ENGR 065: Circuit Theory

Problem Set #1

Read Chapter 1 from [1] and then solve the following problems:

Problem 1 (25%): Consider the following circuit element:
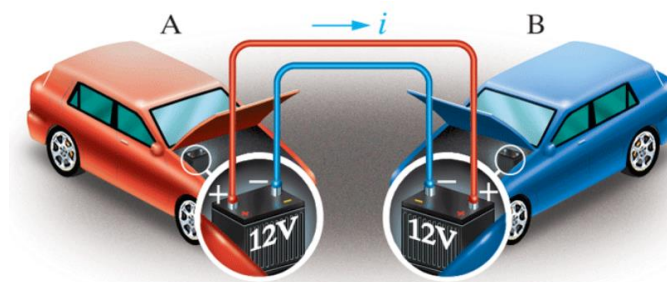

The current at the terminals of this element is

$$i(t) = \begin{cases} 0 & \text{for} \quad t \le 0 \\ 125e^{-2500t} \quad mA & \text{for} \quad t \ge 0 \end{cases}$$

a) Find the expression, $q(t)$, the charge accumulating at the upper terminal, for $t \ge 0$.

b) Find the charge that has accumulated as $t \to \infty$.

Problem 2 (25%): When a car has a dead battery, it can often be started by connecting the battery from another car across its terminals. The positive terminals are connected as are the negative terminals. The connection is illustrated in the figure shown below. Assume the current i in the figure is measured and found to be 40 A.

a) Which car has the dead battery?

b) If this connection is maintained for 1.5 min, how much energy is transferred to the dead battery?

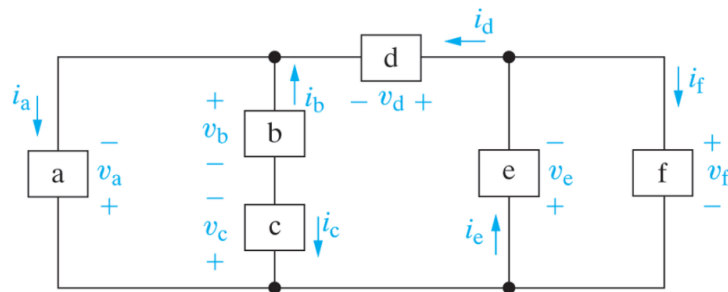**Problem 3 (25%)**: Consider the following circuit element:
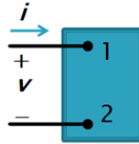
The voltage and current at the terminals of this element are zero for $t < 0$. For $t > 0$, they are:

$$v(t) = 15e^{-250t} \text{ V}$$
$$i(t) = 40e^{-250t} \text{ mA}$$

a) Find the power supplied to the element at $t=10$ ms
b) Find the total energy delivered by the element.

Problem 4 (25%): Consider the following interconnection of electric elements:

The numerical values of the voltages and currents are given in the following table. Does the interconnection satisfy the power check?

Element	Voltage (kV)	Current (mA)
a	−3	−250
b	4	−400
c	1	400
d	1	150
e	−4	200
f	4	50

References

[1] W. Nilsson and S. Riedel, "Electric Circuits", 11th Edition, 2018, Pearson-Prentice Hall