Review of Previous Lesson

5/10/2018

- State as many Vocabulary words and Learning Objectives that you remember from the last lesson as you can.
- Now complete the content learning objectives.
- Remember to grade yourself from 0 – 3.

1

5/10/2018

Electric Circuits

2

Learning Objectives

5/10/2018

Content:	Start	End
Construct a circuit diagram including the symbols for batteries, bulbs, resistors, and switches to represent a real circuit.		
Define resistance and voltage.		
Explain how resistance is related to thickness or length of a wire.		
Differentiate total resistance from the individual resistance of each component.		

3

Learning Objectives

5/10/2018

Content:	Start	End
Calculate equivalent resistances in series and in parallel and use them to analyse a circuit.		
State Ohm's law and use it to calculate any quantity.		
Calculate using Ohm's law both for a total circuit and for each individual component.		
Distinguish between a series and parallel circuit.		
Apply Ohm's law to any series circuit and simple parallel circuits.		
Describe the behaviour of current and voltage drop around each.		
Construct a VIR chart from a circuit diagram.		

Note: make students aware that series and parallel, despite common usage, refer to the arrangement of components within the circuit, and that you can have a complete circuit that is neither series nor parallel because both arrangements are used within the circuit.

4

How to Use a Multimeter

5/10/2018

(SparkFun Electronics)
https://www.youtube.com/watch?v=SLkPtmnglOI&t=8s

5

Introduction to circuits and Ohm's law

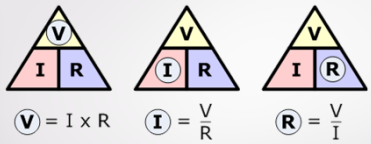
5/10/2018

(Khan Academy)
https://www.khanacademy.org/science/physics/circuits-topic/circuits-resistance/v/circuits-part-1

6

5/10/2018

Ohm's Law



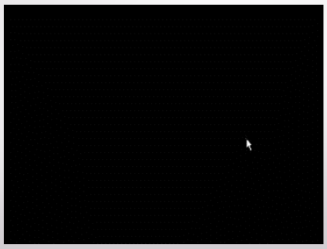
Voltage, (V)
Current, (I)
Resistance, (R)

7

5/10/2018

Resistors in series

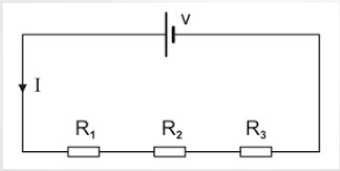
(Khan Academy)
https://www.khanacademy.org/science/physics/circuits-topic/circuits-resistance/v/circuits-part-2



8

5/10/2018

Resistors in series



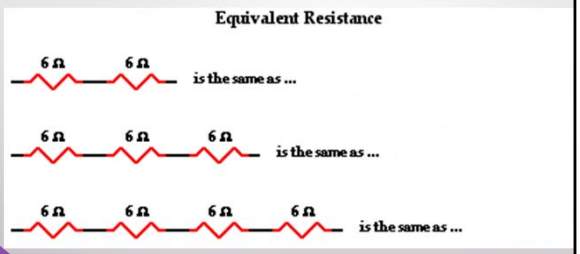
- $R_{eq} = R_1 + R_2 + R_3 + \ldots$

9

5/10/2018

Resistors in series

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits

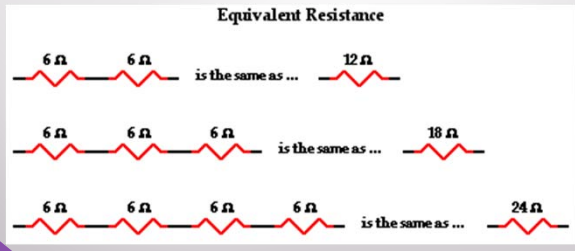


10

5/10/2018

Resistors in series

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits

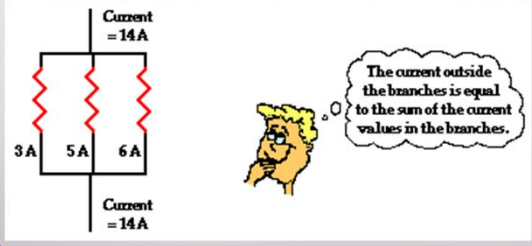


11

5/10/2018

Resistors in parallel

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits



- $I_{total} = I_1 + I_2 + I_3 + \ldots$

12

Resistors in parallel

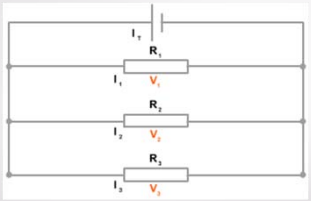
5/10/2018

(Khan Academy)
https://www.khanacademy.org/science/physics/circuits-topic/circuits-resistance/v/circuits-part-3

