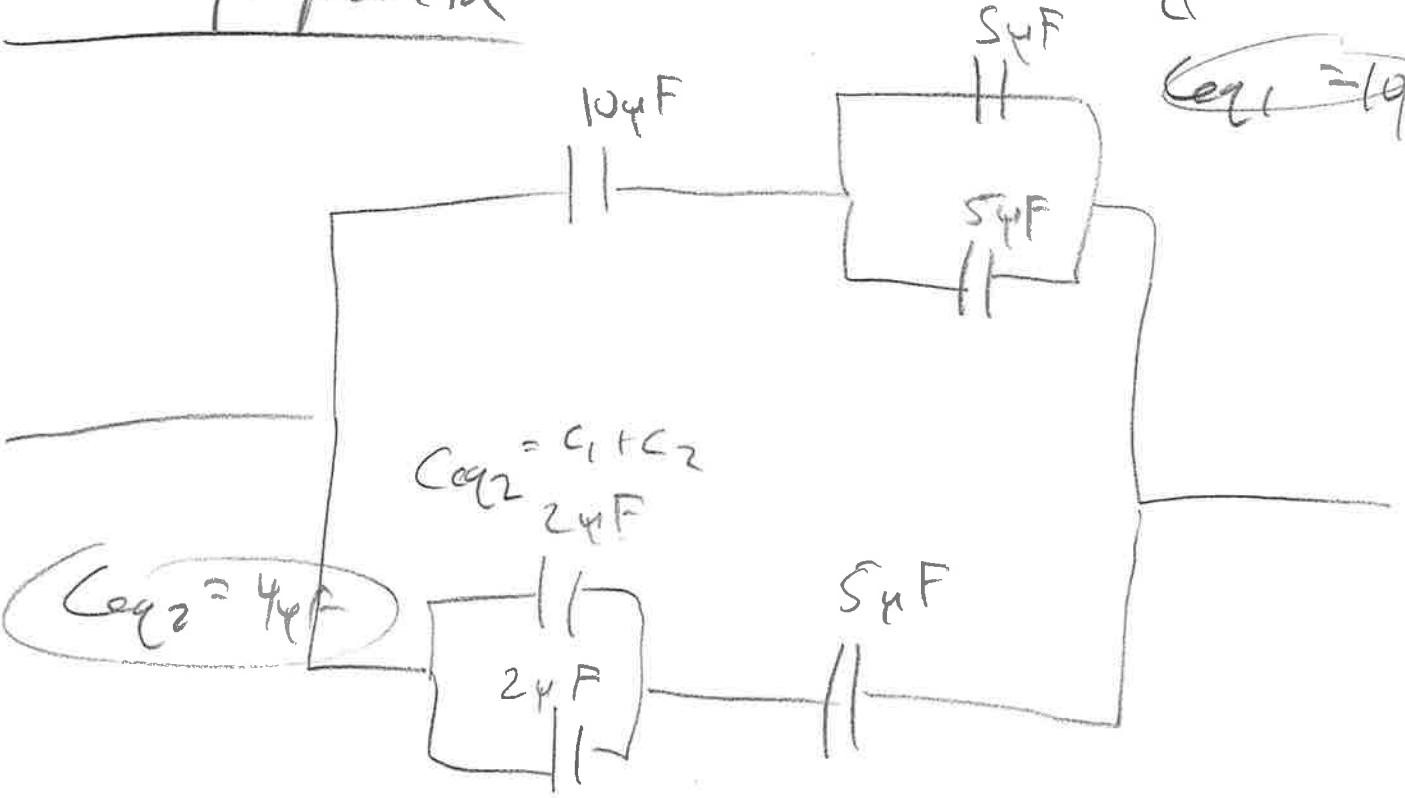
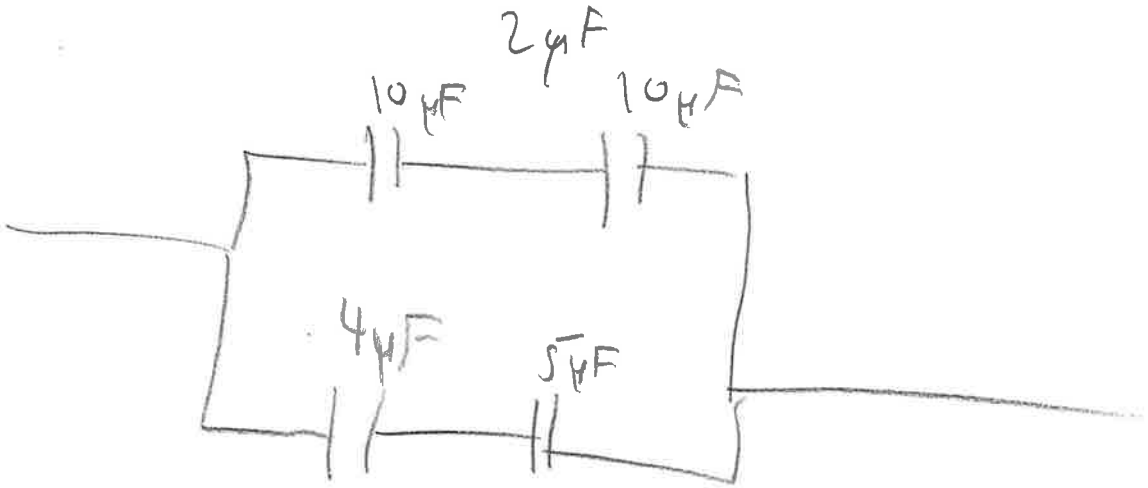
Warm up problem

