

CASE WESTERN RESERVE UNIVERSITY
Case School of Engineering
Department of Electrical Engineering and Computer Science
ENGR 210. Introduction to Circuits and Instruments (4)

Quiz No. 1**SOLUTIONS**

1/23/04

PUT ANSWERS IN THE SPACE PROVIDED AND SHOW YOUR WORK IF APPROPRIATE

Problem 1 (10 points)

A particular circuit has three devices with electrical parameters as shown below. Complete this table and indicate whether each device is absorbing (**A**) or delivering (**D**) power. Current is defined to be positive when it flows into the positive terminal of the device.

Device	Voltage	Current	Power	A/D
1	+5 V	0.25 A	+1.250 W	A
2	+2.5 V	0.25 A	+ 0.625 W	A
3	- 7.5 V	0.25 A	-1.875 W	D

Solution Notes. The horizontal lines are related by $P=vi$ which is easily calculated. The only difficult box was the power for component 3. A circuit is a closed system, i.e., equal amounts of power being supplied by sources (active elements) and being dissipated by passive elements. In this problem you were only given powers for components 1 and 2. Just as in HW problem 1-22 the total power should be zero, i.e., $P_1+P_2+P_3=0$, giving $P_3=-1.875$ watts

Problem 2 (5 points)

Complete the following table using the first row as your example.

Quantity	Numerical Value	Physical Unit
0.730 nJ	0.73×10^{-9}	Joule (energy)
24.6 kV	2.46×10^4	Volts (energy change/electron)
0.36 millimicro Ω	3.6×10^{-10}	Ohms (resistance)
0.1 μC	1×10^{-7}	Coulombs (charge) — Capacitance could also be correct
0.99 mA	9.9×10^{-4}	Amperes (current)

Solution Notes: This was a pretty straightforward problem. The term millimicro caused some confusion but combinations of prefixes are often valid. In this case it represents a thousandth of a millionth, i.e., $10^{-3} \times 10^{-6}$, or 10^{-9} which is actually equal to nano. C can actually be used to represent several physical units such as charge or capacitance and we will give credit for any reasonable physical unit.

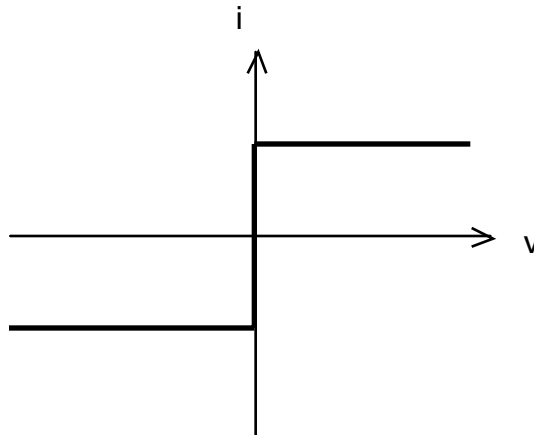
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Problem 3 (5 points)

You are on a CO-OP assignment and use a Keithley parameter analyzer to measure the I-v characteristics of an electronic device. It gives you the i-v curve shown below. Please check the appropriate box indicating whether the following statements are true or false.



TRUE	FALSE	Statement
	X	The device is linear.
X		The device is passive.

SOLUTION NOTES: This problem is very similar to problem 2-9 which covered the terms linear, bilateral, and active/passive.

- According to our textbook a linear device is one which has an I-v characteristic which is a straight line passing through the origin. Since this is clearly not a straight line it cannot be a linear device and the first statement is false.
- According to problem 2-9's solution a passive device is one which absorbs power. Consider any point on the curve in quadrant #1 — both the voltage and current are always positive so $P=vi$ will always be positive in quadrant #1. Consider any point on the curve in quadrant #3 — both the voltage and current are always negative so $P=vi$ will always be positive in quadrant #3. Consequently the device always absorbs power and is passive. The second statement is true. Some students were confused by the vertical part of the curve but $v=0$ and consequently $P=0$ along the vertical line which does not change the absorbing nature of the device.