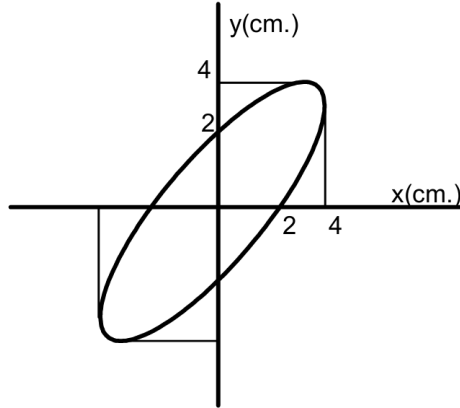


*This part of the experiment is prepared with Online LaTeX Editor Overleaf. Visit the website for the source here:*

<https://www.overleaf.com/read/khqqbrzzvcn#466db0>

## 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.

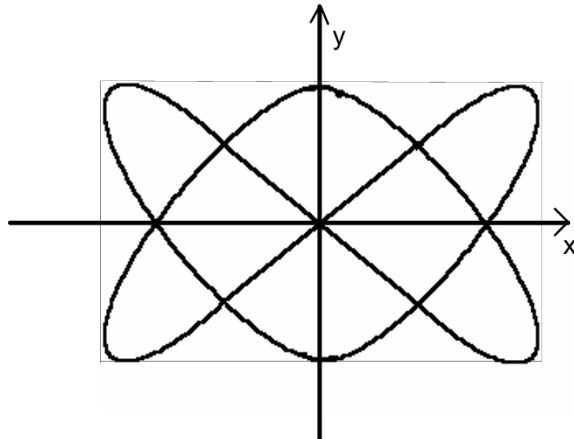


**Figure 4**

**Answer:** The phase shift can be obtained by taking the arcsine of the ratio of the amplitude of the voltage function and the  $y$ -intercept of the Lissajous pattern. 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**