(1) $C_{eq_1} = C_1 + C_2$

$C_{eq_1} = 10\mu F$





$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$C_{eq} = \left(\frac{1}{C_1} + \frac{1}{C_2} \right)^{-1}$$

$$C_{eq3} = \left(\frac{1}{10} + \frac{1}{10}\right)^{-1}$$

$$C_{eq3} = \left(\frac{2}{10}\right)^{-1}$$

$$\boxed{C_{eq3} = 5\,\mu F}$$

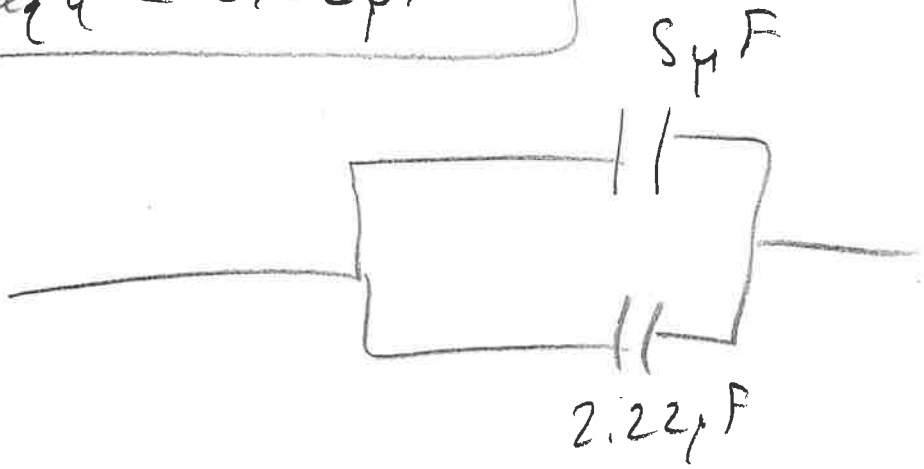
$$C_{eq4} = \left(\frac{1}{4} + \frac{1}{5}\right)^{-1}$$

