**Supporting Information**

**Learning Electricity using Arduino-Android based Game to Improve STEM Literacy**

Alifa Irna Yasin1, Eka Cahya Prima1\*, Hayat Sholihin2

1Department of Science Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Indonesia

2Department of Chemistry Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Indonesia

\*Corresponding Author. [ekacahyaprima@upi.edu](mailto:ekacahyaprima@upi.edu)

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Lesson Scheme of Work

**Madania Secondary School**

**Physics**

**Grade 8 - Semester 2 - 2016/2017**

**Week 17**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic:**  Electricity | | | **Time frame:**  3 periods (3 x 40 minutes) |
| **Expected Outcomes** | | | |
| 1. **Core Competencies:** | | | |
| 1.  2.  3.  4. | Menghayati dan mengamalkan ajaran agama yang dianutnya.  Menghayati dan mengamalkan perilaku jujur, disiplin, tanggung jawab, peduli (gotong royong, kerjasama, toleran, damai), santun, responsif dan pro-aktif serta menunjukkan sikap sebagai bagian dari berbagai permasalahan dalam berinteraksi secara efektif dengan lingkungan sosial dan alam, dan dalam menempatkan diri sebagai cerminan bangsa dalam pergaulan dunia.  Memahami, menerapkan, menganalisa, konseptual, prosedural berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya, dan humaniora dengan wawasan kemanusiaan, kebangsaan, kenegaraan, dan peradaban, terkait penyebab fenomena dan kejadian, serta menerapkan pengetahuan prosedural pada bidang kajian yang spesifik sesuai dengan bakat dan minatnya untuk memecahkan masalah.  Mengolah, menalar, menyaji, dan mencipta dalam ranah kongkret dan ranah abstrak terkait dengan pengembangan dari yang dipelajarinya di sekolah secara mandiri, dan mampu menggunakan metoda sesuai kaidah keilmuan. | | |
| 1. **Basic Competencies:** | | | |
| 4.2 | Understand the electrical quantities and its properties | | |
| 4.3 | Understand how electric circuit works | | |
| 1. **Indicators:** | | | |
| 4.2.2 | To state the current is related to the flow of charge and measured by ammeter | | |
| 4.2.3 | To state the e.m.f of an electrical source of energy is measured in volts | | |
| 4.2.4 | To state that the potential difference (p.d) across a circuit component is measured in volts | | |
| 4.2.5 | To state that resistance = p.d / current and the changes in p.d or resistance will affect current | | |
| 4.2.6 | To understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings | | |
| 4.3.1 | To draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), light-dependent resistors, lamps, ammeters, and voltmeters | | |
| 4.3.2 | To understand how the current, resistor and potential difference in both series and parallel circuit | | |
| 1. **Lessons Objectives**   **Students will be able to :**   1. State the current is related to the flow of charge 2. State the e.m.f of an electrical source of energy is measured in volts 3. state that the potential difference (p.d) across a circuit component is measured in volts 4. State that resistance = p.d / current and the changes in p.d or resistance will affect current 5. Understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings 6. Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), light-dependent resistors, lamps, ammeters, and voltmeters 7. Understand how the current, resistor and potential difference in both series and parallel circuit | | | |
| 1. **Materials/Subtopics:**  * Current * Electromotive force * Potential difference * Resistance * Electrical circuit | | | |
| 1. **Teaching Approach/Teaching Model/ Teaching Method** | | | |
| * Teaching Approach * Teaching Model * Teaching Method | | : STEM Learning  : Cooperative Learning  : Group Discussion, Question and Answer | |
| **G. Lesson Plan** | | | |
| **Session 1 (3 x 40 minutes)** | | | |
| Duration: 3 periods ( 3 x 40 minutes)   1. **Opening ( 15 minutes)**   **(Science)**  Recalling the previous materials; electrical quantities and how current is affected by resistors and potential differences   1. **Main Activity: (90 minutes)**     1. Students are divided into 8 groups ( 1 group consist of 2 people)    2. Students are asked to open the MGames Science in their phone.   **(Science and Technology Literacy )**   * 1. To introduce the game which will be used and recalling their previous materials, students are asked to complete the questions in the worksheet by opening “Learn About Circuit” page in MGames Science .   **(Science, Technology and Mathematics Literacy)**   * 1. Students are asked to play and finish the stage of MGames Science   2. Students are asked to make drawing scheme and result from each stage in their worksheet   3. Students are introduced to YWrobot, Arduino and how to use it with protoboard, lamp and wire.   4. Students are asked to draw scheme of their circuit in their worksheet.  1. **Closing: (15 minutes)** **(Technology)** 2. Students are introduced about the using Arduino Uno with the video of traffic light by using Arduino Uno. 3. Students are asked to submit their worksheet | | | |
| **Reflection** | | | |
| **Class Materials** | | | |
| * 1. LCD Projector   2. Computer/Laptop   3. Phone   4. Worksheets and Guidance book   5. Arduino Uno   6. YWrobot   7. Lamps   8. Resistors   9. Jumper Wires   10. Protoboard   11. Markers   12. Internet connection/Library books | | | |
| **Resources** | | | |
| MGmames Science Game | | | |

