{v}{4L_1}$

$f_1 = f_2$

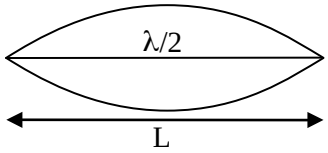
$\frac{v}{4L_1} = \frac{v}{L_2} \Rightarrow L_2 = 4L_1$

$60 = 4 \times L_1$

$L_1 = 15$ cm

5. Ans. (60)

Sol.



$f_0 = 400$ Hz ; $v = \sqrt{\frac{T}{\mu}}$ = constant

$\frac{\lambda}{2} = L$; $v = f_0\lambda$

$\frac{v}{2f_0} = L \Rightarrow v = 2Lf_0$

$L' = \frac{v}{2f'} = \frac{2Lf_0}{2f'}$

$= \frac{Lf_0}{f'} = \frac{90 \cdot 400}{600} = 60$

6. Ans. (740)

Sol. The difference in frequency in open organ pipe

$= f = \frac{nv}{2L}$

$\Delta f = \frac{6v}{2 \cdot 0.6} - \frac{5v}{2 \cdot 0.9}$

v = 333 m/s

$\Delta f = 740$ Hz

7. Ans. (16)

Sol. For closed organ pipe

$f_c = (2n+1)\frac{v}{4} = \frac{15v}{4}$

For open organ pipe

$f_o = (n+1)\frac{v}{2} = \frac{8v}{2}$

$\frac{f_c}{f_o} = \frac{15}{16} = \frac{a-1}{a} \Rightarrow a = 16$