$$R = \frac{\rho L}{A}$$

ρ – resistivity it is material parameter

units of $\Omega\,m$

$$\rho = \rho_0 \left(1 + \alpha (T - T_0)\right)$$

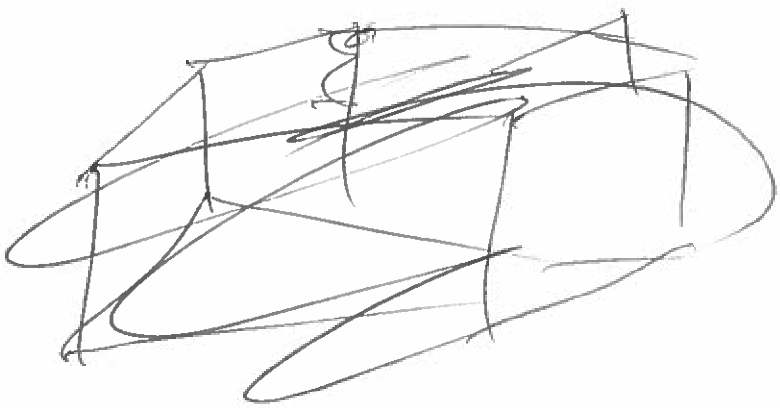
ρ_0 is resistivity @ $20^\circ C$

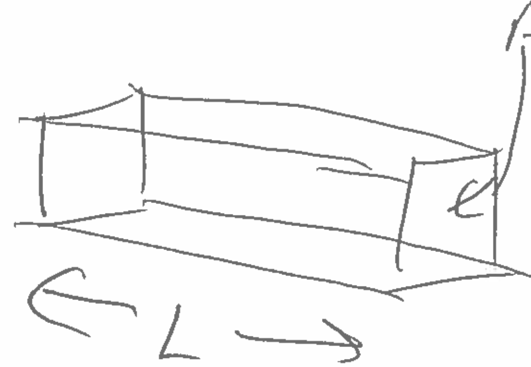
T_0 is $20^\circ C$

for most materials $\alpha > 0$

That means $\rho \uparrow$ as $T \uparrow$

α is thermal factor $({}/{}^\circ C)$





$\rho = 5 \times 10^{-6}\,\Omega\,m \quad A = .10\,m^2 \quad L = 1.0\,m$

$$R = \frac{(5 \times 10^{-6}\,\Omega\,m)(1.0\,m)}{.10\,m^2} = 5 \times 10^{-7}\,\Omega$$

Power is iV

Ohm's Law $i = \frac{V}{R}$ or $V = iR$

$P_{resistor} = i(iR) = i^2 R$ ← Joule heating

$P_{resistor} = \frac{V}{R} V = \frac{V^2}{R}$

$R_{filament}$ for 60W light bulb

$P = \frac{V^2}{R}$ $\quad R = \frac{V^2}{P}$

$$R = \frac{(110V)^2}{60W} = 202\,\Omega$$

$$P = iV \Rightarrow i = \frac{P}{V} = \frac{60W}{110V} = \underline{0.55A}$$

$$i = \frac{1}{R} V$$

$$i = G V$$

G is conductance

units S (siemens)

$$G = \frac{\sigma A}{L} \qquad R = \frac{\rho L}{A} \qquad \sigma = \frac{1}{\rho}$$

σ is conductivity

ρ resistivity

<u>Transducers</u> are devices which have a physical property that changes due to an external system change.

