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LECTURE 01

IDEAL VOLTAGE AND CURRENT SOURCES
OPEN AND SHORT CIRCUITS

Topics

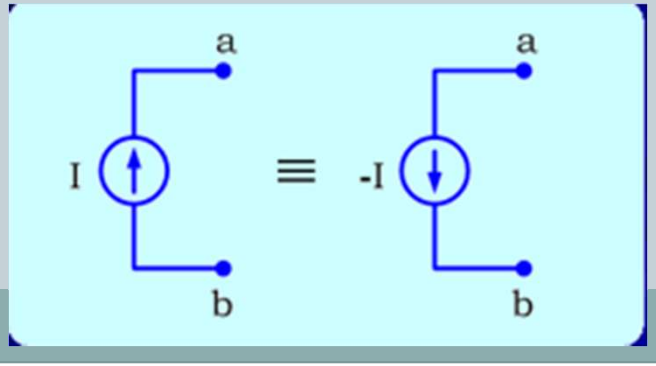
- Ideal voltage source
- Ideal current source
- Open circuit
- Short circuit

Objectives

- Recognize the symbols of ideal voltage and current sources
- Find voltage polarity
- Find current direction
- Calculate voltage and current in simple resistive circuits
- Recognize invalid connections to the ideal voltage and current sources

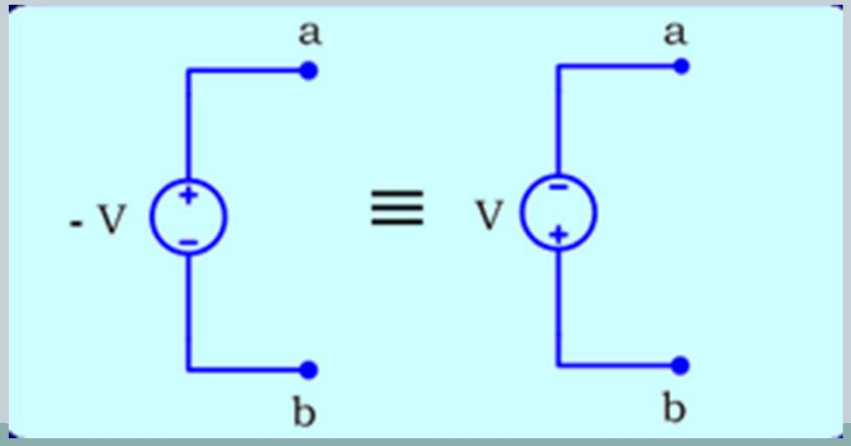
Review of electrical fundemantal

- Charge : its samples (q) its unite (coulomb)
- $q_{e=}-1.602 \times 10^{-19}$ (مقدار شحنة الالكترون)
- $q_{p=}+1.602 \times 10^{-19}$ (شحنة البروتون)
- Current :its symbol (i) its unite (Ampere(A)) or (milli ampere(mA)).
- $i=\frac{dq}{dt}$ its unite $= \frac{\text{coulomb}}{sec}$= Ampere
- Voltage source : its symbol (V) its unite (volt(v)).
- The direction of current source as
- Shown in figure below



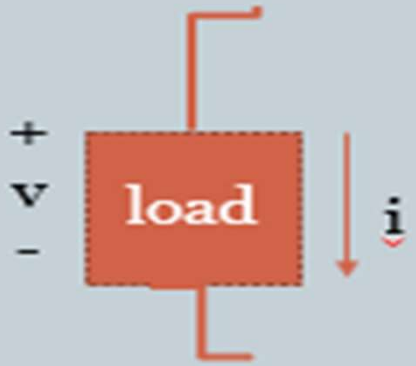
Review of electrical fundamental

- Voltage source : its symbol (V) its unite (volt(v)).
- $v=\frac{dw}{dq}$ its unite $=\frac{\text{joule}}{coulomb}=$ volt
- Where w represent the energy .
- The polarity of the voltage source as shown in figure below

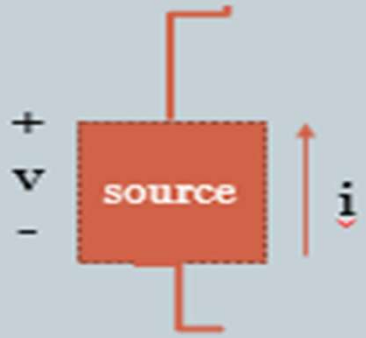


Review of electrical fundamental

- The passive element: is the element dissipated energy like (resistance (load)).

