Electrical Science: 2021-22
Lecture 1
Power Sources

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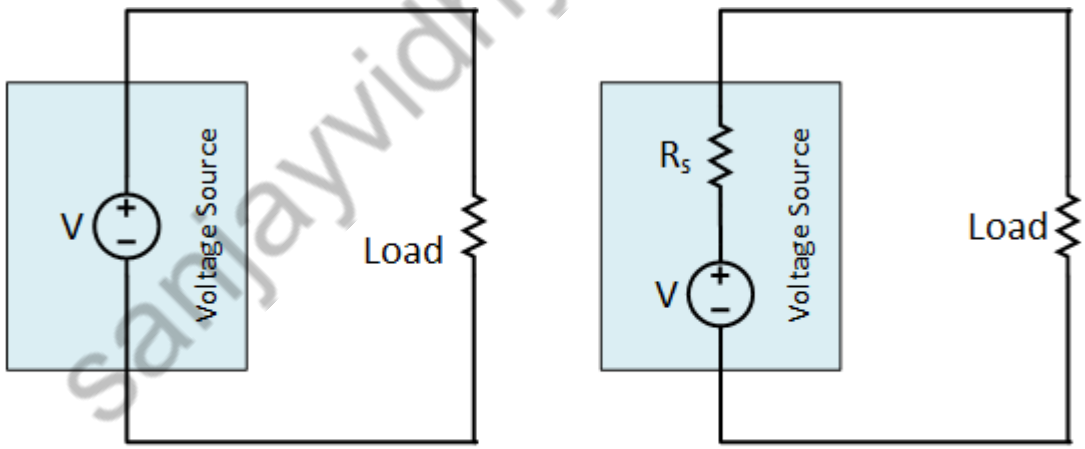
Ideal vs. Practical Voltage Sources

An imaginary voltage source, which can provide a constant voltage to load ranging from zero to infinity. Such voltage source is having zero internal resistance, and is called an **Ideal Voltage Source**. Practically it is not possible to build a voltage source with no internal resistance and constant voltage for that long-range of the load.

Practical voltage sources always have some resistance value in series with an ideal voltage source. And because of that series resistance, voltage drops when current passes through it. So, **Practical Voltage Source has internal resistance and slightly variable voltage**.

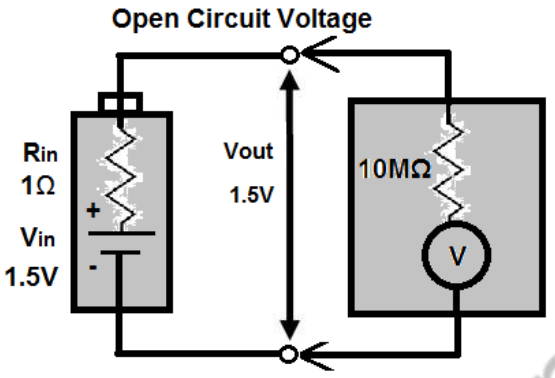


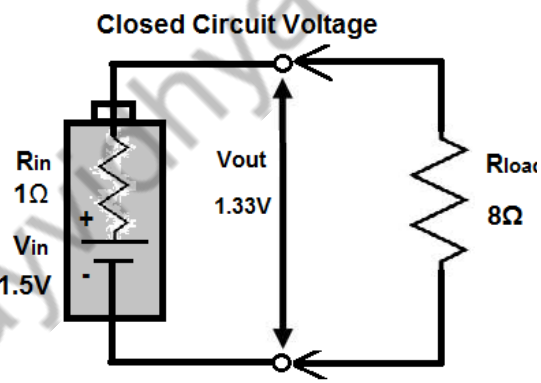
Ideal Voltage Source

Practical Voltage Source

Battery Internal Resistance

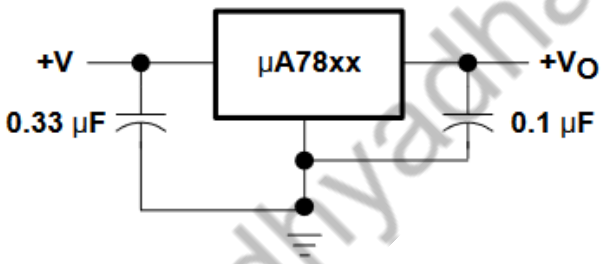
Batteries have internal resistance because the elements that make it up aren't perfect conductors. The electrodes and electrolytes aren't 100% conductive. So, they will have some resistance (internal resistance) in them.

