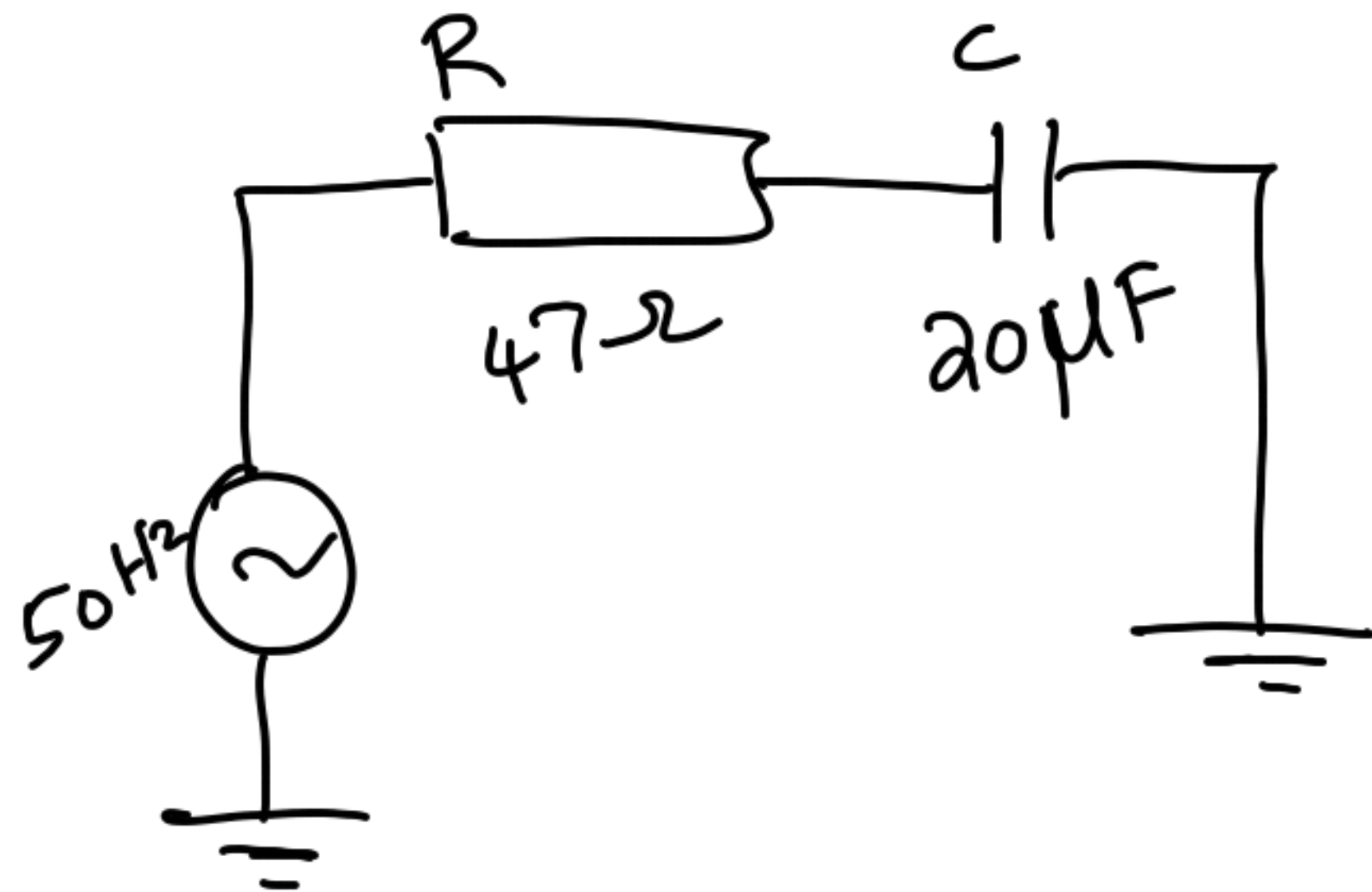


1) Determine the Reactance, impedance and phase angle for the following Circuit.



