HW #21 Solutions EE301

Ch. 15 #'s 29, 35, 43d, 54ac, 55ac, 56

15.29) a. $V_m = 170V$, $f = 60Hz$

$\omega = 2\pi f = 2\pi(60) = 377\ rad/s$

↑ use when calculator in RADIAN mode

$$v(t) = 170V \sin(377\ rad/s)t$$

b. $I_m = 40\mu A$, $T = 10ms$

$\omega = \frac{2\pi}{T} = \frac{2\pi}{10ms} = 628\ rad/s$

$$I(t) = 40\mu A \sin(628\ rad/s)t$$

c. $T = 120\mu s$, $v(12\mu s) = 10V$

$\omega = \frac{2\pi}{T} = \frac{2\pi}{120\mu s} = 52.36\times10^3\ rad/s$

$v(t) = V_m \sin\omega t$

$v(12\mu s) = V_m \sin(52.36\times10^3\ rad/s)(12\times10^{-6}\ s)$

$10V = V_m(0.588)$

$V_m = 17V$

$$v(t) = 17V \sin(52.36\times10^3\ rad/s)t$$

15.35) a. $i_m = 5mA$

$\omega = 1000\ rad/s$

phase shift $= \theta = \frac{\pi}{5}\ rad\left(\frac{360°}{2\pi\ rad}\right) = 36°$

$$i(t) = 5mA \sin((1000\ rad/s)t + 36°)$$

b. $i_m = 10A$

$\omega = \frac{2\pi}{T} = \frac{2\pi}{50\times10^{-3}} = 126\ rad/s$

$\theta = 180° - 60° = 120°$

$$i(t) = 10A \sin((126\ rad/s) + 120°)$$

15.35) c. $V_M = 40V$

$\omega = 2\pi f = 2\pi(900) = 5655 \text{ rad/s}$

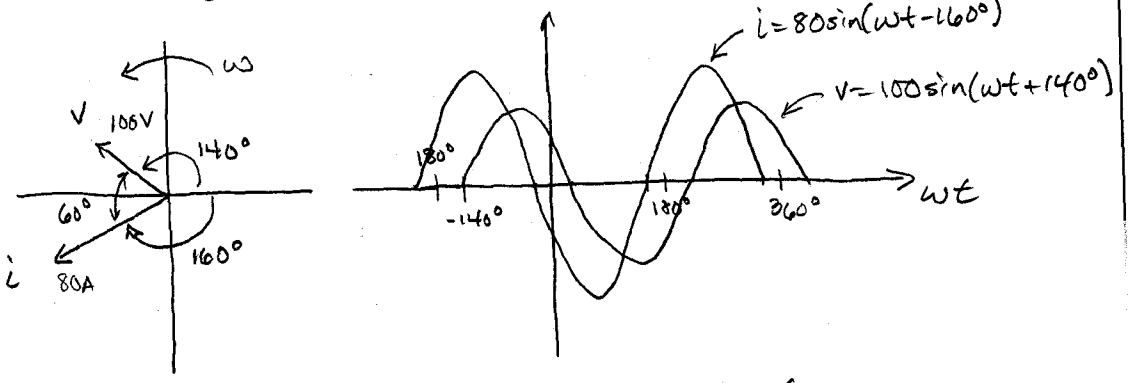
$\theta = -\frac{\pi}{4}\text{rad}\left(\frac{360°}{2\pi\text{rad}}\right) = -45°$

$$v(t) = 40V\sin((5655\text{rad/s}) - 45°)$$

Note the starting point for the sine cycle has shifted $\frac{\pi}{4}$ rad to the right thus giving a negative phase shift.

15.43) d. $v = 100\sin(\omega t + 140°)$

$i = 80\sin(\omega t - 160°)$



From phasor, we can see that current leads voltage by 40°.

15.54) a. Determine effective value of $v = 100V\sin\omega t$

$$V_{eff} = \frac{V_m}{\sqrt{2}} = \frac{100V}{\sqrt{2}} = \boxed{70.7V}$$

c. $v = 40V\sin(\omega t + 40°)$

$$V_{eff} = \frac{V_m}{\sqrt{2}} = \frac{40V}{\sqrt{2}} = \boxed{28.3V}$$

15.55) a. 12 volt battery

$$V_{rms} = \sqrt{V_{DC}^2 + V_{AC}^2} = \sqrt{(12V)^2 + 0^2} = \boxed{12V}$$

c. $v = 10V + 24V\sin\omega t$

$V_{DC} = 10V$, $V_{AC} = \frac{24V}{\sqrt{2}} = 16.97V$

$$V_{rms} = \sqrt{V_{DC}^2 + V_{AC}^2} = \sqrt{(10V)^2 + (16.97V)^2} = \boxed{19.7V}$$

15.56) If $V_{eff} = 9V$ for a sine curve, what is V_m?

$$V_{eff} = \frac{V_m}{\sqrt{2}}$$

$$V_m = V_{eff}\sqrt{2}$$

$$= 9V\sqrt{2}$$

$$\boxed{V_m = 12.7V}$$