Circuits and System 1 - 2^{nd} Semester - Week 2

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Switches

Switches have two distinct states: open and close

Closed switch: switch acts as short circuit

Open switch: switch acts as open circuit

A switch consists of pole(s) and throw(s)

Single pole single throw

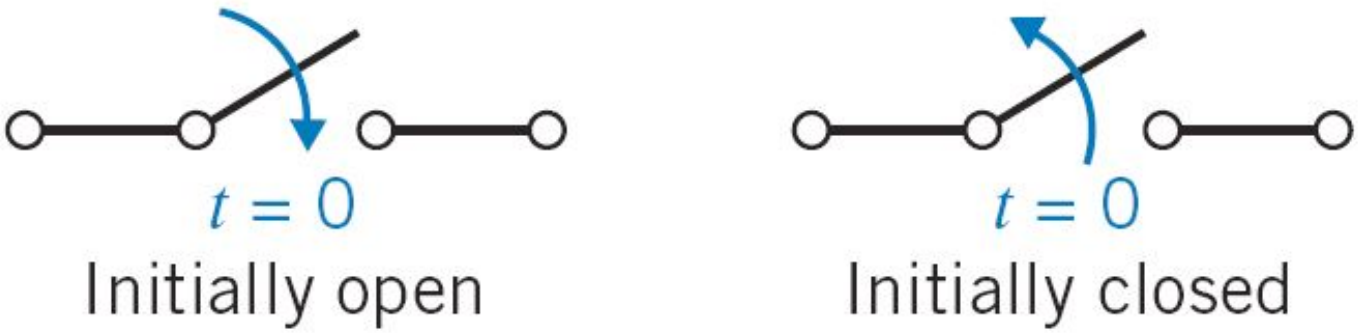

Figure: Single Pole Single Throw Switch

Single pole double throw

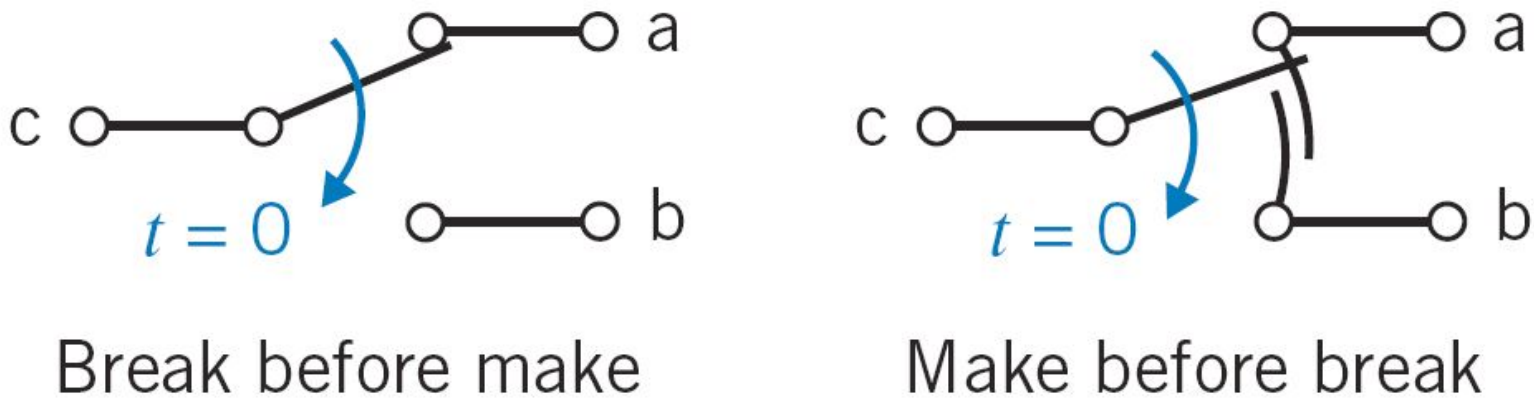

Figure: Single Pole Double Throw Switch

Problem 2.4.1 on page 45

Compute v and power absorbed by resistor if $i_s = 3A$ and $R = 7\Omega$

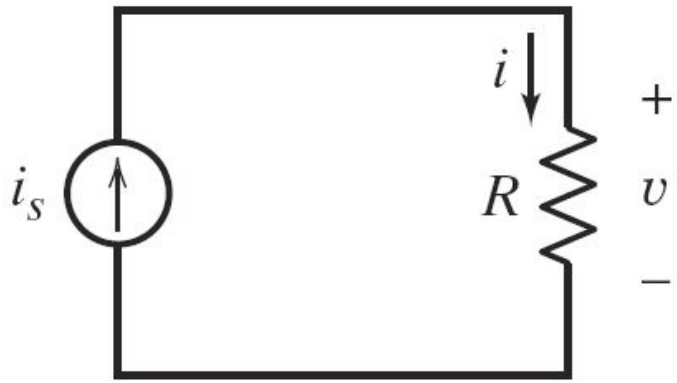

Figure: Problem 2.4.1 on Page 45 of textbook

Problem 2.4.7 on page 46

An electric heater is connected to a constant $\mathbf{250}\boldsymbol{V}$ source and absorbs $\mathbf{1000}\boldsymbol{W}$. Subsequently, the heater is connected to a constant $\mathbf{220}\boldsymbol{V}$ source. What power does it absorb from $\mathbf{220}\boldsymbol{V}$ source? (Hint: model the heater as resistor)

Solution:

