*This part of the experiment is prepared with Online LaTeX Editor Overleaf. Visit the website for the source here:*

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## 2. EXPERIMENT 2 - PRELIMINARY WORK

**2.1** The Lissajous pattern shown in *Fig. 4* is observed on the CRT screen. Find the phase shift between the signals applied to the $X$ and $Y$ inputs of the scope.

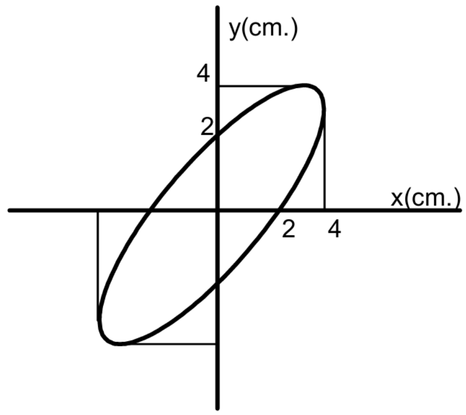



**Figure 4**

**Answer**: The phase shift can be obtained by taking the arcsine of the ratio of the $y$-intercept of the Lissajous pattern and the amplitude of the voltage function. The semi-major axis of the ellipse has a positive slope.

$$\text{Phase shift: } \theta = \sin^{-1}\left(\frac{2}{4}\right) = \boxed{30^\circ}$$

**2.2** *Fig. 5* shows a Lissajous pattern observed on the CRT screen. Determine the frequency relationship between the signals applied to the $X$ and $Y$ inputs of the scope.

