Q- A series combination of R = 1000Ω, L = 500 mH and C = 150μF is connected to a sinusoidal voltage supply of frequency 50Hz. The circuit has peak amplitude of 1A. Calculate the voltage amplitude of the supply generator.

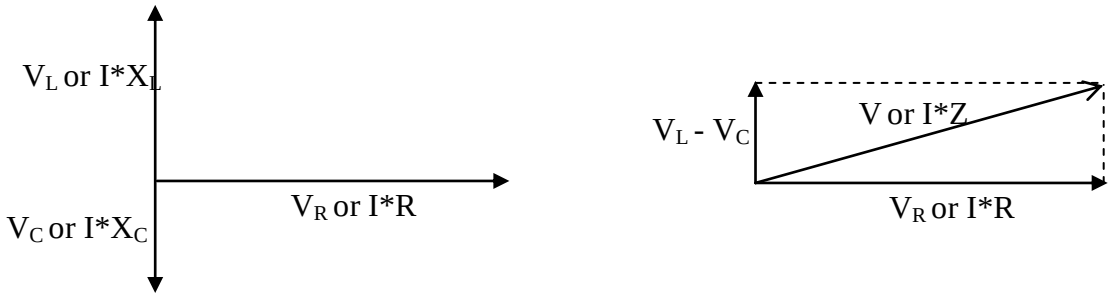
The current in an AC circuit is opposed by resistance and reactance both.

The voltage is ahead of current by a phase difference of 90^0 and in inductor and lagging behind by 90^0 in a capacitor. Hence the total reactance in the circuit is considered as the difference of the two reactance and is given by

$$X = X_L - X_C = 2\pi fL - \frac{1}{2\pi fC}$$

Now as the total voltage across the resistance and the reactance is having a phase difference equal to 90^0, the resultant oppose of the circuit is called impedance Z of the circuit and is given by

$$Z = \sqrt{R^2 + X^2} = \sqrt{R^2 + \left(X_L - X_C\right)^2} = \sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC}\right)^2}$$



Hence the voltage amplitude across the whole circuit or of the supply generator is given by

V = I*Z

Or $$V = I * Z = I * \sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC}\right)^2}$$

Or $$V = 1 * \sqrt{1000^2 + \left(2\pi * 50 * 500 * 10^{-3} - \frac{1}{2\pi * 50 * 150 * 10^{-6}}\right)^2}$$

Or $$V = \sqrt{1000^2 + \left(157.1 - 21.2\right)^2} = \sqrt{1000^2 + 135.9^2} = 1009.2\,\text{V}$$