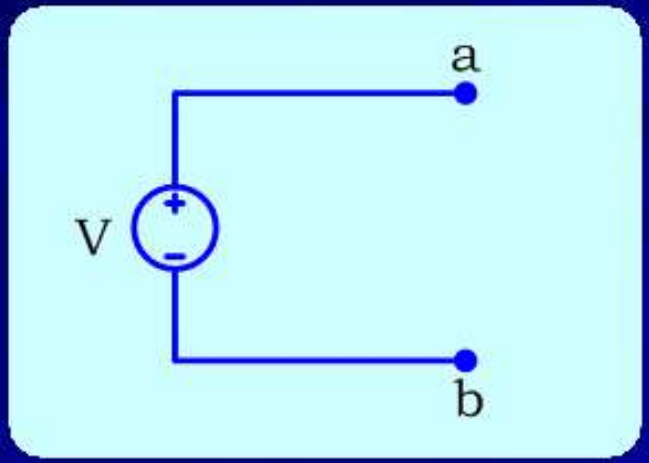


- The active element: is the element produced energy like (d.c supply (voltage source).



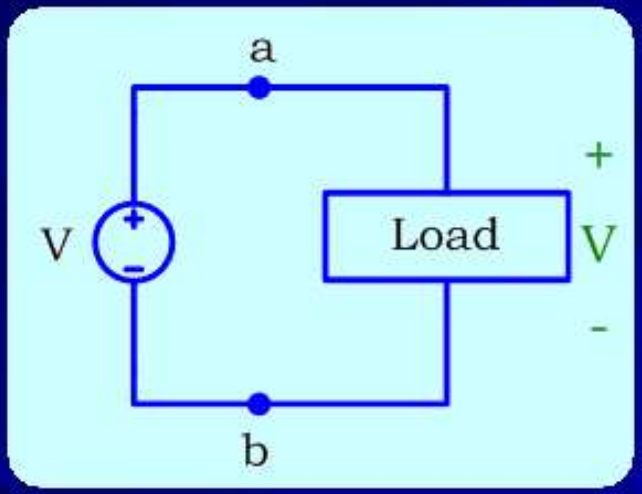
Ideal Voltage Source

The symbol of an ideal voltage source is shown. The value of the voltage source is V volts and the terminals a and b are used to connect the ideal voltage source to other elements.



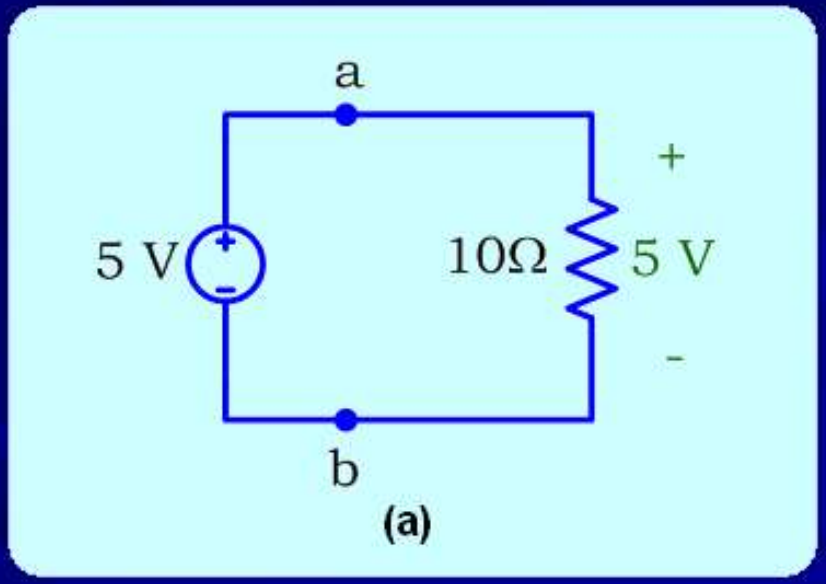
Ideal Voltage Source

When any load is connected across the terminals of an ideal voltage source of voltage V, the same voltage V appears across the load, irrespective of the load.

