(6) a) Equivalent means total.

$$R_T = \frac{1}{\frac{1}{12} + \frac{1}{6}} = 4\,\Omega$$

b) a and b → 3V

c and d → 3V

Separate branches get a full 3V each.

c) Battery → point A

$$V_T = I_T R_T$$

$$I_T = \frac{V_T}{R_T} = \frac{3\text{ V}}{4\,\Omega} = 0.75\text{ A}$$

Branch 1:

$$I = \frac{V}{R} = \frac{3}{12} = \frac{1}{4} = 0.25\text{ A}$$

Branch 2:

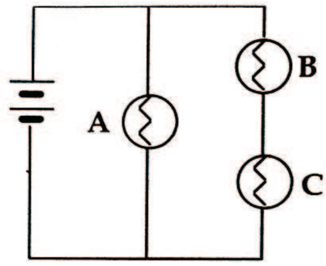
$$I = \frac{V}{R} = \frac{3}{6} = \frac{1}{2} = 0.5\text{ A}$$

d) $P = VI = 3(0.25) = 0.75\text{ W}$ (branch 1)

$P = VI = 3(0.75) = 2.25\text{ W}$ (branch 2)

4. You decide to change the lighting arrangement in your home. Instead of hiring an electrician, you hire your neighbor who says he "knows all about 'lectricity".

You're incredibly surprised and shocked to discover that he didn't do a very good job. Your three wall lights are not all the same brightness, even though the bulbs have the same power rating. Frustrated, you take a look at his wiring yourself, and find that the bulbs are set up as follows:




a) Assume all the bulbs have identical resistance. If the source voltage was 3 V, what would the voltage drop across each bulb be?

A: 3V   B: 1.5V   C: 1.5V

Voltage is spread across the components in each branch.

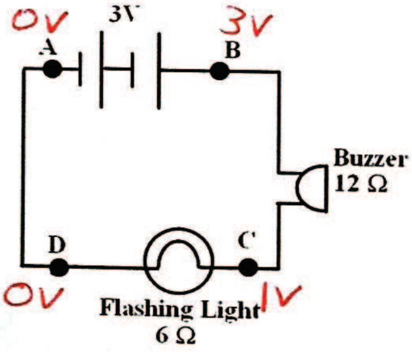
b) How does the flow rate (current) through A compare to that through B?

The current is higher in A, because that branch has less resistance (only one bulb).

c) How is the brightness of each bulb different? (Which are brighter? Which are dimmer?) Explain.

A is brighter than B + C, because it has a higher potential difference (voltage) and also a higher current.

5. A particularly annoying series circuit contains a buzzer (with 12 Ohms of resistance), a flashing light (with 6 Ohms of resistance), and a 3 Volt battery.




a. What is the ΔV between:

a and b → 3V (Voltage of battery)

b and c → 2V

c and d → 1V

d and a → 0V

Reason: The potential difference of BOTH the buzzer and light must be 3V. The buzzer has double the resistance of the light and by V=IR it must therefore have double the voltage.

b. What is the current in this circuit?

$R_T = 12 + 6 = 18\,\Omega$

$I = \frac{V_T}{R_T}$

$I = \frac{3}{18}$

$I = 1/6$ amps

c. What power is dissipated by each resistor?

$P = VI$

$P = 3(\frac{1}{6}) = \frac{1}{2}$ Watts

$P = 0.5$ W

(8) a) No effect - still 6V.

b) Lower, because some of the current has to go down the new path (3rd branch).

c) ~~No effect~~
The total resistance of the circuit is less because the electrons have an extra path to go through.

According to V=IR, if R increases and V is still the same, then I must decrease.

So the total current of the circuit (point G) will be less.

a) Parallel part:

$$R_T = \frac{1}{\frac{1}{12} + \frac{1}{6}} = 4\,\Omega$$

Combine parallel part with the 8 Ω resistor:

$$R_T = 4 + 8 = 12\,\Omega$$

b) First calculate maximum current. (Current of the whole circuit).

$$V = IR$$

$$I = \frac{V}{R} = \frac{6}{12} = 0.5\,A$$

Current through the 8 Ω resistor $= 0.5\,A$

At point A, this current splits into two. Since Path A→B has double the resistance of path C→D, the current in A→B will be half that of C→D.

So: $\frac{2}{3}\,0.5 = \frac{1}{3}\,A$

$\frac{1}{3}\,0.5 = \frac{1}{6}\,A$

c) $V = IR = \frac{1}{3}(6) = 2\,V$ ← 6 Ω resistor

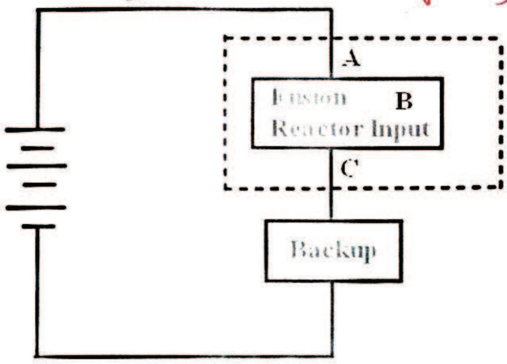
$V = IR = \frac{1}{6}(12) = 2\,V$ ← 12 Ω resistor

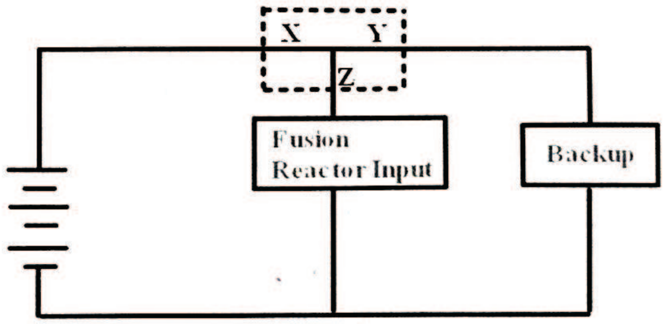
$6 - 2 = 4\,V$ ← 8 Ω resistor.

2. Han realizes the problem is with resister C, which is a switch for a backup system. Unfortunately he is not sure how the system should be wired, and so he has to consider the impact of voltages and currents on the components.

a. How do the electron flow rates in A, B and C compare to each other? = current

It is all one path, so the current is the same in A, B and C.




A = entering the reactor
B = through the reactor
C = leaving the reactor

X = entering the junction
Y = on the way to the backup from the junction
Z = on the way to the reactor from the junction

b. How does the potential at A, B and C compare to each other? Explain.

Potential before (A) is highest (voltage of battery.)
Potential after (C) is lowest (some of the voltage has been used)
So B must be in between.
A > B > C

c. How do the flow rates in X, Y and Z compare to each other?

X = Y + Z
The flow rate (current) going into the junction is equal to the flow rate going out. Electrons split down the two paths.

d. How does the potential at X, Y and Z compare to each other? Explain.

Same: X = Y = Z because at all three points none of the battery's potential has yet been used.

3. After careful consideration, he chooses the second wiring (the one on the right). Why do you think that might be?

If the fusion reactor breaks in the series circuit, the circuit will be broken, and the backup won't work.
If it breaks in the parallel circuit, the backup will still work, because there is still a complete circuit.
Therefore, the parallel circuit is better.