Soln:

$$f = 50 \text{ Hz}$$

$$R = 47 \Omega$$

$$C = 20 \mu\text{F}$$

$$X_C = ?$$

$$Z = ?$$

$$\phi = ?$$

Reactance

$$X_C = \frac{1}{2\pi f C}$$

$$= \frac{1}{2\pi \times 50 \times 20 \times 10^{-6}}$$

$$X_C = 159.15 \Omega$$

Impedance: $Z = \sqrt{R^2 + X_C^2} = \sqrt{47^2 + (159.15)^2}$

$$Z = 165.95 \Omega$$

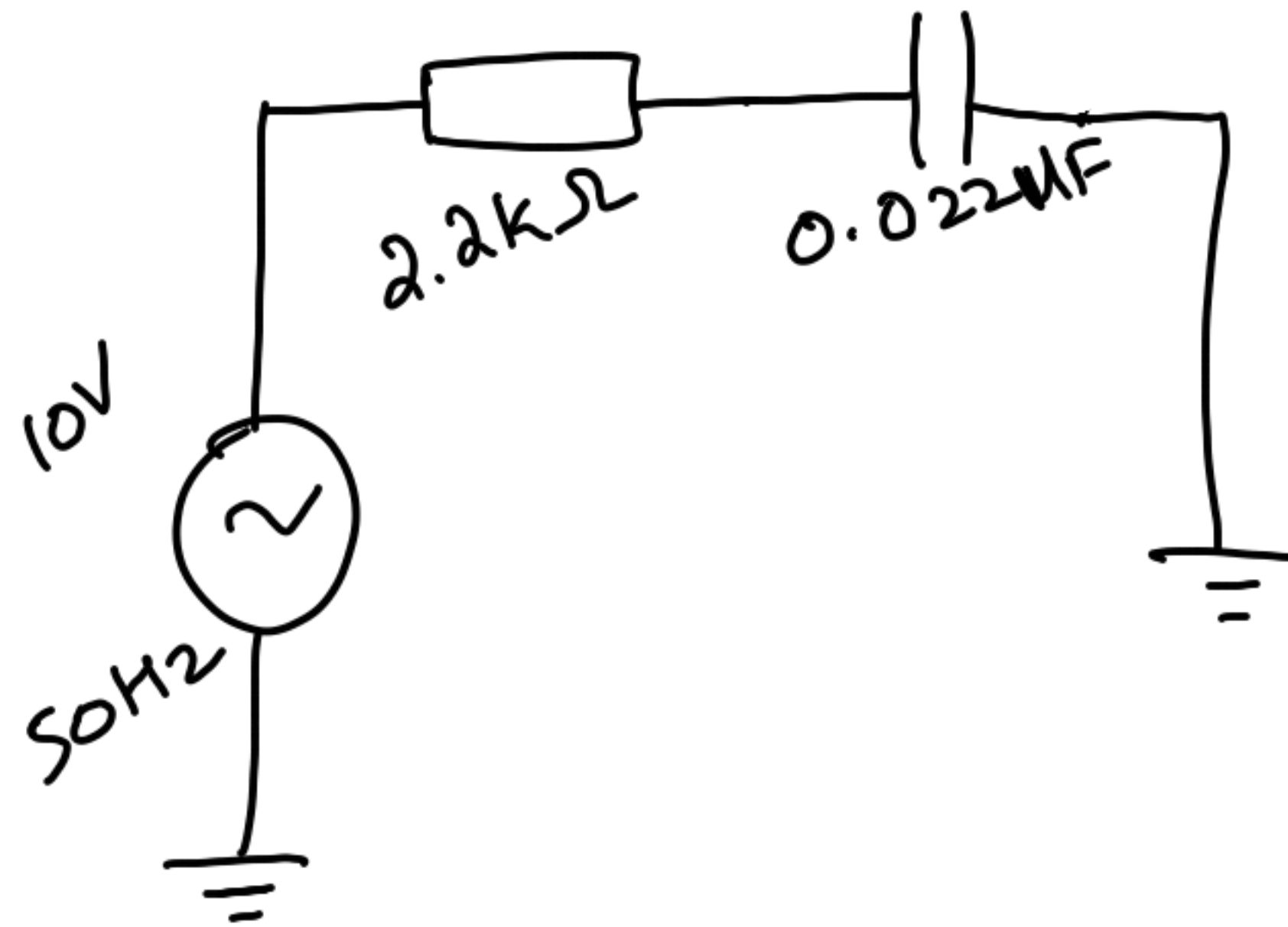
Phase angle

$$\phi = \tan^{-1} \left(\frac{X_L}{R} \right)$$

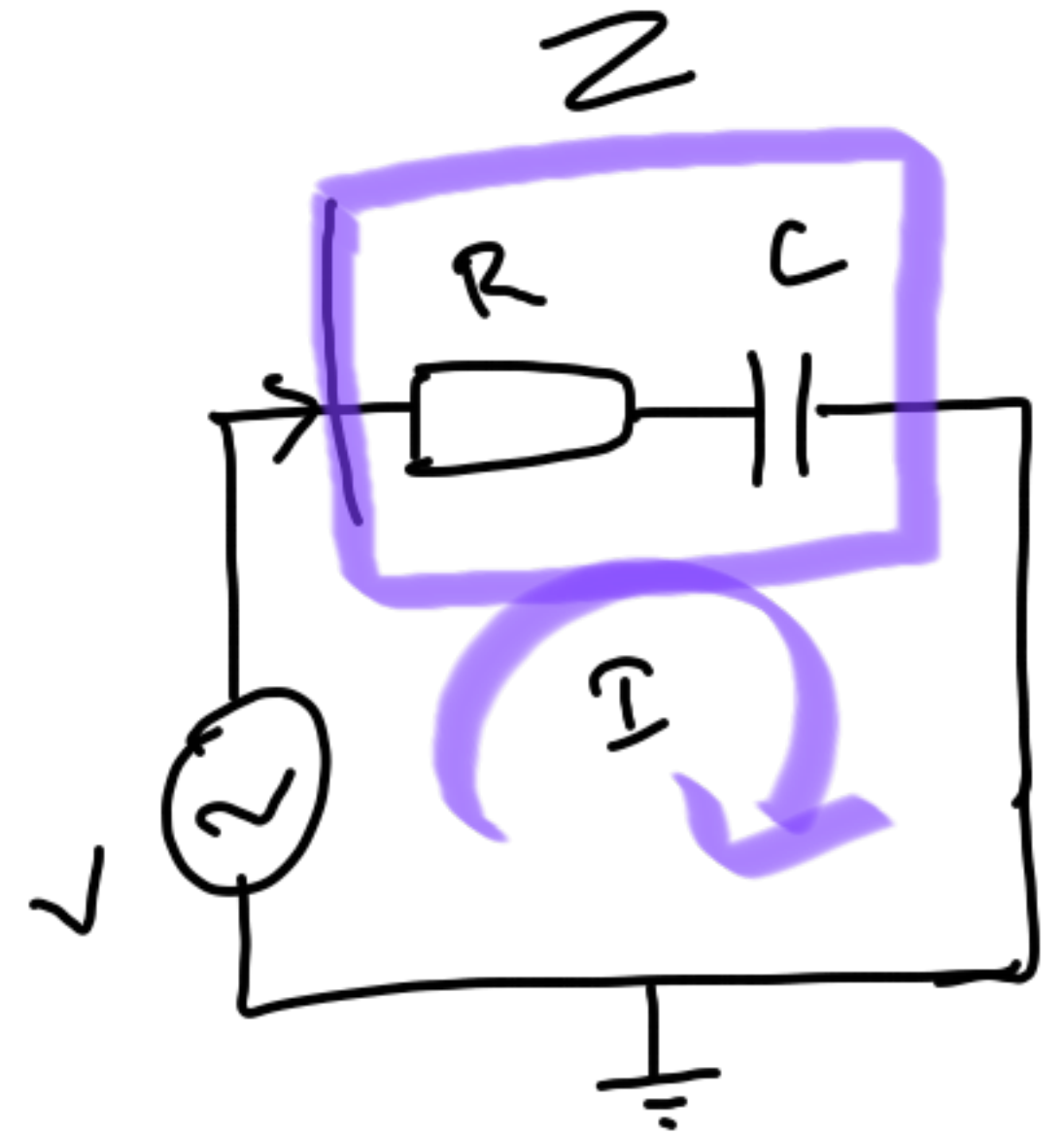
$$= \tan^{-1} \left(\frac{159.15}{47} \right)$$

