Polar form

Ex $4.23 + j\,4.23$

$$\text{Mag} = \sqrt{(4.23)^2 + (4.23)^2} \qquad \text{Angle} = \tan^{-1}\left(\frac{4.23}{4.23}\right)$$

Polar form $4.23\sqrt{2} \angle \pi/4$

Ex (a) $v = \sqrt{2}(50)\sin(377t - 35)$

$v = 50 \angle -35 \qquad \omega = 377$

(b) $v = 83.6 \cos(400t - 15^\circ)$

$= \frac{83.6}{\sqrt{2}} \angle 15^\circ = 59.1 \angle 15^\circ$

(c) $i = 3.46 \cos(815t + 30^\circ)\ A$

$= 2.45 \angle 30^\circ$

(d) $i = 10.2 \angle -40^\circ \qquad \omega = 377\ \text{rad/s}$

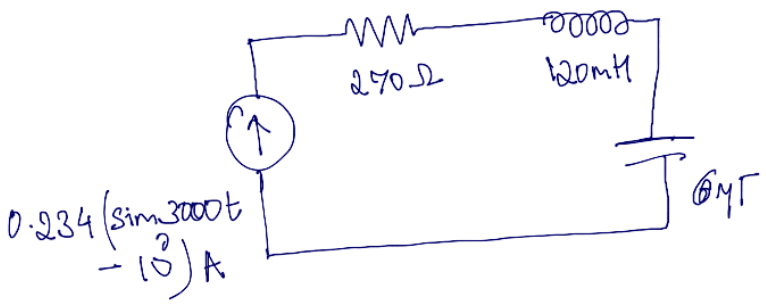
$10.2\left[\cos(\omega t - 40) - \sin(\omega t - 400^\circ)\right]$

$\Rightarrow \quad 10.2\sqrt{2}\cos(\omega t - 40)$

(e) $4 - j6 = \sqrt{4^2 + 6^2} \angle \tan^{-1}\left(\frac{-3}{2}\right) = 7.2 \angle -56^\circ$

$= 7.2\cos(\omega t - 56^\circ)$

Ex




Find $V_s$

$\omega = 3000$

$X_L = j\omega L = j\ 3000 * 120m = 360j$

$X_C = \frac{1}{j\omega C} = \frac{-j}{3000 * 6\mu} = -j\ \frac{1000}{18} = -j\ 55.56$

$I_s = 0.234 \angle -10^\circ$

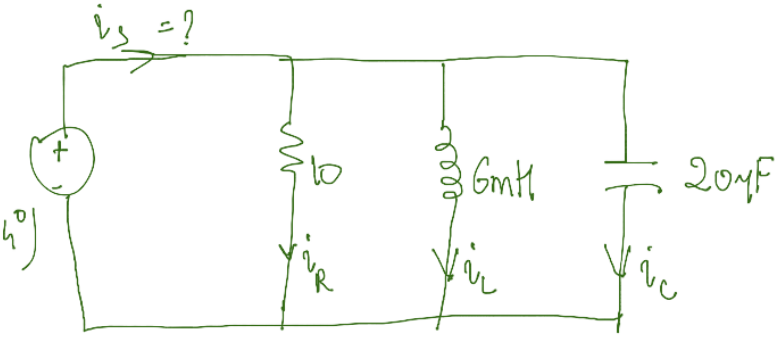
$V_s = .234 \angle -10^\circ \left( 270 + 360j - 55.56j \right)$

$= 0.234 \angle -10^\circ \left( 270 + j\ 304.44 \right)$

$= .234 \angle -10^\circ \quad 406 \angle \tan^{-1} \frac{304}{270}$

$= .234 * 406 \angle 48.56 + 0 = 95 \angle 38.56$

Ex




$V_s$

$150 \sin(2500t - 34°)$

$\Rightarrow \omega = 2500$

Find $i_s$

$i_s$ =?