Problem 2.5.2 on page 47

A current source and voltage source are connected in series as shown below. If $v_s = 10V$, $i_s = 3A$, $R = 5\Omega$, then compute voltage, current and power across the resistor. If the voltage source is changed to $5V$, then compute voltage, current and power across the resistor.

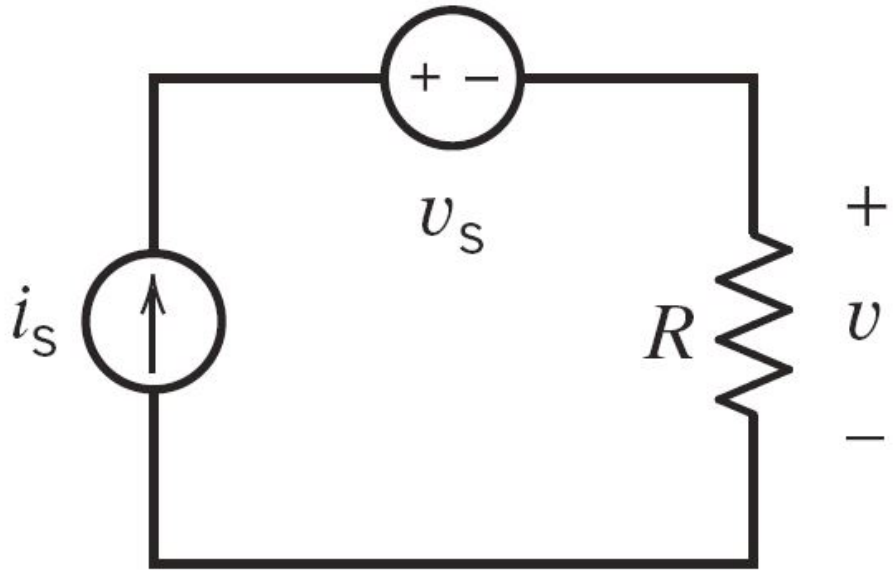

Figure: Problem 2.5.2 on Page 47 of textbook

Problem 2.5.2 on page 47

Solution:

Problem 2.5.5 on page 47

Compute the power supplied by the following voltage source and the energy supplied in the interval $\mathbf{0 \leq t \leq 1}$

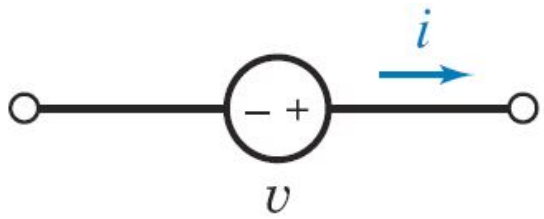

Figure: Problem 2.5.5 on Page 47 of textbook

$$v = 5 \cos tV$$

$$i = 20 \cos tmA$$

Problem 2.5.5 on page 47

Solution:

Problem 2.5.6 on page 47

Ampere-hours ($\boldsymbol{Ah}$): The capacity of battery to supply current for 1 hour.

For example: A $\boldsymbol{12Ah}$ battery can supply $\boldsymbol{12A}$ of current for 1 hour. If we are drawing $\boldsymbol{6A}$ current from $\boldsymbol{12Ah}$ battery, then it will take 2 hours to drain.

