Complex Circuits & Electrical Instruments
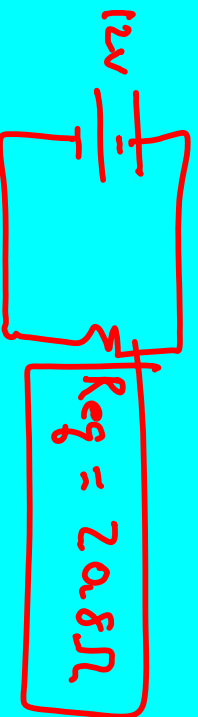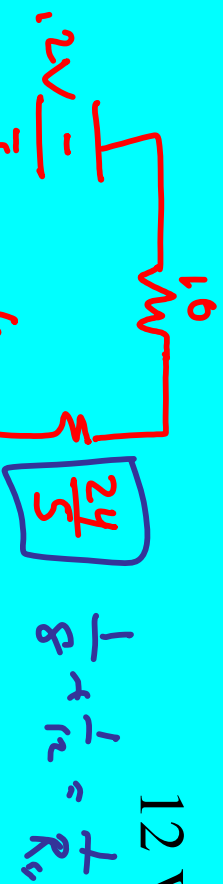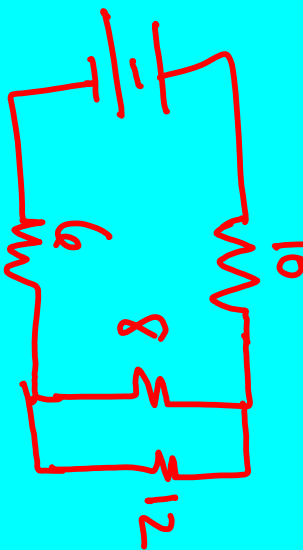
"Who wants to hear actors talk?" Harry M. Warner, Warner Brothers, 1927.
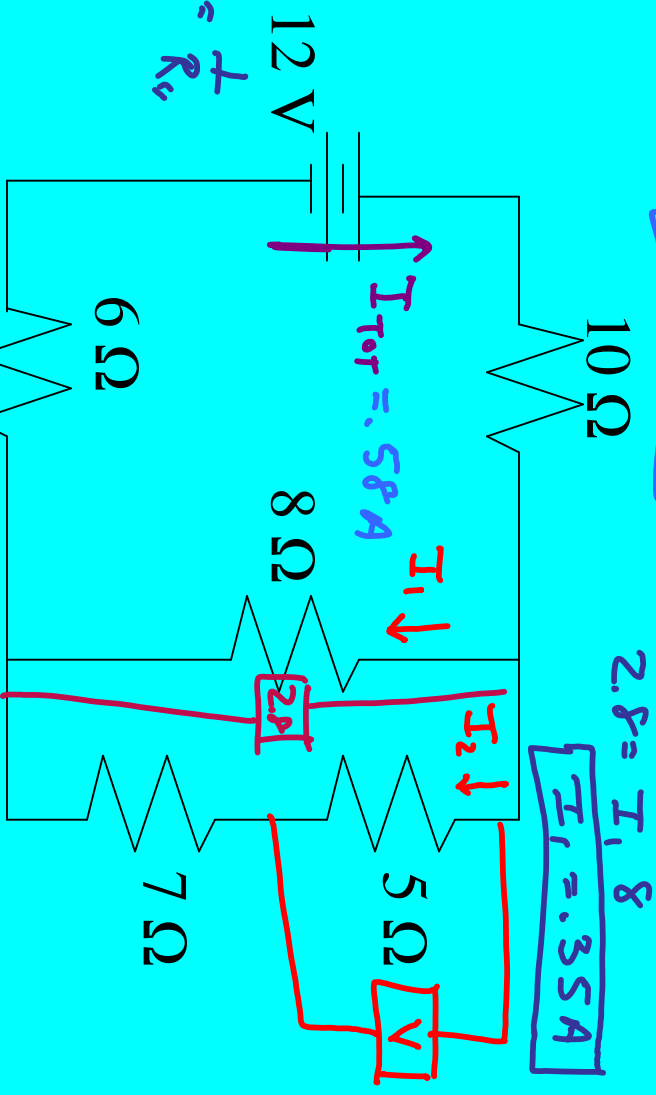
Complex Circuit

- Complex circuits involve circuit with resistors in _Series & Parallel_.

