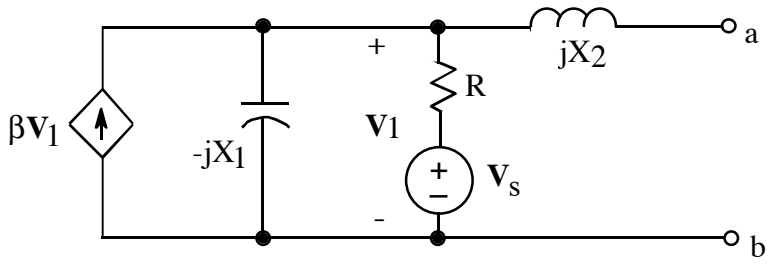
EX:



Construct a frequency-domain Thevenin's equivalent circuit at terminals **a** and **b**.

SOL'N:

V_{Th} = open circuit output V (phasor) = V_1 (since no drop across jX_2)

Use Node-V: $\frac{V_1 - V_S}{R} + \frac{V_1}{-jX_1} - \beta V_1 = 0\ A$

$V_1\left(\frac{1}{R} - \frac{1}{jX_1} - \beta\right) = \frac{V_S}{R}$

$V_{Th} = V_1 = V_S \frac{\left(R \parallel -jX_1 \parallel -\frac{1}{\beta}\right)}{R}$ or $V_S\left(1 \parallel \frac{jX_1}{R} \parallel \frac{1}{R\beta}\right)$

$Z_{Th} = \frac{1\angle 0°\,V}{I_q}$ with V_S set to 0 V

Use Node-V: $\frac{V_1 - 1\angle 0°\,V}{jX_2} + \frac{V_1}{R} + \frac{V_1}{-jX_1} - \beta V_1 = 0\ A$

$V_1\left(\frac{1}{jX_2} + \frac{1}{R} - \frac{1}{jX_1} - \beta\right) = \frac{1\angle 0°\,V}{jX_2}$, $-I_q = \frac{V_1 - 1\angle 0°\,V}{jX_2}$

$Z_{Th} = \frac{-jX_2\ 1\angle 0°\,V}{V_1 - 1\angle 0°\,V} = -jX_2 \Big/ \left(1 \parallel \frac{R}{jX_2} \parallel \frac{-X_1}{X_2} \parallel \frac{-1}{jX_2\beta} - 1\right)$