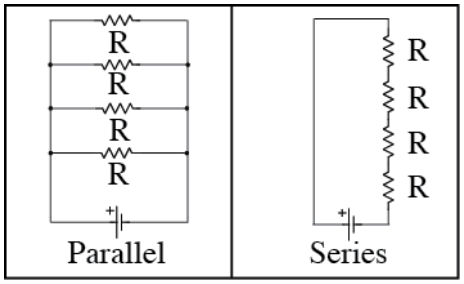
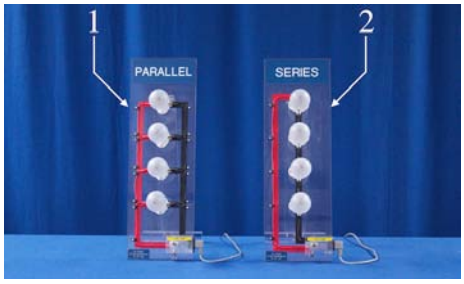
SERIES AND PARALLEL LIGHT BULBS 5F20.50





Concept:

The brightness of the bulbs arranged in the above circuits is determined by the power dissipated, $P = V^2/R_{eq}$. Thus, the bulb brightness is inversely proportional to the *equivalent resistance*, R_{eq}. The supplied voltage, V, is the same for both circuits. R_{eq} is the equivalent resistance of four 60 W bulbs arranged either in series, or parallel, each bulb with resistance R.

For the series arrangement of four bulbs,

$$R_{eq} = R_s = R + R + R + R = 4R$$

For the parallel arrangement of four bulbs,

$$R_{eq} = R_p = \frac{1}{\frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \frac{1}{R}} = \frac{R}{4}$$

Since the brightness of each circuit of bulbs is inversely proportional to R_{eq}, we see that the *parallel* circuit of bulbs *should* be brighter than the *series* circuit by a factor of 16. In fact the parallel circuit is less than 16 times brighter because of the effect a *hotter* filament has on bulb resistance. We have neglected this non-ohmic effect, and the measured value of power ratio is closer to a factor of 8 instead of 16.

Equipment:

1. Parallel Circuit Board with (4) 120V 60W Light Bulbs
2. Series Circuit Board with (4) 120V 60W Light Bulbs
3. Safety Gloves (not pictured)

Procedure:

1. Describe the arrangement of the circuits on each board for the class and ask the class what will happen when you power the circuits.
2. Turn on the power to both circuits and discuss what you see and how that relates to voltages, currents and resistances for various sections of the circuit.
3. Poll the class to answer what happens if a single bulb is removed from each circuit (be sure to use the gloves provided.