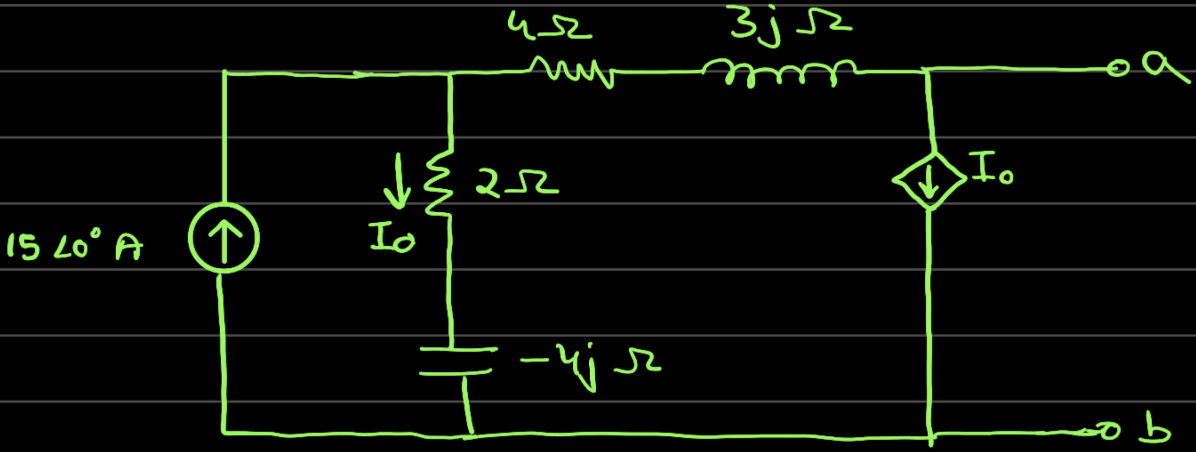
Day-8

1.)



Find V_{Th}, Z_{Th}.

Ans.)

$$I_o + 0.5 I_o = 15$$

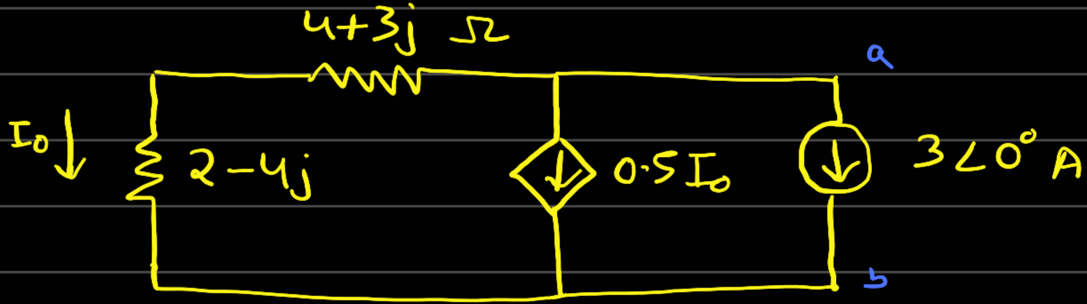
$$\Rightarrow I_o = 10 \angle 0^\circ \text{ A}$$