$$\phi = 73.55^\circ$$

2) Determine the current in the following circuit



Soln. $I = \frac{V}{Z}$



$$V = I \cdot (Z)$$

$$X_C = \frac{1}{2\pi fC}$$

$$= \frac{1}{2\pi \times 50 \times 0.022 \times 10^{-6}}$$

$$X_C = 144.68 \times 10^3 \Omega$$

$$X_C = 144.68 \text{ k}\Omega.$$

$$Z = \sqrt{R^2 + X_C^2}$$

$$Z = \sqrt{(2.2 \times 10^3)^2 + (144.68 \times 10^3)^2}$$

$$Z = 146349.34 \Omega = 146.35 \text{ k}\Omega$$

Current.

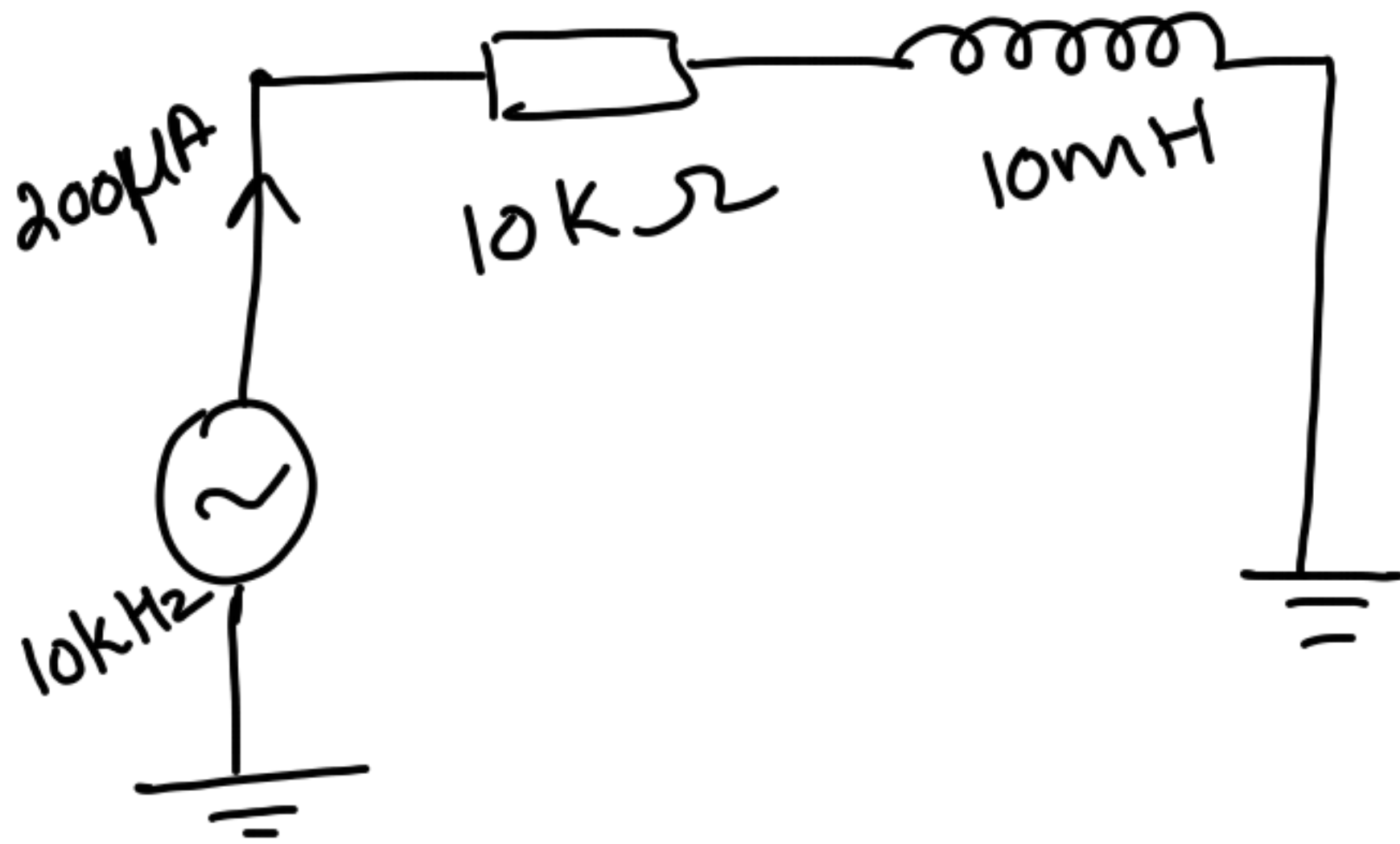
$$I = \frac{V}{Z} = \frac{10}{146.35 \times 10^3}$$

