1) Consider the circuit element shown. Give the algebraic expression for the effective resistance of this system of resistors. If $R_1 = R_3 = R_5 = 5$ ohms and $R_2 = R_4 = 3$ ohms, what is the effective resistance? [10 pts]

$$R_{23} = R_2 + R_3 = 3 + 5 = 8\, \Omega$$

$$R_{234} = \left[ \frac{1}{R_2} + \frac{1}{R_4} \right]^{-1} = \left[ \frac{1}{3} + \frac{1}{3} \right]^{-1} = \frac{24}{11}$$

$$R_{eq} = R_1 + R_{234} + R_5 = 5 + \frac{24}{11} + 5 = 12.18\, \Omega$$

2) Consider the circuit element shown. Give the algebraic expression for the effective capacitance of this system of capacitors. If $C_1 = 1\, \text{mF}$ and $C_2 = C_3 = 10\, \text{mF}$, what is the effective capacitance? [10 pts]

$$C_{12} = C_1 + C_2 = 1 + 10 = 11\, \text{mF}$$

$$C_{eq} = \left[ \frac{1}{C_{12}} + \frac{1}{C_3} \right]^{-1} = \left[ \frac{1}{11} + \frac{1}{10} \right]^{-1} = 5.24\, \text{mF}$$