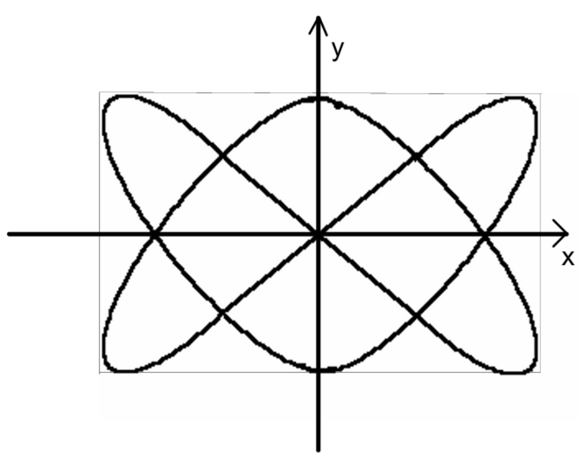


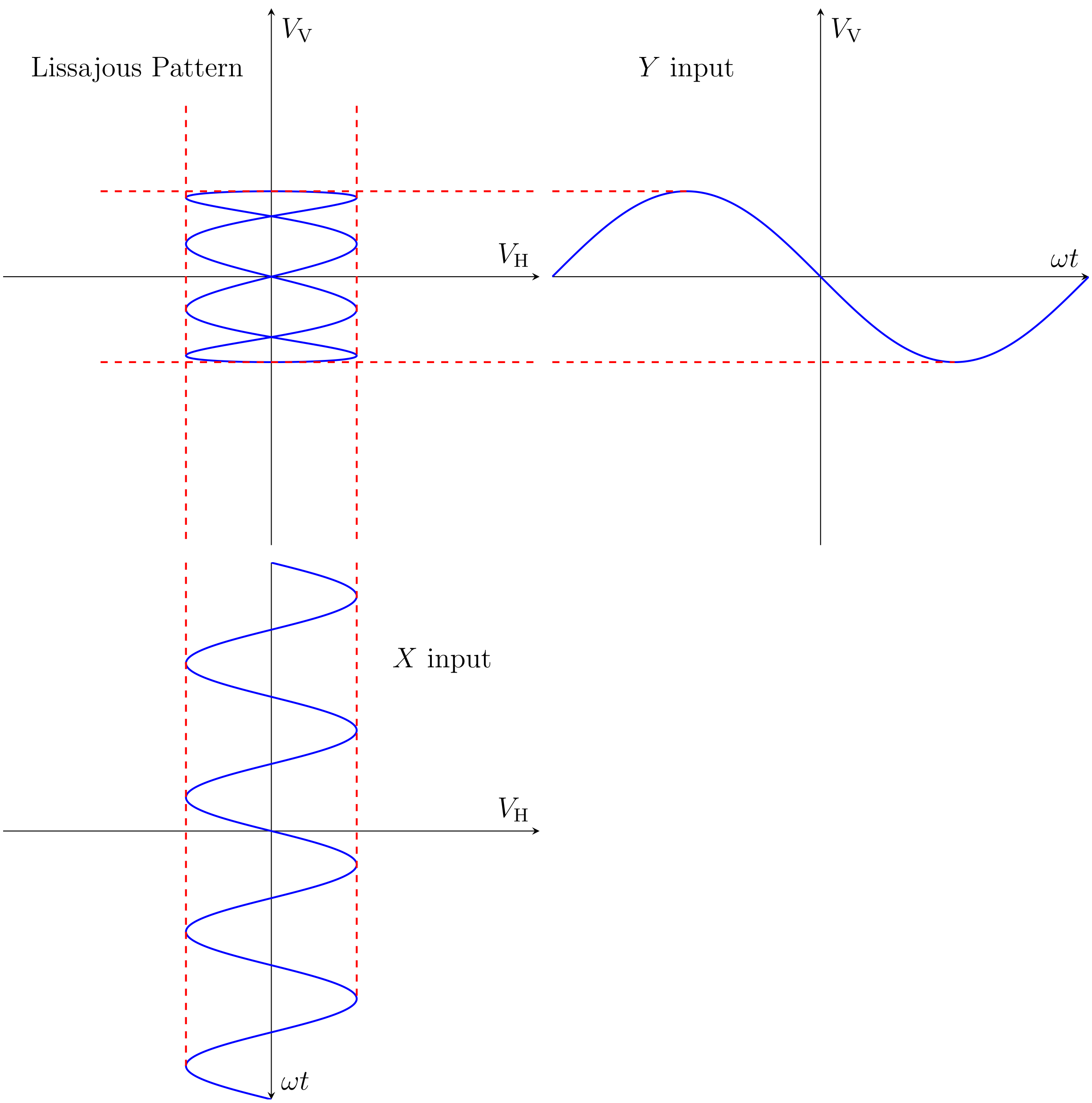

**Figure 5**

**Answer**:
$$\frac{f_X}{f_Y} = \frac{\text{Number of vertical tangents}}{\text{Number of horizontal tangents}} = \frac{4}{6} \implies \boxed{3f_X = 2f_Y}$$

**2.3** Two sinusoidal inputs having the same amplitudes but different period are applied to the X and Y inputs of the CRO. Draw the Lissajous pattern that will be observed on the CRT, for $T_Y = 4T_X$.

**Answer**: Since $T_Y = 4T_X$, we have $4f_Y = f_X$, from which we can draw the Lissajous pattern.

$$\frac{f_X}{f_Y} = \frac{4}{1}$$

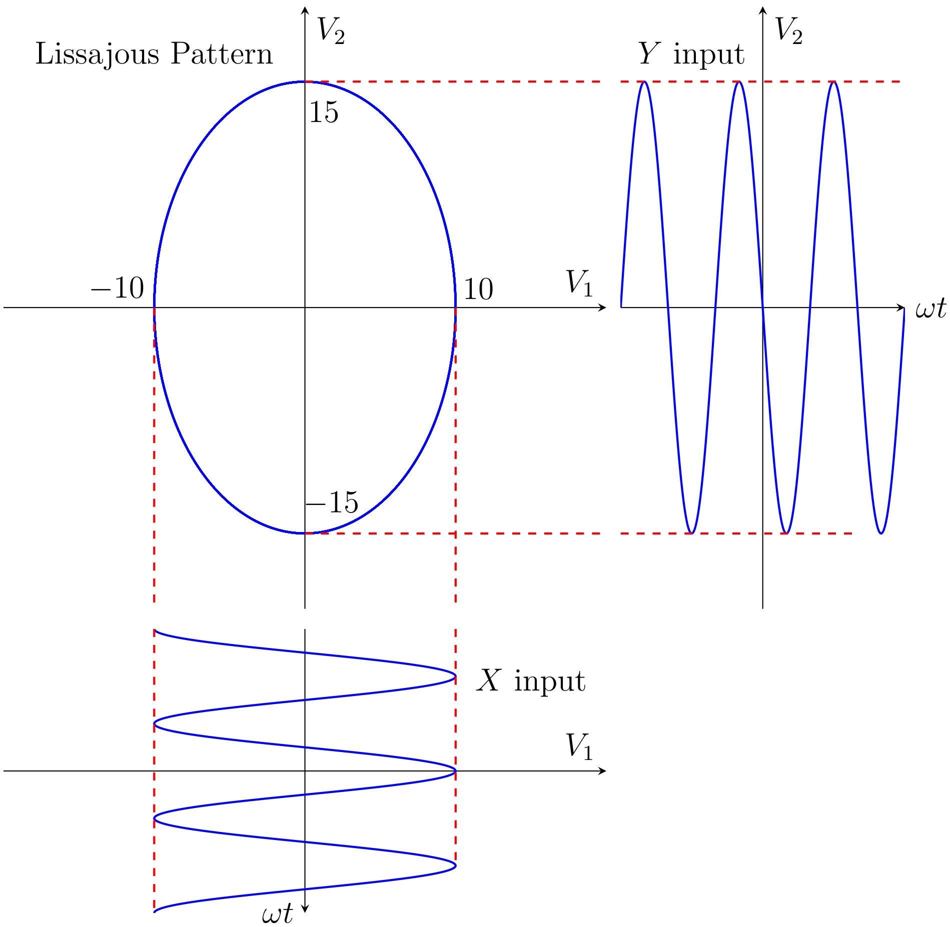



Axes in all graphs have the same scale and the same length.

**2.4** The signals $V_1$ and $V_2$ are applied to the $X$ and $Y$ inputs of the scope. Sketch the Lissajous pattern and calculate the phase difference between the two signals.

$$V_1 = 10\cos(\omega t), \qquad V_2 = 15\sin(\omega t - 180°)$$

**Answer**: $V_1 = 10\cos(\omega t) = 10\sin(\omega t + 90°)$




Phase angle: $90° - (-180°) = 270°$.