S1. Ans.(c)

Fundamental harmonic frequency open pipe $= \frac{v}{2L} = v_1$ (say)

Fundamental harmonic frequency closed pipe $= \frac{v}{4L} = v_2$ (say)

$\Rightarrow \frac{v_1}{v_2} = \frac{\frac{v}{2L}}{\frac{v}{4L}}$ 2: 1

S2. Ans.(b)

$v \propto \sqrt{\text{Tension}}$

$\frac{v_i}{v_f} = \sqrt{\frac{T_i}{T_f}}$

$\frac{v_i}{v_f} = \sqrt{\frac{T}{2T}}$

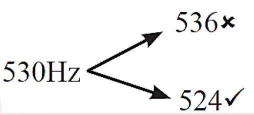
$\frac{v_i}{v_f} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$

S3. Ans.(a)

$\upsilon = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

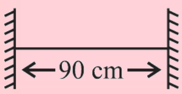
Tension decreases means frequency decreases

$|\eta_A - \eta_B| = 6Hz$

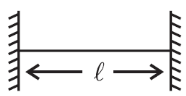


$|\eta_A - \eta_B^1| = 7Hz$

S4. Ans.(a)



$f = 120Hz = \frac{v}{2l} \Rightarrow 120 = \frac{v}{2(0.9)}$



$f = 180Hz = \frac{v}{2l}$

$\Rightarrow 180 = \frac{120\times0.9}{l} \Rightarrow l = 60cm$

S5. Ans.(c)

Open O.P. $= f_0 = \frac{v}{2l_1}$

Closed O.P. $= f_3 = \frac{3v}{4l_2}$

$\frac{v}{2l_1} = \frac{3v}{4l_2} \Rightarrow \frac{1}{l_1} = \frac{3}{2\times20}$ $(\because l_2 = 20)$

$l_1 = \frac{40}{3} = 13.33\ cm$

S6. Ans.(b)

$\frac{\lambda}{2} = 73 - 20 = 53cm$

$V = f\lambda = 320 \times (53 \times 2 \times 10^{-2}) = 339.2$

S7. Ans.(a)

In a closed organ pipe

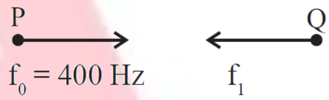
Fundamental frequency $f_0 = \frac{v}{4l}$ only odd harmonics produce so difference between any two successive harmonics

$260 - 220 = \frac{2v}{4l}$

$40 = \frac{2v}{4l}$

$40 = 2f_0 \Rightarrow f_0 = 20\ Hz$

S8. Ans.(c)



$v_0 = 22m/s$ $v_0 = 16.5\ m/s$

$f_1 = f_0\left[\frac{v+v_0}{v-v_s}\right]$

$f_1 = 400\left[\frac{340+16.5}{340-22}\right]$

$f_1 = 448\ Hz$

S9. Ans.(d)

Shifting in wavelength $\Delta\lambda = 0.1$Å

$\lambda = 6000$ Å

$\frac{V}{C} = \frac{\Delta\lambda}{\lambda}$

$V = \frac{\Delta\lambda\ C}{\lambda}$

$= \frac{0.1\times10^{-10}\times3\times10^8}{6000\times10^{-10}}$

$= 0.5 \times 10^4\ ms^{-1} = 5kms^{-1}$

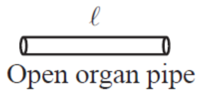
S10. Ans.(b)

$f = \frac{V}{2l}$

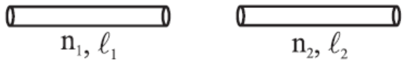
$1.2 \times 10^3 Hz = \frac{V}{2\times1}$

$V = 2.4 \times 10^3\ m/s$

S11. Ans.(d)



$n = \frac{v}{2l} \Rightarrow l = \frac{v}{2n}$



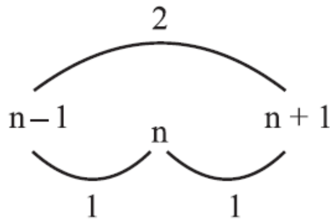
$l_1 = \frac{v}{2n_1}$ $\qquad$ $l_2 = \frac{v}{2n_2}$

$l = l_1 + l_2$

$\frac{v}{2n} = \frac{v}{2n_1} + \frac{v}{2n_2}$

$n = \frac{n_1 n_2}{n_1 + n_2}$

S12. Ans.(b)



Beats: Max difference between two wave frequency. Therefore (n + 1) – (n – 1) = 2

S13. Ans.(d)

For second overtone (3rd harmonic) in open organ pipe,

$f' = \frac{3v}{2L_{open}}$

For first overtone (3rd harmonic) in closed organ pipe,

$f = \frac{3v}{4L_{closed}}$

$f = f'$

$L_{open} = 2L$

S14. Ans.(b)