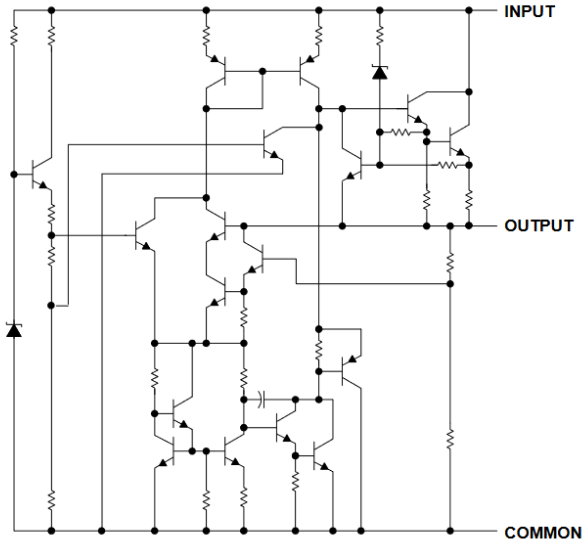




Battery	Internal Resistance
9-V zinc carbon	35Ω
9-V lithium	16Ω to 18Ω
9-V alkaline	1Ω to 2Ω
AA alkaline	0.15Ω
AA NiMH	0.02Ω
D Alkaline	0.1Ω
D NiCad	0.009Ω
D SLA	0.006Ω
AC13 zinc-air	5Ω
76 silver	10Ω
675 mercury	10Ω

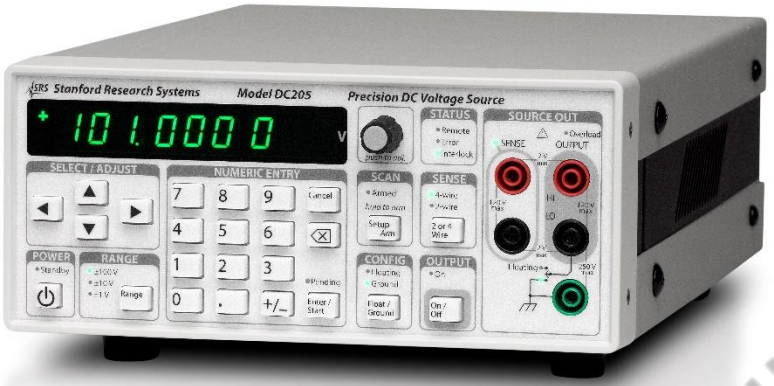
Internal Resistance of Regulated Voltage Sources





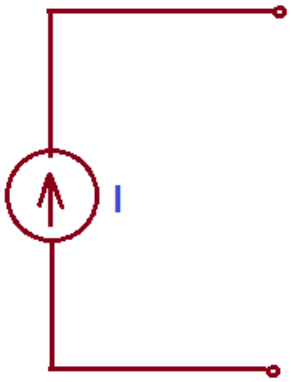
			MIN	MAX	UNIT
V_I	Input voltage	µA7805C	7	25	V
		µA7808C	10.5	25	
		µA7810C	12.5	28	
		µA7812C	14.5	30	
		µA7815C	17.5	30	
		µA7824C	27	38	
I_O	Output current			1.5	A
T_J	Operating virtual junction temperature	µA7800C series	0	125	°C

