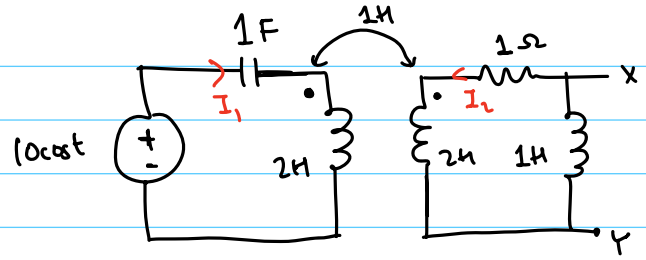
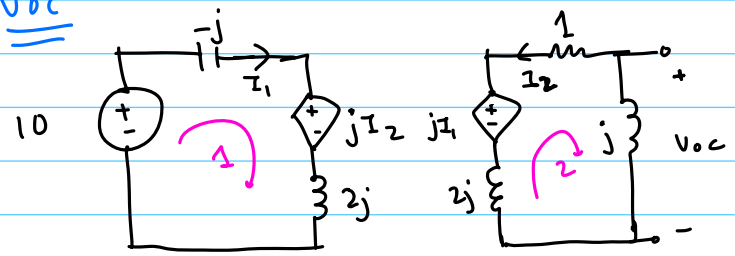
Ans.1



Voc



KVL in loop 1

$$10 + jI_1 - jI_2 - 2jI_1 = 0$$

$$10 = j(I_1 + I_2) \Rightarrow \boxed{I_1 + I_2 \Rightarrow -10j} \quad -(1)$$

KVL in loop 2

$$2jI_2 + jI_1 + I_2 + jI_2 = 0$$

$$\boxed{I_2(1+3j) + jI_1 = 0}$$

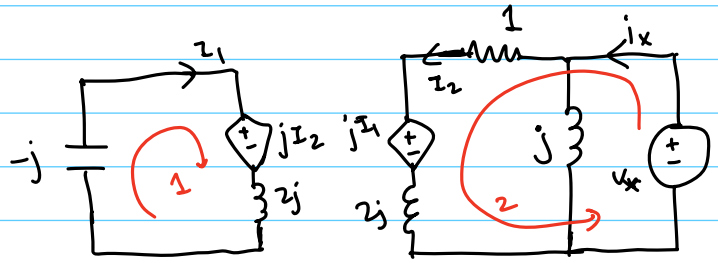
substitute $I_1 = -10j - I_2$

$$I_2(1+3j) + 10 - jI_2 = 0$$

$$I_2(1+2j) = -10 \Rightarrow I_2 = \frac{-10}{1+2j} \Rightarrow -2+4j$$

$$V_{OC} = -jI_2 = 4+2j \Rightarrow 4.47\angle 26.565^\circ \Rightarrow 4.47\cos(t+26.565)^\circ$$