Bogor, 25 of April 2017

Checked and approved by:

Subject teacher Apprentice teacher

Name: Irfan Wahyudi Name: Alifa Irna Yasin



Lesson Scheme of Work

**Madania Secondary School**

**Physics**

**Grade 8 - Semester 2 - 2016/2017**

**Week 19**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic:**  Electricity | | | **Time frame:**  3 periods (3 x 40 minutes) |
|  | | | |
| **Expected Outcomes** | | | |
| 1. **Core Competencies:** | | | |
| 1.  2.  3.  4. | Menghayati dan mengamalkan ajaran agama yang dianutnya.  Menghayati dan mengamalkan perilaku jujur, disiplin, tanggung jawab, peduli (gotong royong, kerjasama, toleran, damai), santun, responsif dan pro-aktif serta menunjukkan sikap sebagai bagian dari berbagai permasalahan dalam berinteraksi secara efektif dengan lingkungan sosial dan alam, dan dalam menempatkan diri sebagai cerminan bangsa dalam pergaulan dunia.  Memahami, menerapkan, menganalisa, konseptual, prosedural berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya, dan humaniora dengan wawasan kemanusiaan, kebangsaan, kenegaraan, dan peradaban, terkait penyebab fenomena dan kejadian, serta menerapkan pengetahuan prosedural pada bidang kajian yang spesifik sesuai dengan bakat dan minatnya untuk memecahkan masalah.  Mengolah, menalar, menyaji, dan mencipta dalam ranah kongkret dan ranah abstrak terkait dengan pengembangan dari yang dipelajarinya di sekolah secara mandiri, dan mampu menggunakan metoda sesuai kaidah keilmuan. | | |
| 1. **Basic Competencies:** | | | |
| 4.2 | Understand the electrical quantities and its properties | | |
| 4.3 | Understand how electric circuit works | | |
| 1. **Indicators:** | | | |
| 4.2.2 | To state the current is related to the flow of charge and measured by ammeter | | |
| 4.2.3 | To state the e.m.f of an electrical source of energy is measured in volts | | |
| 4.2.4 | To state that the potential difference (p.d) across a circuit component is measured in volts | | |
| 4.2.5 | To state that resistance = p.d / current and the changes in p.d or resistance will affect current | | |
| 4.2.6 | To understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings | | |
| 4.3.1 | To draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), light-dependent resistors, lamps, ammeters, and voltmeters | | |
| 4.3.2 | To understand how the current, resistor and potential difference in both series and parallel circuit | | |
| 1. **Lessons Objectives**   **Students will be able to :**   1. State the current is related to the flow of charge 2. State the e.m.f of an electrical source of energy is measured in volts 3. state that the potential difference (p.d) across a circuit component is measured in volts 4. State that resistance = p.d / current and the changes in p.d or resistance will affect current 5. Understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings 6. Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), light-dependent resistors, lamps, ammeters, and voltmeters 7. Understand how the current, resistor and potential difference in both series and parallel circuit | | | |
| 1. **Materials/Subtopics:**  * Current * Electromotive force * Potential difference * Resistance * Electrical circuit | | | |
| 1. **Teaching Approach/Teaching Model/ Teaching Method** | | | |
| * Teaching Approach * Teaching Model * Teaching Method | | : STEM Learning  : Cooperative Learning  : Group Discussion and Experiment | |
| **G. Lesson Plan** | | | |
| **Session 1 (3 x 40 minutes)** | | | |
| Duration: 3 periods ( 3 x 40 minutes)   1. **Opening ( 15 minutes) (Technology)**    1. Students are explained about electrical components.    2. Teacher explain about YWrobot 2. **Main Activity: (90 minutes)** 3. Students are divided into 5 groups, each group consist of 3-4 students. 4. Students are given worksheet to guide in YWrobot experiments   **(Science, Technology and Engineering)**   1. Students are asked to try and arrange resistor or lamp in series or parallel circuit   using YWrobot and protoboard by reading the worksheet.   1. Students are asked to measure the current and voltage by using multimeter. 2. Students are challenged to make series circuit with two lamps 3. Students are challenged to make combination circuit ( series and parallel with   three lamps)   1. Students are asked to draw scheme of their circuit in their worksheet. 2. **Closing: (15 minutes)** **(Technology)** 3. Students are introduced about the using Arduino Uno with the video of traffic light by using Arduino Uno. 4. Students are asked to submit their worksheet | | | |
| **Reflection** | | | |
|  | | | |
| **Class Materials** | | | |
| * 1. LCD Projector   2. Computer/Laptop   3. Phone   4. Worksheets and Guidance book   5. Arduino Uno   6. YWrobot   7. Lamps   8. Resistors   9. Jumper Wires   10. Protoboard   11. Markers   12. Internet connection/Library books | | | |
| **Resources** | | | |
| **Assessment**  *(Attached, in the form of worksheet)* | | | |

Bogor, 8th of May 2017

Checked and approved by:

