Seminar 8: Lectures 15-16

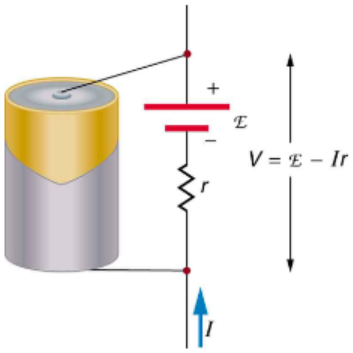
Print and answer all questions found below.
Please bring your completed worksheet to the Seminar Class. [1]

Question 1

(a) Define electromotive force (emf) and terminal voltage in a circuit.

(b) Calculate the terminal voltage across a battery with an (emf) of 12 V and internal resistance of 0.5 Ω, when connected to a load resistor of 11.5 Ω.

(c) Discuss the factors that influence terminal voltage in practical circuits.



[1] It is assumed that you have access to the standard physical constants.

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Question 2

A car battery with a 12 V emf and an internal resistance of 0.050Ω is being charged with a current of 60 A. Note that in this process the battery is being charged.

(a) What is the potential difference across its terminals?

(b) At what rate is thermal energy being dissipated in the battery?

(c) At what rate is electric energy being converted to chemical energy?

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Question 3

Three resistors having resistances of 1.6 Ω, 2.4 Ω and 4.8Ω

respectively, are connected in parallel to a 28.0 V battery that has negligible internal resistance. Find:

(a) the equivalent resistance of the combination,

(b) the current in each resistor,

(c) the total current through the battery,

(d) the voltage across each resistor, and

(e) the power dissipated in each resistor.

(f) Which resistor dissipates the most power, the one with the greatest resistance or the one with the least resistance? Explain why.

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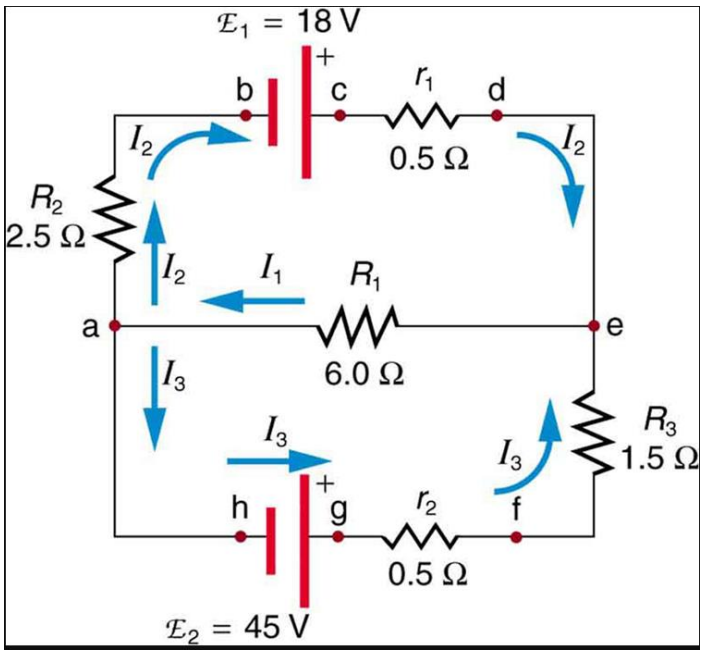
Question 4

(a) What is Kirchhoff ‘s 1st and 2nd law?
(b) Find the currents flowing in the circuit provided using Kirchhoff’s Rules.



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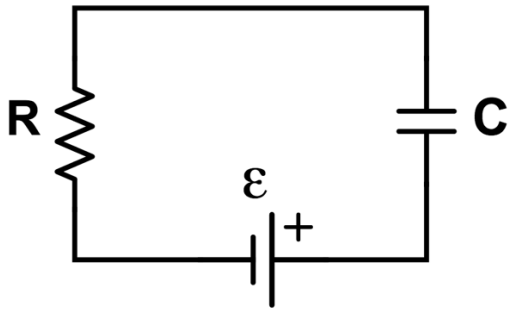
Question 5

Using the exact exponential treatment, determine how much time is required to charge an initially uncharged 100 nF capacitor through a 75.0 MΩ resistor to 90.0% of its final voltage in a RC circuit.



Question 6

(a) What voltage will accelerate electrons to a speed of $6 \times 10^7\ m/s$?

(b) Find the radius of curvature of the path of a proton accelerated through this potential in a $0.5\ T$ field and compare this with the radius of curvature of an electron accelerated through the same potential.

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Question 7

An electron moving at $4 \times 103\ m/s$ in a $1.25\ T$ magnetic field experiences a magnetic force of $1.4 \times\ 10^{-16}\ N$. What angle does the velocity of the electron make with the magnetic field? There are two answers.

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Question 8

Consider a capacitor C being discharged through a resistor R as shown in the figure. The initial potential difference across the capacitor is 3.0 V, the capacitance is 2.70×10^{-6} F, and the resistance is 1.80 Ω.

(a) How long does it take for the charge on the capacitor to drop to one-fourth of its initial value?

(b) Compute the initial charge and time constant.

(c) How long does it take to discharge all but the last quantum of charge, 1.60×10^{-19} C. if the initial potential difference across the capacitor is 12.0 V, the capacitance is equal to 3.50×10^{-6} F, and the resistance is 2.0 Ω.

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Extension Questions

Question 9

A child's electronic toy is supplied by three 1.58 V alkaline cells having internal resistances of 0.0200Ω in series with a 1.53 V carbon-zinc dry cell having a 0.100 Ω internal resistance. The load resistance is 10.0Ω.

(a) Draw a circuit diagram of the toy and its batteries.

(b) What current flows?

(c) How much power is supplied to the load?

(d) What is the internal resistance of the dry cell if it goes bad, resulting in only 0.500 W being supplied to the load?

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Question 10

A network of five equal resistors R is connected to a battery $\mathcal{E}$ as shown in the figure.

(a) Determine the current I that flows out of the battery.

(b) Use the value determined for I to find the single resistor R_{eq} that is equivalent to the five-resistor network.