$$I = 6.83 \times 10^{-5}$$

$$I = 68.3 \times 10^{-6} \text{ A}$$

$$I = 68.3 \mu\text{A}$$

3) Determine the supply Voltage for the following Circuit



Soln ::

$$V = I Z$$

Reactance

$$X_L = 2\pi fL$$

$$= 2\pi \times 10 \times 1000 \times 10 \times 10^{-3}$$

$$X_L = 628.28\Omega$$

Impedance

$$Z = \sqrt{R^2 + X_L^2}$$

$$= \sqrt{(10 \times 10^3)^2 + (628.28)^2}$$

$$Z = 10019.72\Omega$$

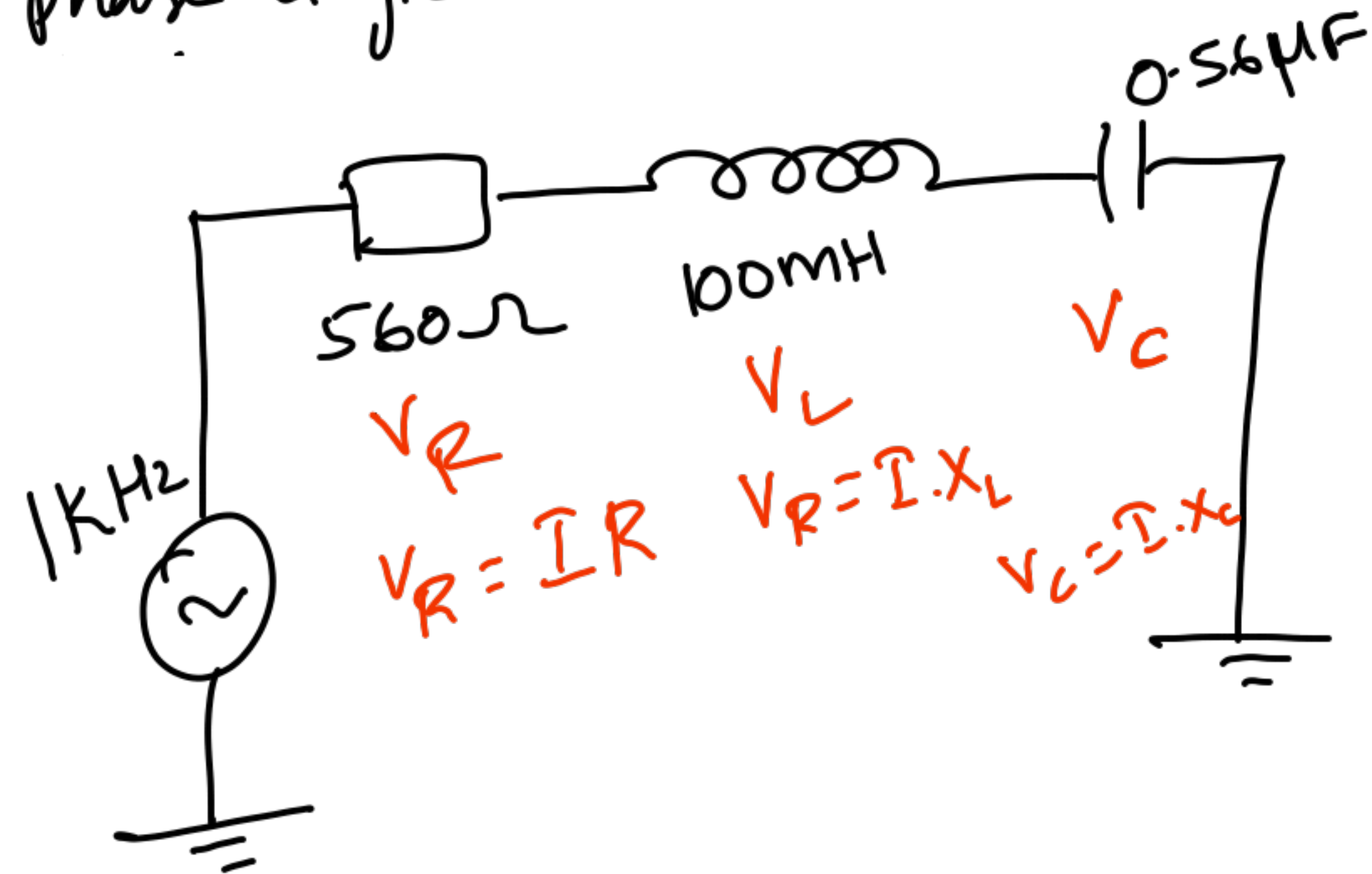
Voltage

$$V = I \cdot Z$$

$$= 200 \times 10^{-6} \times 10019.72$$

$$V = 2V$$

4) Calculate the impedance and phase angle for the circuit shown below



Soln

$$X_L = 2\pi fL$$

$$= 2\pi \times 1000 \times 100 \times 10^{-3}$$

$$X_L = 628.3 \Omega$$

$$X_C = \frac{1}{2\pi fC}$$

$$= \frac{1}{2\pi \times 1000 \times 0.56 \times 10^{-6}}$$

$$X_C = 284.2 \Omega$$

Impedance

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$Z = \sqrt{560^2 + (628.3 - 284.2)^2}$$

