KCL Analysis Again

Below is another circuit to analyze. The goal is to determine the voltage at nodes X and Y.



All the nodes have been named and all currents labeled. The common node is the is the ground node which usually appears as a common lead across the bottom of a circuit diagram.

The next step is to write the KCL equation for each node except the common node, or for nodes that have a voltage source between the node and common. Notice Z is such a node. For node Z, we see by inspection that its value is 5V.

For node Y, the KCL equation is: I2 - I3 + I4 = 0

At node X, the KCL equation is: -.001 - I1 - I2 = 0

Now do the Ohm's law replacement (I = V/R) For example:

I1 = Vx / 3000 (where Vx is the voltage at node X)I2 = (Vx - Vy) / 1000I3 = Vy / 2000I4 = (5 - Vy) / 1000

Now substitute these expressions for the currents in the original equations.

$$((Vx - Vy) / 1000) - (Vy / 2000) + ((5 - Vy) / 1000) = 0$$
 @ node Y

$$-.001 - (Vx / 3000) - (Vx - Vy / 1000) = 0$$
 @ node X

now we have two independent equations with two unknowns. Let's solve.

Simplify both equations at X and Y first -.001 - (Vx / 3000) - (Vx - Vy / 1000) = 0-3 - (Vx) - (3Vx - 3Vy) = 0-3 - Vx - 3Vx + 3Vy = 0-4Vx + 3Vy = 3

@ node X equation(multiply through by 3000)(remove parenthesis)(gather terms)

(2Vx - 2Vy) - (Vy) + (10 - 2Vy) = 0 (multiply through by 200 2Vx - 2Vy - Vy + 10 - 2Vy = 0 (remove parenthesis) 2Vx - 5Vy = -10 (gather terms)	((Vx - Vy) / 1000) - (Vy / 2000) + ((5 - Vy) / 1000) = 0 (@node Y equation
2Vx - 2Vy - Vy + 10 - 2Vy = 0 (remove parenthesis) 2Vx - 5Vy = -10 (gather terms)	(2Vx - 2Vy) - (Vy) + (10 - 2Vy) = 0	(multiply through by 2000)
2Vx - 5Vy = -10 (gather terms)	2Vx - 2Vy - Vy + 10 - 2Vy = 0	(remove parenthesis)
(gener certain)	2Vx - 5Vy = -10	(gather terms)

Now, with the simplified equation at node Y, solve for Vx in terms of Vy: 2Vx - 5Vy = -10 2Vx = 5Vy -10Vx = 5/2Vy -5

Take this form for Vx and substitute into the simplified equation for X:-4Vx + 3Vy = 3simplified X equation-4(5/2Vy - 5) + 3Vy = 3substitute in equation for Vx-10Vy + 20 + 3Vy = 3multiply out-7Vy = -17Vy = 17/7 = 2.43V

Substitute Vy in the simplified equation for Y to solve for Vx:Simplified Y equation2Vx - 5Vy = -10simplified Y equation2Vx -5(17/7) = -10substitute in Vy2Vx -85/7 = -10multiply outVx = (-10 + 85/7) / 2 = 1.07Vmultiply out