Subject teacher Apprentice teacher

Name: Irfan Wahyudi Name: Alifa Irna Yasin

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Lesson Scheme of Work

**Madania Secondary School**

**Physics**

**Grade 8 - Semester 2 - 2016/2017**

**Week 21**

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic:**  Electricity | | | **Time frame:**  3 periods (3 x 40 minutes) |
|  | | | |
| **Expected Outcomes** | | | |
| 1. **Core Competencies:** | | | |
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| 1. **Lessons Objectives**   **Students will be able to :**   1. State the current is related to the flow of charge 2. State the e.m.f of an electrical source of energy is measured in volts 3. state that the potential difference (p.d) across a circuit component is measured in volts 4. State that resistance = p.d / current and the changes in p.d or resistance will affect current 5. Understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings 6. Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), light-dependent resistors, lamps, ammeters, and voltmeters 7. Understand how the current, resistor and potential difference in both series and parallel circuit | | | |
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| **G. Lesson Plan** | | | |
| **Session 1 (3 x 40 minutes)** | | | |
| Duration: 3 periods ( 3 x 40 minutes)  **Opening ( 15 minutes)**  Student are asked to gathered with their previous group.  **(Engineering and Technology)**  Students are asked make blink project by seeing the instruction on the screen.   1. **Main Activity: (65 minutes)(Engineering and Technology)**   Students are asked to make traffic light project by reading their guidance book and worksheet.  Students are asked to make scheme of their traffic light.  Students are asked to modify their circuit ( changing lamp, resistor, “delayed” time, or even adding lamps).  Students are asked to make scheme of their modified traffic light circuit   1. **Closing (40 minutes)**   Students are asked to submit their worksheet.  Students are asked to do post test. | | | |
| **Reflection** | | | |
|  | | | |
| **Class Materials** | | | |
| * 1. LCD Projector   2. Computer/Laptop   3. Phone   4. Worksheets and Guidance book   5. Arduino Uno   6. YWrobot   7. Lamps   8. Resistors   9. Jumper Wires   10. Protoboard   11. Markers   12. Internet connection/Library books | | | |
| **Resources** | | | |
| **Assessment**  *(Attached, in the form of worksheet)* | | | |

Bogor,24th of May 2017

Checked and approved by:

Subject teacher Apprentice teacher

Name: Irfan Wahyudi Name: Alifa Irna Yasin

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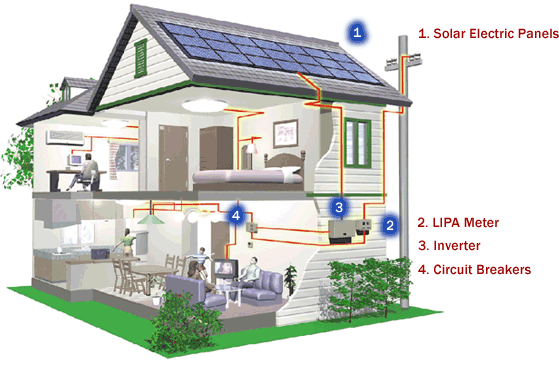
**MADANIA SECONDARY SCHOOL**

GRADE 8 - STUDENT WORKSHEET

ELECTRICAL CIRCUIT

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Class:8\_\_\_\_\_\_\_\_Date:\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| **Basic Competition** | |
| 4.2 | Understand the electrical quantities and its properties |
| 4.3 | Understand how electric circuit works |
| **Indicator** | |
| 4.2.2 | To state the current is related to the flow of charge and measured by ammeter |
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| 4.3.2 | To understand how the current, resistor and potential difference in both series and parallel circuit |

Home Electricity

Do you know homes have parallel circuitry (as opposed to series circuits) ? Its because everything does not rely on everything else. If a light bulb burns out in your kitchen, you can still use a lamp in your dining room.

Recall that a series circuit is essentially one big loop. The power source connects to the refrigerator, which connects to the water heater, which connects to the light bulb in a lamp, then back to the power source. The only way electricity can flow through all three is if all the items are working - as soon as one breaks, electrons cannot flow, therefore nothing works.

Figure 1 Home with solar electric panel

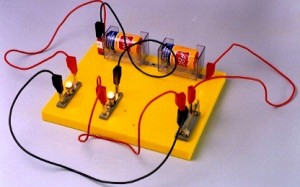
*Source : rock construction.com*

A parallel circuit, in contrast, connects each item directly to the power source. Essentially, the water heater has a connection to the power source, the refrigerator has a connection to the power source, and the lamp has a connection to the power source. You can picture a circuit for each that does not have any other objects (except for maybe a switch) impeding the flow of electricity.

Could you identify how electricity works in your home ? or the simplest scheme of your electrical appliances which connected in electrical circuit in your home ?

Now, we will identify the simplest scheme of electrical circuit and try to calculate electrical properties such as current, potential difference and resistance in circuit by using the game of MGames Science.

Do you still remember about ?

(forgot ?, please open “Learn About Circuit “ page in that game)

1. How is current produced in this circuit ?

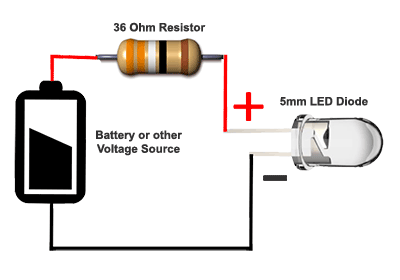
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Figure 2 Parallel Circuit

*Source : http://www.kompasiana.com*



1. Is there any resistor in that circuit ? what is the function of resistor ?

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Figure 3 Series Circuit with 36Ω resistor

Source : http://www.ledsupply.com/

1. How does Ohm’s law mention about circuit ?

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1. Look at these circuit !