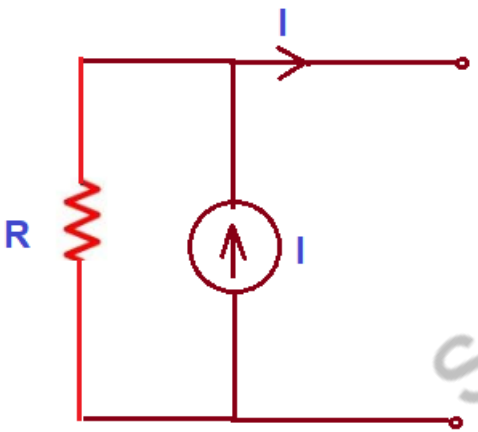
Internal Resistance of Regulated Voltage Sources

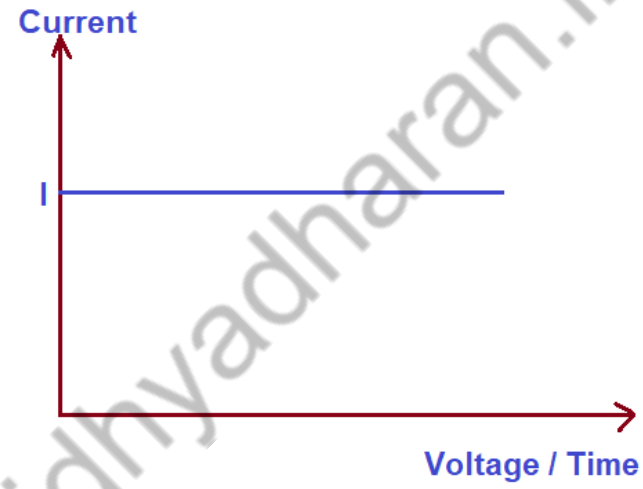


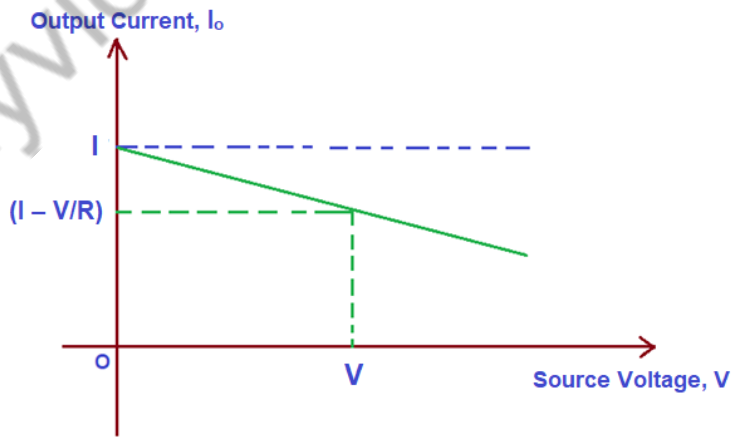
The DC205 low-noise, high-resolution DC voltage source is the right tool when a precision bias source is needed. Its bipolar, four-quadrant output delivers up to 100 V with 1 μV resolution and up to 50 mA of current.

