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1st-Midterm Exam Circuit Analysis

2015/10/29

1. (10%) Please give the answer for the following statements. State your reasoning.

   (1) A network with a branches, and b independent loops, and c nodes will satisfy the fundamental theorem of network topology: $a = b + c - 1$. (true or false)

   (2) For a graph, what is a tree? A tree is also a loop. (true or false)

   (3) A mesh is a dependent loop. Also, the mesh current is equal to the branch current. (true or false)

   (4) Kirchhoff's current law can state that the algebraic sum of currents entering a closed boundary is zero. (true or false)

   (5) Nodal analysis applies KCL to find unknown currents in a given circuit, while mesh analysis applies KVL to find unknown voltages. (true or false)

2. (15%) (a) (5%) The current that enters an element is shown in Fig. 1. Find the charge $q(18)$.

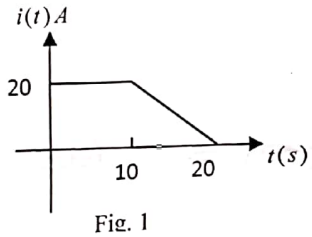

Fig. 1

(b) (10%) Fig. 2 shows the current through and the voltage across an element

(i) Sketch the power in the element for $t \geq 0$.

(ii) Find the energy absorbed by the element at $t = 1$ and $t = 3$.

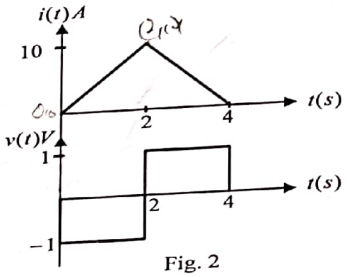

Fig. 2

3. (10%) Obtain v and i in the circuit in Fig. 3.

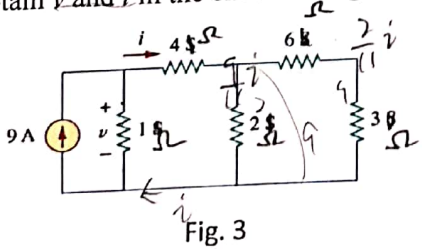

Fig. 3

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4. (15%) Determine V in the circuit of Fig. 4.

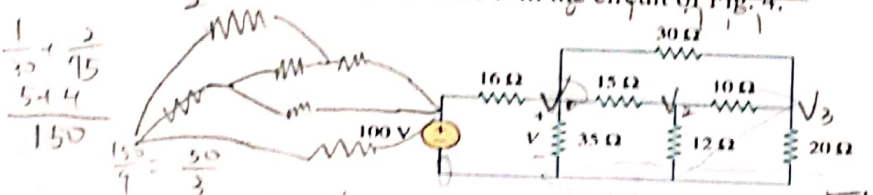

Fig. 4

5. (10%) In a certain application, the circuit in Fig. 5 must be designed to meet these two criteria: (i) $V_o / V_s = 0.05$ (ii) $R_{eq} = 40\ \text{k}\Omega$

If the load resistor 5 kΩ is fixed, find R_1 and R_2 to meet the criteria.

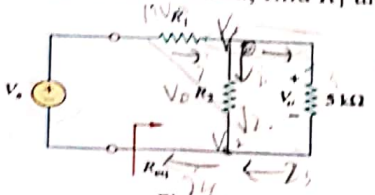

Fig. 5

6. (10%) Obtain the equivalent resistance at the terminals a-b for each of the circuits in Fig. 6.

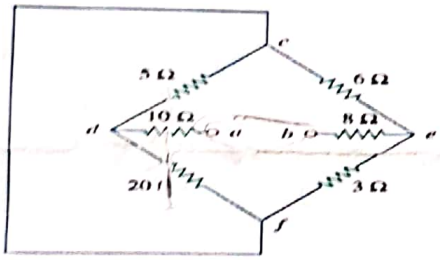

Fig. 6

7. (15%) For the circuit in Fig. 7, find currents i_1 and i_2 using the mesh analysis.

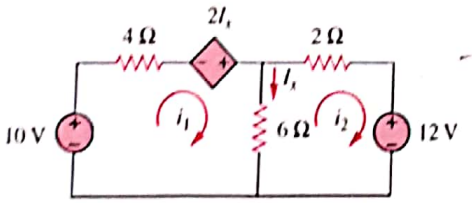

Fig. 7

8. (15%) For the circuit in Fig. 8, find v_1, v_2, and v_3 using nodal analysis.

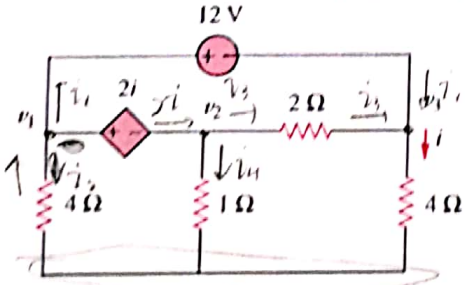

Fig. 8

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