$$C_{eq4} = \left(\frac{5}{20} + \frac{4}{20}\right)^{-1}$$

$$C_{eq4} = \left(\frac{9}{20}\right)^{-1}$$

$$C_{eq4} = \frac{20}{9}$$

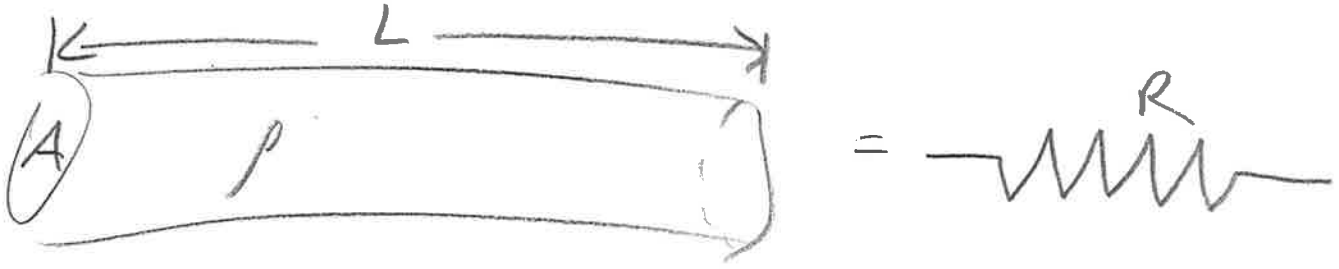
$$\boxed{C_{eq4} = 2.22\,pF}$$



$$C_{eq\,total} = C_1 + C_2$$

$C_{eq\,total} = 7.22\mu F$

Resistivity



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

R – resistance (Ω)

ρ – resistivity ($\Omega \cdot m$)

L – length of wire (m)

A – cross-sectional area (m^2)

– ρ is property of the material.

Resistance Problem

what length of copper wire, with diameter 1mm, is required to produce 0.1Ω of resistance? (9)

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

$$A = \frac{1}{4}\pi d^2$$

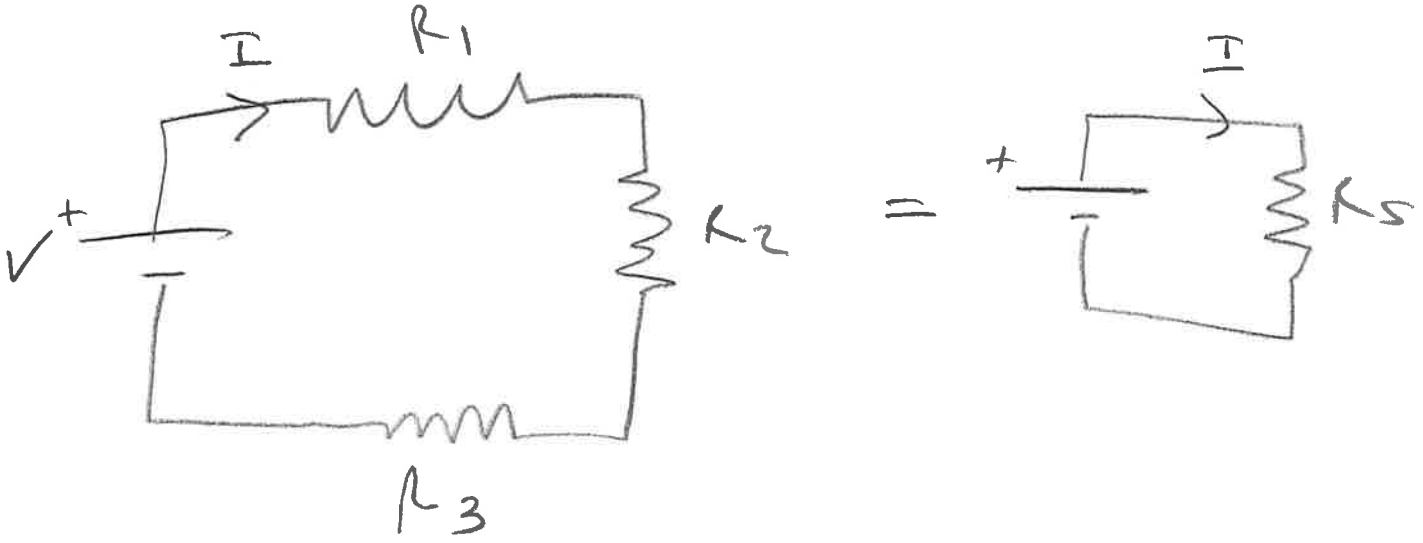
$$R = \frac{\rho L}{\frac{1}{4}\pi d^2}$$

