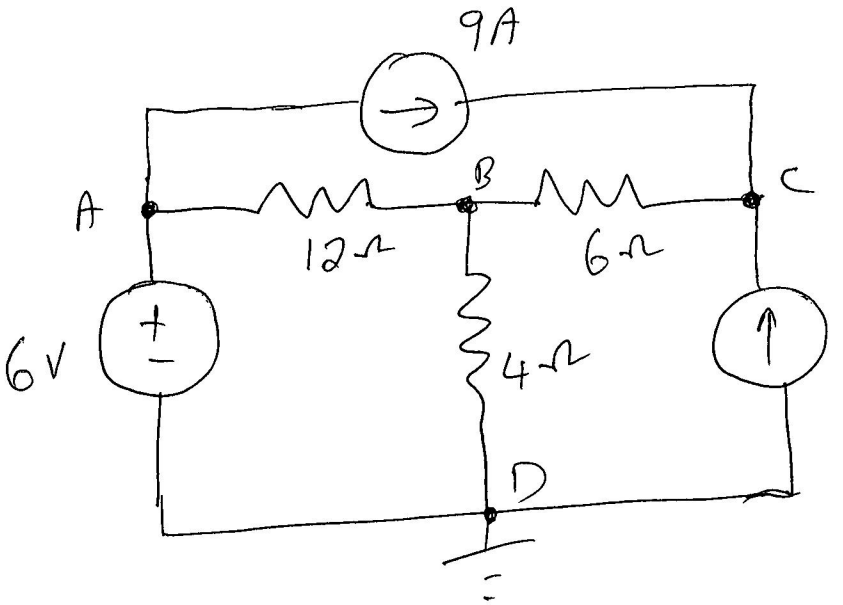
Nodal Analysis Example-2



1) Find V_A, V_B and V_C using nodal analysis

$V_A = 6V$

B: $$-\frac{1}{12}V_A + \left(\frac{1}{12}+\frac{1}{4}+\frac{1}{6}\right)V_B - \frac{1}{6}V_C = 0$$

$$\frac{6}{12}V_B - \frac{1}{6}V_C = \frac{1}{12}V_A = \frac{6}{12}$$

$$6V_B - 2V_C = 6 \quad \text{——— (1)}$$

C: $$-\frac{1}{6}V_B + \frac{1}{6}V_C = 9A - 6A = 0$$

$$-\frac{1}{6}V_B + \frac{1}{6}V_C = 15$$

$$-V_B + V_C = 90 \quad \text{——— (2)}$$

$$-2V_B + 2V_C = 180 \quad \text{——— (3)}$$

Add (1) and (3) $4V_B = 186$, $\boxed{V_B = \frac{93}{2} = 46.5\,V}$

Since $V_B = \frac{93}{2}$ we can plug this value in (2) to get

$$-\frac{93}{2} + V_C = 90 \Rightarrow V_C = 90 + \frac{93}{2}$$

$$\boxed{V_C = \frac{273}{2}\ V}$$

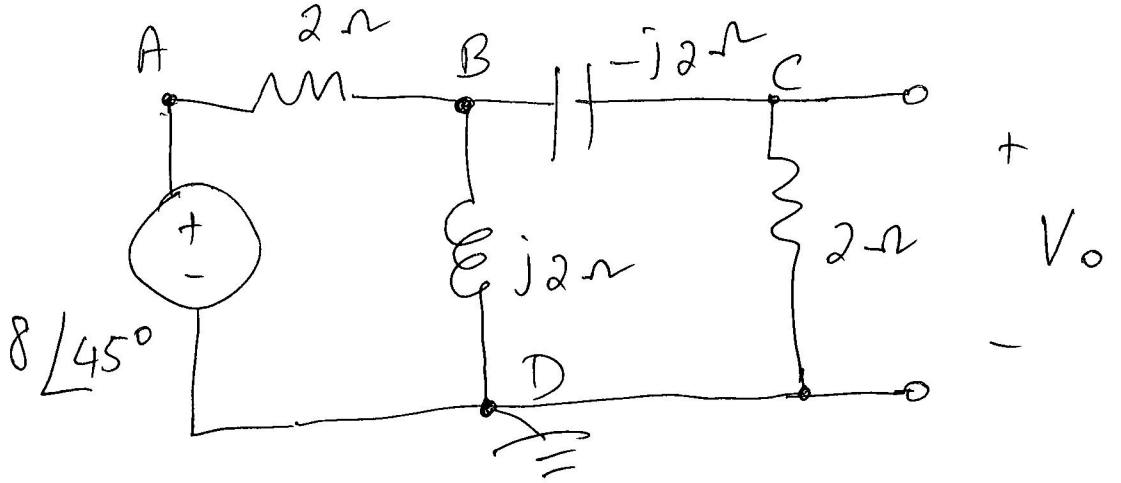
Check

Current (right to left) in 6Ω

is $\frac{V_C - V_B}{6} = \frac{\frac{273}{2} - \frac{93}{2}}{6} = \frac{90}{6} = 15A$

Apply KCL at C, the algebraic sum is zero and so our answer is correct.

2) Find V_o using nodal analysis



$$V_A = 8\angle 45^\circ$$

$$B: \quad -\frac{1}{2}V_A + \left(\frac{1}{2} + \frac{1}{j2} + \frac{1}{-j2}\right)V_B - \frac{1}{-j2}V_C = 0$$

$$\frac{1}{2}V_B - j\frac{1}{2}V_C = \frac{1}{2}V_A = 4\angle 45^\circ$$

$$V_B - jV_C = 8\angle 45^\circ \quad \text{——} \quad (1)$$

$$C: \quad -\frac{1}{-j2}V_B + \left(\frac{1}{2} + \frac{1}{-j2}\right)V_C = 0$$

$$-j\frac{1}{2}V_B + \left(\frac{1}{2} + j\frac{1}{2}\right)V_C = 0$$

$$-jV_B + (1+j)V_C = 0 \quad \text{—} \quad (2)$$

Solve

$$V_B - jV_C = 8\angle 45^\circ$$

$$-jV_B + (1+j)V_C = 0$$

$$jV_B = (1+j)V_C$$

$$V_B = \frac{1+j}{j}V_C = (1-j)V_C$$

$$(1-j)V_C - jV_C = 8\angle 45^\circ$$

$$(1-j2)V_C = 8\angle 45^\circ$$

$$V_C = \frac{8\angle 45^\circ}{1-j2} = \frac{8\angle 45^\circ}{\sqrt{5}\angle -63^\circ}$$

$$\boxed{V_C = \frac{8}{\sqrt{5}}\angle 108^\circ = 3.6\angle 108^\circ}$$