$$V_{ab} = (2-4j) I_o - (4+3j)(0.5 I_o)$$

$$= 20 - 40j - 20 - 15j$$

$$= -55j$$

So $V_{ab} = 55 \angle -90^\circ$ V



$$I_o = 2 \angle 0^\circ \text{ A}$$

$$V_{ab} = (4+3j+2-4j)(2)$$

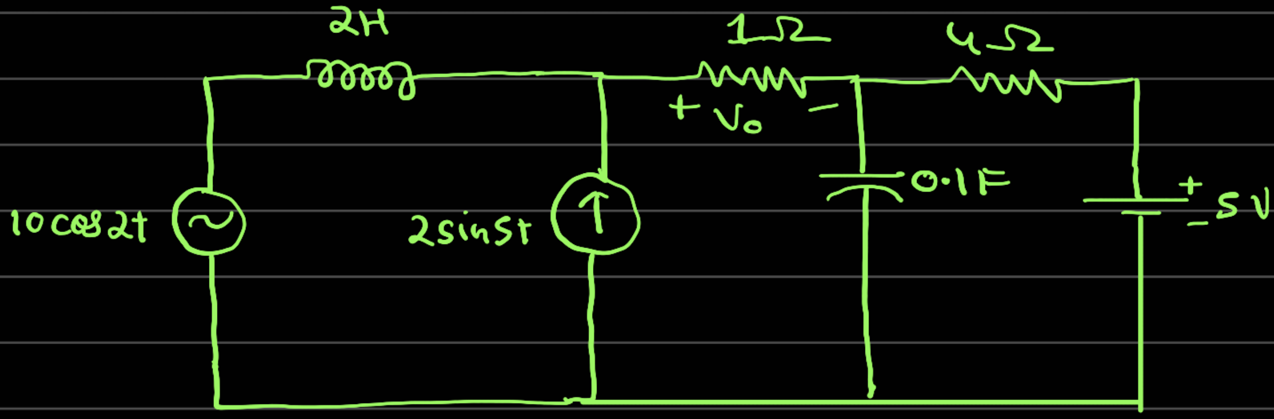
$$= 2(6-j)$$

$$Z = 2(6-j)$$

$$= 4 - \frac{2j}{3}$$

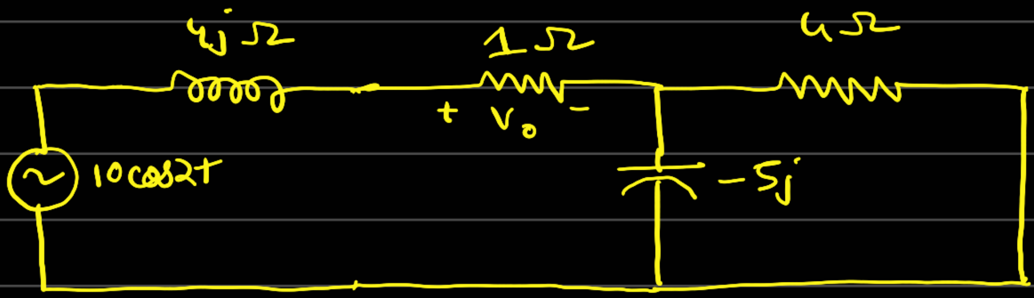
$$= 4.055 \angle -9.46^\circ \ \Omega$$

2.)



Find V_o

Ans.) Use superposition.



