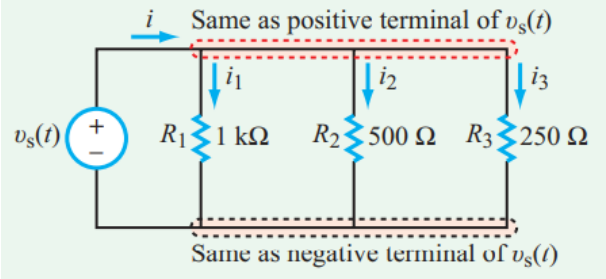
ECEN203 Tutorial 2: Resistive Circuits (with answers)

Answer all 10 questions. Answers provided for your self-checking.

Q1. Three loads – 1 kΩ, 500 Ω and 250 Ω, are connected in parallel to a ac voltage source as shown in the figure below.



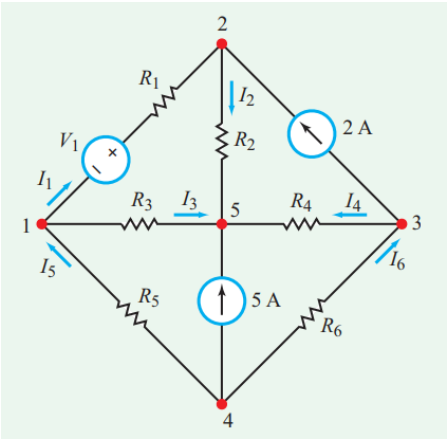
The source is cosinusoidal in time at a frequency of 60 Hz and its amplitude is 170 V. Hence, it can be described as

$$v_s(t) = 170 \cos (2\pi \times 60t) = 170 \cos(377t) \text{ V}.$$

Determine the currents supplied by the source to the three loads, and the total current supplied.

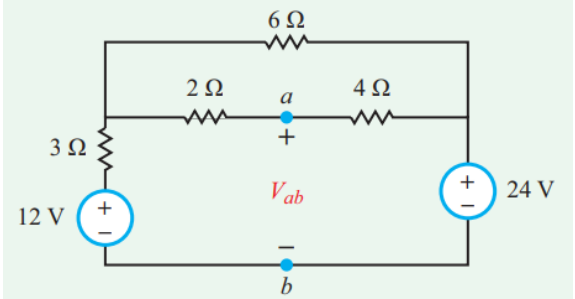
(Answer: $i_1(t) = 0.17\cos(377t)$ A, $i_2(t) = 0.34 \cos(377t)$ A, $i_3(t) = 0.68 \cos(377t)$ A, $i(t) = 1.19\cos(377t)$ A.)

Q2. Write the KCL equations at nodes 1 to 5 in the circuit as shown below.



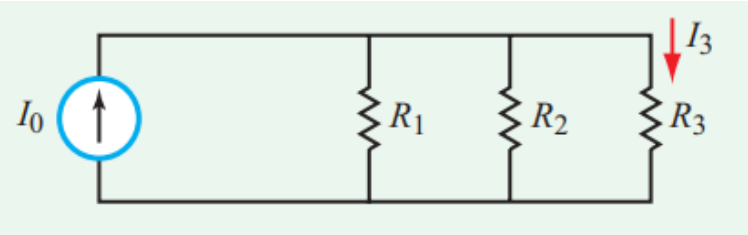
(Answer: not provided)

Q3. Determine V_{ab} in the circuit shown in the figure below.



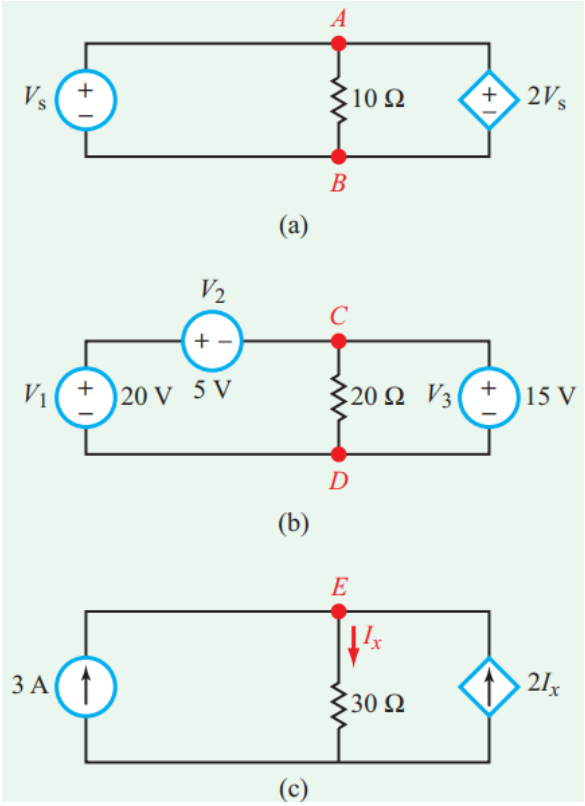
(Answer: V_{ab} = 20 V.)