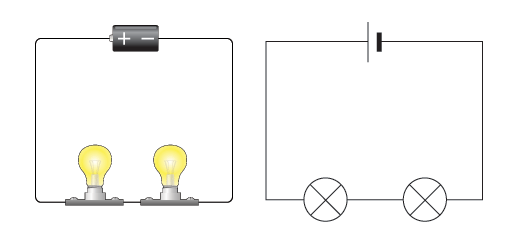


Figure 4 series and parallel circuit

Source : bbc.co.uk

What is the differences between series and parallel circuit ?

In Series : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In Parallel :\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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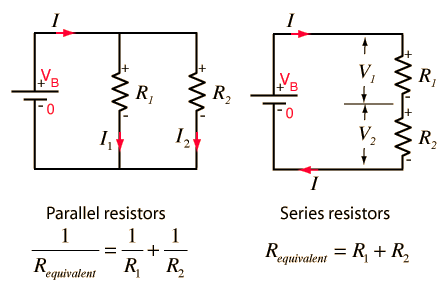
1. How do you calculate the resistance of series and parallel circuit ?

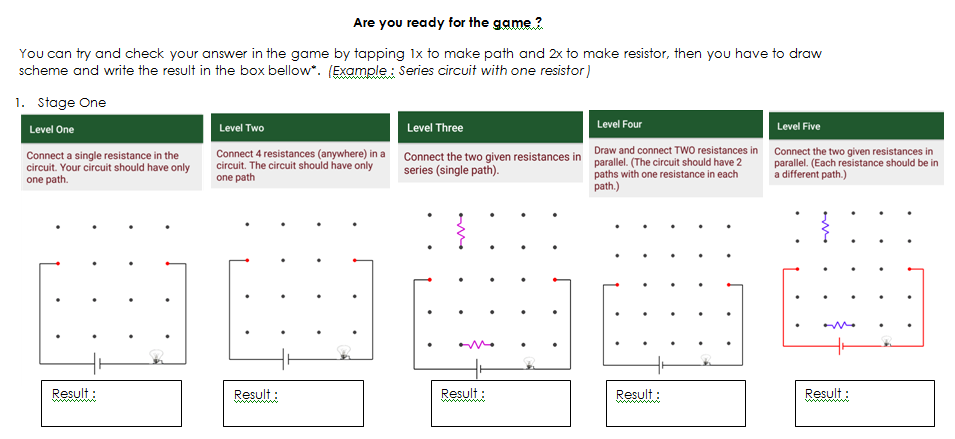
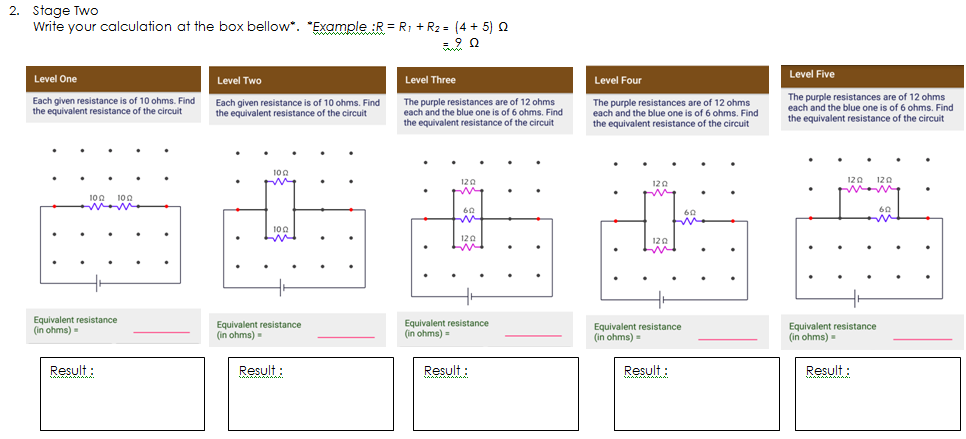
Figure 5 resistance in series and parallel circuit