If a $\boldsymbol{12V}$ battery having $\boldsymbol{800mAh}$ capacity is connected to a load which draws $\boldsymbol{25mA}$, then how much time will it take for the battery to discharge? Compute the energy supplied by battery during the total time of discharge also.

Problem 2.5.6 on page 47

Solution:

Problem 2.7.1 on page 49

Determine the value of r if $i_a = 2A$ and $v_b = 8V$ in the following circuit.

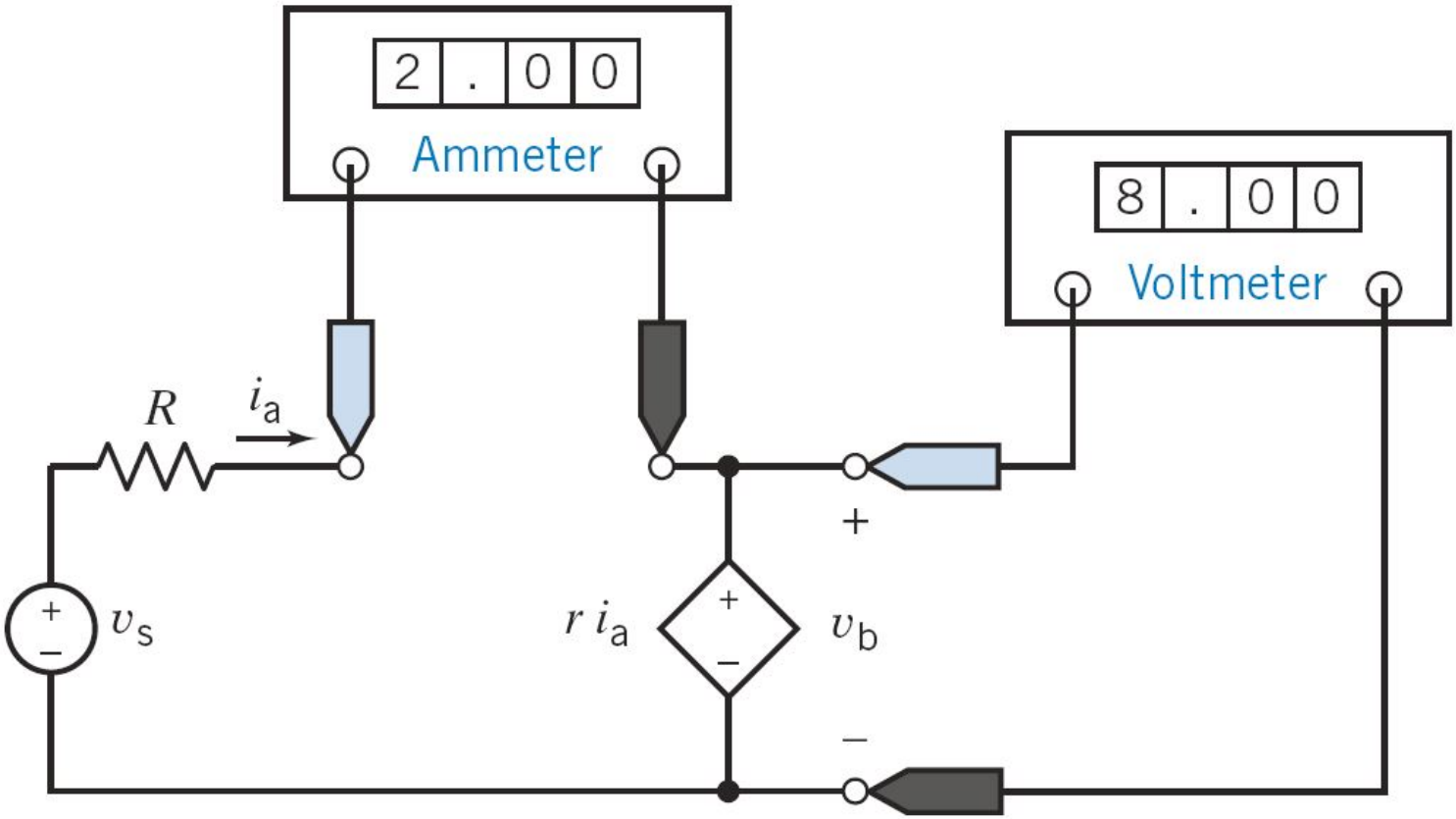

Figure: Problem 2.7.1 on page 49 of textbook

Problem 2.7.1 on page 49

Solution:

Problem 2.7.5 on page 50

Determine the value of $\boldsymbol{R}$ and the gain of dependant source, denoted by $\boldsymbol{A}$, in the following circuit.