Ideal vs. Practical Current Sources



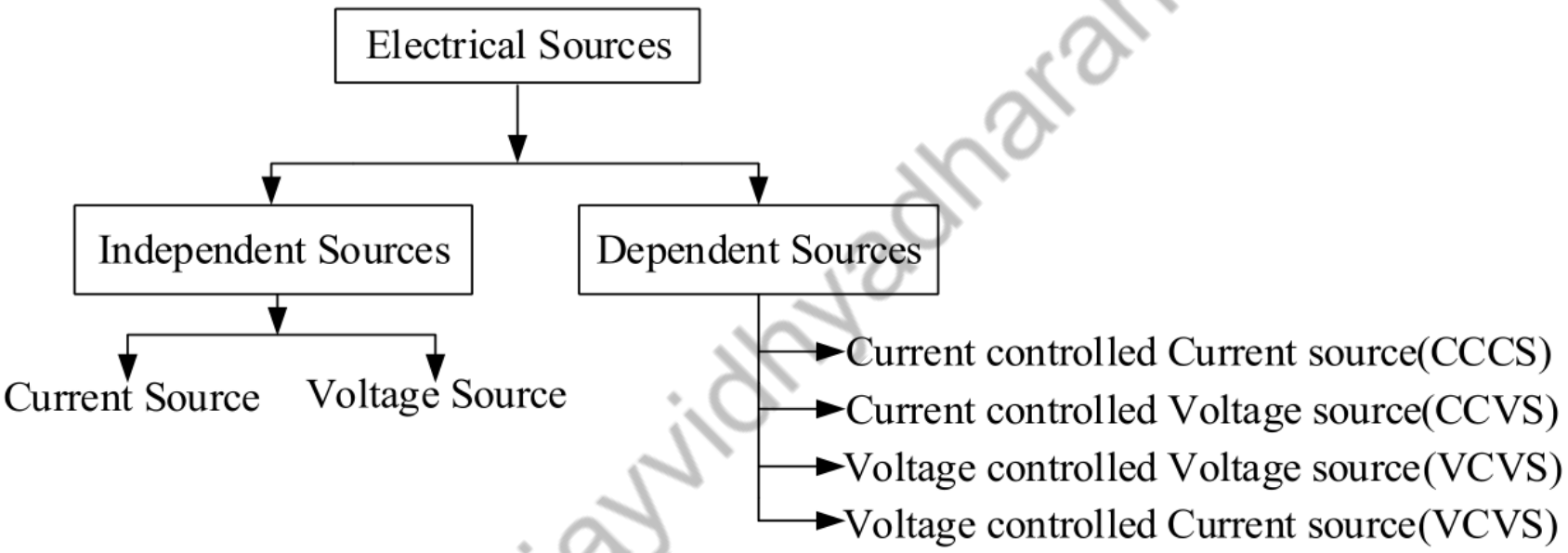






Classification of Power Sources

Classification

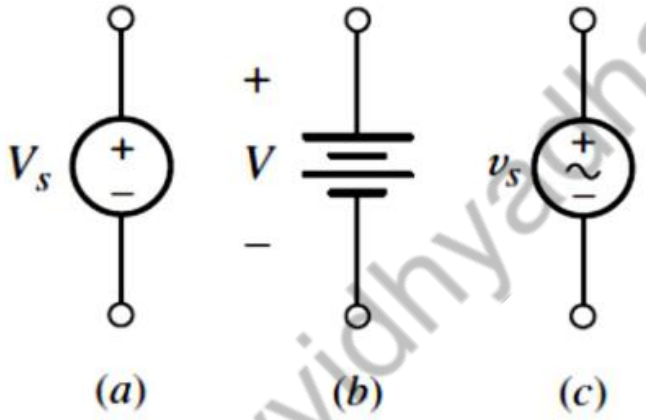


Sources in which the voltage is completely independent of the current, or the current is completely independent of the voltage; these are termed independent sources.

Special kinds of sources for which either the source voltage or current, depends upon a current or voltage elsewhere in the circuit; such sources are referred to as dependent sources.