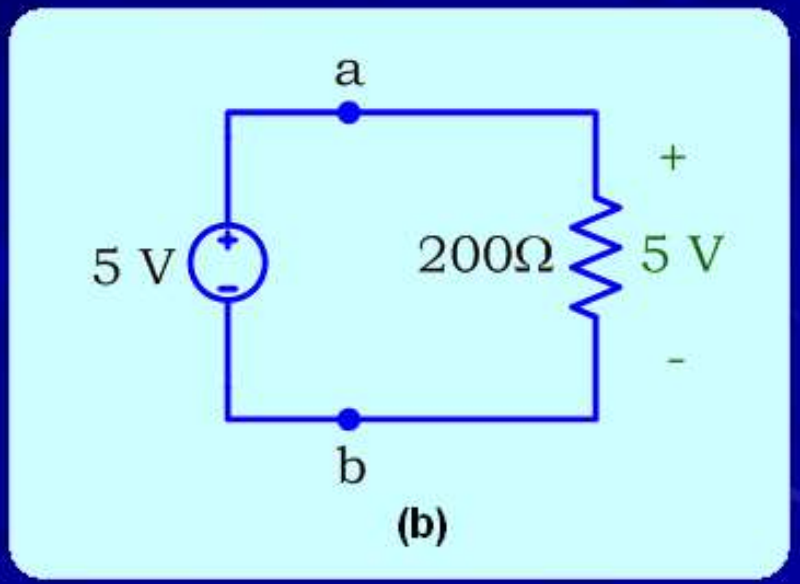


Example1

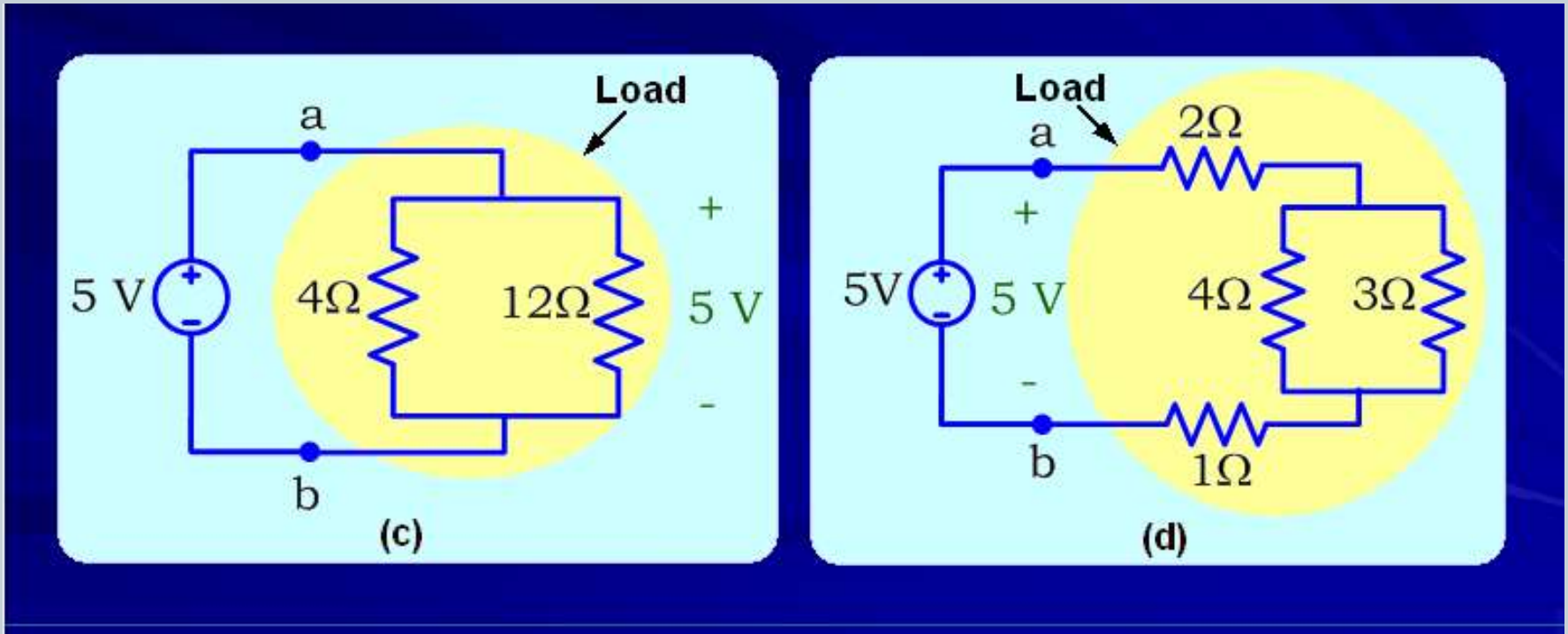
Various resistive loads are connected to the 5V ideal voltage source as shown in the figure below. In each case, the voltage across the load is 5V.