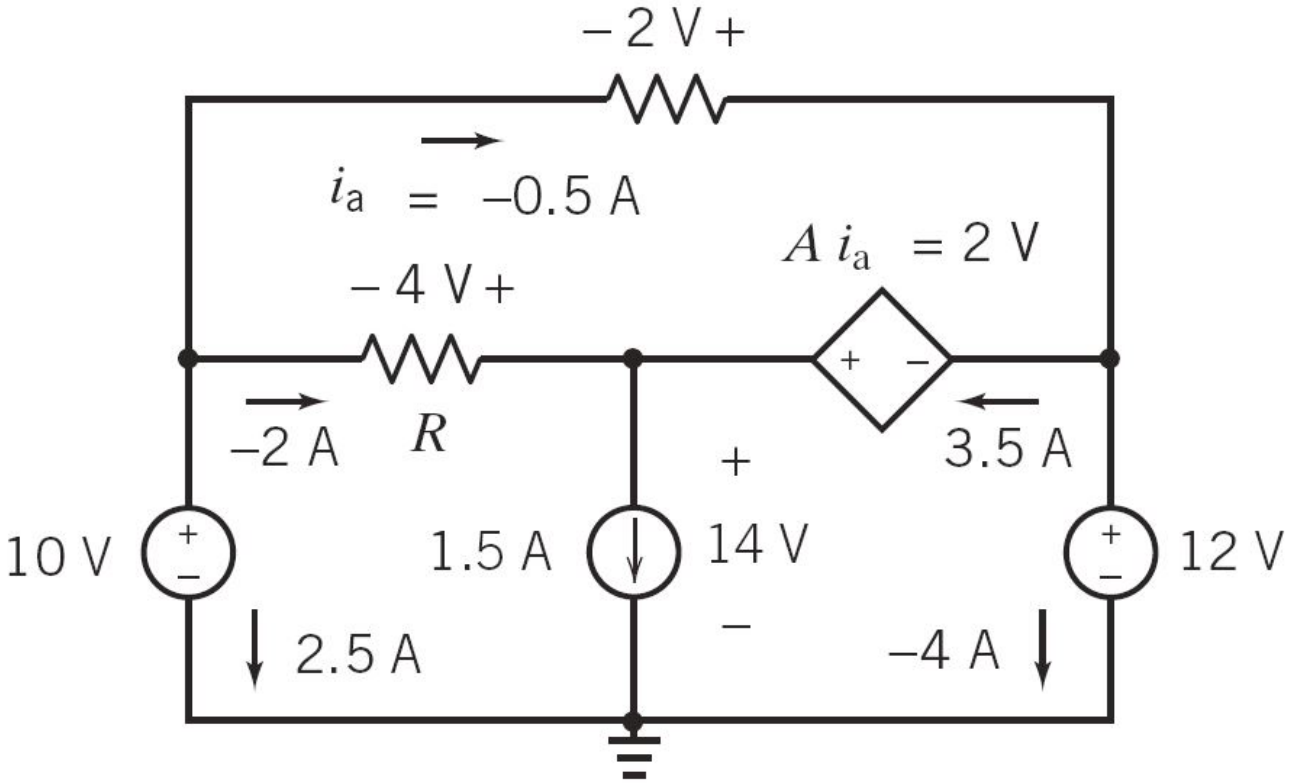

Figure: Problem 2.7.5 on page 50 of textbook

Problem 2.7.5 on page 50

Solution:

Problem 2.7.10 on page 51

Determine the value of i_b if $k = 0.09 A/V$, in the following circuit.