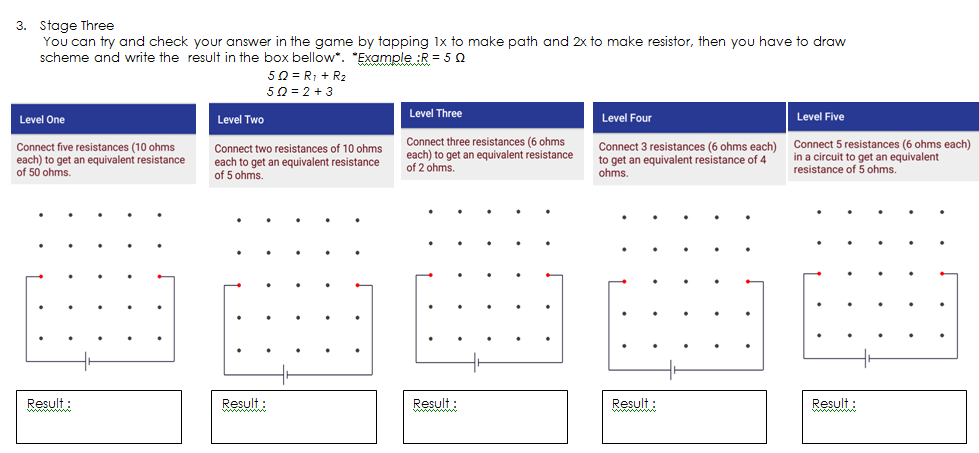
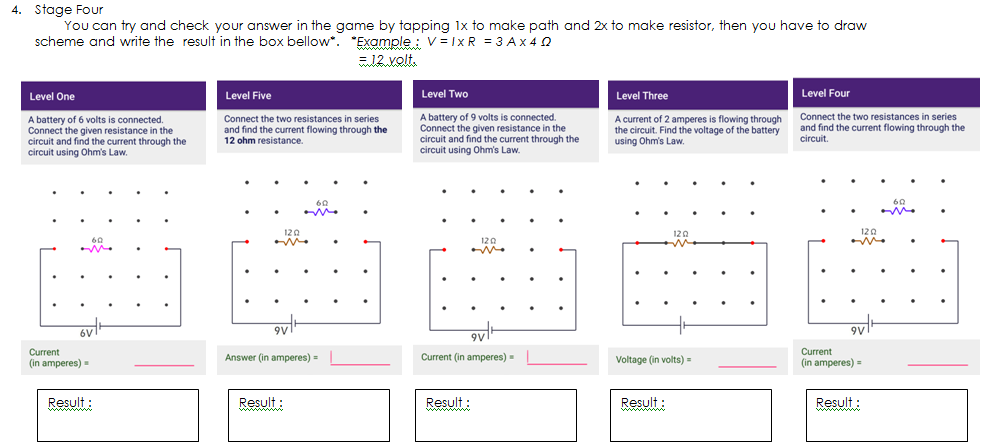
Source : bp.blogspot.com

In Series : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In Parallel :\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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 Bogor, 25 of April 2017

Checked and approved by:

Subject teacher Apprentice teacher

Name: Irfan Wahyudi Name: Alifa Irna Yasin



**MADANIA SECONDARY SCHOOL**

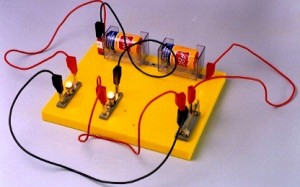
GRADE 8 - STUDENT WORKSHEET

ELECTRICAL CIRCUIT

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_­\_\_Class:8\_\_\_\_\_\_\_\_Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| **Basic Competency** | |
| 4.2 | Understand the electrical quantities and its properties |
| 4.3 | Understand how electric circuit works |
| **Indicator** | |
| 4.2.2 | To state the current is related to the flow of charge and measured by ammeter |
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**Getting Started with YWrobot Power Adaptor and Arduino Uno Microcontroller**



This application of series and parallel circuit can’t be developed by using this kit. The design of each kit is very basic so it can’t be modified. Technically those kinds of tools can’t be found in the application of electric appliances. However, the tool explains the basic principle of basic series-parallel concept which in line with curriculum demands and electricity problems which commonly found at theoretical exam questions.

Figure 6 Electrical parallel circuit which commonly used in school

*Source : www.kompasiana.com*

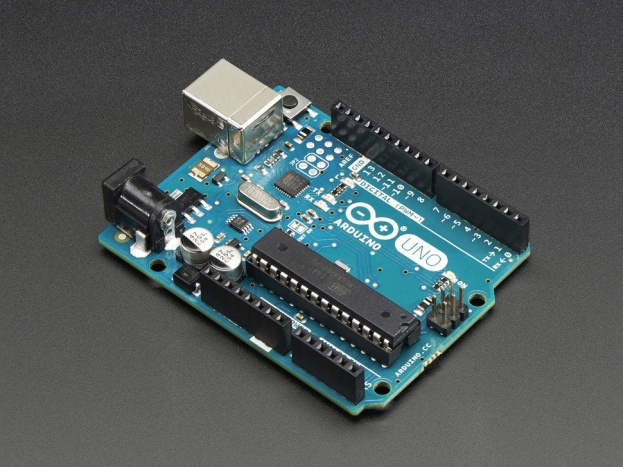
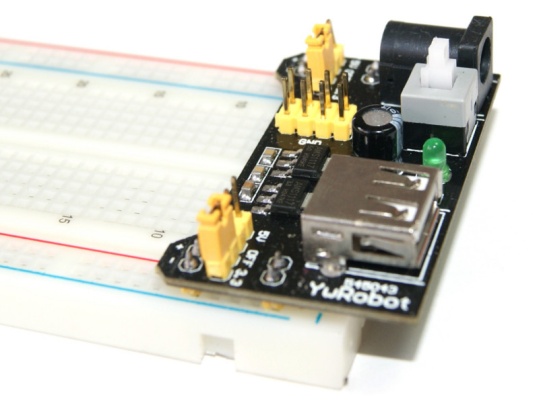


Figure 7YWrobot

Source : hetpro-store.com

Figure 8Arduino Uno

Source : adafruit.com

Nowadays, parallel and series electrical circuit using breadboard with YWrobot and Arduino Uno is become a trending topic. Yes, its true the price is relatively expensive, but it can be developed, modified and long-term used application. YWrobot provide the voltage source, which connected use a USB to Laptop, Adapter, and Battery. While Arduino Uno Microcontroller also provide voltage source, which connected use a USB to Laptop and it can control the device or appliances such as LED and LDR lamps or even thermometer which use LM35 sensor by inputting the formulae inside Arduino. Availability is very abundant in the market, but technical practitioners must know in advance the basic principles and the technical specifications.