R_{TH}



Loop 1

$$jI_1 - jI_2 - 2jI_1 = 0$$

$$I_1 + I_2 \Rightarrow 0$$

Loop 2

$$V_x - I_2 - jI_1 - 2jI_2 = 0$$

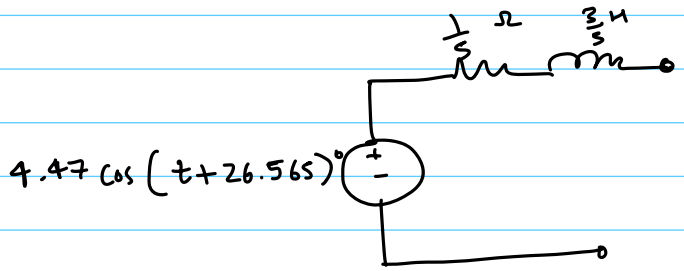
$$V_x = I_2(1+2j) + I_1(j)$$

$$V_x = I_2(1+2j) - jI_2$$

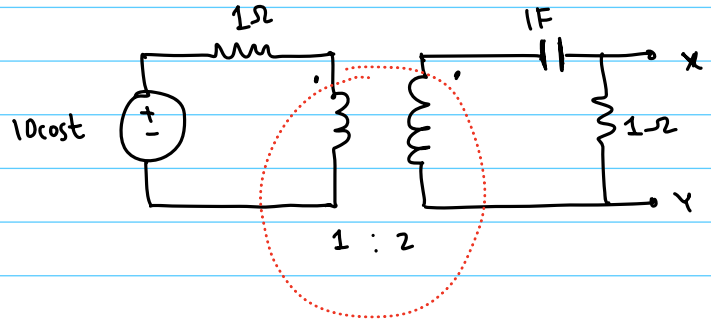
$$V_x = I_2(1+j)$$

$$I_2 = \frac{V_x}{1+j}$$

$$Z_{TH} = j \parallel (1+j) \Rightarrow \frac{1}{5} + \frac{3}{5}j$$



Ans.2

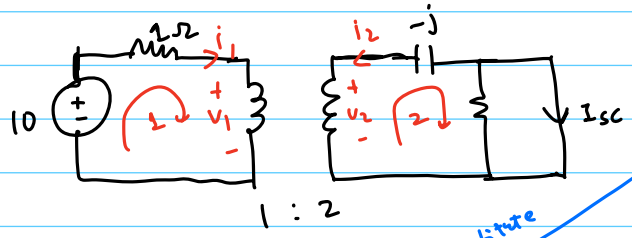


Ideal Transformer

$V_2 = 2V_1$

$i_2 = \frac{-i_1}{2}$

I_{sc}



Substitute

Loop 1

$$10 - i_1 - V_1 = 0$$

$$\downarrow$$

$$10 + 2i_2 - \frac{V_2}{2} = 0$$

Loop 2

$$V_2 - ji_2 = 0$$

$$\downarrow$$

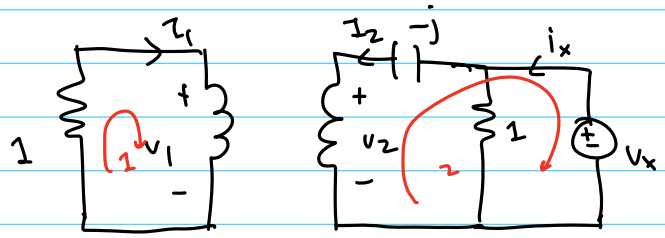
$$V_2 = ji_2$$

$$10 + 2i_2 - \frac{j}{2} i_2 = 0$$

$$10 = \left(-2 + \frac{j}{2}\right) i_2$$

$$i_2 = \frac{20}{-4+j} \quad ; \quad \boxed{I_{sc} = -i_2 \Rightarrow \frac{-20}{-4+j} \Rightarrow \frac{80}{17} + \frac{20}{17} j \Rightarrow 4.85\angle 14.03^\circ}$$

R_N



$v_2 = 2v_1$ → Ideal Txf.

$I_2 = -\frac{I_1}{2}$

KVL in loop 1

Substitute

$V_1 = -I_1$

$v_2 = -2I_1 \Rightarrow 4I_2$

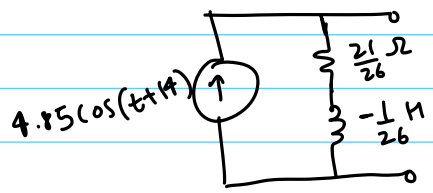
KVL in loop 2

$$v_2 - jI_2 - V_x = 0$$

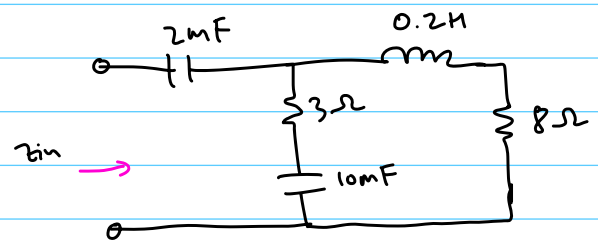
$$4I_2 - jI_2 - V_x = 0$$

$$I_2(4-j) = V_x$$

$$\frac{V_x}{I_2} = 4 - j \qquad R_N \Rightarrow (4-j) \| 1 \Rightarrow \frac{4-j}{5-j} \Rightarrow \frac{21}{26} - \frac{1}{26} i$$