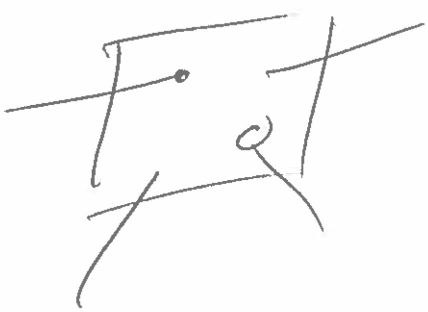
A rod expands as temperature increases

$$i = K T$$

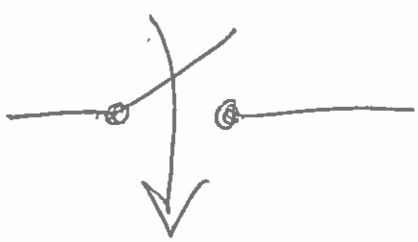
K ← parameter

T ← Temperature

$$V = A F$$ – stress transducer

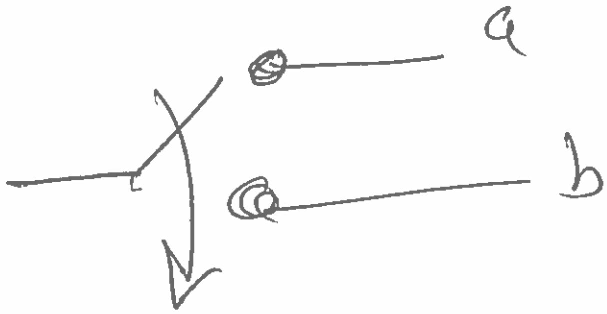


Switches

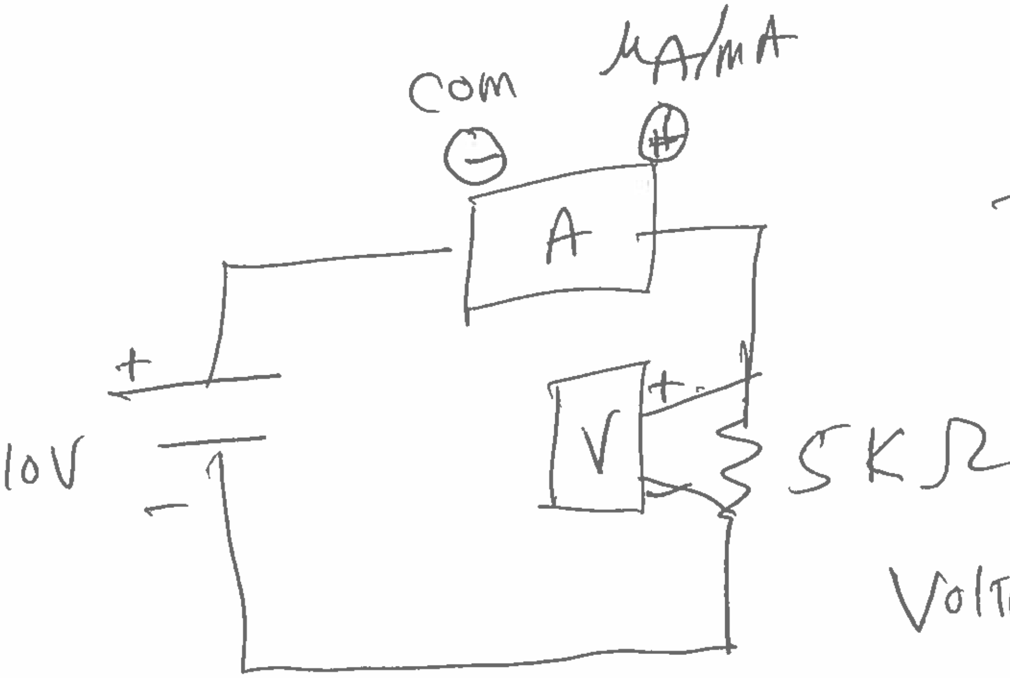


switch closes at time t_a

switch opens at time t_b



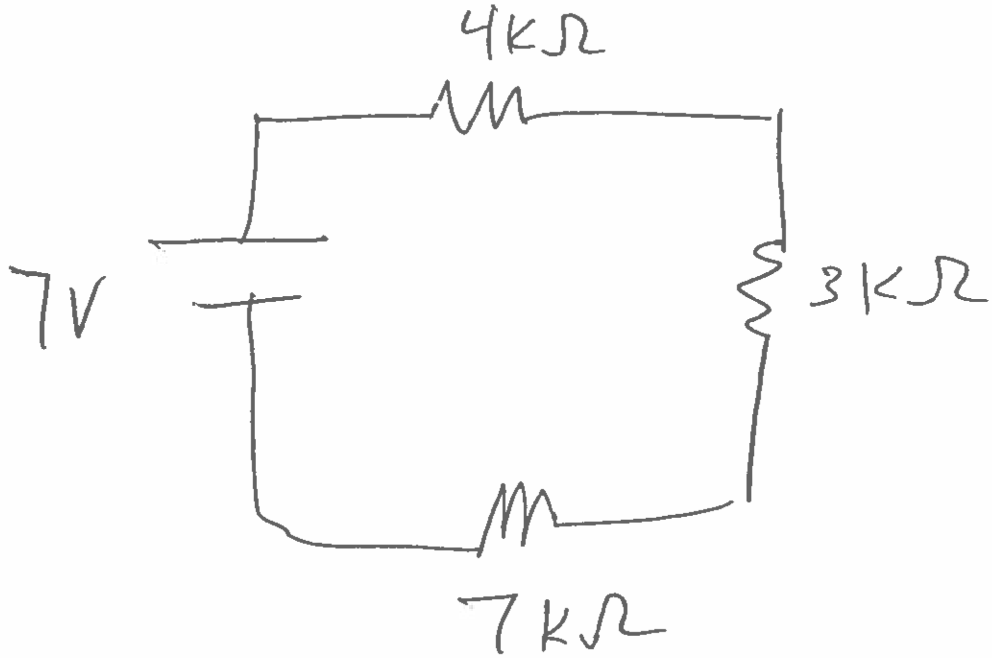
$t = \tau_c$ switch goes from line a to line b at τ_c



Ammeter reads −2 mA

Voltmeter reads +10V

$$i = \frac{V}{R} = \frac{10V}{5K\Omega} = 2\,mA$$



$$i = \frac{V_{TOT}}{R_{TOT}} = \frac{7V}{4K\Omega + 3K\Omega + 7K\Omega} = \frac{7V}{14K\Omega}$$

$$i = .5\,mA$$

