1. The two would be attracted towards each other, just like magnets (equal forces). Electrons represent the negative side of the magnet, and protons represent the positive side. When you place both sides together, they attract.
2. Because the attraction force is the same, but protons are heavier compared to electrons, the electron will accelerate faster
3. Nope. Ohm's law is $V = IR$, if $V$ is doubled and $R$ remains constant, that means that I has to double, in other words, $V$ is directly proportional to $I$
4. Using the resistance equation: $R = \frac{\rho L}{A}$

   If ρ and $L$ don't change, therefore $A$ must change

   $A = \frac{1}{4}\pi d^2$

   $4R = \frac{pL}{\frac{1}{4}A}$

   $\frac{1}{4}A = \frac{1}{4}\pi(\frac{1}{2}d)^2$

   In order for resistance to be 4 times larger than B, wire A's diameter must be $\frac{1}{2}$ of wire B's. In other words, wire A's diameter must be wire A's radius
5. Because the volume remains constant, we know that if the length increases by two times, the cross-section area must change by its inverse, or $\frac{1}{2}$

   $R = \frac{\rho L}{A}$

   $4R = \frac{\rho \times 2L}{\frac{1}{2}A}$

   Resistance increases by 4 times
6. Let Bulb A be $P = 25W$

   Let Bulb B be $P = 100W$

   $P_A = I_A V$

   $I_A = 0.208A$

   $V = I_A R_A$

   $R_A = 576.923\Omega$

   $P_B = I_B V$

   $I_B = 0.833A$

   $V = I_B R_B$

   $R_B = 144.058\Omega$

   Bulb B ($100W$) has a smaller resistance compared to Bulb A ($25W$)
7. A.

   $V = IR$

   $R = 20\Omega$

   B.

$P = IV$

$P = 7.2W$

$7.2W \times \frac{1J}{1s} \times \frac{60s}{1m} = 432\frac{J}{m}$

8. B=E>C=D>A=F
9. A.

$V_T = \frac{110}{8}V = 13.75V$

B.

Because this is a series circuit, $I_T = I_n$

$V_n = I_T R_n$

$R_n = \frac{13.75V}{0.5A} = 27.5\Omega$

$P_n = I_T V_n = 6.875W$

10. A.

Let $R_P$ be the resistance of the parallel circuit (left two resistors)

Let $R_S$ be the resistance of the right resistor ($470\Omega$)

$\frac{1}{R_P} = \frac{1}{820\Omega} + \frac{1}{680\Omega}$

$R_P = 371.73\Omega$

We can consider $R_P$ as a giant resistor, so now it is a series circuit consisting of $R_P$ and $R_R$

$R_T = R_P + R_R$

$R_T = 841.73\Omega$

B.

By using the $R_T$ from part A

$V_T = I_T R_T$

$I_T = 0.014A$

C.

Let $V_L$ be the voltage drop for the left resistor ($820\Omega$)

Let $V_M$ be the voltage drop for the middle resistor ($680\Omega$)

Let $V_R$ be the voltage drop for the right resistor ($470\Omega$)

Solving for current

$I_T = I_P = I_R$

$V_R = I_R R_R = 6.58V$

Because $V_L$ and $V_M$ are configured as parallel circuits, their voltage drop is the same

$V_P = V_T - V_R = 5.42V$

11. A.

Let $R$ be the resistance of each resistor (they are equal)

When open: $R_T = R_1 + R_3 = 2R$

When closed: $R_T = R_1 + \frac{R_2 R_3}{R_2 + R_3} = R + \frac{1}{2}R$

The equivalent resistance decreases by $\frac{1}{2}R$ when $S$ is closed

B.

When open: $I_T = I_1 = I_3$

When closed: $I_T = I_1 = I_2 + I_3$

When closed, all resistors will have an increase in current except for $I_3$, which has a decreases

C.

When open: $V_T = V_1 + V_3$

When closed: $V_T = V_1 + V_2 = V_1 + V_3$

We can conclude that: $V_2 = V_3$, therefore $V_2$ increases while $V_3$ decreases. Therefore $V_1$ increases

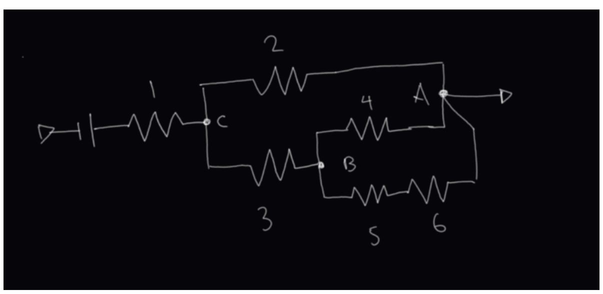
D.

When open: $P_T = I_T V_T$

When closed: $P_T = I_T V_T$

Because $I_T$ increases, the power increases when $S$ is open

12. This circuit can be drawn as




Therefore, the equation for the equivalent resistance of the circuit is $R_T = R_1 + R_{23R_{P456}}$

The resistance of the parallel circuit with $R_4$, $R_5$, and $R_6$, can be represented with

$\frac{1}{R_{P456}} = \frac{1}{R_4} + \frac{1}{R_5 + R_6}$

$R_{P456} = 1.86k\Omega$

The resistance of the parallel circuit with $R_2$, $R_3$ and $R_{P456}$ can be represented with

$R_{23R_{P456}} = \frac{1}{R_2} + \frac{1}{R_3 + R_{P456}}$

$R_{23R_{P456}} = 1.74k\Omega$

Therefore:

$R_T = 1.74k\Omega + 2.8k\Omega = 4.54k\Omega$

13. $I_1 = I_2 + I_3$

    Assumption: $I_2$ flows to the right

    Loop 1 $V_1 \rightarrow R_2 \rightarrow R_1 \rightarrow V_1$

    $9V - 18\Omega I_2 - 22\Omega I_1 = 0$

    Loop 2 $V_3 \rightarrow R_2 \rightarrow V_3$

    $6V + 18\Omega I_2 = 0$

    Solving for system of equations:

    $I_1 = \frac{15}{22}A$

    $I_2 = -\frac{1}{3}A$

    $I_3 = \frac{66}{66}A$

    $I_1 = 0.68A \leftarrow$

    $I_2 = 0.33A \leftarrow$

14. When another bulb is added to the circuit, the total current increases, which means the total resistance decreases. When total current increases, that means $R_1$ becomes brighter, which means the voltage drop is greater. When the voltage drop is greater, that means all the bulbs except $R_1$ in the parallel circuit become dimmer.