(a)



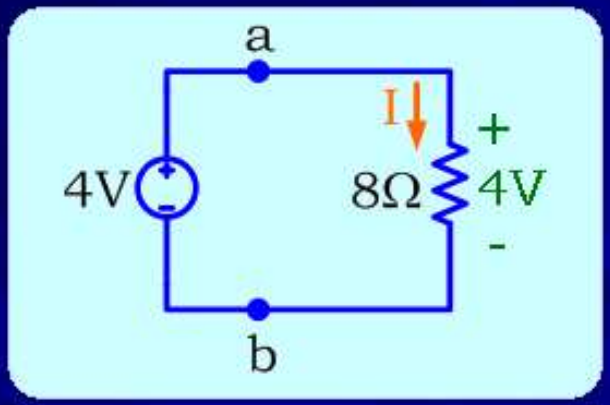
(b)



Note that the equivalent resistance of the resistive load shown in circuit (c) and circuit (d) is considered to be the load

Example 2

Calculate the current I in the following circuit

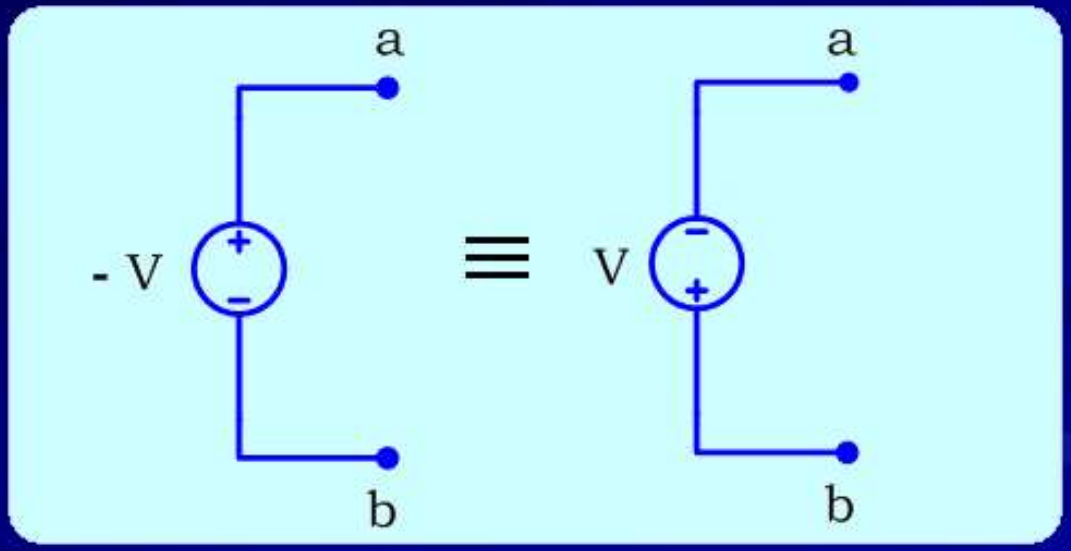


Using Ohm's law

$$I = \frac{V}{R} = \frac{4}{8} = 0.5\text{A}$$

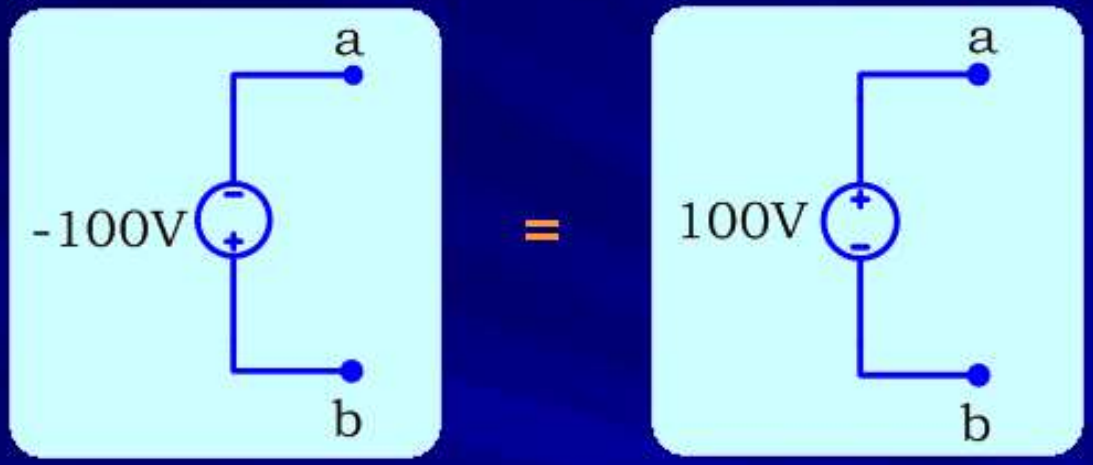
Equivalent source

The following ideal voltage sources are equivalent. If you invert the algebraic sign of the voltage V, you must also reverse the polarity. Otherwise, the sources are not equivalent.



Example 3

