Lissajous Figures:

$x = A_1 \cos\omega t$ ...... (1) $\qquad \cos\omega t = x/A_1$

$y = A_2 \cos(2\omega t + \delta)$ ...... (2) $\qquad \sin\omega t =$

frequency 1:2

$\cos 2\omega t \cos\delta - \sin 2\omega t \sin\delta$

$= (2\cos^2\omega t - 1)\cos\delta - 2\sin\omega t \cos\omega t \sin\delta$

$= \left(2\frac{x^2}{A_1^2} - 1\right)\cos\delta - 2\sin\omega t \cos\omega t \sin\delta$

$$= \left(\frac{y}{A_2} + \cos\delta\right)^2 + \frac{4x^2}{A_1^2}\left(\frac{x^2}{A_1^2} - 1 - \frac{y}{A_2}\cos\delta\right) = 0 \text{ ---- (4)}$$

it represents closed path having two loops.

(i) $\delta = 0$

$$\left(\frac{y}{A_2} + 1\right)^2 + \frac{4x^2}{A_1^2}\left(\frac{x^2}{A_1^2} - 1 - \frac{y}{A_2}\right) = 0$$

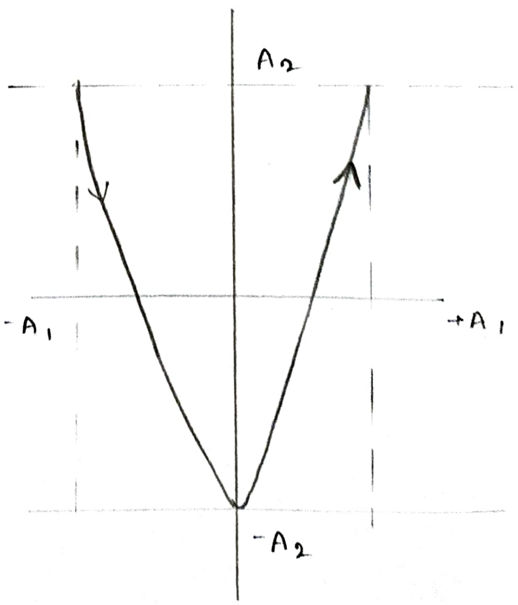
$$\left(\frac{y}{A_2} - 2\frac{y^2}{A_1^2} + 1\right)^2 = 0 \text{ ---- (5)}$$

two coincident parabola wit vertices $(0, -A)$

$$\boxed{x^2 = \frac{A_1^2}{2A_2}(y + A_2)}$$

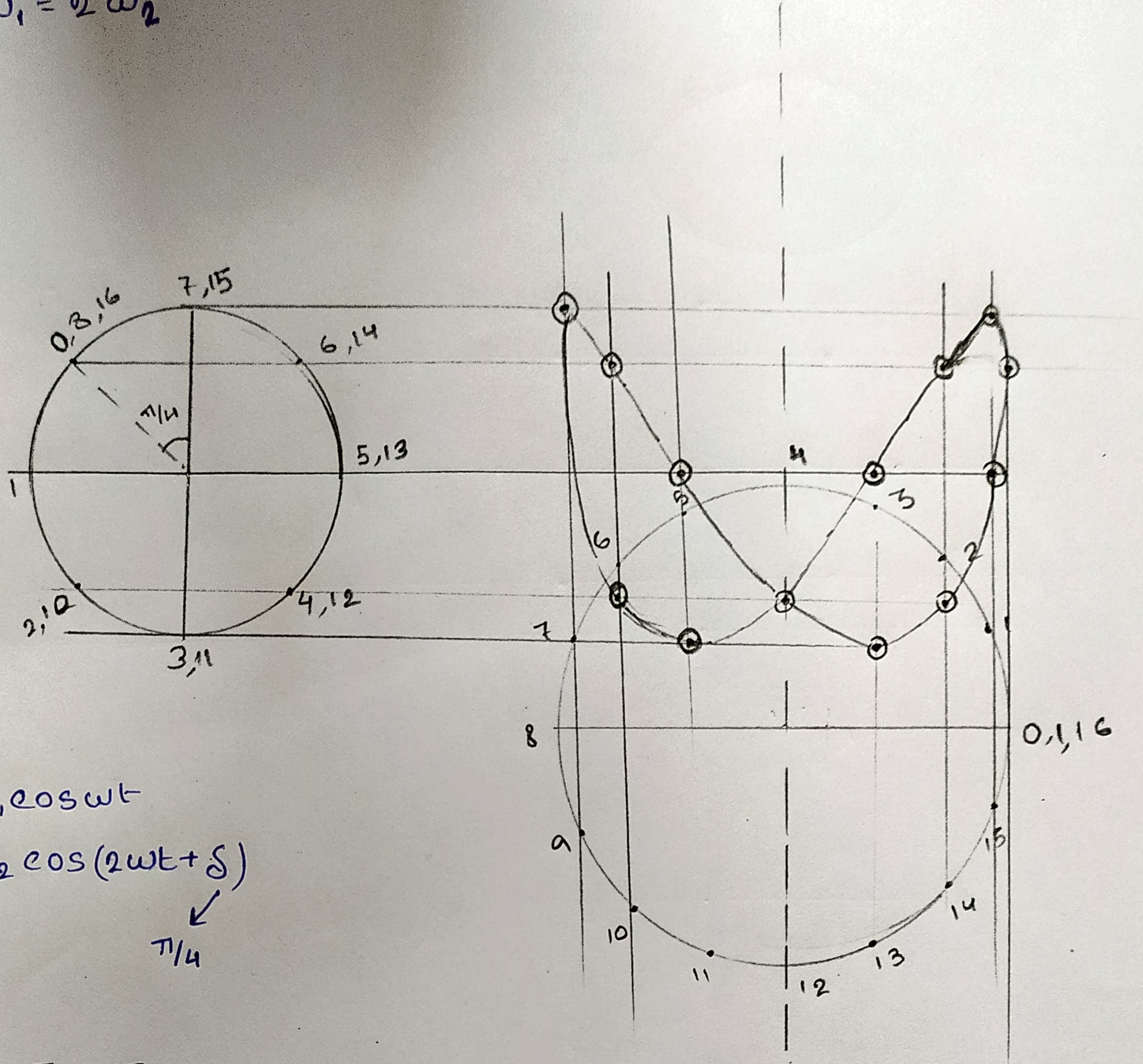
Application of LF:

- → Shape and nature of single wavefront can be determine
- → Amp of a wave
- → Investigate vibrations of violin string



$\delta = \pi/4$

$\omega_1 = 2\omega_2$



$x = A_1 \cos \omega t$

$y = A_2 \cos(2\omega t + \delta)$

$\pi/4$

H.W

$\delta = \pi/2,\ 3\pi/4,\ \pi$

$x = A_1 \cos \omega t$

$y = A_2 \cos(3\omega t + \delta)$

① Comparison of frequencies: