1.

a. The total resistance of the circuit is 5Ω, so the current through the battery is 1.8A.

b. The voltage across bulb A must be -5.4V, so the voltage across both bulbs B and C is -3.6V.

Using $P = \frac{-\Delta V^2}{R}$ $P_A = -9.72W$, $P_B = 2.16W$, $P_C = 4.32W$ so bulb A is brightest

c. Bulb C goes out because its branch can carry no current and $P = -I^2R$. Bulb A becomes less bright because the total resistance of the circuit has increased, making the current through bulb A lower. However, this makes the voltage across bulb A lower, meaning the voltage across bulb B must be higher. Bulb B increases in brightness.

2.

a.
i. $\Delta U = q \cdot \Delta V = (1.6 \times 10^{-19} C)(-24V) = -3.84 \times 10^{-18} J$
ii. loses

b. 10Ω

c.
i. The total current in the circuit is 2.4A, so the current through Y will be $\frac{2}{3}(2.4A) = 1.6A$.
ii. The conventional current, I, is to the right.

d. $I_C = 1.6A$, so $P_C = (1.6^2)(12) = -30.72W$. $E = P \cdot \Delta t = (-30.72)(5) = -153.6J$

e. Using $P = -I^2R$

$P_A = -3.84W$
$P_B = -7.68W$
$P_C = -30.72W$
$P_D = -15.36W$

$P_C > P_D > P_B > P_A$

3.

a.

i. $30 = \frac{120^2}{R}$ so R = 480Ω and 120 = (I)(480) so I = 0.25A

ii. $40 = \frac{120^2}{R}$ so R = 360Ω and 120 = (I)(360) so I = 0.33A

b.

i. R = 480Ω and I = 0.143A

ii. R = 360Ω and I = 0.143A

c. Using $P = I^2R$

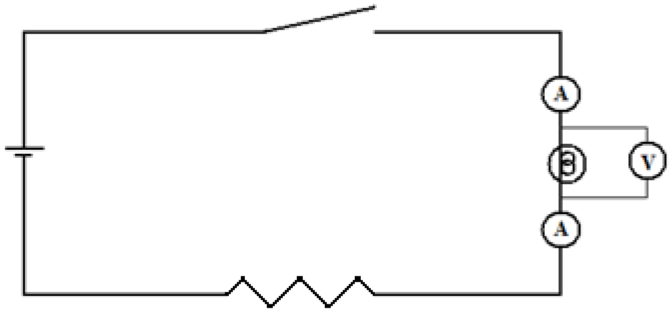
40W bulb in the parallel circuit: 40W
30W bulb in the parallel circuit: 30W
30W bulb in the series circuit: 9.80W
40W bulb in the series circuit: 7.35W

d.

i. Parallel circuit: P = 70W
ii. Series circuit: P = 17.15W

4.

a. Create a single-loop circuit with a power supply (set to 10V), one lightbulb, one switch, one resistor and two ammeters. Add a voltmeter in parallel with the lightbulb.



b.

i. When the switch is closed, if the two ammeters read the same current, then the same number of electrons passes through each during the same time, indicating that the same number of electrons exit the bulb as enter the bulb.

ii. If the voltmeter reads a non-zero value, then the charge must be changing in potential energy according to the equation $\Delta V = \frac{\Delta U}{Q}$.

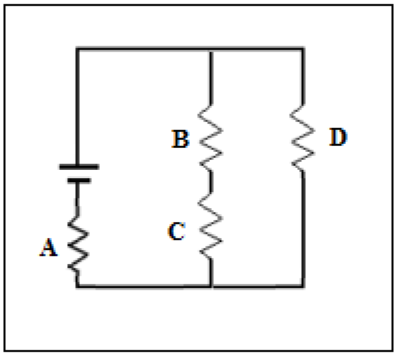
c.

i. No changes are needed to the circuit.

ii. Set the power supply to different voltages ranging from 1V to 10V in steps of 1V. At each voltage, record the current in the top ammeter and the voltage across the voltmeter.

d. If the graph of voltmeter voltage versus ammeter current is not linear, then the bulb is non-ohmic. However, because each data point has a range of uncertainty around it, it is impossible to know that any function is perfectly linear and therefore any bulb or resistor perfectly ohmic.

5.
a.



b. Using I^2R, the highest current will have the highest power. $I_A = I_{BC} + I_D$, so bulb A is the highest power. Because branch D has a lower resistance than branch BC, $I_D > I_{BC}$ and $P_D > P_B = P_C$.

c.

i. The brightness of bulb A will decrease because the current through A will decrease. This is because removing bulb D increases the total resistance of the circuit.

ii. If the brightness of bulb A decreases, then the voltage across A must have decreased. This implies the voltage across bulbs B and C increased. The brightness of B must then increase.

6.

a.

i. P = $\frac{24^2}{90}$ = 6.4W

ii. P = (3)($\frac{24^2}{30}$) = 57.6W

b.