Q4. For the circuit shown below, (a) Write I_3 in terms of I_0 and resistance R_1 to R_3, (b) Write I_3 in terms of I_0 as conductances G_1 to G_3, where $G_i = 1/R_i$.



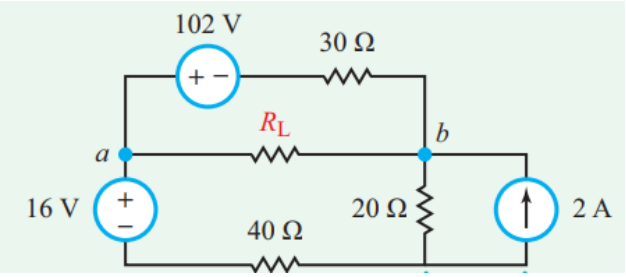
(Answer: (a) $I_3\left(\frac{R_1R_2}{R_2R_3+R_1R_3+R_1R_2}\right)I_0$, (b) $I_3\left(\frac{G_3}{G_1+G_2+G_3}\right)I_0$.)

Q5. Given that the voltage difference between any two nodes in a circuit has to be unique (cannot have multiple values simultaneously), and that the current in any given branch also is unique, determine which of the three circuits below are realizable and which are unrealizable.

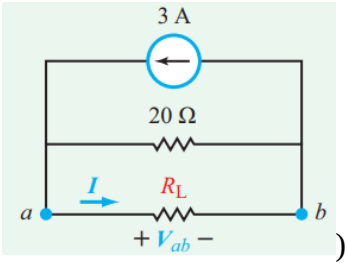


(Answer: (a) Unrealizable, (b) realizable, (c) realizable.)

Q6. While keeping the load resistor R_L in the circuit below intact, apply source transformations until the circuit simplifies to a current divider, then determine V_{ab} for $R_L = 10\ \Omega$.



(Answer: V_{ab} = 20 V.



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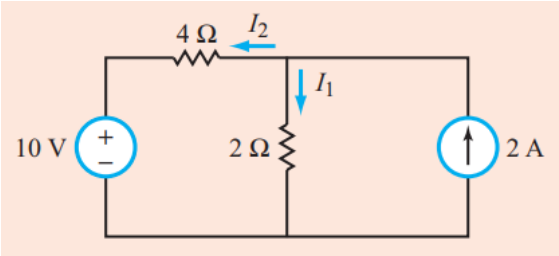
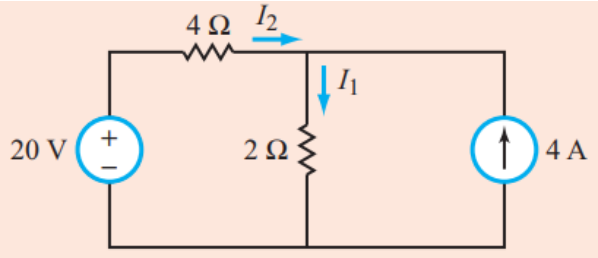
Q7. If I_1 = 3 A in the circuit below, what is I_2?



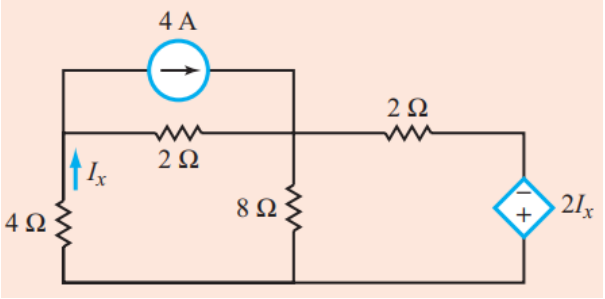
(Answer: I_2 = -1 A.)

Q8. Apply KCL and KVL to find I_1 and I_2 in the circuit below.



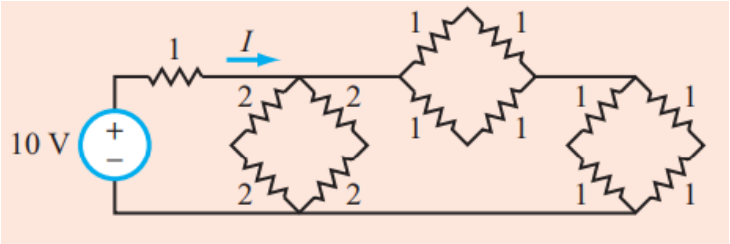
(Answer: I_1 = 6 A, I_2 = 2 A.)

Q9. Determine I_x in the circuit below.



(Answer: I_x = 1.33 A.)

Q10. Apply resistance combining to simplify the circuit below in order to find I. All resistor values are in ohms.



(Answer: I = 5 A.)