QUESTION NO 1

$i_1 = -4\sin(377t + 55^\circ)$

$i_2 = 5\cos(377t - 65^\circ)$

for I_1

$i_1 = 4\cos(377t + 55 + 90)$

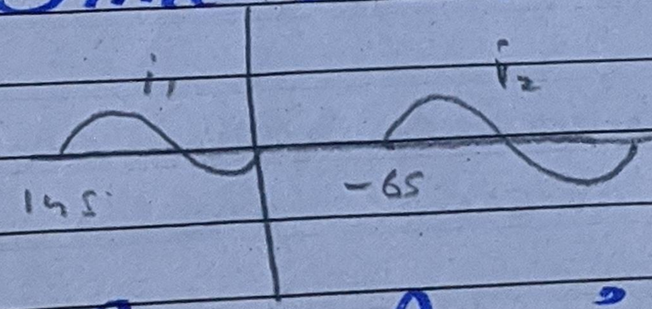
$i_1 = 4\cos(377t + 145^\circ)$

Phase difference

$\phi = 145 - (-65)$

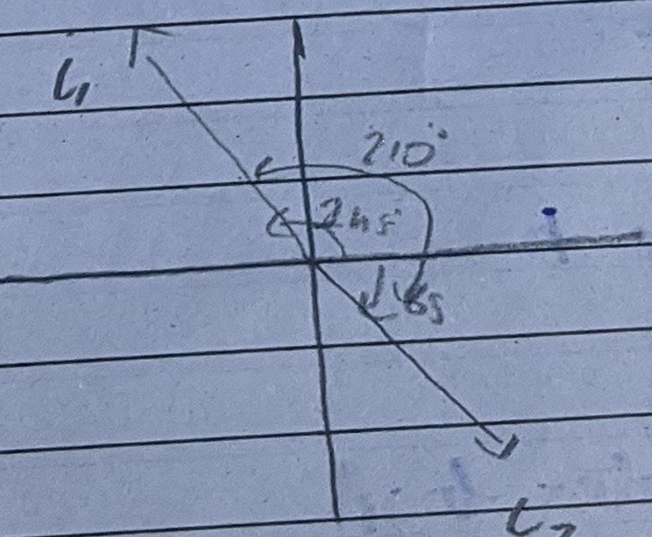
$\phi = 210^\circ$

Time Domain

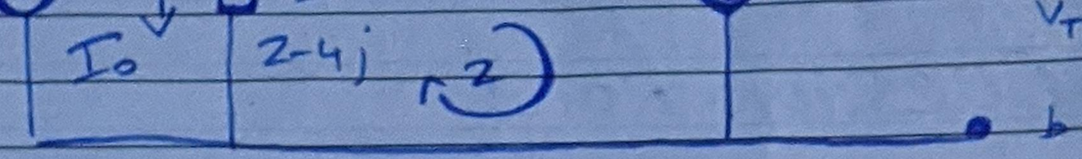


i_1 leads i_2 by 210°

Phasor Domain



i_1 leads i_2 by 210°



Apply KCL at node a

$$15 = 0.5I_o + I_o$$

$$1.5I_o = 15$$

$$I_o = 10A$$

Apply KVL at loop 2

$$-I_o(2-4j) + 0.5I_o(4+3j) + V_{TH} = 0$$

$$-10(2-4j) + 0.5\times10(4+3j) + V_{TH} = 0$$

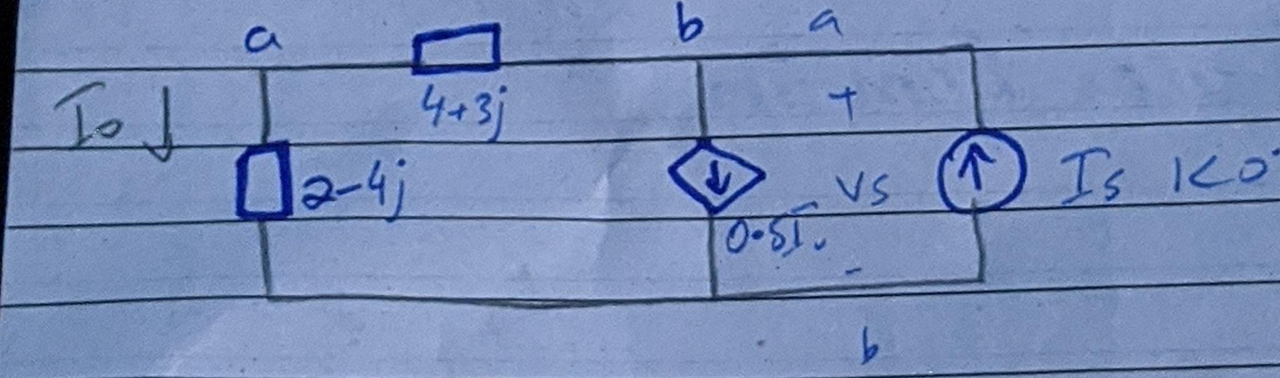
$$V_{TH} = 20 - 40j - 20 - 15j$$

$$V_{TH} = -55j$$

$$V_{TH} = +55\angle -90$$

For Z_{th}

Killing all independant sources and applying a test current source



Apply KCL at node b

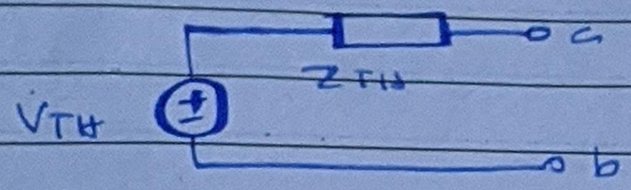
$$-1 + 0.5I_o + I_o = 0$$

$$I_o = 2/3A$$

Apply KVL at outer loop

$$Z^{Th} = \frac{V_S}{I_S} = \frac{2}{3}(6-j)$$

$$Z^{Th} = 4 - 0.6667j$$



For Norton

$$I_N = V_{TH} / Z_{TH} = 55\angle -90 / 4 - 0.6667j$$

$$I_N = 13.56\angle -80.53A$$

For Pmax

$$P_{max} = |V_{TH}|^2 / 8R_{TH} = (55)^2 / 8R_{TH}$$

$\therefore R_{TH}$ is the real part of Z^{Th} so we can find Pmax as

$$P_{max} = (55)^2 / 8(4)$$

$$P_{max} = 1512.5 \text{ watts}$$

But if we put whole of Z^{Th} then

$$P_{max} = \frac{55}{8(4-0.6667j)}$$

$$P_{max} = 1.718\angle 1.193 \text{ watts}$$