$$R = \frac{4\rho L}{\pi d^2}$$

$$L = \frac{\pi d^2 R}{4\rho}$$

$$\boxed{L = 4.57\,m}$$

Resistors in Series



- $\Delta V_R = IR$ (Ohm's Law)
- current I is the same in series

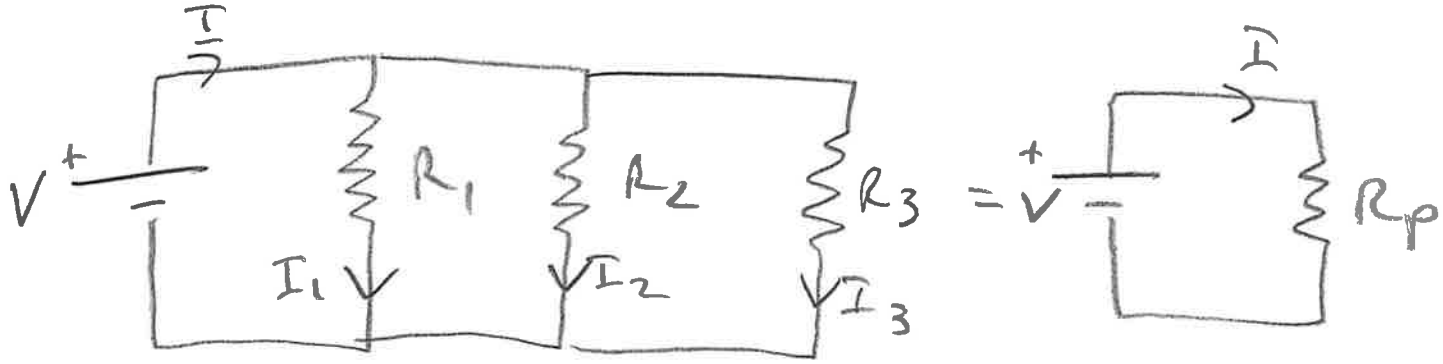
$$IR_1 + IR_2 + IR_3 = IR_s$$

$$\cancel{I}(R_1 + R_2 + R_3) = \cancel{I}(R_s)$$

$$\boxed{R_s = R_1 + R_2 + R_3 + \ldots}$$

Resisters add in series

Resistors in Parallel



$$I = I_1 + I_2 + I_3$$

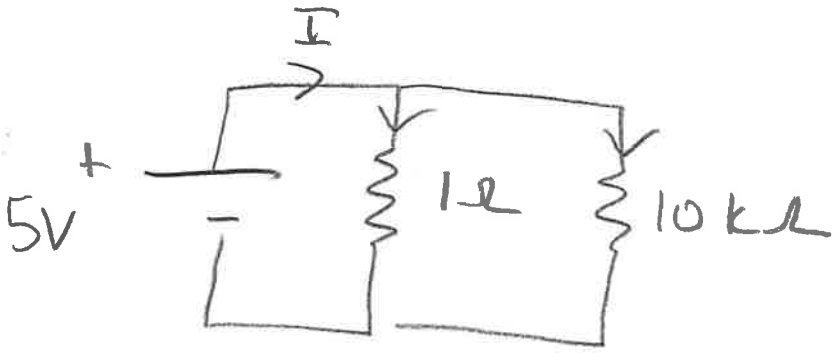
$I_1 = \frac{V}{R_1}$ — voltage is the same in parallel.

$$\frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$V\left(\frac{1}{R_p}\right) = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$\boxed{\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$$