Classification of Power Sources

Independent Voltage Sources

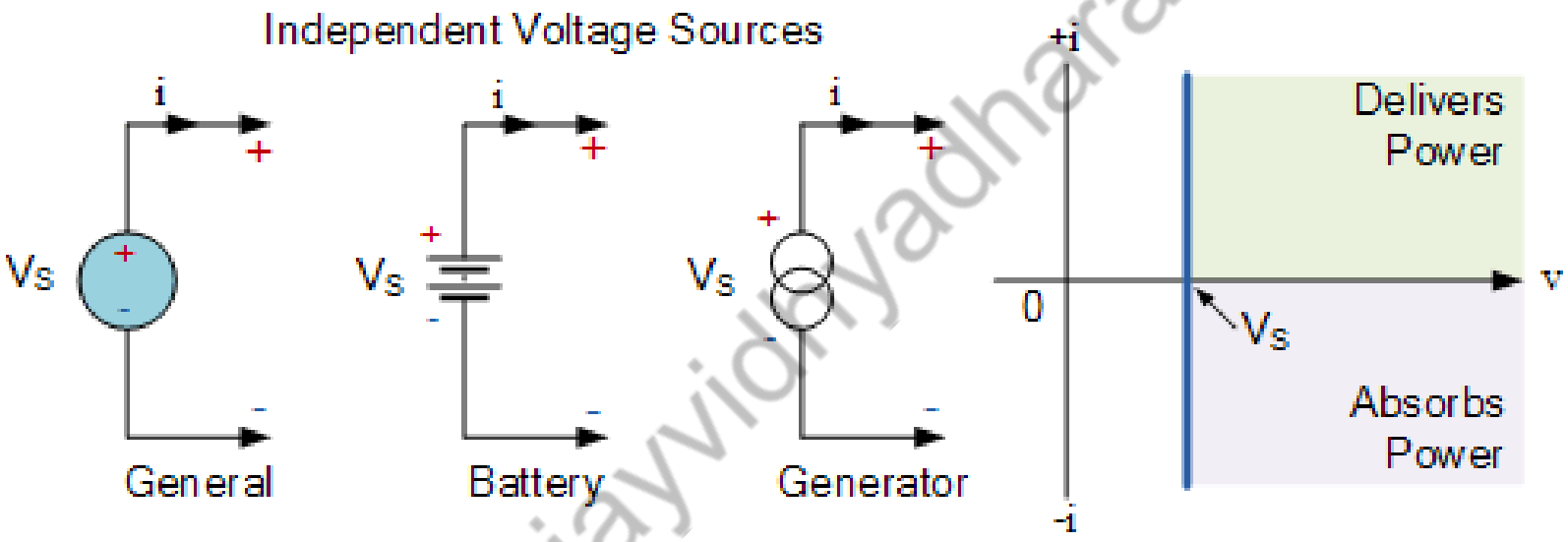


(a) DC voltage source; (b) battery symbol; (c) AC voltage source symbol

The terminal voltage is completely independent of the current through it.

