Solution of EECS 300 Test 4 F08

1. In the circuit below, find the numerical value of the current I_x due to

(a) The 3A source acting alone.

The 3A current divides between the 3Ω resistor and the equivalent resistance in the other branch which is $4\Omega + 3\Omega \| 6\Omega$ or 6Ω. Therefore the current through the 4Ω resistor is $I_4 = 3\text{A}\dfrac{3\Omega}{3\Omega + 6\Omega} = 1\text{A}$. This current returns to the current source through the bottom conductor, flowing in the direction opposite that of the arrow for I_x. Therefore I_x for 3A acting alone, = -1A.

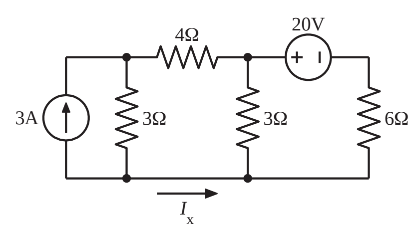
(b) The 20V source acting alone.

The total current flowing out of the positive terminal of the 20V source is

$$I_{20} = \frac{20\text{ V}}{7\Omega \| 3\Omega + 6\Omega} = \frac{20\text{ V}}{8.1\Omega} = 2.47\text{ A}$$

That current then divides between the two paths $4\Omega + 3\Omega$ and 3Ω. The fraction that flows through the $4\Omega + 3\Omega$ path is the same as I_x. That is

$I_x = 2.47\text{ A}\dfrac{3\Omega}{3\Omega + 7\Omega} = 0.741\text{A}$. Therefore, for the 20V source acting alone, $I_x = 0.741\text{A}$.



2. Find the numerical value of the Thevenin equivalent voltage V_{TH} and the Thevenin equivalent resistance R_{TH} for the circuit below.

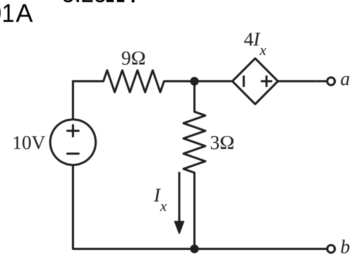
No current flows through the dependent voltage source. Therefore I_x flows through both the 9Ω and 3Ω resistors, making them effectively in series. So $I_x = \frac{10\,\text{V}}{12\Omega} = 0.833\,\text{A}$. The voltage across the 3Ω resistor is 2.5 V. The voltage of the dependent voltage source is 3.333V. Therefore the Thevenin equivalent voltage V_{TH} is 5.833V.

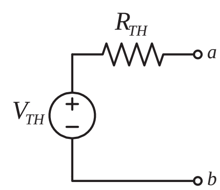
To find the Thevenin equivalent resistance, apply a test 1V source at the *a*-*b* terminals with the 10V source set to zero.

$$3I_x + 4I_x = 1 \Rightarrow I_x = 0.143\,\text{A}$$

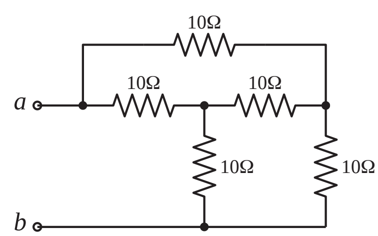
Then the voltage across the 9Ω and 3Ω resistors in parallel is 0.4286 V and the current through the 9Ω resistor is 0.0476A. So the current through the dependent source is 0.191A and the Thevenin equivalent resistance is

$$R_{TH} = \frac{1\text{V}}{0.191\text{A}} = 5.25\Omega\,.$$

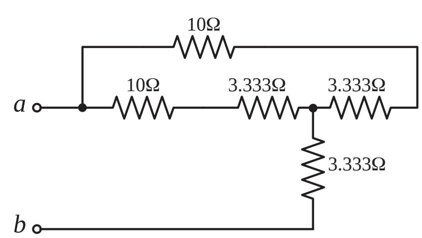




3. Find the numerical value of the resistance between *a* and *b* in the circuit below.



Through a delta-wye conversion we can convert this circuit to



From this point on parallel and series combinations can be used to find the overall equivalent resistance.

$$R_{ab} = \left(10\Omega + 3.333\Omega\right) \,||\, \left(10\Omega + 3.333\Omega\right) + 3.333\Omega = 10\Omega\,.$$

Solution of EECS 300 Test 4 F08

1. In the circuit below, find the numerical value of the current I_x due to

(a) The 5A source acting alone.

