

Answers to S3 Resistance Homework.

1(a) this is a series circuit.

use

$$\begin{aligned} R_s &= R_1 + R_2 + R_3 \\ &= 6 + 9 + 18 \\ &= \underline{\underline{33\Omega}} \end{aligned}$$

(b) this is a parallel circuit

use

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{9} + \frac{1}{18}$$

$$\frac{1}{R_p} = \frac{3}{18} + \frac{2}{18} + \frac{1}{18}$$

$$\frac{1}{R_p} = \frac{6}{18}$$

$$\frac{R_p}{1} = \frac{18}{6}$$

$$\underline{\underline{R_p = 3\Omega}}$$

you need a common denominator.

now you can invert both sides or cross-multiply to find R_p .

(c) this is a mixed circuit (has series & parallel sections).

Start by finding the resistance of the parallel section:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{2}{18} + \frac{1}{18} = \frac{3}{18}$$

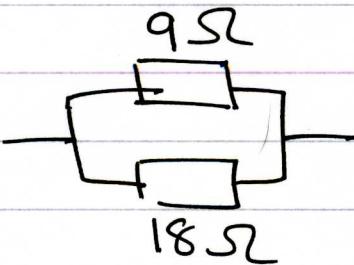
$$\frac{1}{R_p} = \frac{1}{9} + \frac{1}{18}$$

$$\frac{R_p}{1} = \frac{18}{3} \rightarrow R_p = 6\Omega$$

(2)

1(c) continued.

So we replace



with



and the circuit becomes



The total resistance between X and Y is

$$\begin{aligned} R_s &= R_1 + R_2 \\ &= 6 + 6 \\ &= \underline{12 \Omega} \end{aligned}$$

(d) Again, start by replacing the parallel section by a single resistor, R_p .

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{18}$$

$$\frac{1}{R_p} = \frac{3}{18} + \frac{1}{18}$$

$$\frac{1}{R_p} = \frac{4}{18}$$

$$\frac{R_p}{1} = \frac{18}{4} \rightarrow R_p = 4.5 \Omega$$

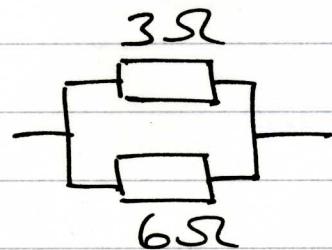
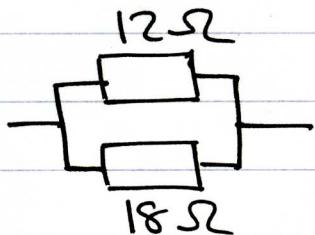
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1(d) continued.

the total resistance between X and Y is

$$\begin{aligned} R_s &= R_1 + R_2 \\ &= 4.5 + 9 \\ &= \underline{13.5\Omega} \end{aligned}$$

2. This mixed circuit has 2 parallel sections.
Find R_p for each of those sections.



$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{1}{12} + \frac{1}{18}$$

$$\frac{1}{R_p} = \frac{1}{3} + \frac{1}{6}$$

$$\frac{1}{R_p} = \frac{3}{36} + \frac{2}{36}$$

$$\frac{1}{R_p} = \frac{2}{6} + \frac{1}{6}$$

$$\frac{1}{R_p} = \frac{5}{36}$$

$$\frac{1}{R_p} = \frac{3}{6}$$

$$\frac{R_p}{1} = \frac{36}{5}$$

$$\frac{R_p}{1} = \frac{6}{3}$$

$$R_p = 7.2\Omega$$

$$R_p = 2\Omega$$

2 continued

the circuit can be redrawn with 4 resistors in series



and use

$$\begin{aligned} R_s &= R_1 + R_2 + R_3 + R_4 \\ &= 7.5 + 7.2 + 3 + 2 \\ &= \underline{\underline{19.7\Omega}} \end{aligned}$$

3. (a) $R_s = R_1 + R_2 + R_3$
 $= 5 + 12 + 7$
 $= \underline{\underline{24\Omega}}$

(b) $V = IR$

$$12 = I \times 24$$

$$I = \frac{12}{24}$$

$$\underline{\underline{I = 0.5A}}$$

this is a series circuit so the current through the 12Ω resistor is the same as the current at any point.
 Use the supply voltage and total resistance to calculate the current.

(c) $0.5A$

current is the same at all points in a series circuit

(5)

3. (d) Use $V = IR$ for each resistor.

Since $I = 0.5A$ at all points, only the value of R is changed in the calculations.

5Ω resistor:

$$V = IR$$

$$V = 0.5 \times 5$$

$$V = \underline{2.5V}$$

12Ω resistor:

$$V = IR$$

$$V = 0.5 \times 12$$

$$V = \underline{6V}$$

7Ω resistor:

$$V = IR$$

$$V = 0.5 \times 7$$

$$V = \underline{3.5V}$$

You can check your answer by adding these 3 voltages together.

$$2.5 + 6 + 3.5 = 12V \text{ (the supply voltage)}$$

4 (a) $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$$\frac{1}{R_p} = \frac{1}{5} + \frac{1}{10} + \frac{1}{15}$$

$$\frac{1}{R_p} = \frac{6}{30} + \frac{3}{30} + \frac{2}{30}$$

$$\frac{1}{R_p} = \frac{11}{30}$$

$$\frac{R_p}{1} = \frac{30}{11} \rightarrow R_p = \underline{2.7\Omega}$$

4 (b) 20V

this is a parallel circuit,
the same voltage exists across
each branch.

(c) Use $V = IR$ for each branch.

$V = 20V$ for all branches but R is different.

5Ω resistor: $V = IR$

$$20 = I \times 5$$

$$I = \frac{20}{5}$$

$$I = \underline{4A}$$

10Ω resistor: $V = IR$

$$20 = I \times 10$$

$$I = \frac{20}{10}$$

$$I = \underline{2A}$$

15Ω resistor: $V = IR$

$$20 = I \times 15$$

$$I = \frac{20}{15}$$

$$I = \underline{1.3A}$$

(d) In a parallel circuit, the total current is equal to the sum of the branch currents.

$$I = I_1 + I_2 + I_3$$

$$I = 4 + 2 + 1.3$$

$$I = \underline{7.3A}$$