Answer on question #52406, Physics, Electric Circuits

Question 2 bulbs 40W and 60W and rated voltage 240V are connected in series across a potential difference of 420V. Which bulb will work at above rated voltage?

Solution Resistance of 40W bulb is

$$R_{40} = \sqrt{\frac{U}{P_{40}}} = \sqrt{\frac{40}{240}} = \frac{1}{\sqrt{6}}\,\Omega$$

Resistance of 60W bulb is

$$R_{60} = \sqrt{\frac{U}{P_{60}}} = \sqrt{\frac{60}{240}} = \frac{1}{2}\,\Omega$$

Current in 420 V loop is

$$I = \frac{U}{R_1 + R_2} = \frac{420}{\frac{1}{\sqrt{6}} + \frac{1}{2}}\,A$$

Voltage on 40W bulb is

$$V_{40} = IR_{40} = \frac{420}{\frac{1}{\sqrt{6}} + \frac{1}{2}} \cdot \frac{1}{\sqrt{6}} = \frac{420}{1 + \sqrt{6}/2} \approx 188.8\,V$$

Voltage on 60W bulb is

$$V_{40} = IR_{60} = \frac{420}{\frac{1}{\sqrt{6}} + \frac{1}{2}} \cdot \frac{1}{2} = \frac{420}{1 + \frac{2}{\sqrt{6}}} \approx 231.2\,V$$

So answer is 60W bulb will work almost at rated voltage.