The 5A current divides between the 3Ω resistor and the equivalent resistance in the other branch which is $4\Omega + 3\Omega \| 6\Omega$ or 6Ω. Therefore the current through the 4Ω resistor is $I_4 = 5\text{A}\dfrac{3\Omega}{3\Omega + 6\Omega} = 1.667\text{A}$. This current returns to the current source through the bottom conductor, flowing in the direction opposite that of the arrow for I_x. Therefore I_x for 5A acting alone, = -1.667A.

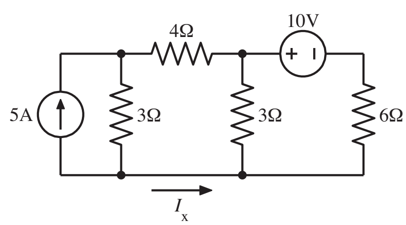
(b) The 10V source acting alone.

The total current flowing out of the positive terminal of the 10V source is

$$I_{20} = \frac{10\text{V}}{7\Omega \| 3\Omega + 6\Omega} = \frac{10\text{V}}{8.1\Omega} = 1.24\text{A}$$

That current then divides between the two paths $4\Omega + 3\Omega$ and 3Ω. The fraction that flows through the $4\Omega + 3\Omega$ path is the same as I_x. That is

$I_x = 1.24\text{A}\dfrac{3\Omega}{3\Omega + 7\Omega} = 0.371\text{A}$. Therefore, for the 20V source acting alone, $I_x = 0.371\text{A}$.



2. Find the numerical value of the Thevenin equivalent voltage V_{TH} and the Thevenin equivalent resistance R_{TH} for the circuit below.

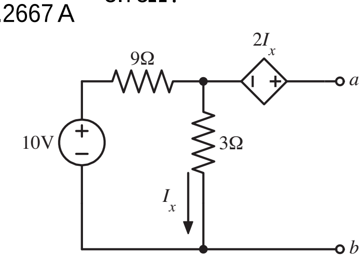
No current flows through the dependent voltage source. Therefore I_x flows through both the 9Ω and 3Ω resistors, making them effectively in series. So $I_x = \frac{10\,\text{V}}{12\Omega} = 0.833\,\text{A}$. The voltage across the 3Ω resistor is 2.5 V. The voltage of the dependent voltage source is 1.667V. Therefore the Thevenin equivalent voltage V_{TH} is 4.167V.

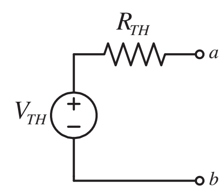
To find the Thevenin equivalent resistance, apply a test 1V source at the *a*-*b* terminals with the 10V source set to zero.

$$3I_x + 2I_x = 1 \Rightarrow I_x = 0.2\,\text{A}$$

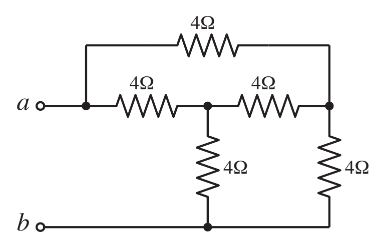
Then the voltage across the 9Ω and 3Ω resistors in parallel is 0.6 V and the current through the 9Ω resistor is 0.0667A. So the current through the dependent source is 0.2667A and the Thevenin equivalent resistance is

$$R_{TH} = \frac{1\,\text{V}}{0.2667\,\text{A}} = 3.75\Omega .$$

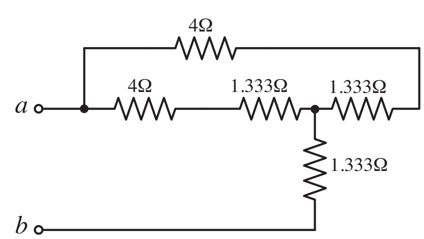




3. Find the numerical value of the resistance between *a* and *b* in the circuit below.



Through a delta-wye conversion we can convert this circuit to



From this point on parallel and series combinations can be used to find the overall equivalent resistance.

$$R_{ab} = \left(4\Omega + 1.333\Omega\right) \,||\, \left(4\Omega + 1.333\Omega\right) + 1.333\Omega = 4\Omega .$$