ENGR 065: Circuit Theory

Problem Set #1

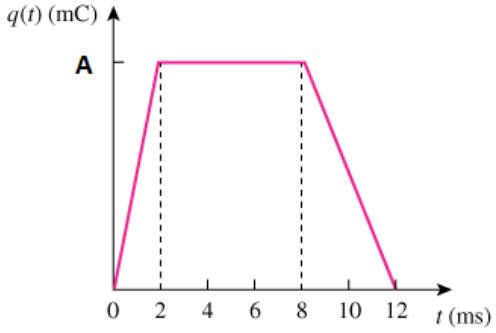
Read Chapter 1 from [1] and then solve the following problems:

Problem 1 (25%): Charge and Current

a) Determine the current flowing through an element if the charge flow is given by the following equation: $q(t) = (14t^2 + 8t - 2)$ C

b) repeat a) with $q(t) = (11e^{-t} - 21e^{-2t})$ nC

c) The charge entering a certain element is shown in the figure below, where A = 90. Find the current at 1 ms, 6 ms, and 10 ms.

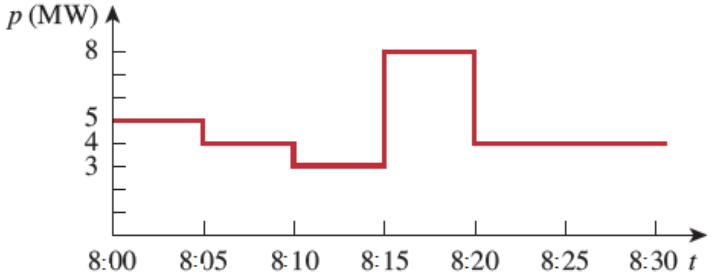


Problem 2 (25%): Applications

a) A 1-kW toaster takes roughly 6 minutes to heat four slices of bread. Find the cost of operating the toaster twice per day for 2 weeks (14 days). Assume energy costs 9 cents/kWh.

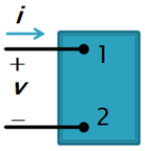
b) How much energy does a 7-hp motor deliver in 30 minutes? Assume that 1 horsepower = 746W.

c) The graph below represents the power drawn by an industrial plant between 8:00 A.M. and 8:30 A.M. Calculate the total energy in MWh consumed by the plant.



Problem 3 (25%): Power and Energy

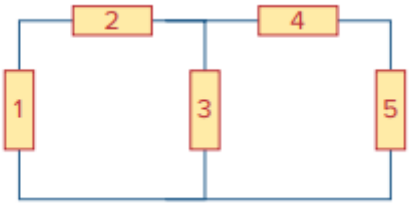
The current entering the positive terminal of a device is $i(t) = 13\ e^{-2t}$ mA and the voltage across the device is $v(t) = 6\ \frac{di}{dt}$ V.



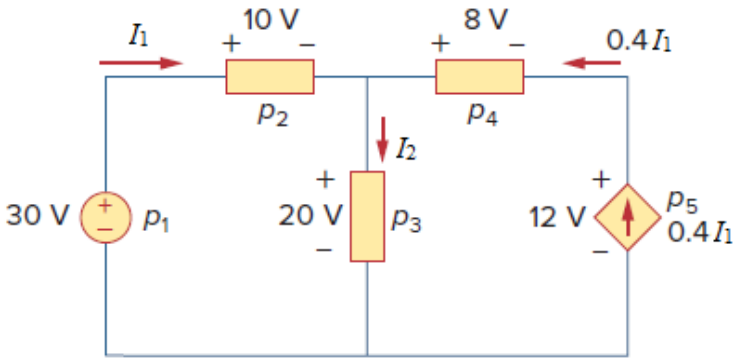
a) Calculate the power absorbed by the device.
b) Determine the energy absorbed in 3 s.

Problem 4 (25%): Power Balance

a) The figure below shows a circuit with five elements. If $p_1 = -195$ W, $p_2 = 50$ W, $p_4 = 35$ W, and $p_5 = 20$ W, calculate the power p_3 absorbed by element 3.



b) Find the power absorbed by each of the elements in the given figure, where $I_1 = 13.00$ A and $I_2 = 18.20$ A.



References

[1] C. Alexander and M. Sadiku "Fundamentals of Electric Circuits", 7th Edition, 2021, McGraw-Hill