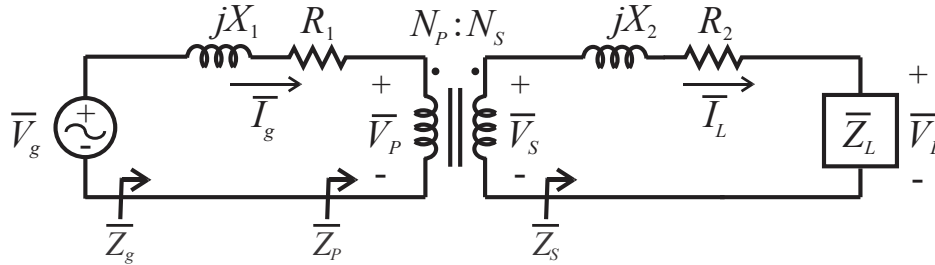


EE 330 Energy Systems (Fall 2026) Quiz #4

Name KEY A

Instructions: Open book & notes. Place answers in indicated spaces and show all work for credit.

For the circuit: $\bar{V}_g = 2400\angle 0^\circ \text{ V}_{\text{rms}}$, $X_1 = 3 \Omega$, $R_1 = 1.5 \Omega$, $N_P = 225$, $N_S = 25$, $X_2 = 1 \Omega$, $R_2 = 0.6 \Omega$, and $\bar{Z}_L = 10 + j4 \Omega$. First, determine the turns ratio. Then, find the currents and voltages shown (phasor form w/ angles in degrees). Assume an ideal transformer.



The turns ratio is $a = N_P / N_S = 225 / 25 \Rightarrow \underline{a=9}$.

$$\bar{Z}_S = jX_2 + R_2 + \bar{Z}_L = j1 + 0.6 + (10 + j4) = 10.6 + j5 \Omega$$

$$\text{Per (3-17), } \bar{Z}_P = a^2 \bar{Z}_S = 9^2 (10.6 + j5) = 858.6 + j405 \Omega$$

$$\bar{Z}_g = jX_1 + R_1 + \bar{Z}_P = j3 + 1.5 + (858.6 + j405) = 860.1 + j408 \Omega$$

$$\bar{I}_g = \bar{V}_g / \bar{Z}_g = 2400\angle 0^\circ / (860.1 + j408) \Rightarrow \underline{\bar{I}_g = 2.521103\angle -25.378^\circ (\text{A}_{\text{rms}})}$$

$$\bar{V}_P = \bar{I}_g \bar{Z}_P = 2.521103\angle -25.378^\circ (858.6 + j405) \Rightarrow \underline{\bar{V}_P = 2393.347\angle -0.1248^\circ (\text{V}_{\text{rms}})}$$

$$\text{Per (3-5), } \bar{V}_S = \bar{V}_P / a = (2393.347\angle -0.1248^\circ) / 9 \Rightarrow \underline{\bar{V}_S = 265.9275\angle -0.1247^\circ (\text{V}_{\text{rms}})}$$

$$\text{Per (3-6), } \bar{I}_L = a \bar{I}_g = 9(2.521103\angle -25.378^\circ) \Rightarrow \underline{\bar{I}_L = 22.6899\angle -25.378^\circ (\text{A}_{\text{rms}})}$$

$$\bar{V}_L = \bar{I}_L \bar{Z}_L = (22.6899\angle -25.378^\circ)(10 + j4) \Rightarrow \underline{\bar{V}_L = 244.378\angle -3.5765^\circ (\text{V}_{\text{rms}})}$$

$$\text{turns ratio} = \underline{a=9} \quad \bar{I}_g = \underline{2.521\angle -25.378^\circ (\text{A}_{\text{rms}})} \quad \bar{V}_P = \underline{2393.35\angle -0.125^\circ (\text{V}_{\text{rms}})}$$