Classification of Power Sources

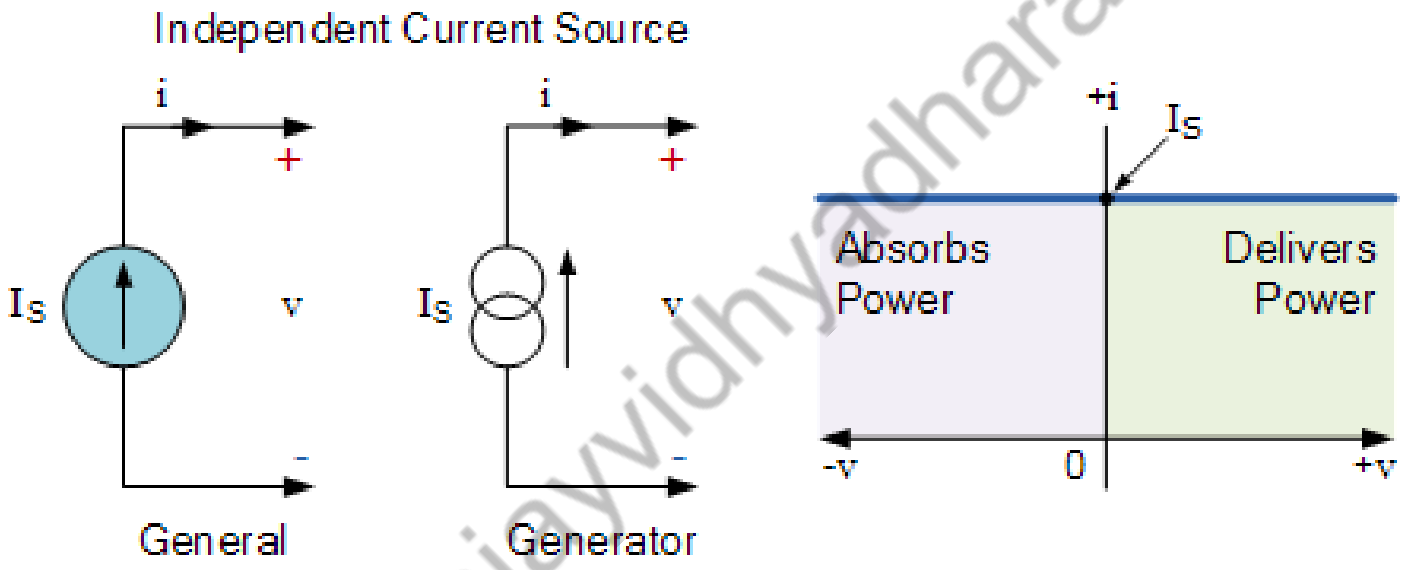
Independent Voltage Sources



The terminal voltage is completely independent of the current through it.

Classification of Power Sources

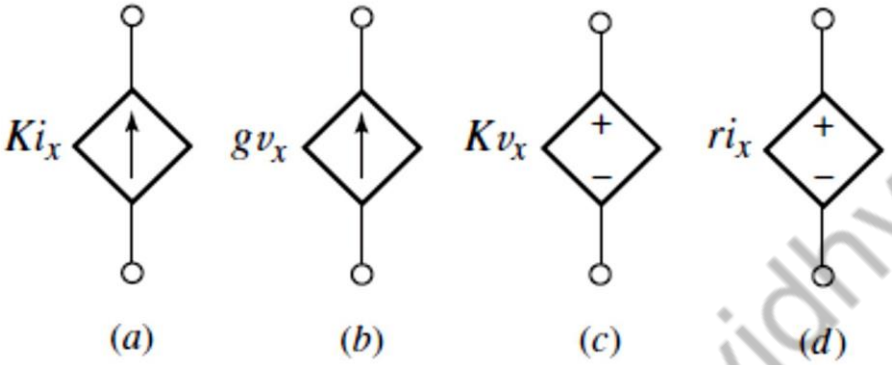
Independent Current Sources

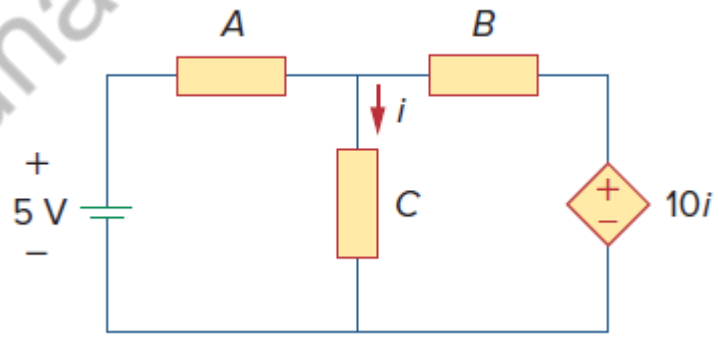


The terminal current is completely independent of the voltage across it.

