Make simplifications by utilizing these four procedures:—

- Redraw the circuit maintaining the same connections or circuit topology.
- By symmetry arguments or otherwise, find nodes which are at the same potential, then these nodes can be connected.
- For components connected in series, the same current flows in all the components.
- For components connected in parallel, the voltage across all of the components is the same.

Example 1
Calculate the resistance between points A and B in the circuit in Figure 5.1.

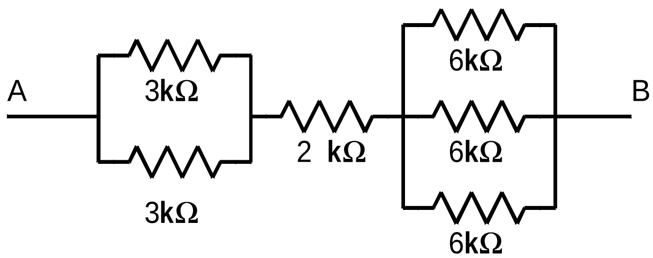


Figure 5.1:—

$$
\begin{aligned}
R_{AB} &= \frac{3k\Omega}{2} + 2k\Omega + \frac{6k\Omega}{3} \\
&= 1.5k\Omega + 2k\Omega + 2k\Omega \\
&= 5.5k\Omega
\end{aligned}
$$

Example 2

Calculate the voltages at points A, B, C, D, E in the resistive ladder network shown in the circuit in Figure 5.2

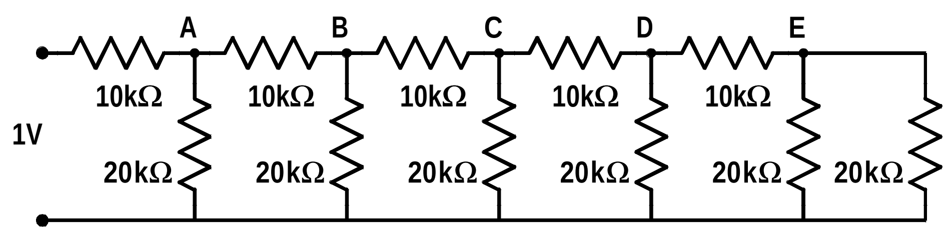


Figure 5.2:—R–2R Resistive Ladder

Use a recursive method.

Consider two $10k\Omega$ resistors.
From the left they appear as a $20k\Omega$ resistor.

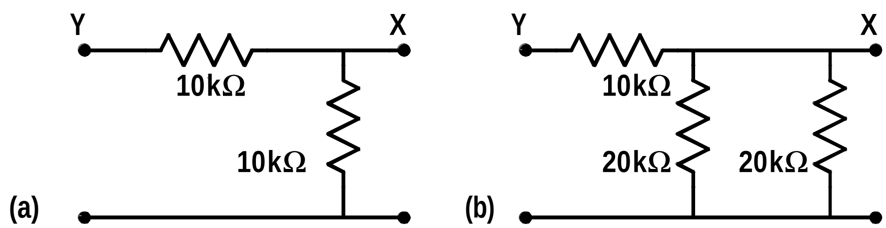


Figure 5.3:— Equivalent circuits

Replace one of the $10k\Omega$ resistors by two $20k\Omega$ resistors in parallel.
From the left it is still $20k\Omega$.

Two equal resistors form a potential divider.

Replace one of the $20k\Omega$ resistors by a copy of the original circuit as shown in Figure 5.4.

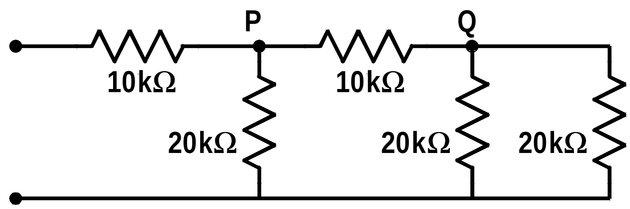


Figure 5.4:— Make a substitution

Voltage at Q is half that at P.

Voltage at each stage A, B, C, etc in Figure 5.2 is half of the value at the earlier node.

$$V_A = \frac{1}{2}V \quad V_B = \frac{1}{4}V \quad V_C = \frac{1}{8}V \quad V_D = \frac{1}{16}V \quad etc$$

Determine the resistance between nodes A and B in the resistor network in Figure 5.5, given that all of the resistors are of value $1k\Omega$.

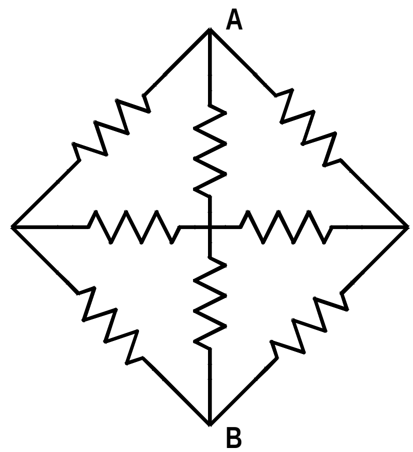


Figure 5.5:— Example 3

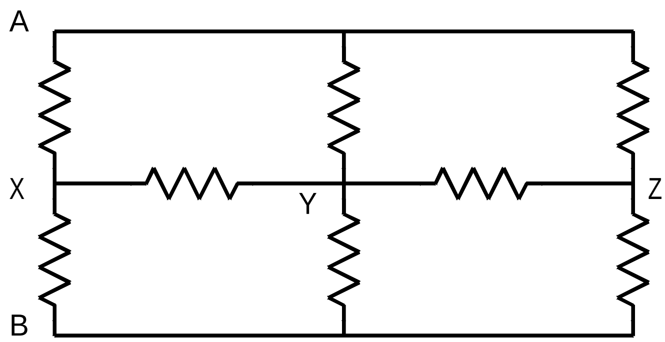


Figure 5.6:— Redraw the circuit.

If a voltage is applied between A and B then, by symmetry, nodes X, Y and Z are at the same potential. Therefore there is no current in the cross resistors and they can be deleted from the circuit.

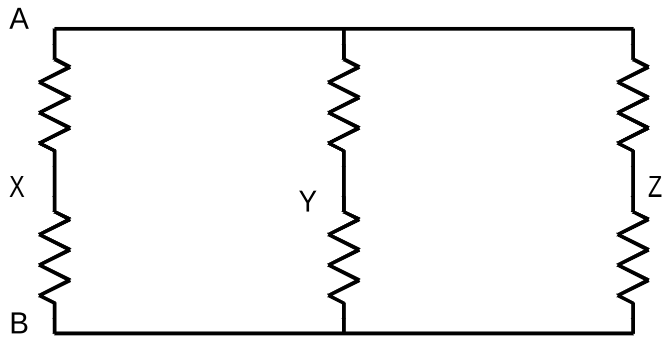


Figure 5.7:— X, Y and Z are at same potential.
Delete cross resistors.

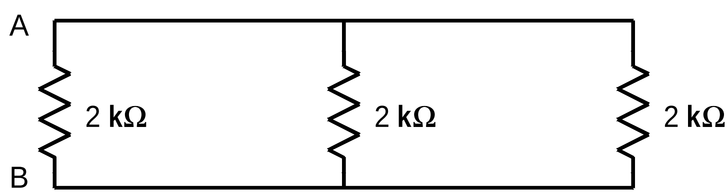


Figure 5.8:— Combine series resistors

Combine the parallel resistors to get a resistance between A and B of 666Ω

Calculate resistances between A and B