Solving Circuits

September 22, 2024

1

Ben is wrong on his first step because he assumes that the voltage drop across the resistor is 20V, however that is the voltage drop across both resistors.
To solve for the current, first find the equivalent resistance which is 5Ω, meaning the current is $20\text{V}/5\Omega = 4\text{A}$.
He is correct that by KCL, the current in the 1Ω resistor is also 4A, and therefore $4\text{A} \times 1\Omega = 4\text{V}$. So $v_1 = 4\text{V}$.

2

Ben is again wrong on his first step. The resistors are not in parralel, but in series connecting to the battery. Therefore the equivalent resistance is not 3Ω, but actually 16Ω.
Finishing to solve the circuit we repeat the rest of Ben's steps and get that the current through the circuit is $9\text{V}/16\Omega = 9/16\text{A}$. Then $v_2 = 9/16\text{A} * 12\Omega = 27/4\text{A}$

3

Yay! Ben solved it correctly.

4

Here, Ben just messed up his math with calculating the equivalent resistance of 6Ω and 10Ω. It should be $1/(1/6\Omega + 1/10\Omega) = \frac{15}{4}\Omega$.
Continuing his steps, the total resistance is $2+15/4 = 23/4\ \Omega$. Then $2/(23/4) = 8/23$ A. Then $8/23\text{ A} \times 15/4\ \Omega = 30/23$ V.
Then finally, the voltage drop $v_4 = 8\text{V} + 30/23$ V

5

Here, Ben is assuming that the 12V source is grounded, but it's not, so we actually need to perform nodal analysis.
Before preforming nodal analysis, we should probably make our life easier by swapping the 12V source with the 4Ω resistor, to create a Thevanin equivalent circuit of those two components. This makes it where there are no floating voltage sources and makes our lives easier.
Now our equation for e_1 becomes $(9 - e_1) + (12 - e_1)/4 = e_1/2$
Solving this for e_1 with algebra comes to $e_1 = 48/7$ V
Finally solving for v_5, we get $v_5 = 9\text{V} - 48/7\text{ V} = 15/7\text{ V}$