Q- A pure inductance L is connected to an AC circuit and the maximum voltage across it is V_{max} = 100V.

(a) If the maximum current is 7.5A at 50Hz, calculate the inductance L

(b) At what angular frequency (ω) is the maximum current 2.5A?

The inductive reactance is given by

$$X_L = L*\omega = 2\pi f * L$$

Where L is the inductance and ω is the angular frequency and f is the frequency of the current.

Clearly the inductive reactance will increase with frequency and is zero for DC circuit.

(a)
The maximum current is given by the Ohm's law as

$$I = \frac{V}{X_L} = \frac{V}{2\pi f * L}$$

Gives $\quad L = \frac{V}{2\pi f * I} = \frac{100}{2\pi * 50 * 7.5} = 0.0424 \text{ H}$

(b)
For the same voltage source and the same inductor

$$I = \frac{V}{2\pi f * L}$$

Gives $\quad I*f$ = constant hence we have

$\qquad I_2 f_2 = I_1 f_1$

Or $\qquad f_2 = I_1 f_1 / I_2 = 7.5*50/2.5 = 150 \text{ Hz}$

Hence the angular frequency $\omega = 2\pi f = 2 * \pi * 150 = 942.5 \text{ rad/s}$