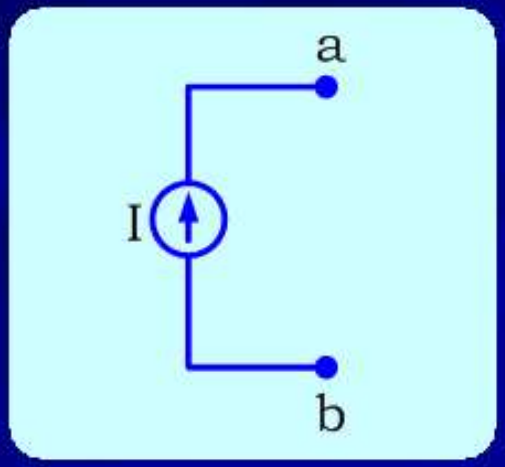
Is the actual polarity of terminal a positive or negative?



By inverting the sign of the ideal voltage source from -100V to +100V and reversing the polarity of the voltage, we conclude that the actual polarity of terminal a is (+) or positive polarity. This means that terminal a is actually at a higher potential than terminal b.

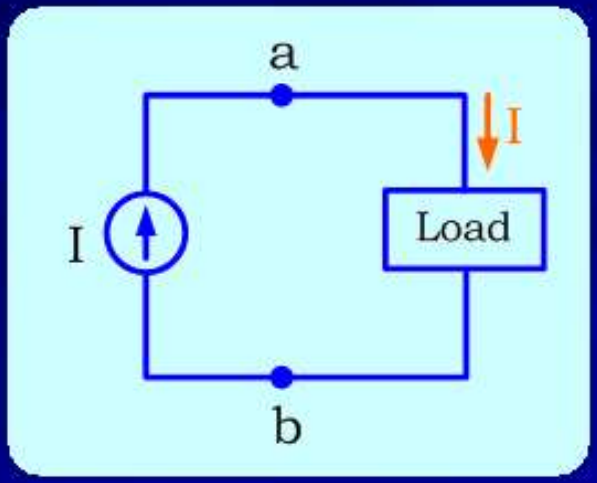
Ideal Current Source

The symbol of an ideal current source is shown. The value of the current source is I amperes and the terminals a and b are used to connect the ideal current source to other circuit elements.



