

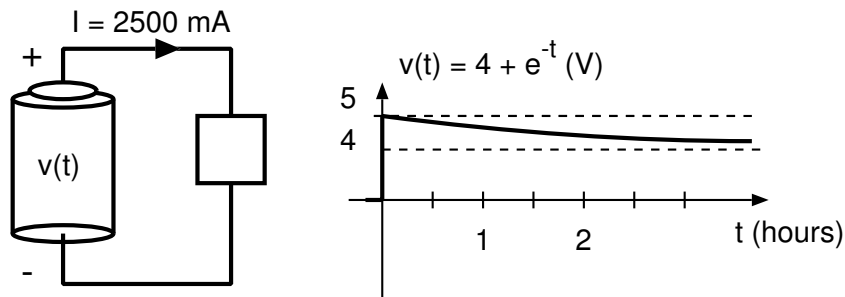
Homework #1

Due August 31, 4:30pm in 4016 SC

Problem 1) A battery-based power supply provides a constant current of 2500 mA at an initial voltage of 5 V. However, the voltage gradually drops with time according to the relation

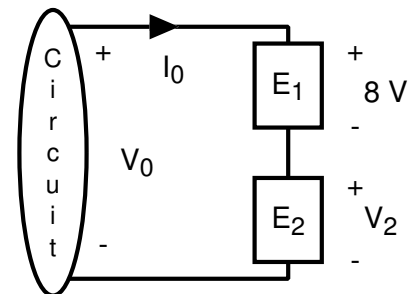
$$v(t) = 4 + e^{-t} \text{ V where } t \text{ is measured in hours.}$$

(A) What is the total charge in Coulombs supplied by the power supply over 2 hours? (B) What is the power supplied at $t = 2$ hours? (C) What is the total energy in Joules supplied by the power supply over 2 hours?

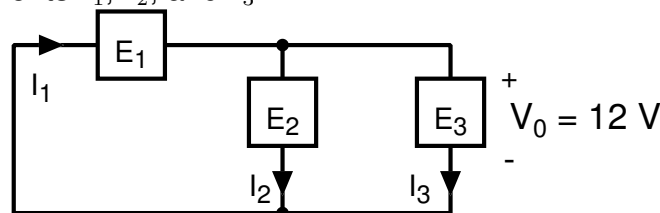


Problem 2) The reported total battery capacity of a Tesla Motors Model S is given as 85 kWh (kilowatt · hours), and is rated for a range of 265 miles. (A) How much energy per mile in Joules does the battery supply? (B) Assuming appropriate adapters could be found, how long would it take to fully charge the battery using an iPhone charger, which supplies current at 1000 mA and 5 V?

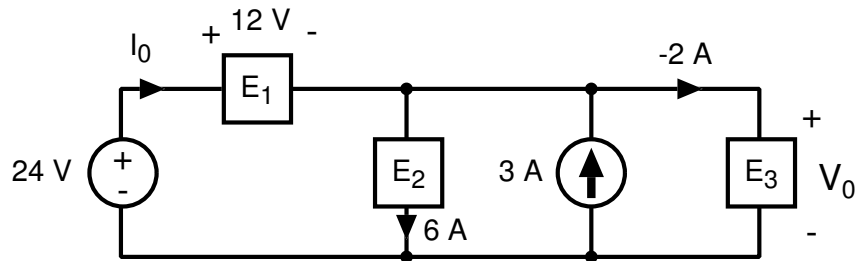
Problem 3) In the circuit shown, element E_1 is absorbing 40 W of power and has a voltage of 8 V across its terminals. The 'circuit' is supplying 60 W of power. (A) What is the current flowing into the 'circuit'? Is positive current flowing into the positive or negative labeled terminal? (B) Find the voltages V_0 and V_2 . (C) Is element E_2 absorbing or supplying power? *You may need to use conservation of power.*



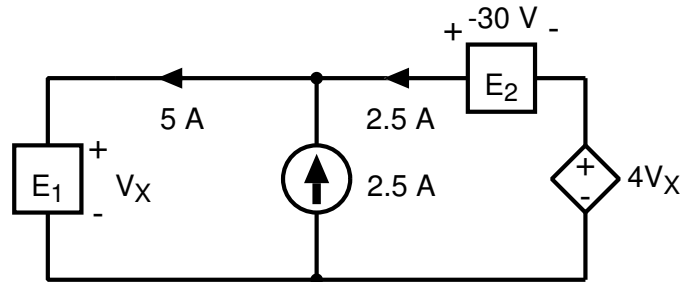
Problem 4) The power in element E_2 is 24 W using the passive sign convention, and the power in E_3 is 18 W. (A) What is the power in element E_1 using the passive sign convention? (B) What are the three currents I_1 , I_2 , and I_3 ?



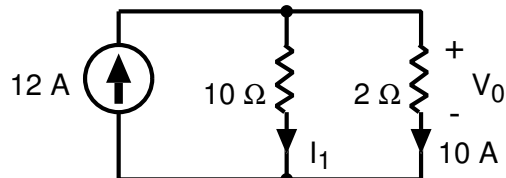
Problem 5) The 3 A current source supplies 36 W of power, that is, the power in the source is -36 W using the passive sign convention. (A) Find the power in elements E_1 , E_2 , and E_3 . (B) Find the current I_0 . You may need to apply conservation of power (Tellegen's Theorem).



Problem 6) Find the voltage V_x and the power in all four elements (E_1 , E_2 , current source, and dependent voltage source). You may need to apply conservation of power (Tellegen's Theorem).



Problem 7) (A) Find the voltage V_0 . (B) Find the current I_1 . (C) Find the power absorbed in each of the two resistors.



Problem 8) (A) Find the current I_0 and the voltages V_1 and V_3 . (B) Find the power supplied by the 15 V source (expressed with the passive sign convention). (C) To what value could we change the 20 Ω resistor to make the 15 V source supply 7.5 W of power? You might need Tellegen's Theorem for these.