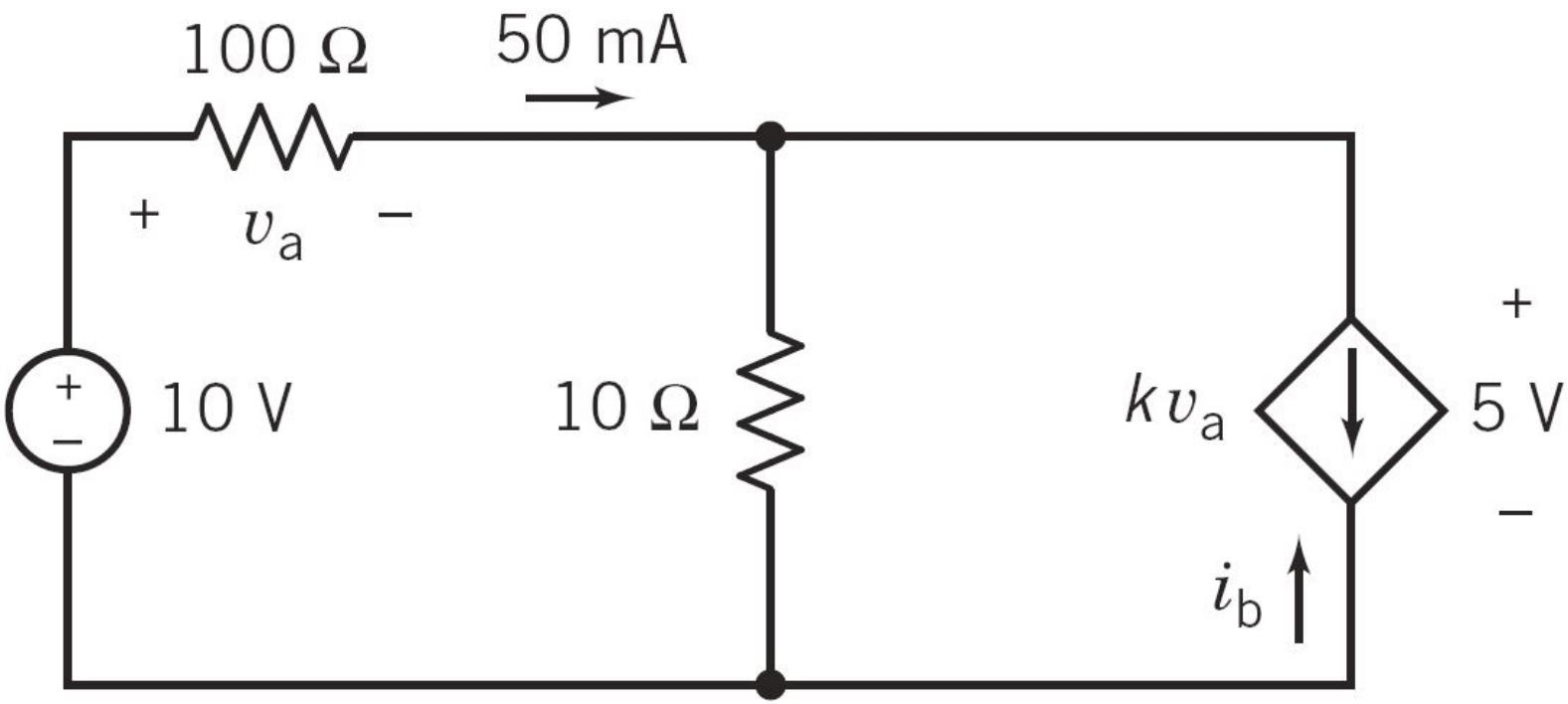

Figure: Problem 2.7.10 on page 51 of textbook

Problem 2.7.10 on page 51

Let us first determine v_a as we know the values of current and resistor.

Now, lets compute i_b as follows:

Problem 2.8.1 on page 51

If the current source $\boldsymbol{I}$ is supplying $\boldsymbol{1.1mA}$ and potentiometer resistor $\boldsymbol{R_p}$ is $\boldsymbol{100k\Omega}$, compute the angle $\boldsymbol{\theta}$ required so that the measured voltage (denoted by $\boldsymbol{v_m}$) is $\boldsymbol{23V}$

