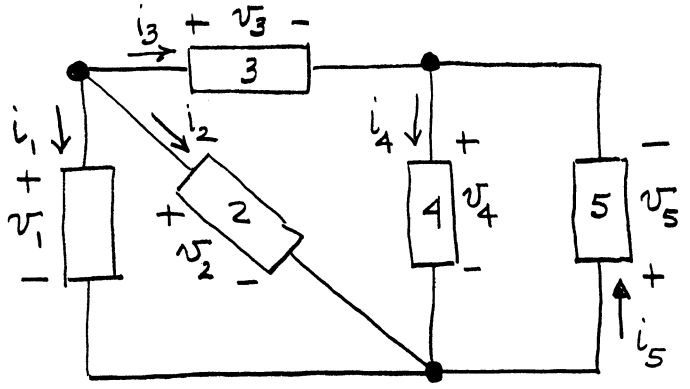
Example 1-3



In this circuit the sign conventions are given on the drawing. If they are not given you should assign them!

The above labeling follows the passive sign convention.
The following circuit variables are measured.
Complete the missing variables. State whether the device is absorbing or supplying power.

	Device 1	Device 2	Device 3	Device 4	Device 5
v	+100 V		+25V	+75V	−75 V
i		+5mA	+5mA		+5mA
p	−1 W	+0.5W		0.75W	

Use $p = vi$

$i_1 = \frac{p_1}{v_1} = \frac{-1}{100} = -.01$ Amp $p_1 < 0 \Rightarrow$ supplying power

$v_2 = \frac{p_2}{i_2} = \frac{0.5}{0.005} = 100V$ $p > 0 \Rightarrow$ absorbing power

$p_3 = v_3 i_3 = (25)(.005) = 0.125$ $p > 0 \Rightarrow$ absorbing power

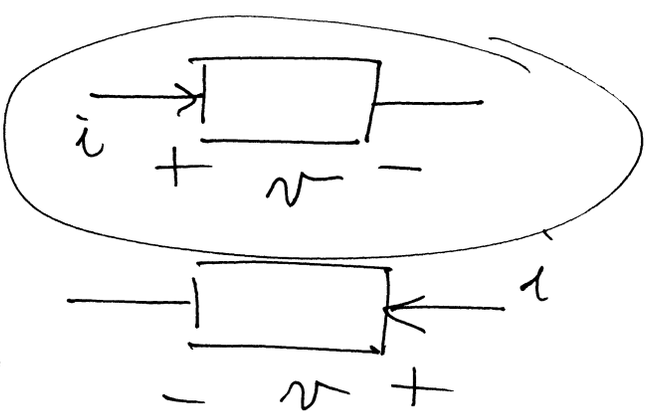
$i_4 = \frac{p_4}{v_4} = \frac{0.75}{(75)} = 0.01$ $p > 0 \Rightarrow$ absorbing power

$p_5 = v_5 i_5 = (-75)(.005) = -0.375$ $p < 0 \Rightarrow$ supplying power

Example 1.4

	Device 1	Device 2
v	+10 V	−13.3 volts.
i	− 3 A	−3 A
P	−30 watt (supplying)	+40W

passive sign convention



$$p = vi$$

$$p = (+10)(-3) = -30 \text{ watts}.$$

$$p = vi$$

$$+40 = v(-3)$$

$$v = \frac{40}{-3} = -13.3 \text{ volts}.$$

Example 1-4

The working variables of a set of two-terminal electrical devices are observed to be as follows:

	Device 1	Device 2	Device 3	Device 4	Device 5
v	+10 V.	?	−15 V.	+5	?
i	−3 A.	−3 A.	+10 mA	?	−12 mA
p		+40 W.	?	+10 mW	−120 mW

Using the passive sign convention, find the magnitude and sign of the unknown variable and state whether the device is absorbing or delivering power.

