

Question 1 (36p)

- (a) (18p) A sinusoidal voltage $v(t) = 150 \sin(1000\pi t + 45^\circ)$ is depicted in Fig. 1. Evaluate the time t_1 when the sinusoid crosses the t -axis (**Hint:** a standard representation of a sinusoid is $a(t) = A_m \sin(2\pi f t + \phi)$), where A_m is the amplitude, f is the cyclic frequency, and ϕ is the phase. Moreover, the period, T , can be calculated as $T = 1/f$.

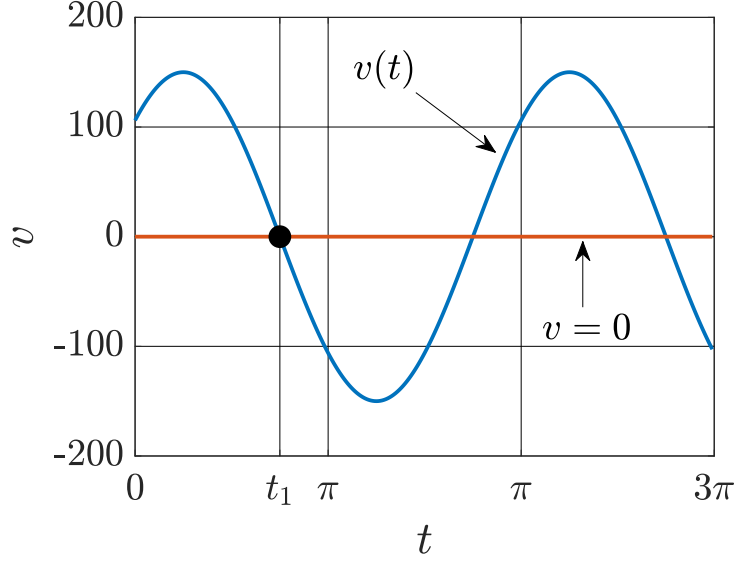


Figure 1: Figure for Question 1 (a)

- (b) (18p) Mathematically show that the integral of $v(t)$ is transformed to the phasor domain as $\mathbf{V}/j\omega$, such that

$$\int v \, dt \quad \Leftrightarrow \quad \frac{\mathbf{V}}{j\omega},$$

where $v(t) = V_m \cos(\omega t + \phi) = \text{Re}(V_m e^{j(\omega t + \phi)}) = \text{Re}(\mathbf{V} e^{j\omega t})$ and $\mathbf{V} = V_m e^{j\phi}$.