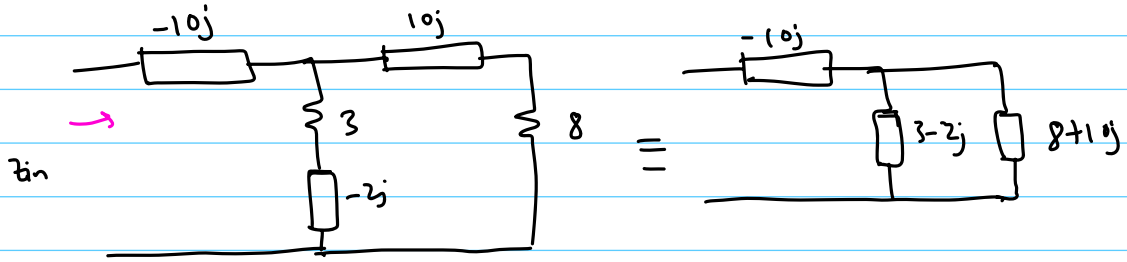
Ans 3



$$2mF \rightarrow \frac{1}{j\,50 \times 2 \times 10^{-3}} \Rightarrow -10j$$

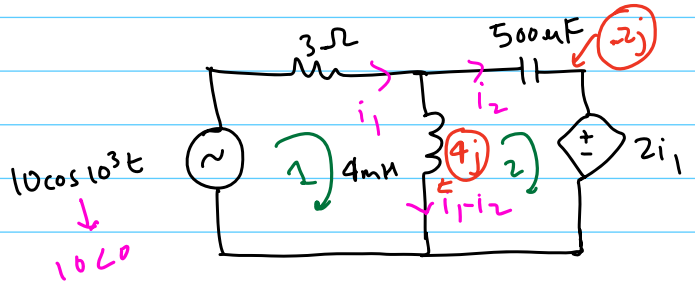
$$10mF \rightarrow -2j$$

$$0.2H \rightarrow j\,50 \times \frac{2}{10} \Rightarrow j10$$



$$Z_{in} = -10j + \frac{(3-2j) \times (8+10j)}{3-2j+8+10j} \Rightarrow 3.22 - j\,11.07$$

Ans. 4



$$4mH \equiv j \times 10^3 \times 4 \times 10^{-3} = 4j$$

$$500mF = \frac{1}{j \times 10^3 \times 500 \times 10^{-6}} \Rightarrow -2j$$

Loop 1

$$10 - 3i_1 - 4j(i_1 - i_2) = 0$$

$$10 - (3+4j)i_1 + 4j i_2 = 0$$

$$(3+4j)i_1 - 4j\, i_2 = 10 \quad -(1)$$

Loop 2

$$4j(i_1 - i_2) - i_2 \times (-2j) - 2i_1 = 0$$

$$4j(i_1 - i_2) + 2i_2 j - 2i_1 = 0$$

$$i_1(4j-2) = i_2(-2j+4j)$$

$$i_2 = i_1 \frac{(4j-2)}{2j} \Rightarrow i_1(2+j) \quad -(2)$$

Substitute (2) in (1)