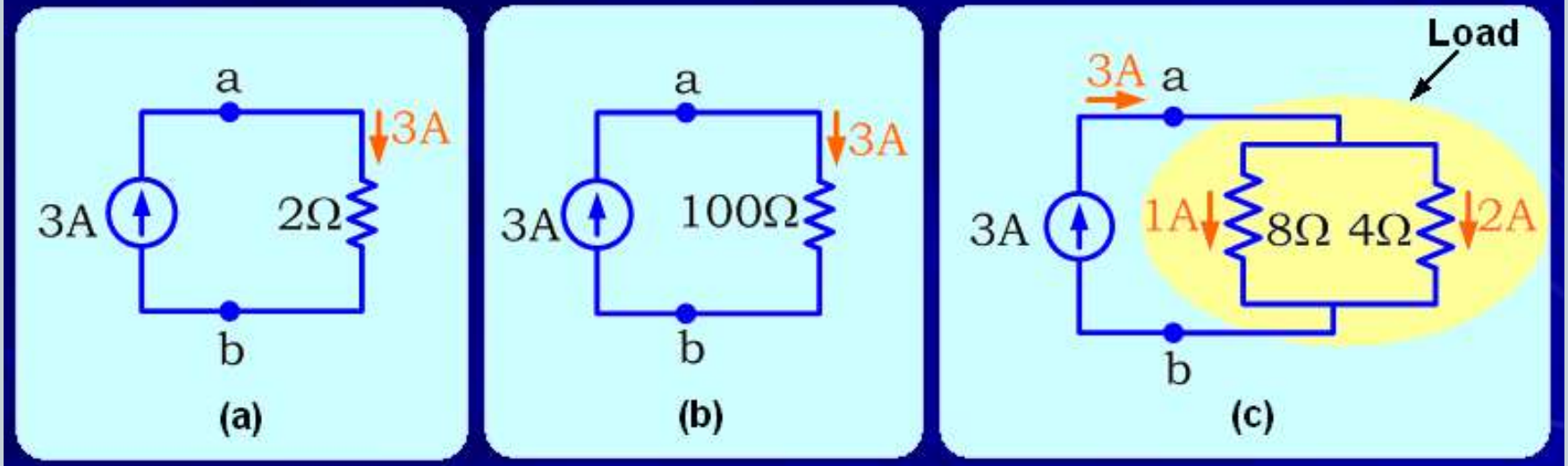
Ideal Current Source

When any load is connected across the terminals of an ideal current source of current I, the same current I flows through the load, irrespective of the load.



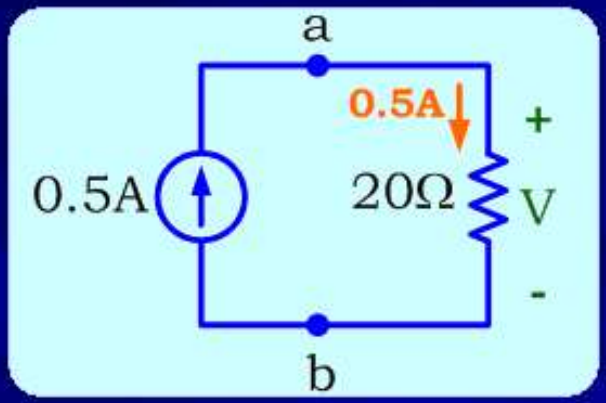
Example1

The 3A ideal current source shown below is connected to different resistive loads. In each case, the current that flows across the load is also 3A. Note that in circuit (c), the current through the resistive load is 3A, but the current that flow into the individual resistances that make up the load are each less than 3A.