13

Resistors in parallel

5/10/2018



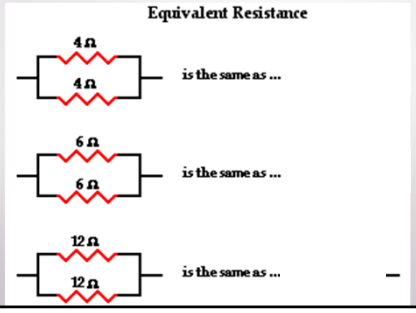
- $1 / R_{eq} = 1 / R_1 + 1 / R_2 + 1 / R_3 + \ldots$

14

Resistors in parallel

5/10/2018

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits

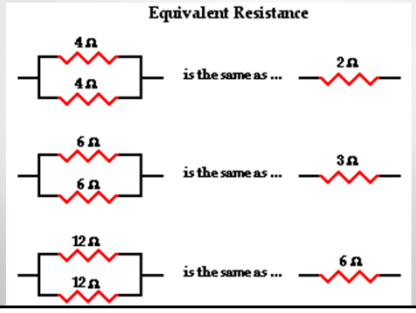


15

Resistors in parallel

5/10/2018

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits

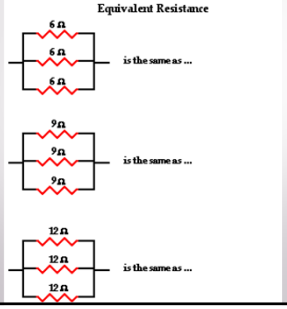


16

Resistors in parallel

5/10/2018

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits

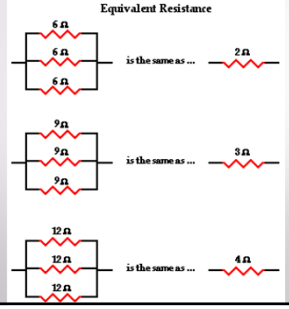


17

Resistors in parallel

5/10/2018

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits



18

Resistors in parallel

5/10/2018

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits

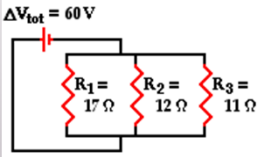
- Suppose a tollbooth is the main location of resistance to car flow on a toll way.
- Adding additional tollbooths within their own branch on a toll way will provide more pathways for cars to flow through the toll station.
- These additional tollbooths will decrease the overall resistance to car flow and increase the rate at which they flow.

19

Resistors in parallel

5/10/2018

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits



R_{eq} = ____ Ω I_{tot} = ____ A

I_1 = ____ A ΔV_1 = ____ V

I_2 = ____ A ΔV_2 = ____ V

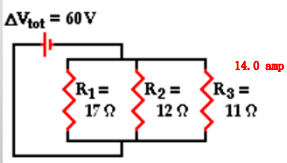
I_3 = ____ A ΔV_3 = ____ V

20

Resistors in parallel

5/10/2018

http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits



R_{eq} = 4.29 Ω I_{tot} = 14.0 A

I_1 = 3.53 A ΔV_1 = 60 V

I_2 = 5.00 A ΔV_2 = 60 V

I_3 = 5.45 A ΔV_3 = 60 V

Is $I_{tot} = I_1 + I_2 + I_3$?

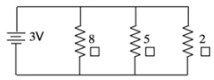
21

V-I-R chart

5/10/2018

(Ryan Melvin)
https://www.youtube.com/watch?v=mt4K7FT42wo

Example 1



Complete a V-I-R chart for the circuit.

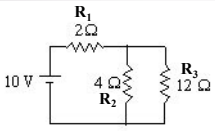
22

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)
https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html

Note: Ohm's law can ONLY be used when two of the 3 entries in a single row are known.



But we have only been given 1 value in each row at this point.

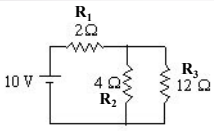
	Voltage	Current	Resistance
R_1			2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V		

23

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)
https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



What is the equivalent resistance of the whole circuit?

