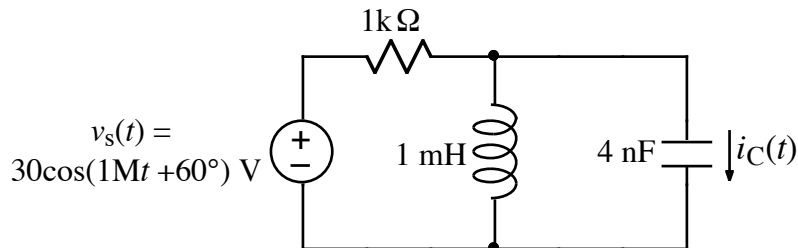


Ex:



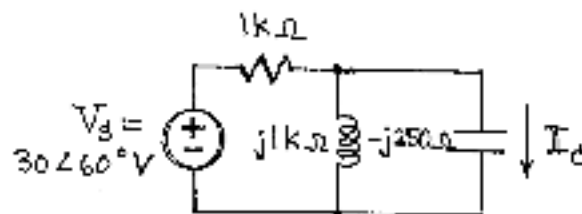
- Find the phasor value for  $v_s(t)$ .
- Draw the frequency-domain circuit diagram, including the phasor value for  $v_s(t)$  and impedance values for components.
- Find the phasor value for  $i_C(t)$ .

sol'n: a)  $P[30 \cos(1Mt + 60^\circ) V] = 30 e^{j60^\circ} V$  or  $30 \angle 60^\circ V$

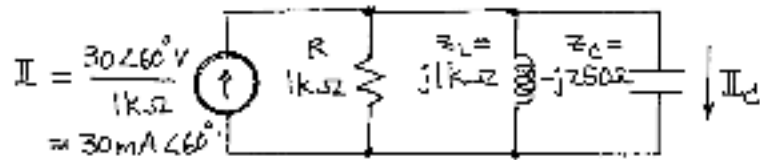
b) We calculate the impedances:

$$z_L = j\omega L = j 1M \cdot 1mH = j1k\Omega$$

$$z_C = \frac{1}{j\omega C} = \frac{-j}{\omega C} = \frac{-j}{1M \cdot 4nF} = \frac{-j}{4m} = -j250\Omega$$



- One way to solve this problem is to use a Norton equivalent for  $V_s$  and the  $1k\Omega$  resistor.



Using the current divider formula, we have

$$I_C = I \frac{R \parallel Z_L}{R \parallel Z_L + Z_C}$$

$$= I \frac{1}{1 + \frac{Z_C}{R \parallel Z_L}}$$

$$= I \frac{1}{1 + Z_C \left( \frac{1}{R} + \frac{1}{Z_L} \right)}$$

$$= I \frac{1}{1 + \frac{Z_C}{R} + \frac{Z_C}{Z_L}}$$

$$= 30 \text{ mA} \angle 60^\circ \frac{1}{1 + \frac{-j250 \Omega}{1 \text{ k}\Omega} + \frac{-j250 \Omega}{j1 \text{ k}\Omega}}$$

$$= 30 \text{ mA} \angle 60^\circ \frac{1}{1 - \frac{1}{4} - j\frac{1}{4}}$$

$$= \frac{30 \text{ mA} \angle 60^\circ}{\frac{3}{4} - j\frac{1}{4}}$$

$$= \frac{120 \text{ mA} \angle 60^\circ}{3-j}$$

$$= \frac{120 \text{ mA} \angle 60^\circ}{3-j} \cdot \frac{3+j}{3+j}$$

$$= \frac{120 \text{ mA} \angle 60^\circ (3+j)}{3^2+1^2}$$

$$= 12 \text{ mA} \angle 60^\circ (3+j)$$

$$= 12 \text{ mA} \left( \frac{1}{2} + j\frac{\sqrt{3}}{2} \right) (3+j)$$

$$= 12 \text{ mA} \left[ \frac{3}{2} - \frac{\sqrt{3}}{2} + j\left(\frac{1}{2} + \frac{3\sqrt{3}}{2}\right) \right]$$

$$\mathbb{I}_c = 6 \text{ mA} \left[ 3 - \sqrt{3} + j(1 + 3\sqrt{3}) \right]$$

Note: This is an exact answer, but an approximate polar answer is more useful.

$$\mathbb{I}_c = 12 \text{ mA} \angle 60^\circ (3+j)$$

$$= 12 \text{ mA} \angle 60^\circ \cdot \sqrt{3^2+1^2} \angle \tan^{-1} \frac{1}{3}$$

$$= 12 \text{ mA} \angle 60^\circ \cdot \sqrt{10} \angle 18.4^\circ$$

$$\mathbb{I}_c = 12\sqrt{10} \text{ mA} \angle 78.4^\circ$$

Note:  $i_c(t) = 12\sqrt{10} \text{ mA} \cos(1Mt + 78.4^\circ)$