$$X_L = j\omega L = j\, 2500 * 6m = 15j$$

$$X_C = \frac{-j}{\omega C} = \frac{-j * 1000}{2500 * 2} = -20j$$

$$i_s = i_R + i_L + i_C$$

$$= \frac{V_s}{R} + \frac{V_s}{X_L} + \frac{V_s}{X_C}$$

$$= V_s \left(\frac{1}{10} + \frac{1}{5j} - \frac{1}{20j}\right) = V_s (0.1 - j\,0.0667 + .05j)$$

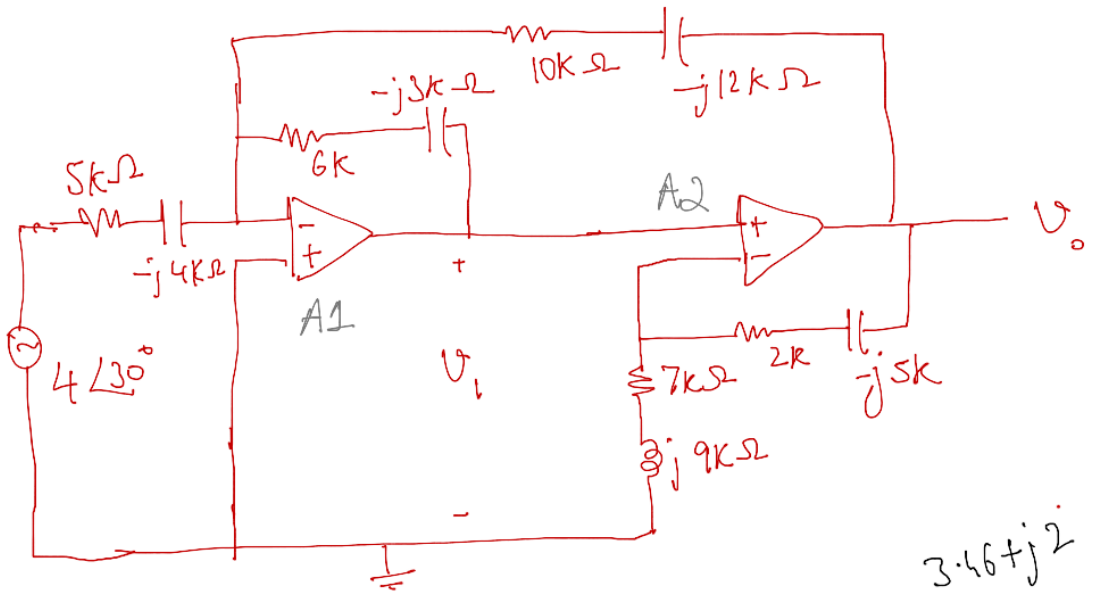
$$= V_s (0.1 - j0.01667)$$

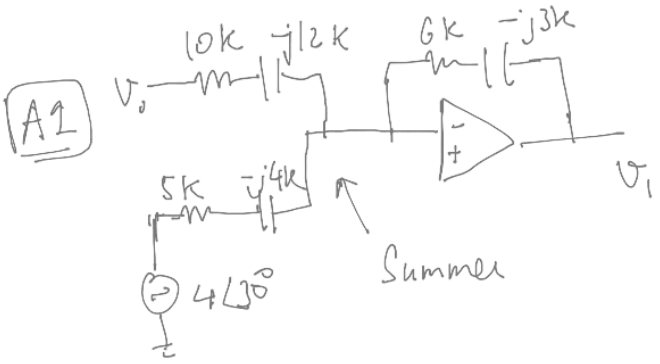
$$= 150 \angle -34° * \sqrt{.1^2 + .01667^2}\ \angle \tan^{-1}(-.1667)$$

$$i_s = 150 \times 0.10138 \angle -34.946 = 15.207 \angle -43.46$$

Example

Find $V_o$



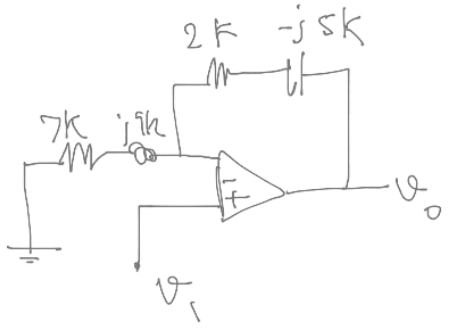




$$V_1 = -\left[\frac{6-j3}{5-j4} * 4\angle 30^\circ + \frac{6-j3}{10-j12} V_o\right]$$