Answer:

Device 1: $p = vi = (+10)(-3) = -30$ watts (delivering power)

Device 2: $p = vi = v(-3) = +40 \Rightarrow v = \frac{40}{-3} = -13.3$ volts

($p > 0$, absorbing power)

Device 3: $p = vi = (-15)(10\times10^{-3}) = -150\times10^{-3} = -0.15$ watts < 0

(delivering power)

Device 4: $p = vi = (5)i = 10\text{mW} \Rightarrow i = \frac{10\text{mW}}{5\text{V}} = \frac{10\times10^{-3}}{5} = 2\times10^{-3} = 2\text{mW}$

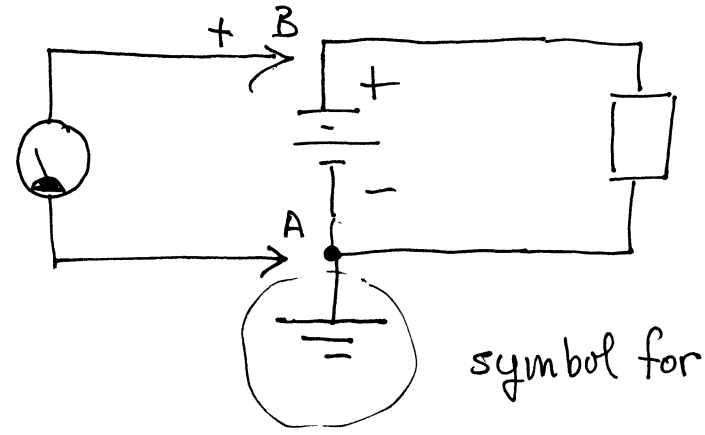
(absorbing power)

Device 5: $p = vi = v(-12\text{mA}) = -120\text{mW}$

$$\Rightarrow v = \frac{-120\text{mW}}{-12\text{mA}} = \frac{-120\times10^{-3}}{-12\times10^{-3}} = +10\text{V}$$

($p < 0$, delivering power)

GROUND — VOLTAGE REFERENCE



meter

passive element

symbol for ground

v_{BA} ← v_B

voltage or current

+ terminal point

− terminal reference.

no second subscript voltage wrt ground.

red − +	+ 7.5
black − −	− 7.5

GROUND

A ○ B ○ C ○

 symbol for electrical ground
common voltage reference

The notation $v_A(t), v_B(t), v_C(t)$ means the voltage at that node with respect to ground, assumed to be zero.

Voltage <u>ALWAYS</u> is measured between two points.

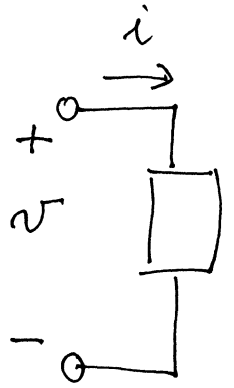
I might also be interested in the voltage

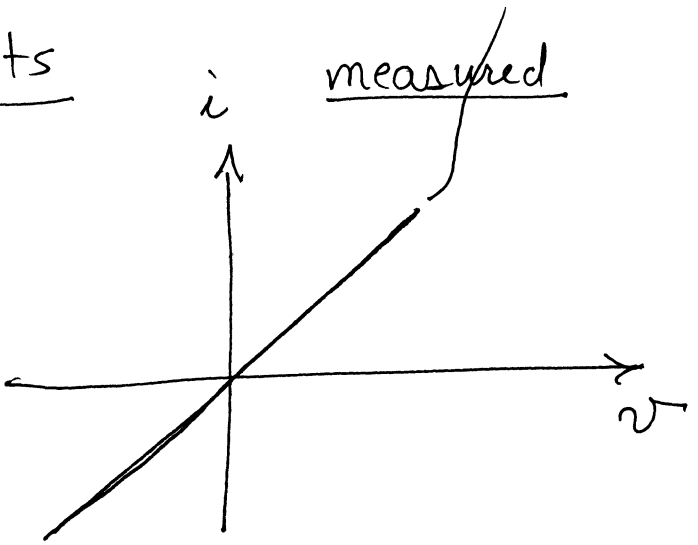
$v_{AB}(t)$ This is the voltage between two nodes. Polarity should be indicated on circuit diagram.

What is ground?
— The reference for all voltage measurements.

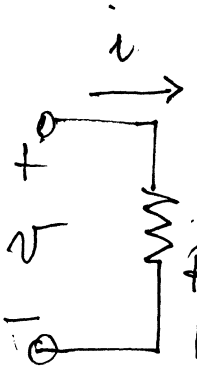
one subscript - measurement wrt ground
two subscripts - measurement between nodes specified

Element constraints





measured



500 ohms

RESISTOR.
(converts electrical energy to heat)

$$i = k v$$

$$i = \left(\frac{1}{R}\right) v = \frac{v}{R}$$

$$v = iR$$ Ohm's Law

ohm

BRN	BRN	YEL	GOLD
1 dig	2 nd dig	MULT	TOL
1	1	10^4	±5%