Now, we will try basic application of YWrobot first.

1. **Experiment 1 (Constructing Series and Parallel Circuit use Breadboard and YWrobot)**

**You will need :**

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Name** | **Figure** | |
| 1. | Jumper Wire | C:\Users\asus\Downloads\IMG_20170331_103557.jpg | |
|  | Ywrobot | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_135752.jpg | |
|  | Breadboard | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_135338.jpg | |
|  | LED Lamp | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_135539.jpg | |
|  | Resistor (270 Ω) | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_135555.jpg | |
|  | Battery ( 9 Volt) | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_135621.jpg | |
|  | Battery Cable Connector | | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_135737.jpg |

1. **Series and Parallel Circuit**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Steps | Figure |  |
| 1. | Connect YwRobot on the breadboard. Four of YwRobot should fit in the hole of breadboard. | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_135907.jpg |  |
| 2. | Take battery cable connector, and connect it into *YWrobot*and two pit of battery . | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_135948.jpg |  |
| 3. | * In Row 15, Connect one resistor in negative line\*. * Connect LED lamp next to resistor\*. * Connect another resistor in positive line\*.   *\*the wire can be replaced by jumper wire*  *\*the shorter leg of LED is attached next to resistor which placed in negative pole, the longer leg of LED is attached next to resistor which placed in one is placed in positive pole.*  *\*the scheme of circuit should be ” - , + , - , + “* | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_140653.jpg |  |
| 4. | In making parallel circuit, you can repeat the third step in row 18-19. | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_141212.jpg |  |

1. **Measuring Voltage and Current in the Working Circuit.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Circuits | Diagram | PD (V) | Current (A) |
| 1. | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_140653.jpg |  |  |  |
| 2. | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_141212.jpg |  |  |  |

1. **Build Your Own Circuit !**

|  |  |  |
| --- | --- | --- |
| No. | Circuits | Schemes \* |
| 1. | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_140944.jpg |  |
| 2. | D:\AliFaz\Anak Pak Hayat dan Pak Eka\STEM Pic\IMG_20170331_141554.jpg |  |
| \*you can draw circuit scheme after your installation is work. | | |

Bogor, 8th of May 2017

Checked and approved by:

Subject teacher Apprentice teacher

Name: Irfan Wahyudi Name: Alifa Irna Yasin



**MADANIA SECONDARY SCHOOL**

GRADE 8 - STUDENT WORKSHEET

ELECTRICAL CIRCUIT

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_­Class:8\_\_\_\_\_\_\_Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| **Basic Competency** | |
| 4.2 | Understand the electrical quantities and its properties |
| 4.3 | Understand how electric circuit works |
| **Indicator** | |
| 4.2.2 | To state the current is related to the flow of charge and measured by ammeter |
| 4.2.3 | To state the e.m.f of an electrical source of energy is measured in volts |
| 4.2.4 | To state that the potential difference (p.d) across a circuit component is measured in volts |
| 4.2.5 | To state that resistance = p.d / current and the changes in p.d or resistance will affect current |
| 4.2.6 | To understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings |
| 4.3.1 | To draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), light-dependent resistors, lamps, ammeters, and voltmeters |
| 4.3.2 | To understand how the current, resistor and potential difference in both series and parallel circuit |

**Getting Started with Arduino Uno Microcontroller**

1. Getting Started with Arduino

Now, you will try to make Traffic Light by using Arduino. The materials which needed is almost same with the experiment before. But, YwRobot is replaced by Arduino and the software of Arduino for inputting the formulae.

|  |  |  |
| --- | --- | --- |
| No. | Steps | Figure |
| 1. | Connect blue connector cable to laptop as Arduinos’ power supply | C:\Users\asus\Downloads\20170410_105441.jpg |
| 1. | * With a wire, connect ground from the *Arduino* (labeled **GND**) to the **negative charge** in the bottom row of the farthest right column of the bread board. * With a wire, connect power from where it says **5V** (the V stands for voltage and this is where the electric power comes from.) on the Arduino to the positive charge in the bottom row, next to right column. | C:\Users\asus\Downloads\1491800453860.jpg |
| 3. | * Connect the **LED Lamps cathode (shorter leg)** to row e7, e11 and e15 and anode (longer leg) to row f7, f11, and f15. * With three wires which connect to digital pit of **12, 11,** and **10**. | C:\Users\asus\Downloads\1491800462658.jpg |
| 4. | Connect the resistor with one end in row **d7, d11, d15** and the other end on the furthest **negative column (ground)**. *(This makes it connect to the resistor through the breadboard because they are on the same row).* | C:\Users\asus\Downloads\1491800468308.jpg |
| 5. | The LED should light up. If it doesn’t, unplug power from the Arduino, check all of your connections and make sure you didn’t plug the LED inversely. Then try power again until it turn on. | C:\Users\asus\Downloads\1491800470805.jpg |
| 9. | Asked your Teacher to add the Script on your Arduino |  |
| 10. | Draw the scheme of the circuit in the tabel. |  |
| 11. | Modify your own project and write which part in the project that has been modified. |  |