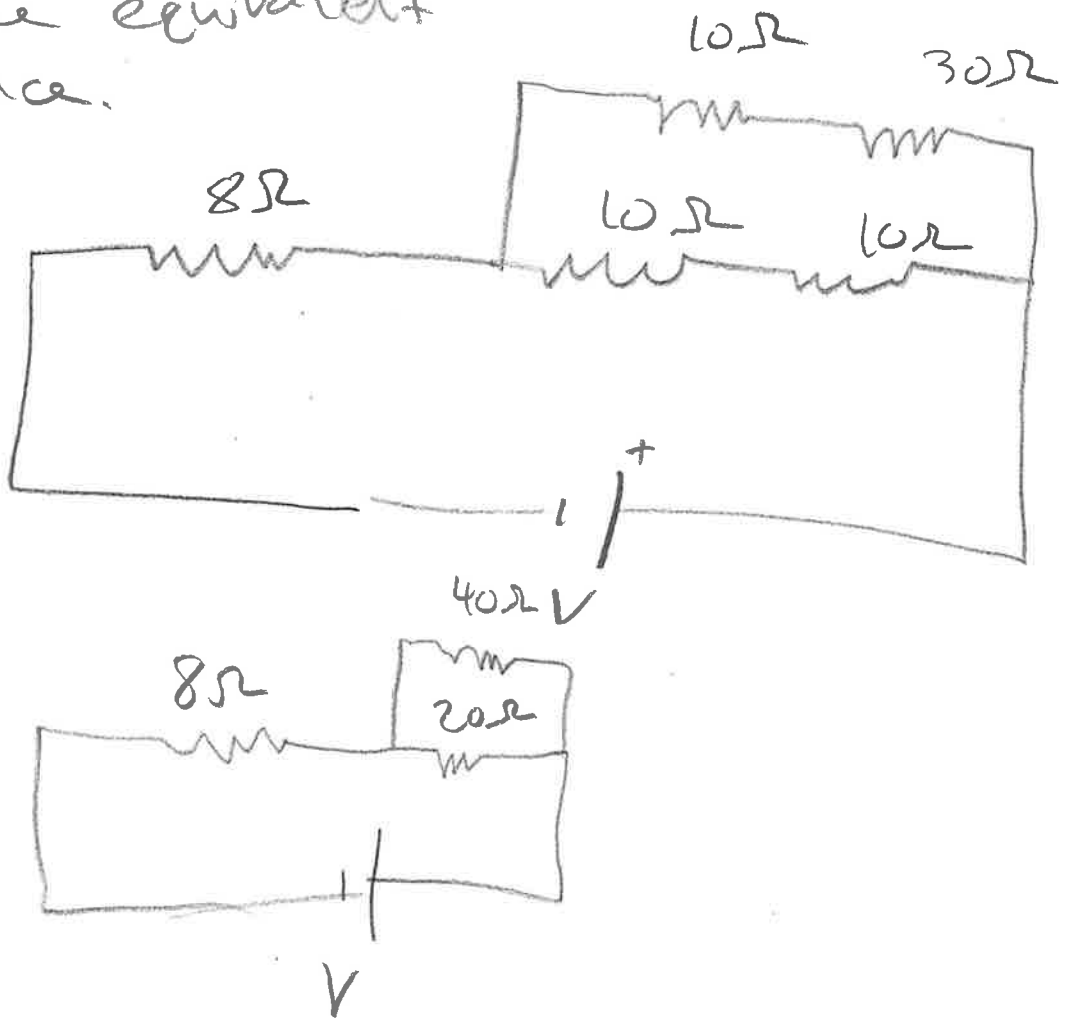
Equivalent resistance in parallel is always less than the smallest constituent resistor.



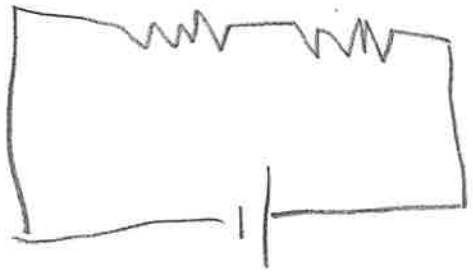
- Some current flows through the large resistor!

Equivalent Resistance Problem

Find the equivalent resistance.



8Ω 13.3Ω



$$R_{eq} = \left(\frac{1}{20} + \frac{1}{40}\right)^{-1}$$

$$R_{eq} = \left(\frac{2}{40} + \frac{1}{40}\right)^{-1}$$

$$R_{eq} = \left(\frac{3}{40}\right)^{-1}$$

$$R_{eq} = \frac{40}{3}$$

$$R_{eq} = 13.3\,\Omega$$

21.3Ω

$R_{eq} = 21.3\,\Omega$