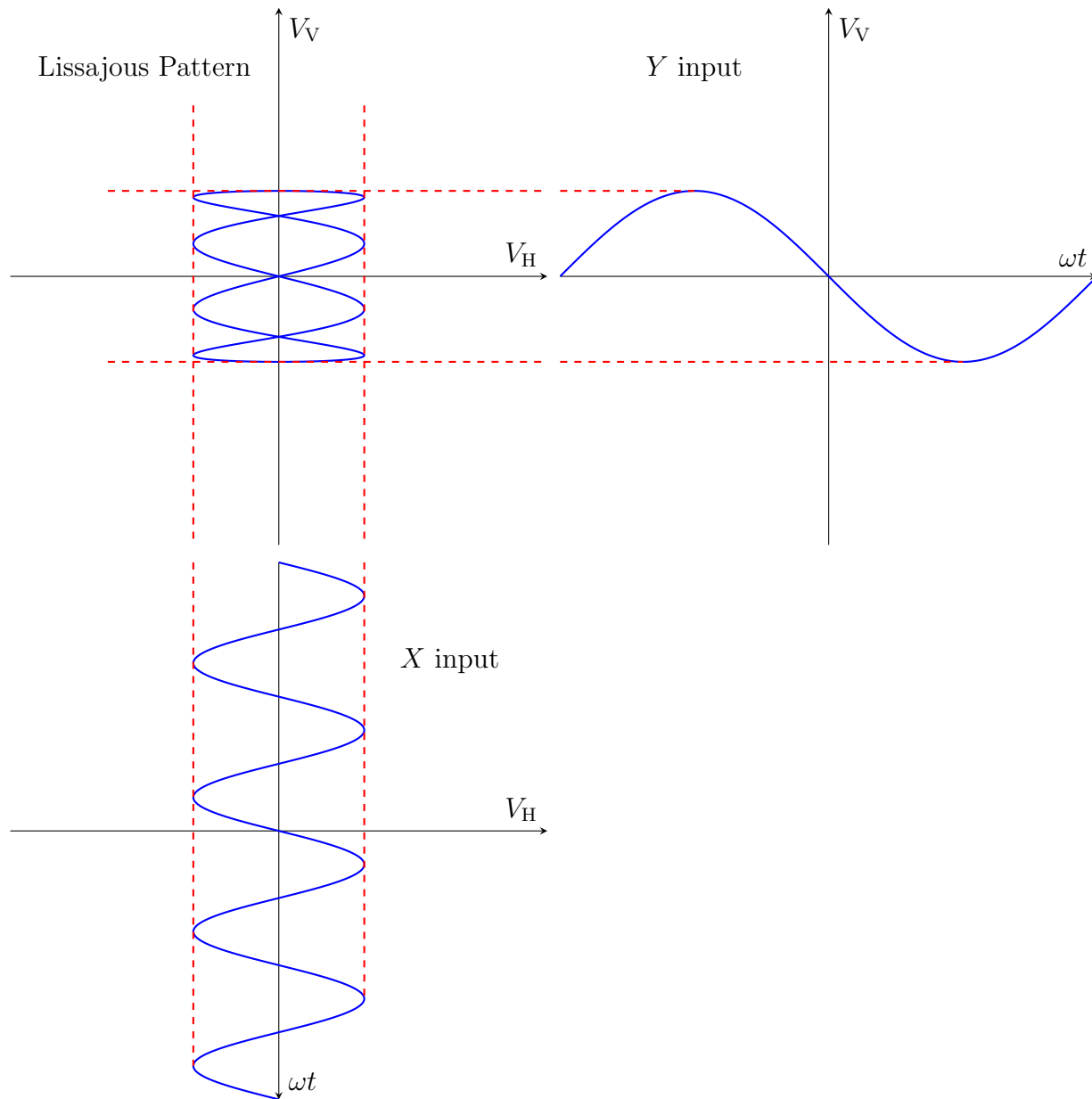
**Answer:**

$$\frac{f_X}{f_Y} = \frac{\text{Number of vertical tangents}}{\text{Number of horizontal tangents}} = \frac{4}{6} \Rightarrow \boxed{3f_X = 2f_Y}$$

**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.

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

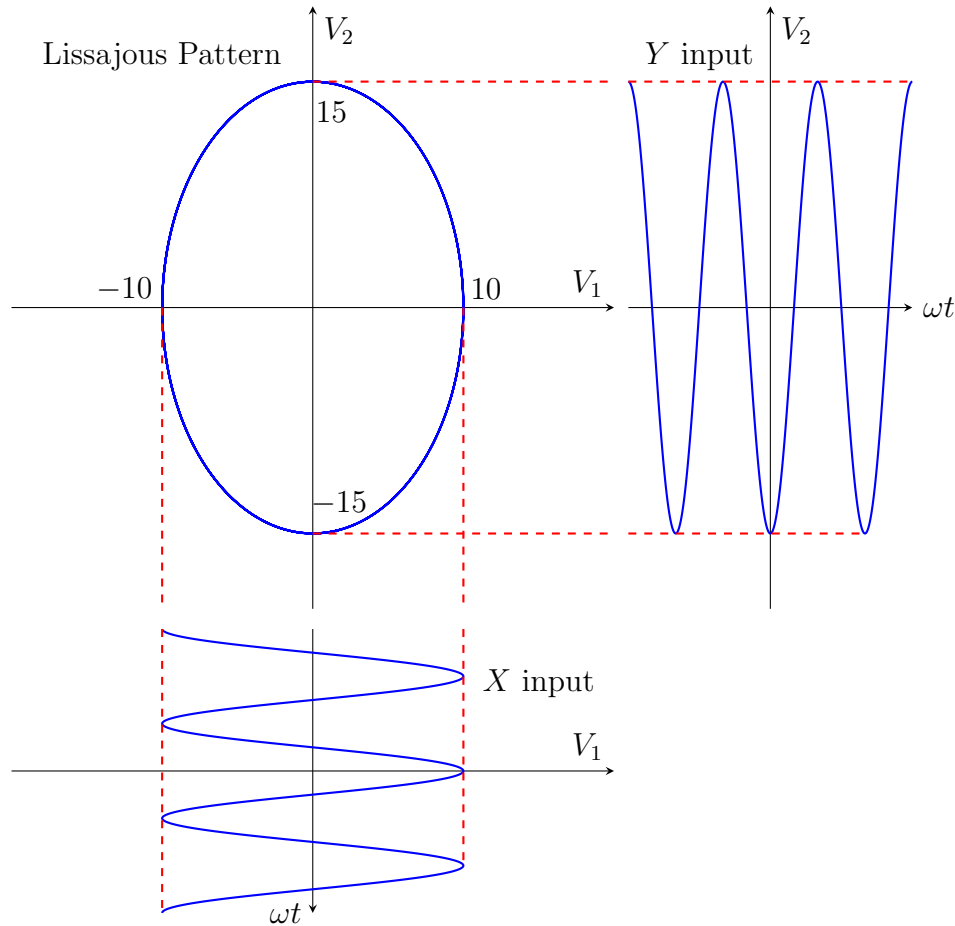


Axes in all graphs have the same scale and the same length.

**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.

$$V_1 = 10 \cos(\omega t), \quad V_2 = 15 \sin(\omega t - 180^\circ)$$

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



Phase angle:  $90^\circ - (-180^\circ) = 270^\circ$ .