1. In this circuit, three resistors receive the same amount of current (4 amps) from a single source. Calculate the amount of voltage "dropped" by each resistor, as well as the amount of power dissipated by each resistor: [12]

\[
\begin{align*}
V_1 &= IR_1 = 4 \times 1 = 4V \\
V_2 &= 4 \times 2 = 8V \\
V_3 &= 4 \times 3 = 12V \\
\end{align*}
\]

\[
\begin{align*}
P_1 &= V_1I = 4 \times 4 = 16W \\
P_2 &= 8 \times 4 = 32W \\
P_3 &= 12 \times 4 = 48W \\
\end{align*}
\]

2. What will happen to the brightness of the light bulb if the switch in this circuit is suddenly closed? [2]

It is a parallel circuit.
Both the bulb and the resistor have independent and full supply of the voltage from the battery. The light bulb will not be affected at all, remaining the same brightness even when the switch for the resistor is ON.

3. a) Determine the amount of voltage impressed across each resistor in this circuit. [2]

Each has 15V as the battery.

b) Find the Total Equivalent of the 2 resistors. [2]

\[
R_T = \frac{100 \Omega}{100 \Omega} = 50 \Omega
\]

c) Find the current from the battery. [2]

\[
I_e = \frac{V}{R_T} = \frac{15}{50} = 0.3A
\]

d) Find the current supplied to each resistor (just from c) without using other formula)
Explain how you come up with your answer (4)

Each branch should have \(\frac{0.3}{2}A = 0.15A\)
as both resistors have the same value, they should have the same supply of current from the original \(I_o\)
4. Identify which of these circuits is a parallel circuit and which are series. [6]

5. a) Calculate the total amount of current that the battery must supply to this parallel circuit. [4]

\[
\begin{align*}
R_f &= \frac{1}{\frac{1}{500} + \frac{1}{500}} = \frac{2}{\frac{1}{250}} \\
R_c &= \frac{500}{2} = 250 \Omega \\
I &= \frac{V}{R_c} = 10 \div 250 = 0.04 \text{ A}
\end{align*}
\]

b) What happens to the current if there is another 50 ohms resistor added but connected in a parallel manner? [3] The current will be More. \[ I = \frac{V}{R_c} = \frac{10}{\frac{500}{2}} = \frac{10 \times 3}{500} = 0.06 A \]

c) What happens to the current if the 2 resistors are connected in series? [3]

\[
R_f = 10 \times 2 = 20 \Omega \quad (\text{as a short circuit})
\]

\[
I = \frac{V}{R} = \frac{10}{200} = 0.05 \text{ A}
\]

6. Choose two resistor values such that one resistor passes 25% of the total current, while the other resistor passes 75% of the total current. [4]

\[
R_1 = \frac{25\% \text{ current}}{\text{hard to be \textit{bigger}} \, \text{than} \, R_2}
\]

\[
I_1 = \frac{30}{7.5} = 4 A
\]

\[
I_2 = \frac{30}{30} = 1 A \quad \text{I}_2 > \text{I}_1 \text{ by 3 times}
\]

\[
I_2 = \frac{30}{10.2} = 3 A
\]

\[
R_f = \frac{1}{\frac{1}{50} + \frac{1}{10}} \quad \text{R}_f = \frac{1}{\frac{1}{30} + \frac{1}{30}} \quad \text{R}_f = \frac{1}{\frac{1}{75} + \frac{1}{75}}
\]

\[
R_1 = \frac{3}{2} \quad \text{R}_2 = \frac{2}{3}
\]

\[
R_1 = 3R_2
\]
7. a) In this circuit, identify which component is the source and which is the load. [2]

The Load is the resistor of 200 Ω in the light bulb.

b) How much electrical power is being dissipated by the light bulb in this circuit? Show clear steps. Hint: you may have to use 2 formulas. [5]

\[ P = VI \]
\[ I = \frac{V}{R} \]
\[ P = \frac{V^2}{R} = \frac{36^2}{200} = 6.48 \text{ W} \]

Substitute in \[ P = VI = 36 \times 0.18 = 6.48 \text{ W} \]

8. In this circuit, three resistors receive the same amount of voltage (24 volts) from a single source.

a) Calculate the amount of current "drawn" by each resistor [6]

\[ V = 24 \text{ V} \]
\[ I = \frac{V}{R} \]
\[ I_1 = \frac{24}{R_1} = 2.4 \text{ A} \]
\[ I_2 = \frac{24}{2} = 12 \text{ A} \]
\[ I_3 = \frac{24}{3} = 8 \text{ A} \]

b) Find the amount of power dissipated by each resistor [6]

\[ P_1 = 24 \times 2.4 = 57.6 \text{ W} \]
\[ P_2 = 24 \times 12 = 288 \text{ W} \]
\[ P_3 = 24 \times 8 = 192 \text{ W} \]

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9. Suppose you were to build this circuit and take measurements of current through the resistor and voltage across the resistor:

Recording these numerical values in a table on the left, the results look something like this:

<table>
<thead>
<tr>
<th>Current (Amp)</th>
<th>Voltage (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.22</td>
<td>0.66</td>
</tr>
<tr>
<td>0.47</td>
<td>1.42</td>
</tr>
<tr>
<td>0.85</td>
<td>2.54</td>
</tr>
<tr>
<td>1.05</td>
<td>3.16</td>
</tr>
<tr>
<td>1.50</td>
<td>4.51</td>
</tr>
<tr>
<td>1.80</td>
<td>5.41</td>
</tr>
<tr>
<td>2.00</td>
<td>5.99</td>
</tr>
<tr>
<td>2.51</td>
<td>7.49</td>
</tr>
</tbody>
</table>

a) In the circuit diagram, label in the circles – which is the Ammeter A and which is the Voltmeter V. [2]

b) Label the polarities of the voltmeter and ammeter. [2]

c) Draw the direction of Current. [1]

\[ \Delta V = 6 - 1.4 = 4.6 \text{ Volts} \]
\[ \Delta I = 2 - 0.5 = 1.5 \text{ Amps} \]

\[ \text{Slope} = \frac{\Delta V}{\Delta I} = \frac{4.6}{1.5} = 3.07 \Omega \text{ Resistance} \]

d) Why does an arrow add to the battery's symbol? [1]