- Approach

1. Find R_{eq} for the entire circuit.

2. Find current through the battery.

3. Use Ohm's Law to solve for V or I for different resistors.

   a) Remember ___I___ is constant in series.

   b) Remember ___ΔV___ is constant in parallel.

   c) Remember voltage must drop to zero after completing the circuit.

Examples

1. Find R_{eq}, I through the battery, the voltage drop across the 5 Ω resistor, and the current through the 8 Ω resistor.

$$\frac{1}{R_c} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{8}$$

$$\frac{24}{5}$$

$$R_{eq} = 20.8\,\Omega$$

$12 = I(20.8)$

$$I = .58\,A$$

$I_{TOT} = .58\,A$

$\Delta V_{11} = .58\left(\frac{24}{5}\right)$

$\Delta V_{11} = 2.8\,V$

$\Delta V_{11} = 2.8\,V$

$I_1 = \frac{I}{8}$

$$I_1 = .35\,A$$

$\Delta V = V$

$.58 - .35 = I_2 \quad I_2 = .23\,A$

$2.8 = I_2(12)$

$I_2 = .23\,A$

$2.8 = I_2(12)$

$\Delta V = .23(5) = 1.17\,V$

$$\Delta V = 1.17\,V$$

12 V

6 Ω   8 Ω   5 Ω

7 Ω

$I_1 \downarrow$ $I_2 \downarrow$

Electrical Instruments

- A device used to measure current is *an ammeter*

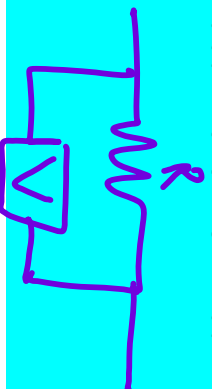- How do you connect an ammeter? Series

- What is the resistance of an ideal ammeter? 0

- A device used to measure potential difference is *Voltmeter*

- How do you connect a voltmeter? //

- What is the resistance of an ideal voltmeter? ∞

Galvanometer

- The galvanometer is the main component in analog ammeters and voltmeters. Transparency.

- A galvanometer has a resistance of about 60 ohms.

- Is this good for an ammeter? So they connect a shunt resistor in _____//_____ with the galvanometer.

  No

- Should the shunt resistor have a high or low resistance?

- To use the galvanometer as a voltmeter, what adjustments should be made.