$$4 \parallel -5j = \frac{4 \times -5j}{4-5j} = \frac{-20j}{4-5j}$$

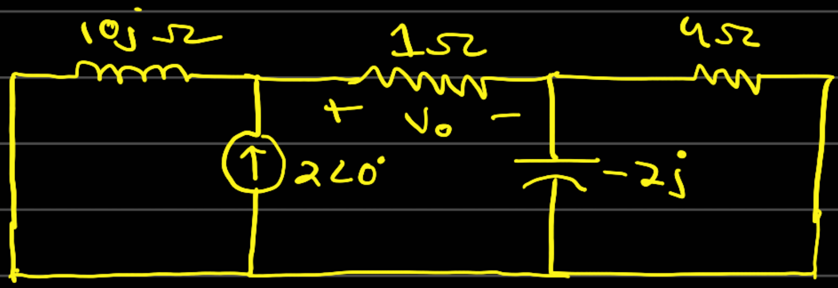
$$= \frac{20}{41}(-5+4j)$$

$$V_o = \frac{10\angle 0^\circ}{1+4j+\frac{20}{41}(-5+4j)}$$

$$= \frac{10\angle 0}{-\frac{59}{41}+\frac{244j}{41}} \text{ V}$$

$$= \frac{410 \angle 0}{-59 + 244j} \text{ V}$$

$$= 2.498 \cos(2t - 30.784^\circ)$$



$$V_o = 2\angle 0 \times \frac{10j}{1 + 10j + \frac{4(-2j)}{4-2j}}$$

$$= 2\angle 0 \times \frac{10j}{1 + 10j + \frac{-4j}{2-j}}$$

$j(2+j)$

$2j - 1$

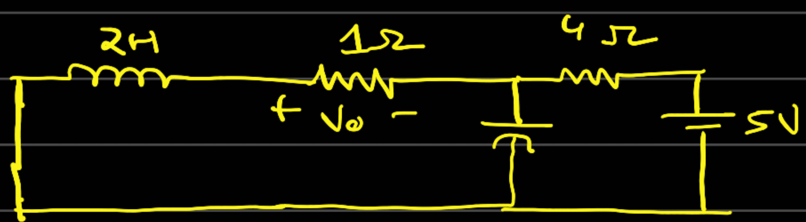
$$= 2\angle 0 \times \frac{10j}{1 + 10j + \frac{4}{5}(1-2j)}$$

$$= 2\angle 0 \times \frac{50j\;(9-42j)}{9+42j}$$

$$= 2\angle 0 \times \frac{50 \times (42+9j)}{1845}$$

$$= \frac{100}{1845}(42+9j)$$

$$= 2.33 \sin(5t + 12.1^\circ)$$

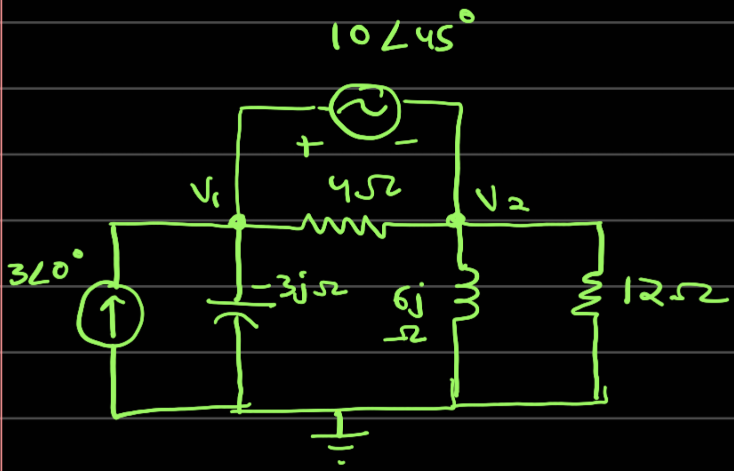


At steady state,

$$V_0 = -1\,V$$

$$V_{1\Omega} = -1 + 2.33\sin(5t + 12.1^\circ) + 2.498\cos(2t - 30.784^\circ)$$

3.)



Find V_1, V_2

Ans)

$$V_1 - V_2 = 10\angle 45^\circ = 5\sqrt{2}(1+j)$$

$$-3 + \frac{V_1}{-3j} + \frac{V_2}{6j} + \frac{V_2}{12} = 0$$

$$\Rightarrow -3 + \frac{V_1 j}{3} - \frac{V_2 j}{6} + \frac{V_2}{12} = 0$$

$$\Rightarrow -36 + 4V_1 j - 2V_2 j + V_2 = 0$$

$$\Rightarrow 4V_1 j + V_2(1-2j) = 36$$

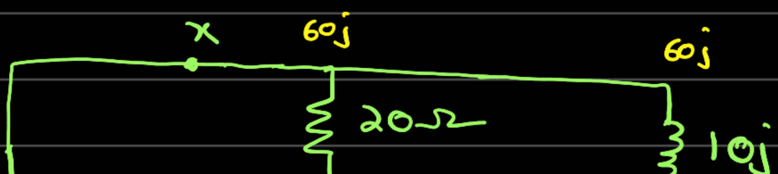
$$\Rightarrow 4(V_2 + 5\sqrt{2} + 5\sqrt{2}j)j + V_2(1-2j) = 36$$