$T = 2\pi\sqrt{\frac{m}{k}}$

$3 = 2\pi\sqrt{\frac{m}{k}}$ $\qquad$ ...(1)

$5 = 2\pi\sqrt{\frac{m+1}{k}}$ $\qquad$ ...(2)

$\frac{9}{25} = \frac{m}{m+1} \Rightarrow m = \frac{9}{16}$

S15. Ans.(c)

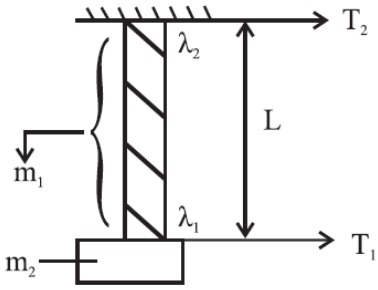
First minimum resonating length for closed organ pipe.

$= \frac{\lambda}{4} = 50\ cm$

Length of the air column

$= \frac{3\lambda}{4} = 150\ cm$

S16. Ans.(b)



$T_1 = m_2 g$

$T_2 = (m_1 + m_2)g$

We know velocity $\propto \sqrt{T}$

Also $\lambda \propto \sqrt{T}$

$\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{T_1}}{\sqrt{T_2}} = \sqrt{\frac{m_2}{m_1+m_2}}$

$\frac{\lambda_2}{\lambda_1} = \sqrt{\frac{m_1+m_2}{m_2}}$

S17. Ans.(c)

$f' = \frac{f_0 \text{v}}{\text{v} - \text{v}_{source}}$

$= \frac{800 \times 330}{330 - 15} = 838\ Hz$

S18. Ans.(b)

Fundamental frequency of closed organ pipe

$f = \frac{v}{4l_c}$

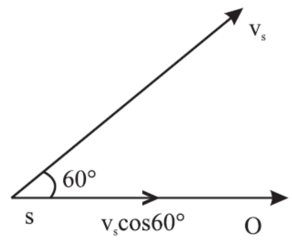
2nd overtone frequency of open organ pipe $f' = \frac{3v}{2l_0}$ Now,

$\frac{\text{v}}{4l_c} = \frac{3\text{v}}{2l_0} \Rightarrow l_0 = 6l_c = 6(20\ cm) = 120\ cm$

S19. Ans.(c)

$f = f_s\left[\frac{\text{v}}{\text{v} - \text{v}_s \cos 60^\circ}\right]$

$\text{v} = 330\ \text{ms}^{-1}$



$f = f_s\left(\frac{v}{v - v_s}\right) = 100\left(\frac{330}{330 - \frac{19.4}{2}}\right) \approx 103Hz$

S20. Ans.(d)

Frequency COP, $f_n = (2n+1)\frac{v}{4l}$

For n = 0, f_0 = 100 Hz

n = 1, f_1 = 300 Hz

n = 2, f_2 = 500 Hz

n = 3, f_3 = 700 Hz

n = 4, f_4 = 900 Hz

n = 5, f_5 = 1100 Hz

Which are less than1250 Hz.

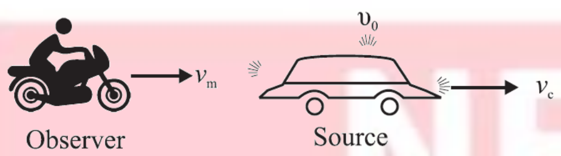
S21. Ans.(a)

Total length of string $l = l_1 + l_2 + l_3$

But frequency $\propto \frac{1}{\text{length}}$

Therefore, $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$

S22. Ans.(c)



Here, speed of motorcyclist,

$v_m = 36 \text{ km hour}^{-1} = 36 \times \frac{5}{18}\text{ms}^{-1} = 10\text{ms}^{-1}$

Speed for car,

$v_c = 18 \text{ km hour}^{-1} = 18 \times \frac{5}{18}\text{ms}^{-1} = 5\text{ms}^{-1}$

Frequency of source, $\upsilon_0 = 1392\ Hz$

Speed of sound, v = 343 ms^{-1}

The frequency of the honk heard by the motorcyclist is

$\upsilon' = \upsilon_0\left(\frac{v + v_m}{v + v_c}\right) = 1392\left(\frac{343+10}{343+5}\right)$

$= \frac{1392 \times 353}{348} = 1412\ Hz$

S23. Ans.(a)

Pressure change will be minimum at both open ends

S24. Ans.(b)

Frequency of unknown source = 246 Hz or 254 Hz.

Second harmonic of this source = 492 Hz or 508 Hz which gives 5 beats per second, when sounded with a source of frequency 513 Hz. Therefore unknown frequency = 254 Hz.

S25. Ans.(b)

$k = \frac{2\pi}{\lambda} = \frac{2\pi}{2\pi} = 1$ and $\omega = 2\pi f = (2\pi)\left(\frac{1}{\pi}\right) = 2$

So equation of wave

$y = \sin(kx - \omega t) = \sin(x - 2t)$