Classification of Power Sources

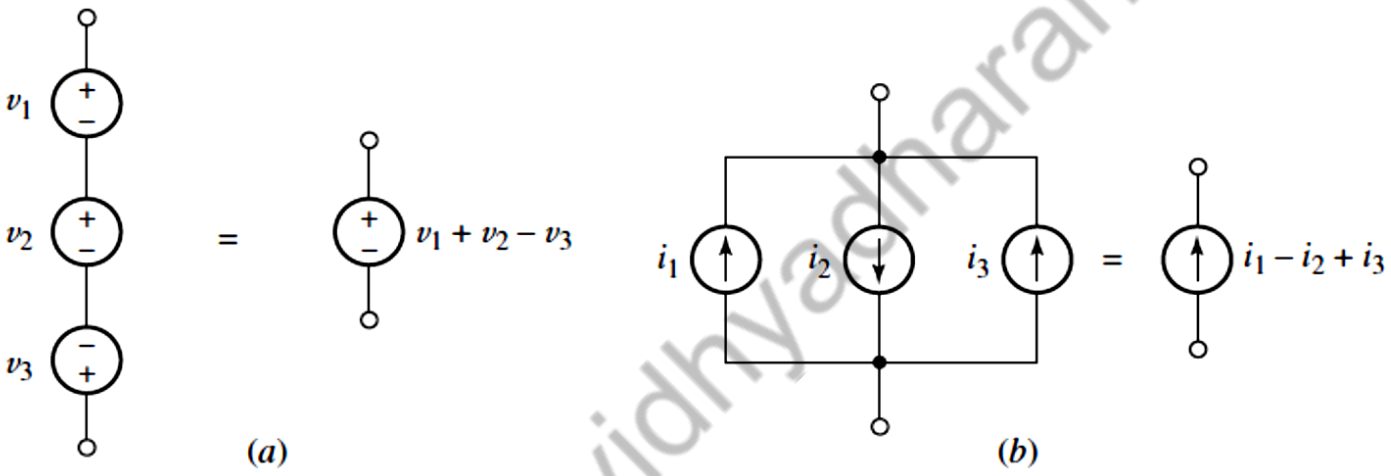
Dependent Power Sources





Current-controlled voltage source

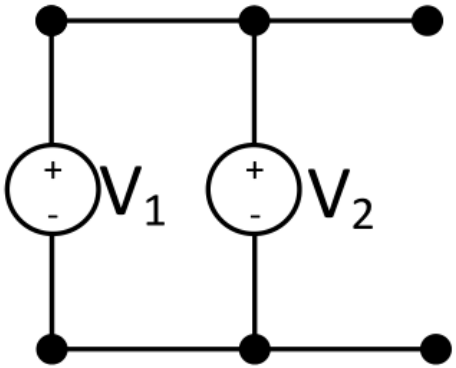
SERIES AND P ARALLEL C ONNECTION OF SOURCES



(a) Series-connected voltage sources can be replaced by a single source.
(b) Parallel current sources can be replaced by a single source.