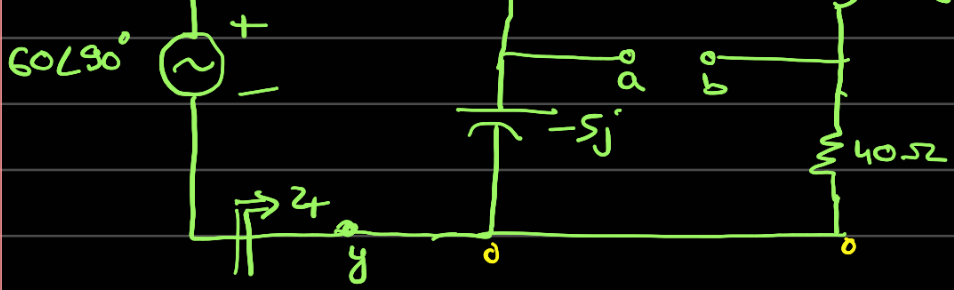
$$\Rightarrow V_2 = \frac{36 + 5\sqrt{2} - 20\sqrt{2}j}{1+2j}$$

$$= 31.41\angle -87.18^\circ\,V$$

$$V_1 = 25.78\angle -70.48^\circ\,V$$

4.)





Find V_{ab} and Z_T (from x–y terminals)

Ans:) $$\frac{(40+10j)(20-5j)}{60+5j} = 14.07 - 1.17j$$

$$= 14.12 \angle -4.75^\circ$$

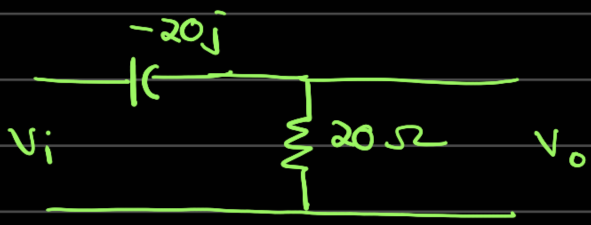
Finding V_{ab}

$$V_{ab} = V_a - V_b = \frac{60j}{20-5j} \times (-5j) - \frac{60j}{40+10j} \times 40$$

$$= 3.53 - 14.12i - (14.12 + 56.47i)$$

$$= -10.59 - 70.59j$$

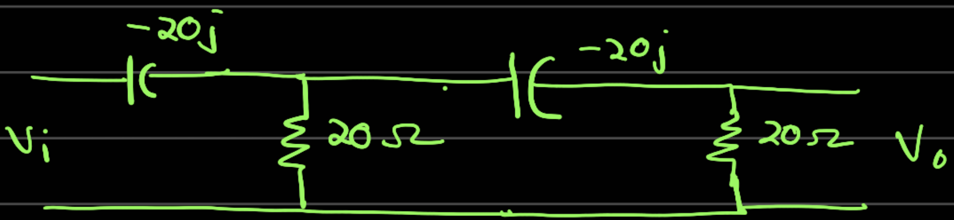
5.)



Ans) $$\frac{V_o}{V_i} = \frac{20}{20-20j} = \frac{1+j}{2}$$

$$= \frac{1}{\sqrt{2}} \angle 45^\circ$$

6.)



$$\frac{V_o}{V_i} = \left(\frac{20}{20-20j}\right)^2 = \left(\frac{1+j}{2}\right)^2$$

$$= \frac{i}{2} = \frac{1}{2}\angle 90^\circ$$

$$20(1-j) \parallel 20$$

$$= \frac{20(1-j)\times 20}{20(2-j)} = 4(3-j)$$

$$I_{net} = \frac{V_i}{12(1-2j)} = \frac{V_i}{60}\frac{(1+2j)}{3-j}$$

$$I_{net} \times 4(3-j) = \frac{V_i}{15}(5+5j)$$

$$= \frac{V_i}{3}(1+j)$$

$$V_o = \frac{\frac{V_i}{3}(1+j)}{20(1-j)} \times 20$$

$$= \frac{V_i j}{3} \Rightarrow \frac{V_o}{V_i} = \frac{j}{3}$$

7.)

Find V_x

Ans.)

$$\frac{(14-3j)\times(3+4j)}{17+j} + 5$$

3.33

$$= 8.33 + 2.57j$$

$$V = -20j$$

$$V_x = -20j \times (3.33+2.57j)$$

$$8.33+2.57j \qquad 14-3j \qquad \times 10$$

$$= 3.63 - 5.68i$$

$$= 6.74 \angle -57.42^\circ$$