$$(3+4j)i_1 - 4j\, i_1(2+j) = 10$$

$$i_1(3+4j - 8j + 4) = 10$$

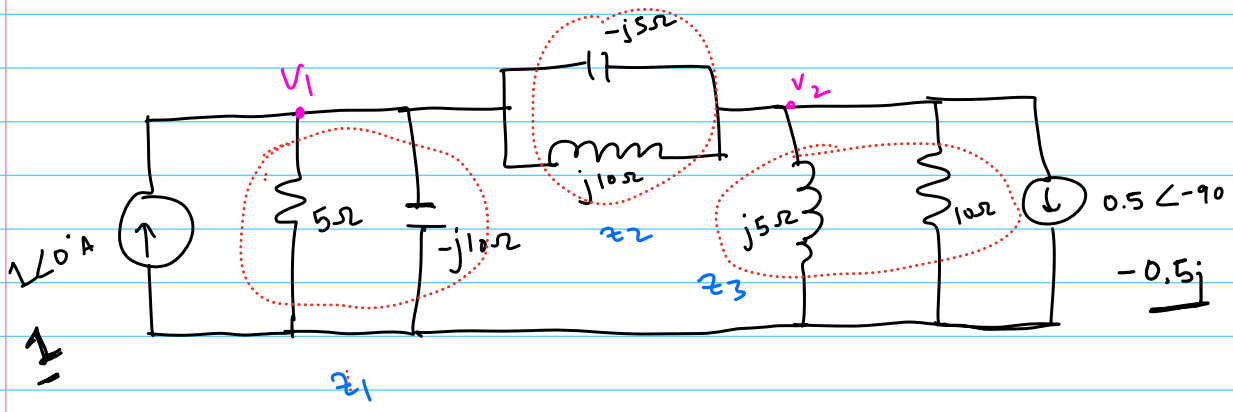
$$i_1 = \frac{10}{7-4j} \Rightarrow 1.24 \angle 29.74$$

$$i_2 = 2.773 \angle 56.3$$

$$i_1(t) = 1.24 \cos(10^3 t + 29.74)$$

$$i_2(t) = 2.773 \cos(10^3 t + 56.3)$$

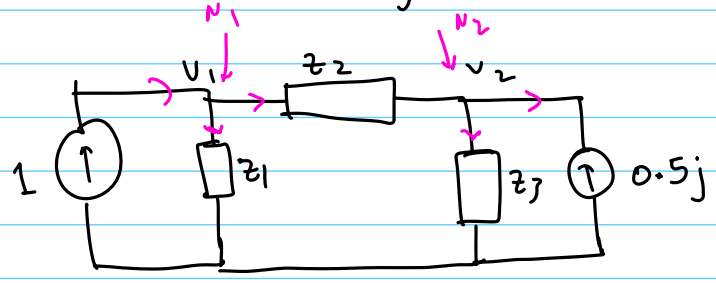
Ans. 5



$$z_1 = \frac{5 \times -j10}{5 - 10j} \Rightarrow \frac{-j10}{1-2j} = \frac{+10j}{2j-1}$$

$$z_2 = \frac{-j5 \times 10j}{5j} \Rightarrow -10j$$

$$z_3 = \frac{10 \times 5j}{10+5j} \Rightarrow \frac{10j}{2+j}$$



KCL @ N_1

$$1 = \frac{V_1}{Z_1} + \frac{V_1 - V_2}{Z_2}$$

$$1 = \frac{V_1 (2j-1)}{10j} + \frac{V_1 - V_2}{-10j}$$

$$10j = V_1 (2j-1) - V_1 + V_2$$

$$\boxed{10j = V_1(2j-2) + V_2} \quad - (1)$$

KCL @ N2

$$\frac{V_1 - V_2}{Z_2} = \frac{V_2}{Z_3} - 0.5j$$

$$\frac{V_1 - V_2}{-10j} = \frac{V_2 (2+j)}{10j} - 0.5j$$

$$V_2 - V_1 = V_2(2+j) + 5$$

$$\boxed{V_2(1+j) + V_1 = -5} \quad -(2)$$

$$V_1 = -5 - V_2(1+j) \quad (\text{from } (2))$$

Substitute this in (1)

$$10j = [-5 - V_2(1+j)][2j-2) + V_2$$

$$10j = [5 + V_2(1+j)](2-2j) + V_2$$

$$10j = [5 + V_2 + V_2 j][2-2j] + V_2$$

$$10j = 10 - 10j + 2V_2 - 2V_2 j + 2V_2 j + 2V_2 + V_2$$

$$-10 + 20j = 5V_2$$

$$\boxed{V_2 = -2 + 4j} \Rightarrow 4.472 \angle 116.56°$$

$$V_1 = 2.24 \angle -63.4°$$

$$\boxed{V_1(t) = 2.24 \cos(\omega t - 63.4°)}$$

$$\boxed{V_2(t) = 4.472 \cos(\omega t + 116.56)}$$