	Voltage	Current	Resistance
R_1			2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V		

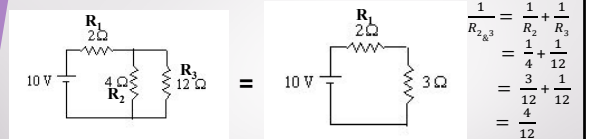
24

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)

https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



$$\frac{1}{R_{2\&3}} = \frac{1}{R_2} + \frac{1}{R_3}$$
$$= \frac{1}{4} + \frac{1}{12}$$
$$= \frac{3}{12} + \frac{1}{12}$$
$$= \frac{4}{12}$$
$$R_{2\&3} = \frac{12}{4} = 3\ \Omega$$

	Voltage	Current	Resistance
R_1			2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V		5 Ω

$R_T = 3 + 2 = 5\ \Omega$

R_T

25

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)

https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html

	Voltage	Current	Resistance
R_1			2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V		5 Ω

What is I_T?

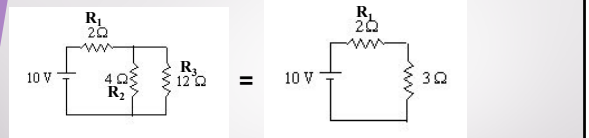
26

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)

https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



	Voltage	Current	Resistance
R_1			2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V	2 A	5 Ω

I_T (Ohm's Law) $V = IR$

27

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)

https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html

What is the current across I_1?

	Voltage	Current	Resistance
R_1			2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V	2 A	5 Ω

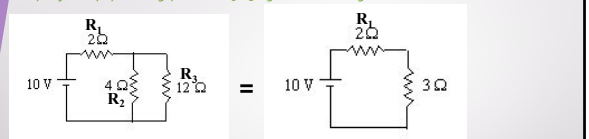
28

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)

https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



	Voltage	Current	Resistance
R_1		2 A	2 Ω
R_2		II	4 Ω
R_3			12 Ω
Total for circuit	10 V	2 A	5 Ω

As R_1 is in series so same as I_T.

29

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)

https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html

What is the Voltage across R_1?

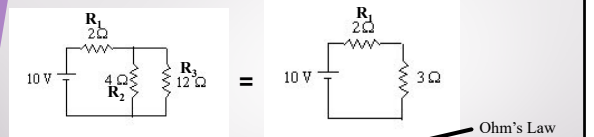
	Voltage	Current	Resistance
R_1		2 A	2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V	2 A	5 Ω

30

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)
https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



	Voltage	Current	Resistance
R_1	4 V	2 A	2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V	2 A	5 Ω

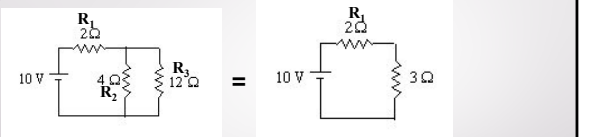
Ohm's Law
$V = IR$

31

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)
https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



	Voltage	Current	Resistance
R_1	4 V	2 A	2 Ω
R_2			4 Ω
R_3			12 Ω
Total for circuit	10 V	2 A	5 Ω

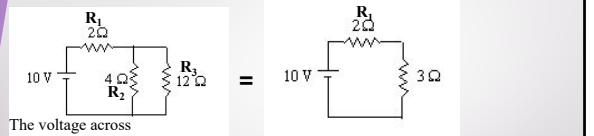
What are the voltages across R_2 & R_3?

32

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)
https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



The voltage across series resistors adds to the total.

	Voltage	Current	Resistance
R_1	4 V	2 A	2 Ω
R_2	6 V		4 Ω
R_3	6 V		12 Ω
Total for circuit	10 V	2 A	5 Ω

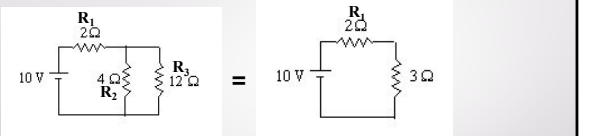
The voltage across parallel resistors is the same.

33

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)
https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



	Voltage	Current	Resistance
R_1	4 V	2 A	2 Ω
R_2	6 V		4 Ω
R_3	6 V		12 Ω
Total for circuit	10 V	2 A	5 Ω

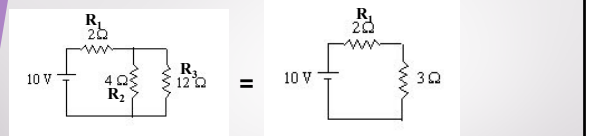
What are the currents through R_2 & R_3?