$$V_{4K\Omega} = 2V = i R_{4K\Omega} = (.5mA)(4K\Omega)$$
$$2V$$

$$V_{3K\Omega} = 1.5V$$

$$V_{7K\Omega} = 3.5V$$

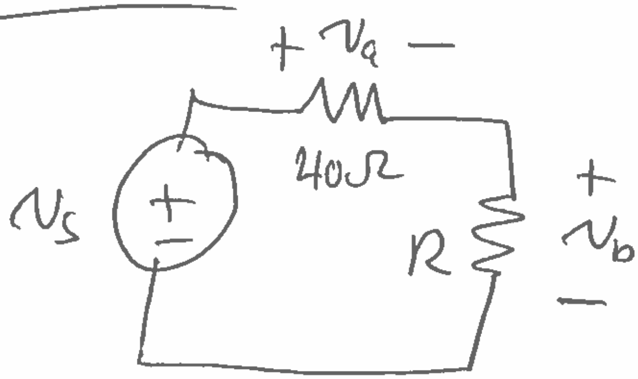
$$P_{7V} = (.5mA)(7V) = +3.5mW$$

$$P_{4K\Omega} = -(.5mA)^2(4K\Omega) = -(.5mA)(2V) = -1.0mW$$

$$P_{3K\Omega} = -(.5mA)(1.5V) = -0.75mW$$

$$P_{7K\Omega} = -(0.5mA)(3.5V) = -1.75mW$$

P. 2.4-10



What is R?

v_a (V)	v_b (V)
11.75	7.05
7.5	4.5
5.625	3.375
10	6
4.375	2.625

$$i = \frac{v_a}{40\Omega} = \frac{v_b}{R}$$

$$v_b = \frac{R}{40\Omega} v_a$$ — Equation of a line

Plot 5 points find best slope

$$\text{Slope} = \frac{R}{40\Omega} \Rightarrow R = 40\Omega(\text{Slope})$$

MATLAB ⇒ slope = 0.6 ⇒ $R = 24\Omega$