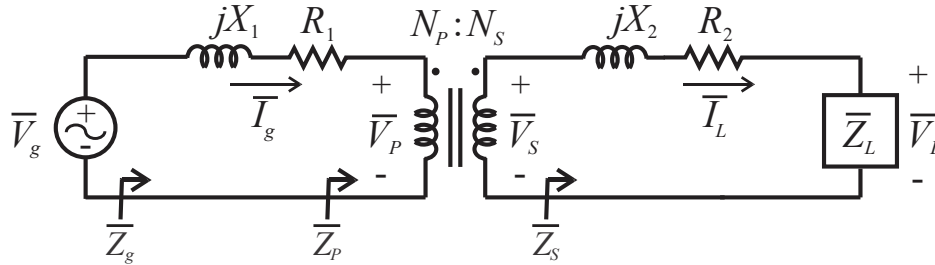
$$\bar{V}_S = \underline{265.93\angle -0.125^\circ (\text{V}_{\text{rms}})} \quad \bar{I}_L = \underline{22.69\angle -25.378^\circ (\text{A}_{\text{rms}})} \quad \bar{V}_L = \underline{244.38\angle -3.58^\circ (\text{V}_{\text{rms}})}$$

EE 330 Energy Systems (Fall 2026) Quiz #4

Name KEY B

Instructions: Open book & notes. Place answers in indicated spaces and show all work for credit.

For the circuit: $\bar{V}_g = 2200\angle 0^\circ \text{ V}_{\text{rms}}$, $X_1 = 2 \Omega$, $R_1 = 1.6 \Omega$, $N_P = 240$, $N_S = 30$, $X_2 = 1.2 \Omega$, $R_2 = 0.8 \Omega$, and $\bar{Z}_L = 12 + j3 \Omega$. First, determine the turns ratio. Then, find the currents and voltages shown (phasor form w/ angles in degrees). Assume an ideal transformer.



The turns ratio is $a = N_P / N_S = 240 / 30 \Rightarrow \underline{a = 8}$.

$$\bar{Z}_S = jX_2 + R_2 + \bar{Z}_L = j1.2 + 0.8 + (12 + j3) = 12.8 + j4.2 \Omega$$

$$\text{Per (3-17), } \bar{Z}_P = a^2 \bar{Z}_S = 8^2 (12.8 + j4.2) = 819.2 + j268.8 \Omega$$

$$\bar{Z}_g = jX_1 + R_1 + \bar{Z}_P = j2 + 1.6 + (819.2 + j268.8) = 820.8 + j270.8 \Omega$$

$$\bar{I}_g = \bar{V}_g / \bar{Z}_g = 2200\angle 0^\circ / (820.8 + j270.8) \Rightarrow \underline{\bar{I}_g = 2.54536\angle -18.25886^\circ (\text{A}_{\text{rms}})}$$

$$\bar{V}_P = \bar{I}_g \bar{Z}_P = 2.54536\angle -18.25886^\circ (819.2 + j268.8) \Rightarrow \underline{\bar{V}_P = 2194.54\angle -0.0929^\circ (\text{V}_{\text{rms}})}$$

$$\text{Per (3-5), } \bar{V}_S = \bar{V}_P / a = (2194.54\angle -0.0929^\circ) / 8 \Rightarrow \underline{\bar{V}_S = 274.31755\angle -0.0929^\circ (\text{V}_{\text{rms}})}$$

$$\text{Per (3-6), } \bar{I}_L = a \bar{I}_g = 8(2.54536\angle -18.25886^\circ) \Rightarrow \underline{\bar{I}_L = 20.36288\angle -18.25886^\circ (\text{A}_{\text{rms}})}$$

$$\bar{V}_L = \bar{I}_L \bar{Z}_L = (20.36288\angle -18.25886^\circ)(12 + j3) \Rightarrow \underline{\bar{V}_L = 251.875\angle -4.2226^\circ (\text{V}_{\text{rms}})}$$

$$\text{turns ratio} = \underline{a = 8} \quad \bar{I}_g = \underline{2.5454\angle -18.26^\circ (\text{A}_{\text{rms}})} \quad \bar{V}_P = \underline{2194.54\angle -0.093^\circ (\text{V}_{\text{rms}})}$$

$$\bar{V}_S = \underline{274.32\angle -0.093^\circ (\text{V}_{\text{rms}})} \quad \bar{I}_L = \underline{20.363\angle -18.26^\circ (\text{A}_{\text{rms}})} \quad \bar{V}_L = \underline{251.875\angle -4.22^\circ (\text{V}_{\text{rms}})}$$