Example 2

Calculate the voltage V in the following circuit

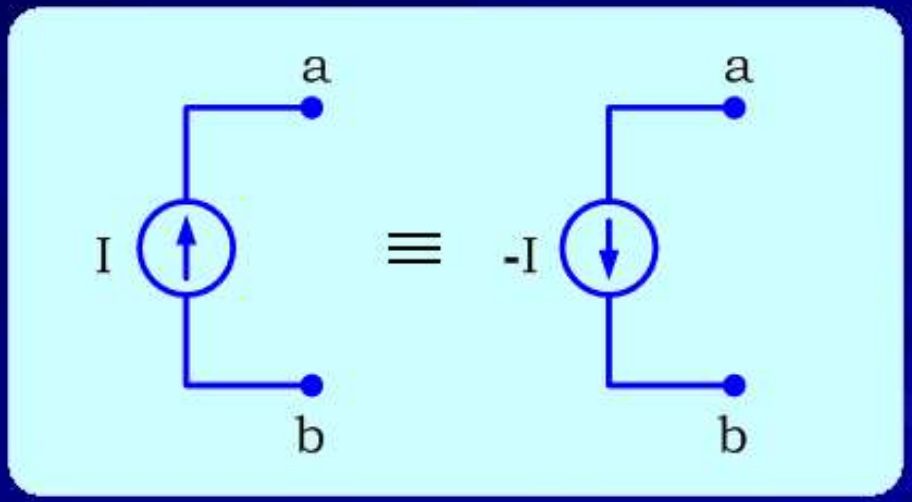


Using Ohm's law

$$V = IR = 0.5 \times 20 = 10\text{V}$$

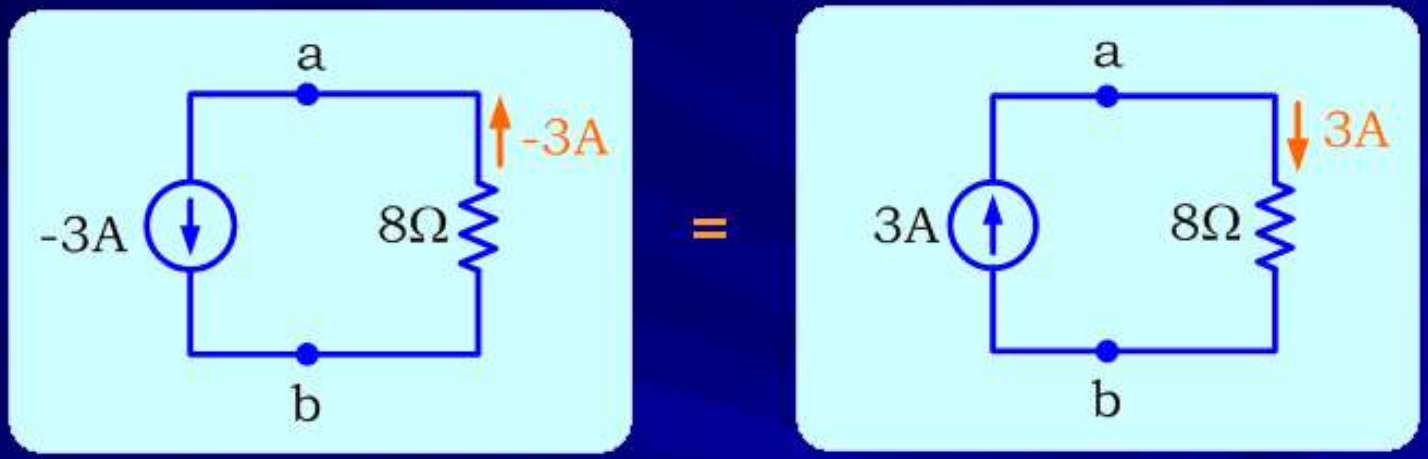
Equivalent source

The following ideal current sources are equivalent. If you invert the algebraic sign of the current I, you must also reverse the direction of current flow. Otherwise, the sources are not equivalent.



Example 3

What is the actual direction of the current in the 8Ω resistor?



By inverting the sign of the ideal current source from -3A to +3A and reversing the direction of current, we conclude that the actual direction of current through 8Ω resistor is from terminal a down to terminal b.

The Short Circuit

When a resistor has zero resistance (i.e. R = 0Ω) we call it a short circuit.

The current through a short circuit is generally not equal to zero. However, the voltage across a short circuit is always equal to zero, because:

$$V = IR = I \times 0 = 0$$