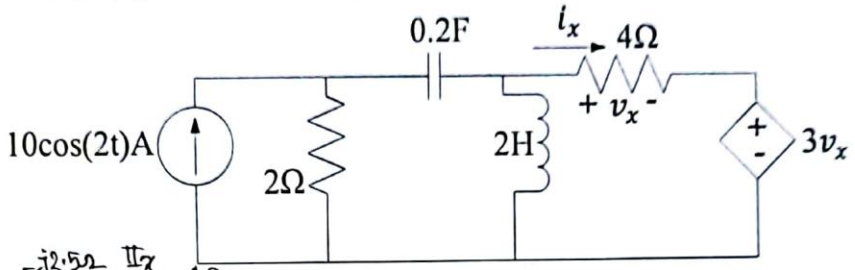
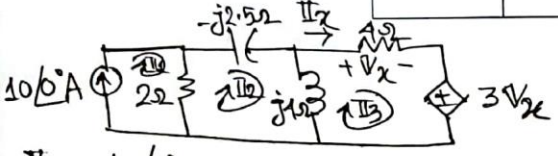
1. Using superposition theorem, find v_x and i_x in the following circuit.





$V_x = 4I_3$

$I_1 = 10\angle 0°$

KVL in Mesh 2:

$$2(I_2 - 10\angle 0°) - j2.5I_2 + j4(I_2 - I_3) = 0$$
$$(2 - j2.5 + j4)I_2 - j4I_3 = 20$$
$$(2 + j1.5)I_2 - j4I_3 = 20 \quad \text{---(1)}$$

KVL in Mesh 3:

$$j4(I_3 - I_2) + 4I_3 + 3V_x = 0$$
$$j4(I_3 - I_2) + 4I_3 + 3\times 4I_3 = 0$$
$$-j4I_2 + (j4 + 4 + 12)I_3 = 0$$
$$-j4I_2 + (j4 + 16)I_3 = 0 \quad \text{---(11)}$$

$$\Delta = \begin{vmatrix} (2+j1.5) & -j4 \\ -j4 & (16+j4) \end{vmatrix}$$
$$= \{(2+j1.5)\times(16+j4)\} - \{(-j4)\times(-j4)\}$$
$$= 52.802\angle 37.304°$$

$$\Delta_3 = \begin{vmatrix} (2+j1.5) & 20 \\ -j4 & 0 \end{vmatrix}$$
$$= -(20\times -j4)$$
$$= 80.006\angle 89.284°$$

$$I_3 = \frac{\Delta_3}{\Delta} = 1.515\angle 51.98° \text{ A}$$
$$V_x = 4I_3 = 4\times 1.515\angle 51.98°$$
$$= 6.06\angle 51.98° \text{ V}$$
$$I_x = I_3 = 1.515\angle 51.98° \text{ A}$$
$$v_x(t) = 6.06\cos(2t + 51.98°) \text{ V}$$
$$i_x(t) = 1.515\cos(2t + 51.98°) \text{ A}$$