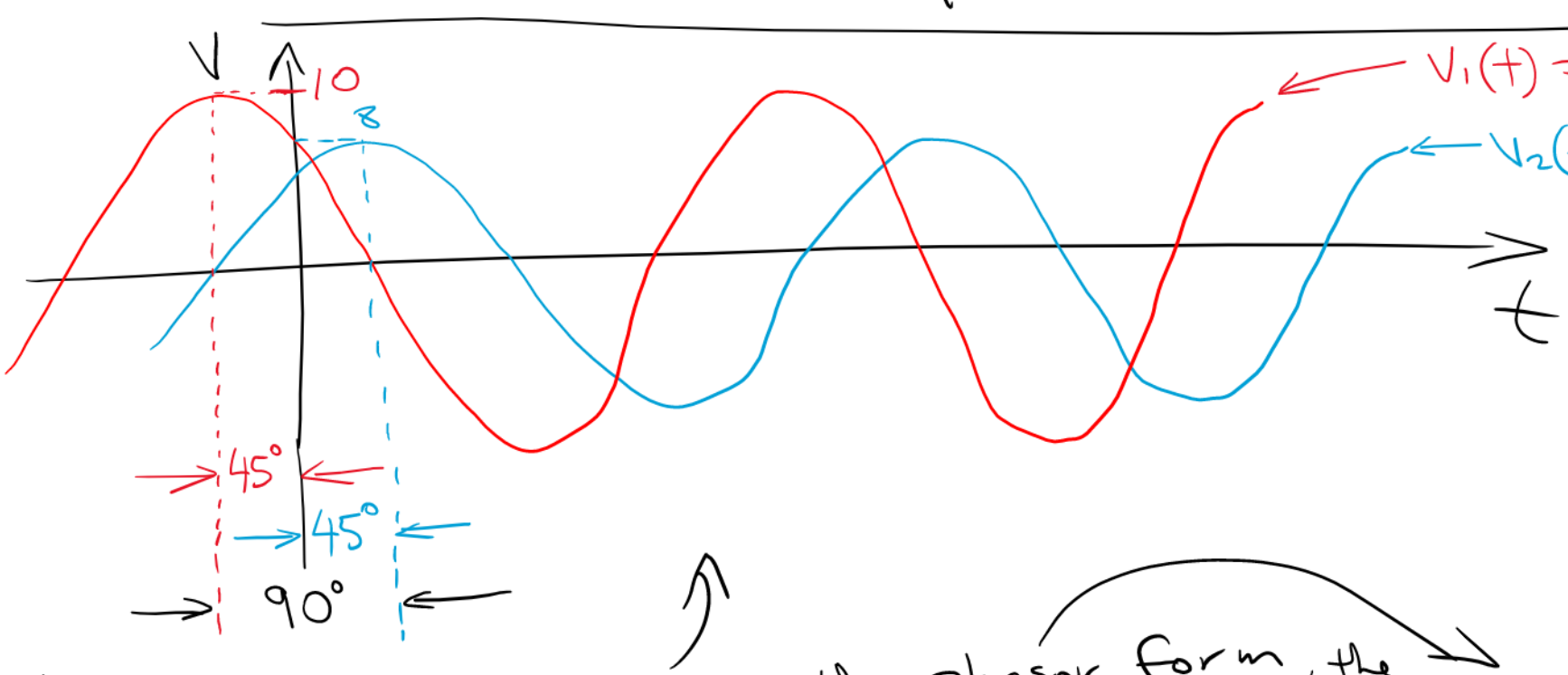
Phase Relationships Between Sinusoids



$v_1(t) = 10\cos(\omega t + 45°)$

$v_2(t) = 8\cos(\omega t - 45°)$

Phasor form

$\bar{V}_1 = 10\angle 45°$

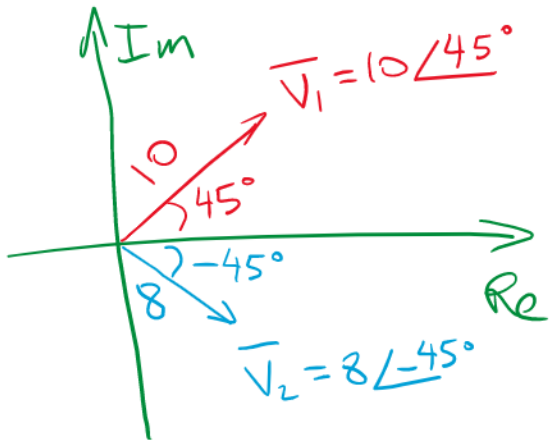
$\bar{V}_2 = 8\angle -45°$

In either the time domain or the phasor form, the following terminology applies.