$$Z = 657.27 \Omega$$

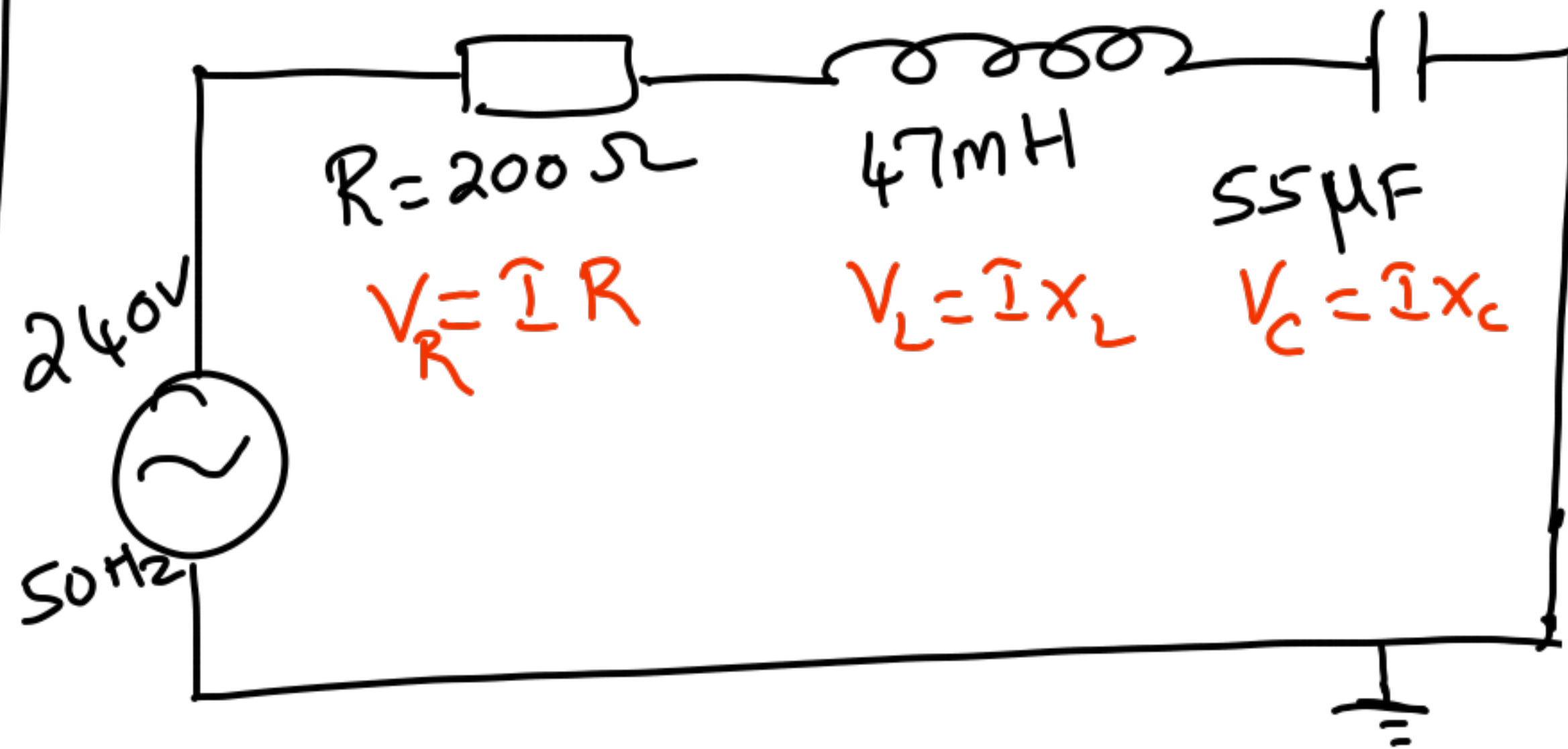
Phase angle

$$\phi = \tan^{-1} \left(\frac{X_L - X_C}{R} \right)$$

$$\phi = \tan^{-1} \left(\frac{628.3 - 284.2}{560} \right)$$

$$\phi = 31.56^\circ$$

⑤ For the circuit shown below, calculate the voltage drop across each component.



Soln:

$$\begin{aligned} X_L &= 2\pi f L \\ &= 2\pi \times 50 \times 47 \times 10^{-3} \end{aligned}$$

$$X_L = 14.77\Omega$$

$$X_C = \frac{1}{2\pi fC}$$

$$= \frac{1}{2\pi \times 50 \times 55 \times 10^{-6}}$$

$$X_C = 57.87 \Omega$$

Impedance

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$Z = \sqrt{200^2 + (14.77 - 57.87)^2}$$

$$Z = 204.6 \Omega$$

Current

$$\hat{I} = \frac{V}{Z} = \frac{240}{204.6}$$

$$\hat{I} = 1.17 A$$

Voltage across each component.