Bogor,24th of May 2017

Checked and approved by:

Subject teacher Apprentice teacher

Name: Irfan Wahyudi Name: Alifa Irna Yasin

**STEM LITERACY INSTRUMENT TEST**

Name : \_\_\_\_\_\_\_\_\_\_\_\_\_ Class : \_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_

**Answer this following question carefully by crossing ( x ) the correct answer**

1. The iron with a 220 W heated for 120 minutes, if the electricity costs is Rp.1150 per kWh, How much we should pay for the cost?

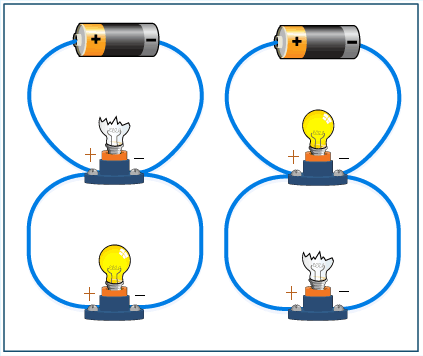
a. Rp 210-,

b. Rp 506-,

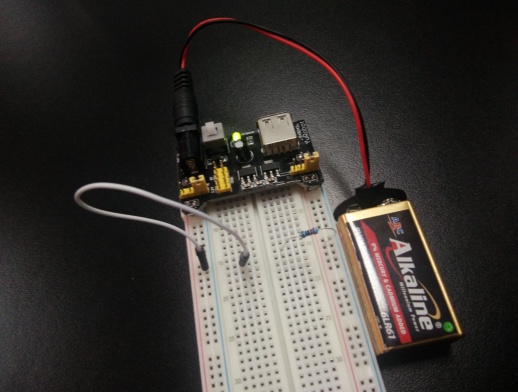
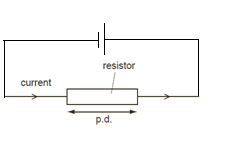
c. Rp 2.108-,

d. Rp 5.600-,

1. Why do you think when one of the lamp is turning off but another lamp is still turning on?



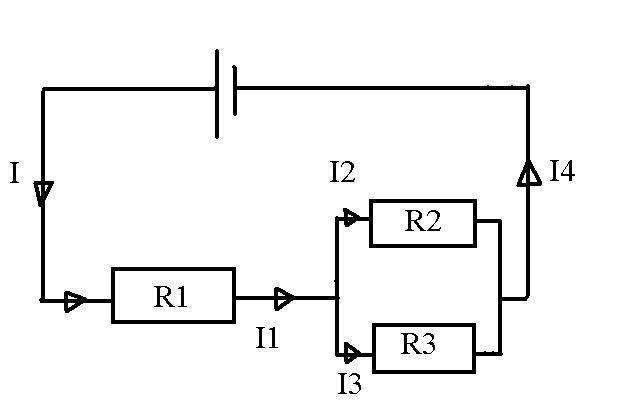
1. Because the circuit is set in series, so the lamps are not connected each other.
2. Because the circuit is set in series, so the wire is not connected each other.
3. Because the circuit is set in parallel, so the lamps are not connected each other.
4. Because the circuit is set in parallel, so the wire is not connected each other.
5. Nindya uses microwave to heat the food. She plugs the microwave into the main source of electricity. The transform of energy used to heat the food is from...
6. electrical energy into heat
7. electrical energy into power
8. electrical energy into watt
9. electrical energy into main electricity
10. A potential difference (**p.d** or **V**) across this resistor cause the current in this circuit Both resistor and p.d can be changed. If thcurrent is increasing, what will happen?

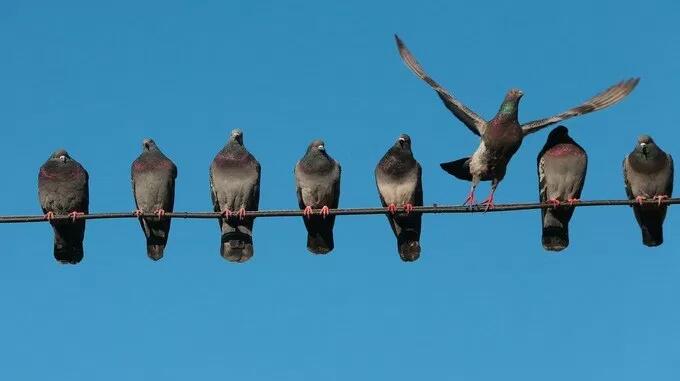


1. Potential difference and resistance will decrease.
2. Potential difference will decrease, while resistance will increase.
3. Potential difference will increase, while resistance will decrease.
4. Potential difference and resistance will increase.
5. This figure shows wires which have different length and different diameters. They are made from same metal. Which wire has a greater resistance ?