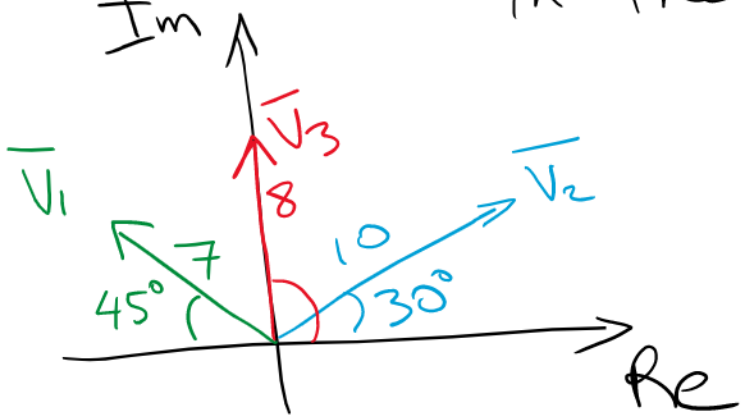
The phase of $v_1(t)$ is 90° higher than the phase of $v_2(t)$.

$v_1(t)$ leads $v_2(t)$ by 90°.

$v_2(t)$ lags $v_1(t)$ by 90°.



Example Express each phasor in the time domain, in the form of $v(t) = V_m \cos(\omega t + \theta)$. Let $f = 100\,Hz$



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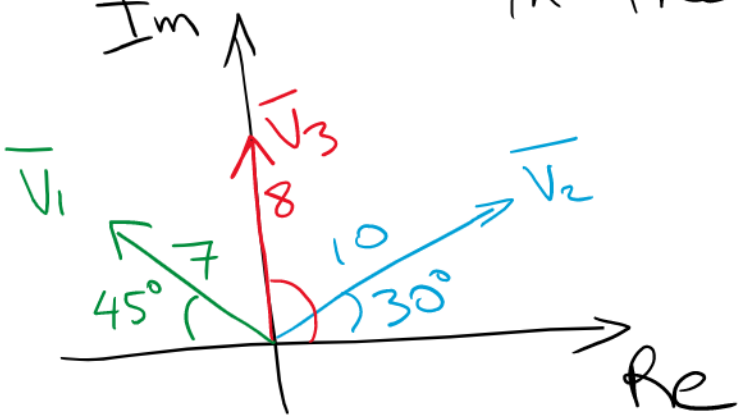
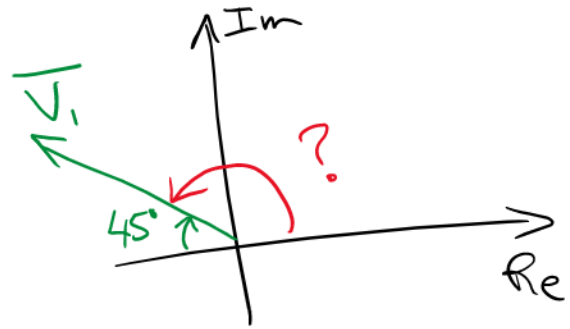


$\bar{V}_1 = 7 \angle 180° - 45° = 7 \angle 135°$

$\bar{V}_2 = 10 \angle 30°$

$\bar{V}_3 = 8 \angle 90°$



Need to convert f into ω. → $f = 100\,Hz$,

$\omega = 2\pi f = 2\pi(100\,Hz)$

$\omega = 200\pi$ radians/sec

$v_1(t) = 7 \cos(200\pi t + 135°)$

$v_2(t) = 10 \cos(200\pi t + 30°)$

$v_3(t) = 8 \cos(200\pi t + 90°)$

$v_1(t)$ leads $v_2(t)$ by: $135° - 30° = 105°$

$v_1(t)$ leads $v_3(t)$ by: $135° - 90° = 45°$

$v_3(t)$ leads $v_2(t)$ by: $90° - 30° = 60°$

$v_3(t)$ lags $v_1(t)$ by: $135° - 90° = 45°$