$3.46+j2$

$$\therefore V_1 = -\left(\frac{R_f}{R_1} * V_1 + \frac{R_f}{R_2} V_2\right)$$

$$V_1 = -\left(\frac{6.7\angle -26^\circ}{6.4\angle -38} 4\angle 30^\circ + \frac{6.7\angle -26}{15.6\angle -50} V_o\right)$$




$$= 4.186\angle -137 - 0.429\angle 23\, V_o$$

$$= (-3.105 - j2.808) - (.393 + .172j) V_o$$

$$V_o = \frac{2-j5}{7+j9} * V_1 = 0.4723\angle -120$$

$$= (-0.2385 - j0.4077) V_1$$

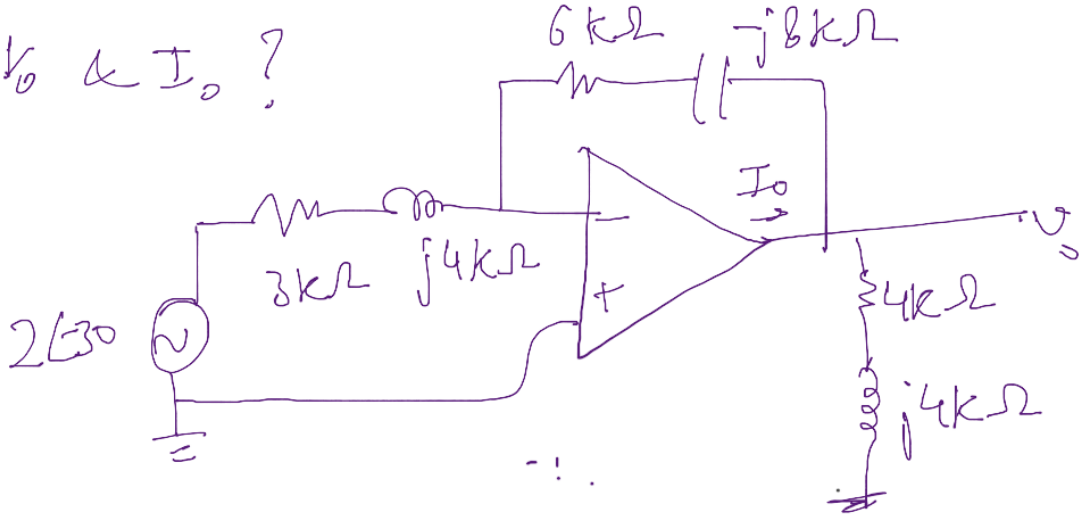
Eliminate $V_1$

$$V_o = (-.2385 - j.4077)\left[(-3.105 - j2.808) - (.393 + j.172) V_o\right]$$

$$V_o\left[1 - (.2395 + .4077j)(0.393 + j.172)\right] = \frac{-.2385 - j\,0.4077}{-3.105 - j2.808}$$

$$V_o = 0.113\angle 29^\circ$$

Example $V_o$ & $I_o$ ?




∴

Sol Inverting Amp with $R_L = (4k + j4k)$

$$V_o = -\frac{Z_f}{Z_1} V_{in} = -\frac{6k - j8k}{3k + j4k} * 2\angle -30$$

$$= 2.88 + j\,2.7616 = 3.996\angle 43^\circ$$

$$I_o = \frac{V_o}{Z_L \| Z_f} = \frac{3.996\angle 43}{(4+j4)\|(6k-j8k)} =$$

$$= 0.760\angle 30$$