34

VIR charts and basic circuits

5/10/2018

(Jacobs Physics)
https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html



	Voltage	Current	Resistance
R_1	4 V	2 A	2 Ω
R_2	6 V	1.5 A	4 Ω
R_3	6 V	0.5 A	12 Ω
Total for circuit	10 V	2 A	5 Ω

Ohm's Law
$V = IR$

35

Common Misconceptions Regarding Electric Circuits

5/10/2018

http://www.physicsclassroom.com/class/circuits/Lesson-2/Common-Misconceptions-Regarding-Electric-Circuits

Statement	True or False?
a. When an electrochemical cell no longer works, it is out of charge and must be recharged before it can be used again.	T or F
b. An electrochemical cell can be a source of charge in a circuit. The charge that flows through the circuit originates in the cell.	T or F
c. Charge becomes used up as it flows through a circuit. The amount of charge that exits a light bulb is less than the amount that enters the light bulb.	T or F
d. Charge flows through circuits at very high speeds. This explains why the light bulb turns on immediately after the wall switch is flipped.	T or F
e. The local electrical utility company supplies millions and millions of electrons to our homes everyday.	T or F

36

Common Misconceptions Regarding Electric Circuits

http://www.physicsclassroom.com/class/circuits/Lesson-2/Common-Misconceptions-Regarding-Electric-Circuits

Statement	True or False?
a. When an electrochemical cell no longer works, it is out of charge and must be recharged before it can be used again.	T or F
b. An electrochemical cell can be a source of charge in a circuit. The charge that flows through the circuit originates in the cell.	T or F
c. Charge becomes used up as it flows through a circuit. The amount of charge that exits a light bulb is less than the amount that enters the light bulb.	T or F
d. Charge flows through circuits at very high speeds. This explains why the light bulb turns on immediately after the wall switch is flipped.	T or F
e. The local electrical utility company supplies millions and millions of electrons to our homes everyday.	T or F

Each of these statements is false.

Common Misconceptions Regarding Electric Circuits

http://www.physicsclassroom.com/class/circuits/Lesson-2/Common-Misconceptions-Regarding-Electric-Circuits

- An electrochemical cell *('battery')* supplies the energy needed to move a charge from a low potential location to a high potential location.
- The charge that flows through a circuit originates in the wires *(the electrons possessed by the atoms that make up the wires)*.
- Charge moves abnormally slowly *(~ 1 m/hour)* through a circuit. But as soon as a switched is turned to ON, charge located everywhere within the circuit begins to move.
- The rate at which charge flows into a light bulb = charge flows out.
- An electrical appliance *(e.g. light bulb)* transforms electrical energy into other forms *(e.g. light energy and thermal energy)*. Thus, the amount of electrical energy possessed by a charge as it exits an appliance is < when it entered the appliance *(voltage drop)*.

Plenary:

- Electric Circuits:
  - http://www.physicsclassroom.com/class/circuits/Lesson-4/Series-Circuits
  - http://www.physicsclassroom.com/class/circuits/Lesson-4/Parallel-Circuits
  - http://www.physicsclassroom.com/class/circuits/Lesson-4/Combination-Circuits
  - https://quizizz.com/admin/quiz/571635b80619d9281647e94d
  - http://www.softschools.com/quizzes/science/series_circuit/quiz3663.html
  - http://www.twothirtyvolts.org.uk/education/revision-quiz/electric-circuits-11t014.html

Plenary:

- Ohm's Law:
  - http://www.physicsclassroom.com/class/circuits/Lesson-3/Ohm-s-Law
  - https://www.allaboutcircuits.com/worksheets/ohms-law/
  - https://en.wikiversity.org/wiki/Electric_Circuit_Analysis/Circuit_Analysis_Quiz_1
  - http://www.learnabout-electronics.org/Resistors/resistors_12.php
  - http://www.twothirtyvolts.org.uk/education/revision-quiz/ohms-law.html
  - https://quizizz.com/admin/quiz/56d596ad5aea7a8959bef885
  - https://www.bbc.co.uk/education/guides/z8b2pv4/test
  - https://sciencesource2.pearsoncanada.ca/resources/hotpotato_quiz_09_11_3.htm
  - https://quizizz.com/admin/quiz/57015965d1dfce5d796cf77a

Plenary:

- VIR tables:
  - https://jacobsphysics.blogspot.hk/2009/03/i-got-email-from-geoff-clarion-other.html
  - https://www.wikihow.com/Solve-Parallel-Circuits
  - https://www.allaboutcircuits.com/textbook/direct-current/chpt-5/simple-parallel-circuits/