- Homework questions 38 & 39.
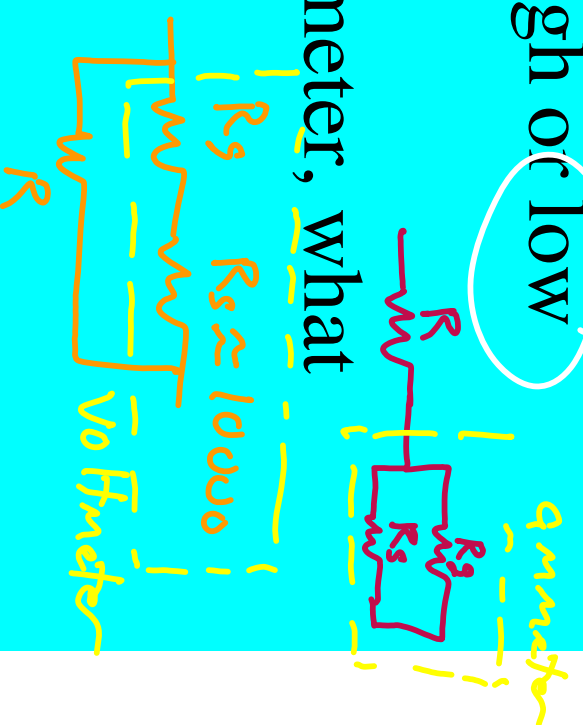
Galvanometer
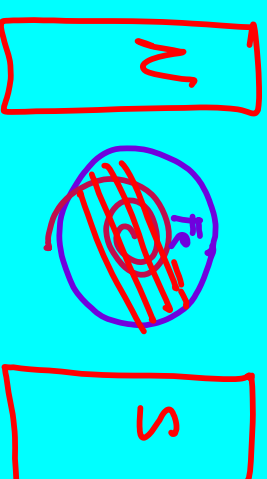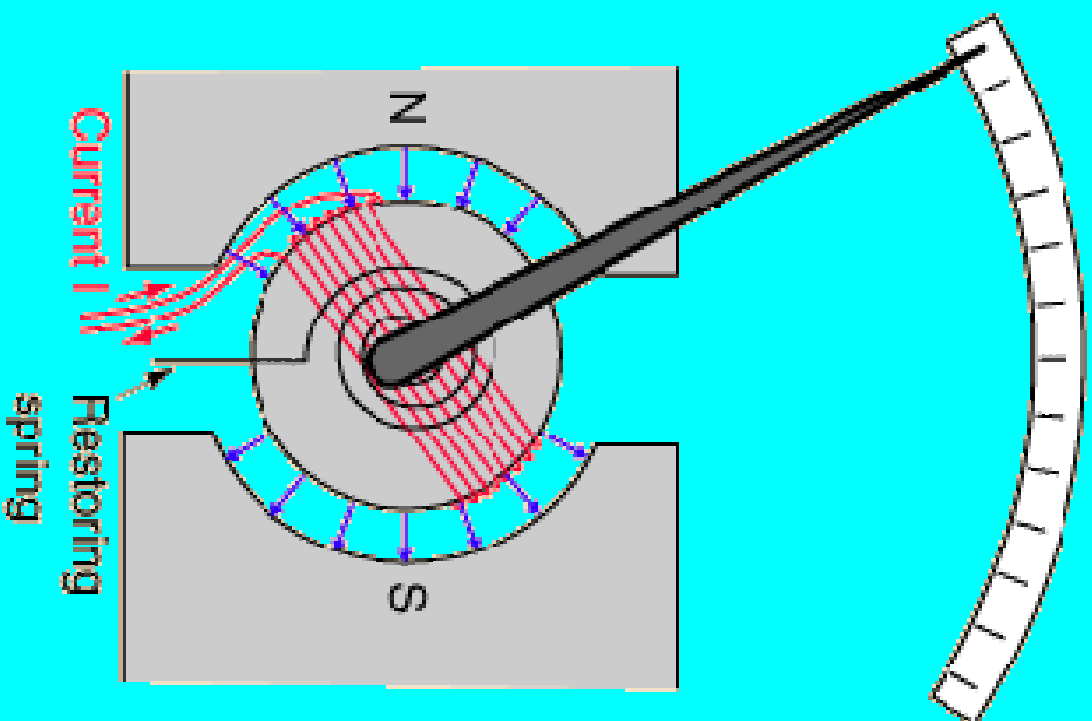
Wheatstone Bridge

- An unknown resistor can be measured using a wheatstone bridge.

- The circuit is balanced when no current flows through the galvanometer.
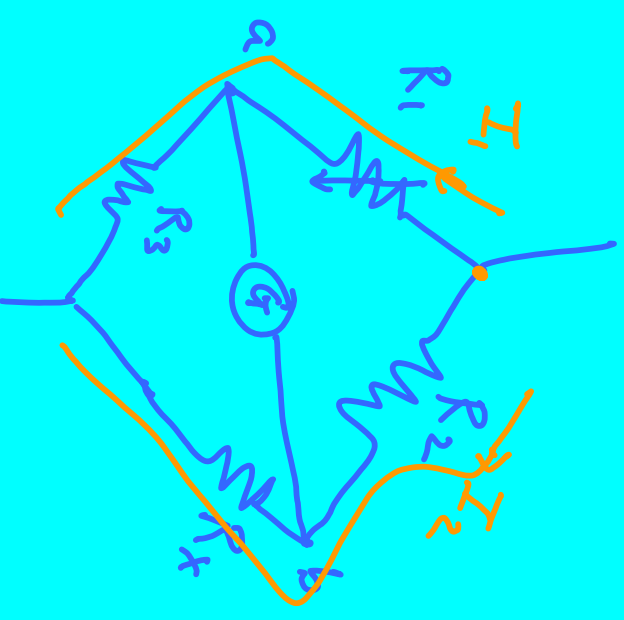
- Solve for R_x

$$V_a = V_b$$
$$R_1 I_1 = R_2 I_2$$
$$R_3 I_1 = R_x I_2$$
$$R_x = \frac{R_2 R_3}{R_1}$$

- A potentiometer is a variable resistor.

Variable resistor
(potentiometer)