SERIES AND P ARALLEL C ONNECTION OF SOURCES

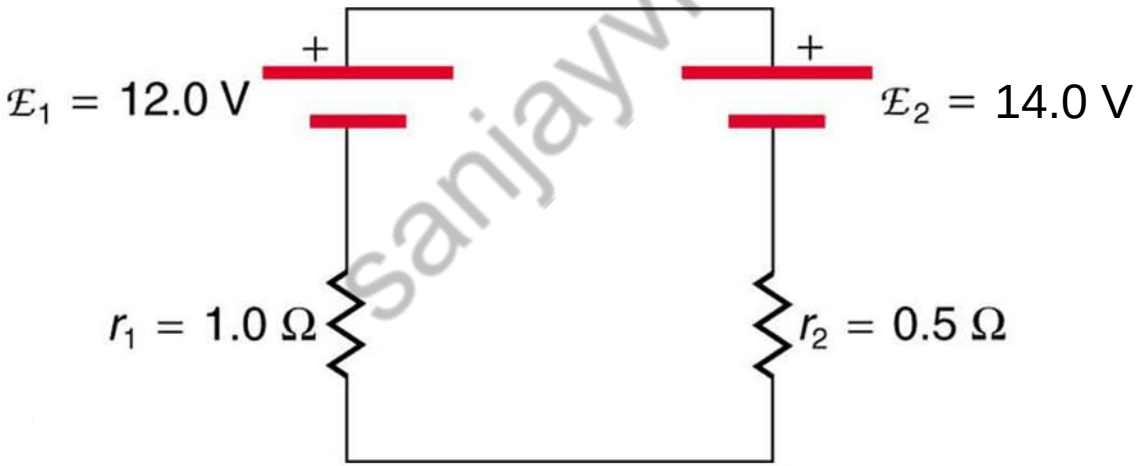
Voltage Sources in Parallel



$V_1 = V_2$ ✓

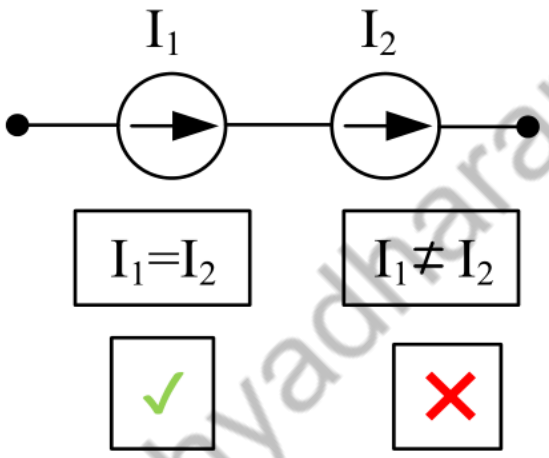
$V_1 \neq V_2$ ✗

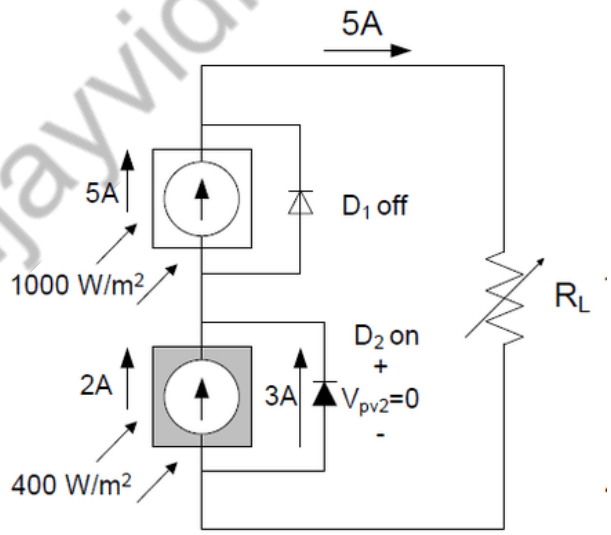
Why to connect Voltage Sources in Parallel ?



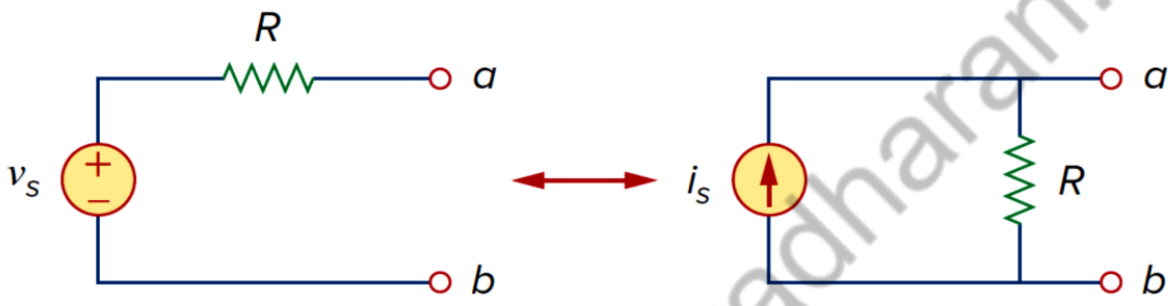
SERIES AND P ARALLEL C ONNECTION OF SOURCES

Current Sources in Series





SOURCE TRANSFORMATION



Transformation of independent sources. ***Provided***, $v_s = i_s \times R \quad or \quad i_s = \frac{v_s}{R}$

A source transformation is the process of replacing a voltage source V_s in series with a resistor R by a current source i_s in parallel with a resistor R, or vice versa.

Thevenin and Norton equivalents

Thank you