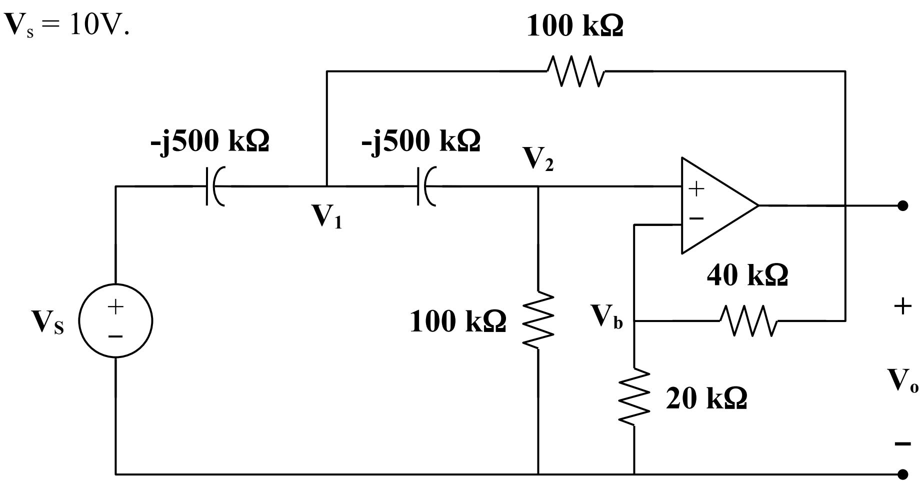
Chapter 10, Solution 75.

$$\omega = 2\times 10^3$$

$$C_1 = C_2 = 1\text{ nF} \longrightarrow \frac{1}{j\omega C_1} = \frac{1}{j(2\times 10^3)(1\times 10^{-9})} = -j500\text{ k}\Omega$$

Consider the circuit shown below.

Let $\mathbf{V}_s = 10\text{V}$.



At node 1,

$$[(\mathbf{V}_1-10)/(-j500k)] + [(\mathbf{V}_1-\mathbf{V}_o)/10^5] + [(\mathbf{V}_1-\mathbf{V}_2)/(-j500k)] = 0$$

or $(1+j0.4)\mathbf{V}_1 - j0.2\mathbf{V}_2 - \mathbf{V}_o = j2$ (1)

At node 2,

$[(\mathbf{V}_2-\mathbf{V}_1)/(-j500k)] + [(\mathbf{V}_2-0)/100k] + 0 = 0$ or

$-j0.2\mathbf{V}_1 + (1+j0.2)\mathbf{V}_2 = 0$ or $\mathbf{V}_1 = [-(1+j0.2)/(-j0.2)]V_2$

$= (1-j5)\mathbf{V}_2$ (2)

At node b,

$$\mathbf{V_b} = \frac{R_3}{R_3+R_4}\mathbf{V}_o = \frac{\mathbf{V}_o}{3} = \mathbf{V_2} \qquad (3)$$

From (2) and (3),

$\mathbf{V}_1 = (0.3333-j1.6667)\mathbf{V}_o$ (4)

Substituting (3) and (4) into (1),

$$(1+j0.4)(0.3333-j1.6667)\mathbf{V}_o - j0.06667\mathbf{V}_o - \mathbf{V}_o = j2$$

$$(1+j0.4)(0.3333-j1.6667) = (1.077\angle 21.8^\circ)(1.6997\angle -78.69^\circ)$$
$$= 1.8306\angle -56.89^\circ = 1-j1.5334$$

$$(1–1+j(–1.5334–0.06667))\mathbf{V_o} = (–j1.6001)\mathbf{V_o} = 1.6001\angle–90^\circ$$

Therefore,

$$\mathbf{V}_o = 2\angle 90^\circ/(1.6001\angle–90^\circ) = 1.2499\angle 180^\circ$$

Since $\mathbf{V}_s = 10$,

$$\mathbf{V}_o/\mathbf{V}_s = \mathbf{0.12499\angle 180}^\circ.$$