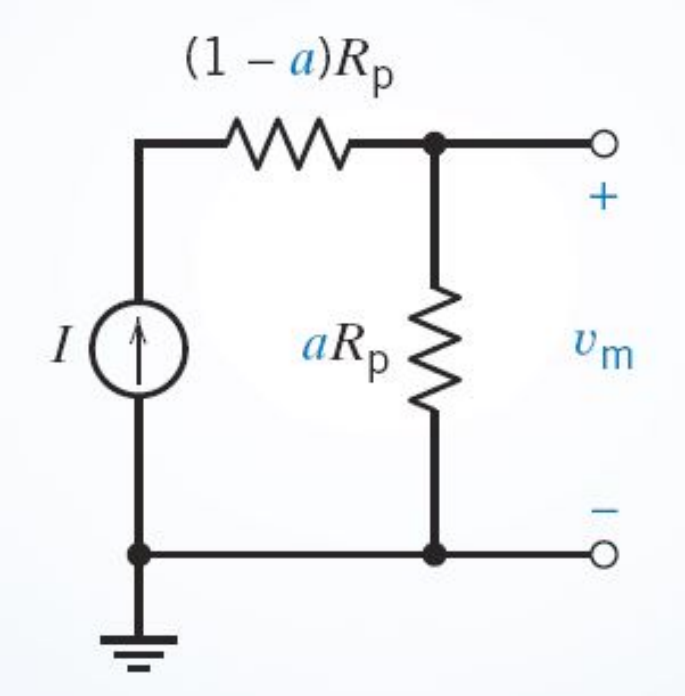

Figure: Problem 2.8.1 on page 51 of textbook

Problem 2.8.1 on page 51

Using formula given on page 38, we can write the following:

$$v_m = R_p I a = R_p I \frac{\theta}{360}$$

$$\frac{v_m 360}{R_p I} = \theta$$

Problem 2.9.1 on page 51

Determine the current i at $t = 1\,\mathbf{sec}$ and $t = 4\,\mathbf{sec}$ for the circuit shown below

