PHYS 212, Honors Section – Review Material

Chapter 28: Direct-Current Circuits

- Emf: For a battery or other power source, the amount of amount of work done per unit charge to force a current through the circuit,

$$\mathcal{E} = \mathrm{d}W/\mathrm{d}q \ .$$

- Internal resistance: All batteries have a small internal resistance r, which can be treated as in series with the battery itself; This implies that the actual terminal voltage V is related to the battery emf $\mathcal{E}$ by

$$V = \mathcal{E} - Ir \ .$$

- Potential differences: Finding the potential difference V across an emf device or a resistor with a current I flowing through it, and across a capacitor with a charge Q on it, including the sign of V.

- Resistors in series: The resistance equivalent to $R_1, R_2, \ldots$ in series is

$$R_{\mathrm{eq}} = R_1 + R_2 + \ldots$$

- Resistors in parallel: The resistance equivalent to $R_1, R_2, \ldots$ in parallel is obtained from

$$R_{\mathrm{eq}}^{-1} = R_1^{-1} + R_2^{-1} + \ldots$$

- Kirchhoff's laws: Statement and use of the loop rule and the junction rule.

- RC circuits: The time constant is $\tau = RC$; What happens to the charge across a capacitor and the current through a resistor when the capacitor is being charged or discharged.
  Charging the capacitor: The voltage varies in time according to

$$V(t) = V_0 \left(1 - \mathrm{e}^{-t/RC}\right) ; \quad \text{similarly, for the charge,} \quad q(t) = Q \left(1 - \mathrm{e}^{-t/RC}\right) .$$

  Discharging the capacitor: The voltage varies in time according to

$$V(t) = V_0 \, \mathrm{e}^{-t/RC} \ .$$

Note: You are not required to know the topics and equations inside square brackets.

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