The battery supply has different voltage output (variable voltage)

e) Plot these figures in the above table on the following graph: [3]

f) What mathematical relationship do you see between voltage and current in this simple circuit? [2]

As voltage increase, the current increase directly proportional.

g) Find the Resistance from the graph by finding the slope of the graph. [3]
10. A common saying about electricity is that it always takes the path of least resistance. Explain how this proverb relates to the following circuit, where electric current from the battery encounters two alternate paths, one being less resistive than the other: [5]

\[ I_1 = \frac{10}{250} = 0.040 \text{A} \]
\[ I_2 = \frac{10}{800} = 0.0125 \text{A} \]

More current is passing through switch 250.

11. The part of circuit show 3 resistors connected in parallel. Their Total equivalent resistance is 25 ohms. Find the value of the unknown Resistor X. [3]

\[ R_{total} = \frac{1}{\frac{1}{100} + \frac{1}{100} + \frac{1}{X}} \]
\[ \frac{1}{25} = \frac{1}{100} + \frac{1}{100} + \frac{1}{X} \]
\[ \frac{1}{25} = \frac{2}{100} + \frac{1}{X} \]
\[ \frac{1}{25} = \frac{1}{50} + \frac{1}{X} \]

\[ X = 50 \Omega \]

12. What will happen in this circuit as the switches are sequentially turned on, starting with switch number 1 and ending with switch number 3?

Describe how the successive closure of these three switches will impact:

a) The voltage drop across each resistor [2]

No change.

b) The current through each resistor [2]

At first, one resistor R4 (Series).

After SW1 is on, R1 will increase. To find battery voltage = R1

The current will depend very much the value of the resistors.

NS: More resistance in parallel, the less the R4 current drawn from the battery [2]
13. The followings show 3 different circuits with the same resistors connected in different manner. The value of $R_1 = 10$, $R_2 = 50$ and $R_3 = 40$ ohms. Find out the Total Equivalent Resistance in each circuit.

**Circuit A**

![Circuit A Diagram]

a) Total Equivalent Resistance in Circuit A \([2]\)

$$R_T = R_1 + R_2 + R_3 = 10 + 50 + 40 = 100 \Omega$$

b) Total Equivalent Resistance in Circuit B \([3]\)

$$\frac{1}{R_T} = \frac{1}{10} + \frac{1}{50} + \frac{1}{40} = \frac{20}{200} + \frac{4}{200} + \frac{5}{200}$$

$$\Rightarrow R_T = \frac{29}{200} = 0.145 \Omega$$

c) Draw another 2 circuit diagrams of Circuit C to demonstrate the sequence of your calculation. \([2+5]\)

![Circuit C Diagrams]

d) Which Circuit has the most and which has the least Total Equivalent Resistance, briefly explain your answer. \([3]\)

The circuit B with all resistors in parallel has the least $R_T$.

The circuit A with all resistors in series has the highest $R_T$.

e) What is another way of setting the circuit with these 3 resistor? Draw the circuit diagram D. Find its Total Equivalent Resistance. \([2 + 4]\)

![Circuit D Diagram]

$$R_T = 10 + \frac{R_E}{50} = 10 + \frac{22.22}{50} = 22.22 \Omega$$
14. Given that $1.60 \times 10^{-19}$ Coulomb for the charge ($Q$) of an electron.

a) a plastic ruler which has been rubbed with your hair and gained $6.9 \times 10^{20}$ electrons. State whether the plastic ruler becomes positively or negatively charged. [1]

The plastic ruler must become negatively charged as electrons are negative.

b) What net charges will be found on the hair? Explain your answer [2]

Positive charge to the same protons as electrons have left from the hair.

c) Explain the observation on the left. [4]

Rubber a plastic ruler on your hair will create static electricity, negative chargers (electrons) left the hair and accumulate on the surface of the ruler. The paper is neutral, however, when a charged ruler is brought near these paper it induce the paper the two charge to the ruler attracting the ruler.

d) Calculate the charge in Coulomb on the plastic ruler with $6.9 \times 10^{10}$ electrons. [3]

Given the Charge = Current x Time:

e) A current of one ampere is a flow of charge at the rate of $\frac{1}{1}$ coulomb per second. [1]

f) Find the current at a point when a charge of 5 C flows past through that point in 3 seconds.

$\text{I} = \frac{\text{Q}}{\text{t}} = \frac{5}{3} = 1.67 \text{A}$ [2]

g) If the current at point is 3.2 A, find the charge flow past this point in 7 seconds. Show your steps: [2]

$Q = \text{I} \times \text{t} = 3.2 \times 7 = 22.4 \text{ C}$

h) Find out the number of electrons in the above charge. [3]

$1 \text{ C} = \frac{1.6 \times 10^{-19} \text{ electrons}}{}$

$= 6.25 \times 10^{18} \text{ electrons}$

$22.4 \text{ C} = 22.4 \times 6.25 \times 10^{18} \times 140 \times 10^{18} = 1.6 \times 10^{20} \text{ electrons}$