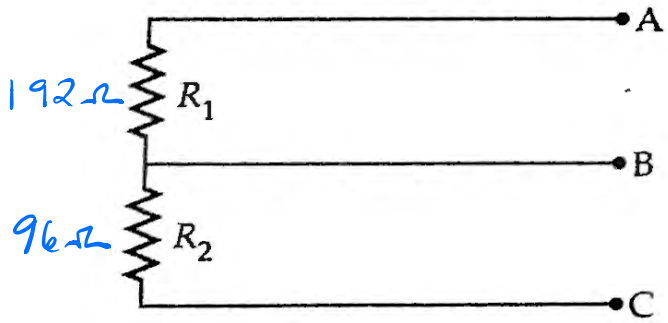
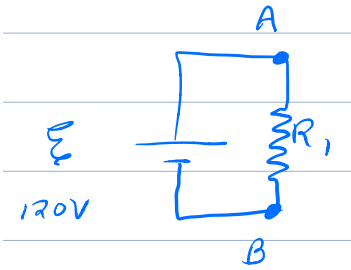
106. •• **A Three-Way Lightbulb** A three-way lightbulb has two filaments with resistances R_1 and R_2 connected in series. The resistors are connected to three terminals, as indicated in **Figure 21–49**, and the light switch determines which two of the three terminals are connected to a potential difference of 120 V at any given time. When terminals A and B are connected to 120 V the bulb uses 75.0 W of power. When terminals A and C are connected to 120 V the bulb uses 50.0 W of power. **(a)** What is the resistance R_1? **(b)** What is the resistance R_2? **(c)** How much power does the bulb use when 120 V is connected to terminals B and C?

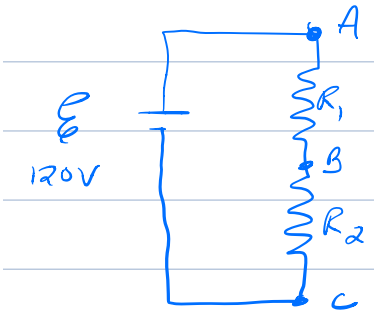


▲ **FIGURE 21–49** Problem 106



$$P_{AB} = 75.0\,W = \frac{\mathcal{E}^2}{R_1}$$

$$R_1 = \frac{\mathcal{E}^2}{75.0\,W} = \frac{(120\,V)^2}{75.0\,W} = \boxed{192\,\Omega}$$

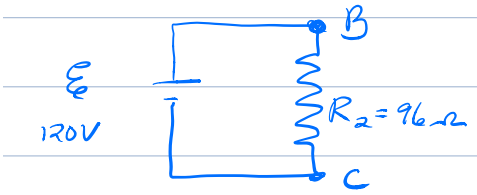


$$P_{AC} = 50.0\,W = \frac{\mathcal{E}^2}{R_1 + R_2}$$

$$R_1 + R_2 = \frac{\mathcal{E}^2}{50.0\,W} = \frac{(120\,V)^2}{50.0\,W} = 288\,\Omega$$

$$R_2 = 288\,\Omega - R_1$$

$$= 288\,\Omega - 192\,\Omega = \boxed{96\,\Omega}$$



$$P_{BC} = \frac{\mathcal{E}^2}{R_2} = \frac{(120\,V)^2}{96\,\Omega} = \boxed{150\,W}$$