$$V_R = \hat{I} R = 1.17 \times 200 = 234 V$$

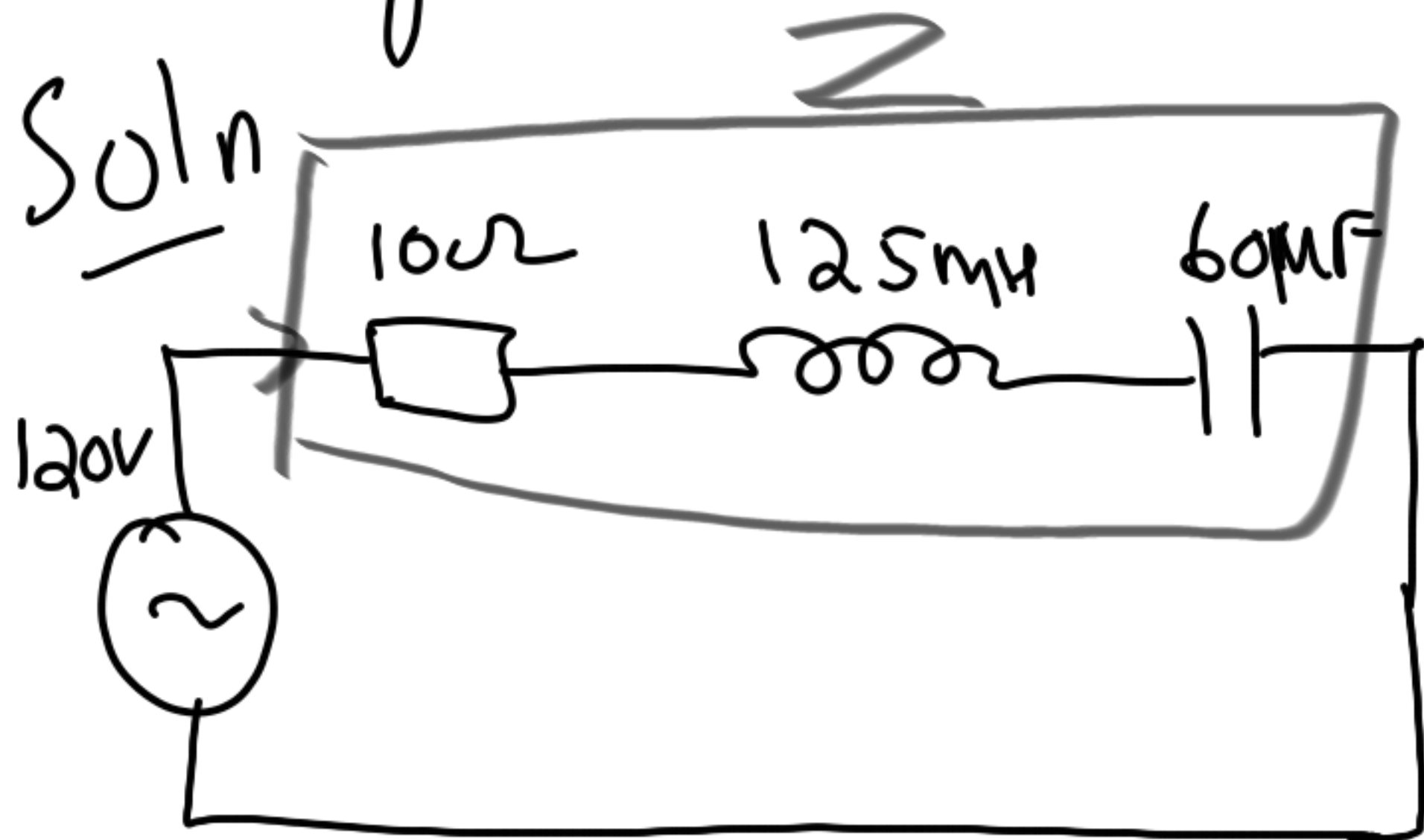
$$V_L = \hat{I} X_L = 1.17 \times 14.77 = 17.3 V$$

$$V_C = \hat{I} X_C = 1.17 \times 57.87 = 67.7 V$$

$$\begin{aligned} V &= 240V \\ V_R &= 234 \\ V_L &= 17.3 \\ V_C &= 67.7 \end{aligned}$$


$$V = \sqrt{V_R^2 + (V_L - V_C)^2}$$

6) A coil having a resistance of 10Ω and an inductance of 125mH is connected in series with a $60\mu\text{F}$ capacitor across a 120V supply. At what frequency does resonance occurs? Find the current flowing at resonance frequency.



$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$f_r = \frac{1}{2\pi\sqrt{125 \times 10^{-3} \times 60 \times 10^{-6}}}$$

$$f_r = 58.12 \text{ Hz.}$$

To find current

$$I = \frac{V}{Z}$$

At resonance

$$Z = R, X_L = X_C$$

$$I = \frac{V}{R} = \frac{120}{10}$$

$$I = 12 A$$