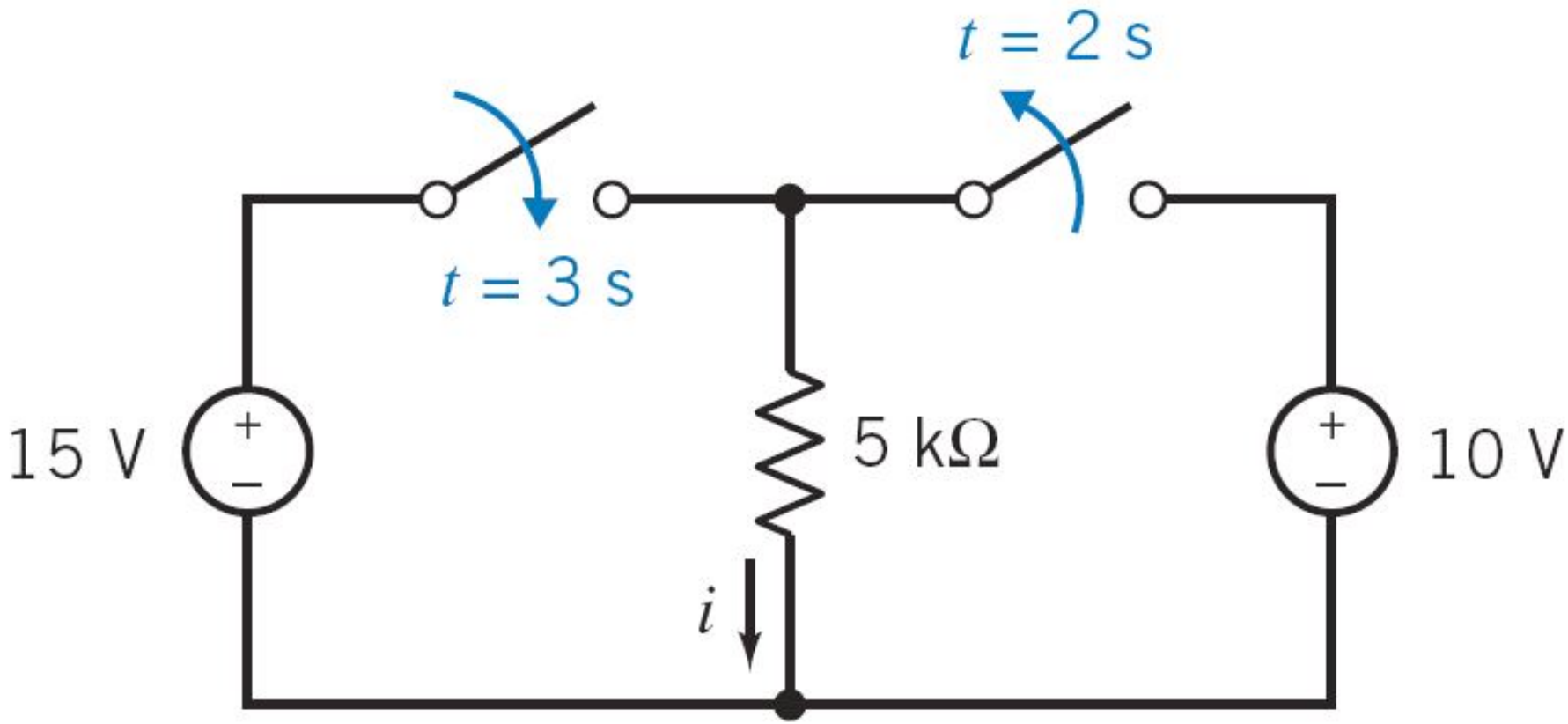

Figure: Problem 2.9.1 on page 51 of textbook

Problem 2.9.1 on page 51

Design Problem 2.1 on page 52

Specify the value of $\boldsymbol{R}$ in the following circuit such that the following 2 conditions are met:

1. $\boldsymbol{i > 40mA}$
2. The power absorbed by the resistor is less than $\boldsymbol{0.5W}$

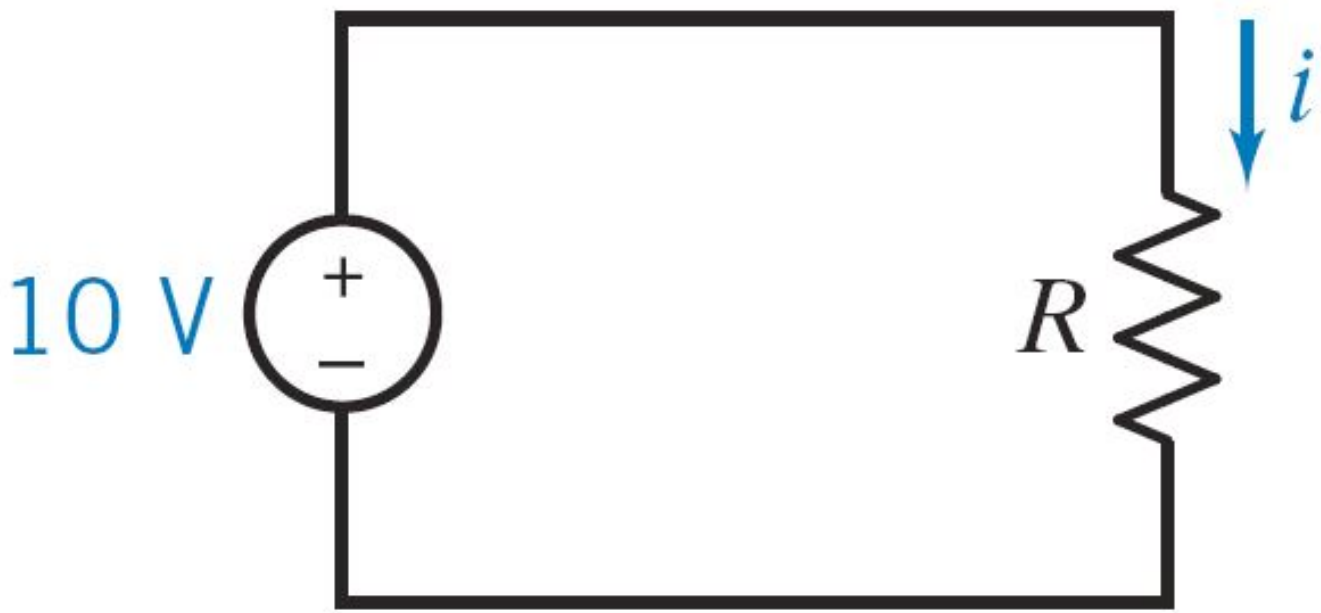

Figure: Design Problem 2.1 on page 51 of textbook

Design Problem 2.1 on page 52

Solution:

Design Problem 2.2 on page 52

Design a circuit by connecting $\boldsymbol{2A}$ current source with a resistor $\boldsymbol{R}$ such that the following two conditions hold:

1. The value of voltage across resistor is greater than $\boldsymbol{40V}$.
2. The power absorbed by the resistor is less than $\boldsymbol{15W}$

Design Problem 2.2 on page 52

Solution:

Next week topics

Till now, we finished chapter 2 including problems. Next week, we will be studying the following topics from chapter 3

- Kirchhoff current law
- Kirchhoff voltage law
- Applications of KCL and KVL in circuits
- Voltage divider and current divider circuits
- Analyze circuits using MATLAB