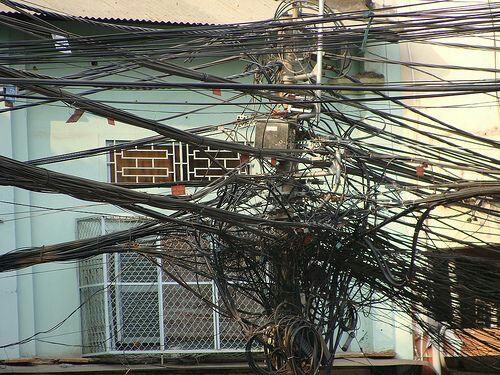
|  |  |
| --- | --- |
| a. | A longer wire with a smaller diameter |
| b. | A shorter wire with a smaller diameter |
| c. | A longer wire with a larger diameter |
| d. | A shorter wire with a larger diameter |



1. Indra arranges a circuit above. From the experiment shows that lamp in R1 is brighter than two other lamps. Which one is the right option to explains this phenomenon?
2. I= I1 = I2=I3 =I4
3. I = I4 , I1 = I2+I3
4. I= I1 , I2=I3 +I4
5. I= I1 + I2+I3 +I4
6. What is the e.m.f of this battery?
7. 12 watt
8. 12 A
9. 9 V
10. 9 e.m.f
11. Look at the figure below

Why are the birds not electrified while they are standing on the high voltage cable wire?

* 1. There is no current flows on the cable
  2. There is no potential difference between two legs of bird.
  3. There are a lot of birds on the wire so each birds have equal current
  4. The birds are standing in the wire

1. One of the electricity problems in big cities is the installation of cable as shown in the figure. If this condition happens continuously, what will happen to this installation?
2. The current flows into houses will become smaller.
3. The cable will be easier to fall to the

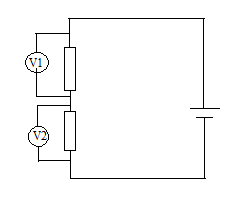
ground.

1. The potential difference among the cables will become higher and easy to

electrify birds.

1. There will be short-circuit.
2. Which picture that shows the wrong way to use voltmeter

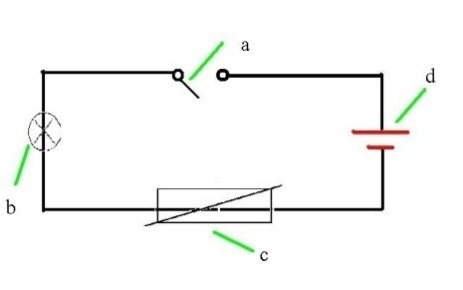
|  |  |  |
| --- | --- | --- |
| A |  | Diagram |
|  | Real Circuit |
|  | Voltage |
| B |  | Diagram |
|  | Real Circuit |
|  | Voltage |
| C |  | Diagram |
|  | Real Circuit |
|  | Voltage |
| D |  | Diagram |
|  | Real Circuit |
|  | Voltage |

1. Two potential differences are connected across a constant 12 V supply. The voltmeter readings are equal when the R1 and R2 has a value of 20 Ω. What happen to the readings when the value of R is reduced from 20 Ω to 10 Ω ?

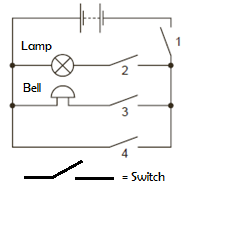
R2

R1

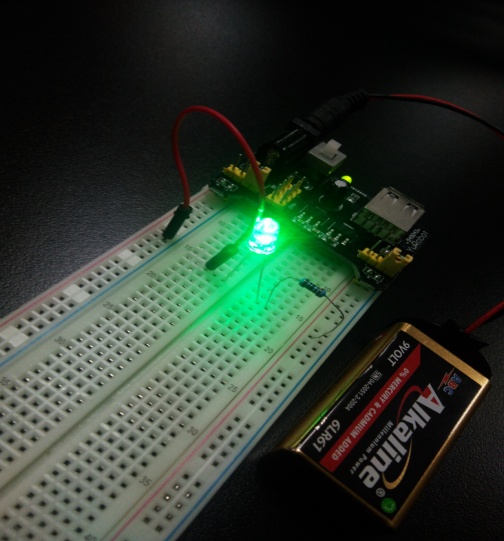
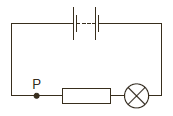
|  |  |  |
| --- | --- | --- |
|  | Reading on V1 | Reading on V2 |
| a | Decreases | Decreases |
| b | Decreases | Increases |
| c | Increases | Decreases |
| d | Increases | Increases |

1. On the circuit diagram below, name the pieces of the apparatus shown. Which pairs show the correct function between its function and electric component?

|  |  |  |
| --- | --- | --- |
|  | Function | Component |
| A. | To cut and connect the current flows | a |
| B. | To reduce the amount of current | d |
| C. | To supply the energy | c |
| D. | To direct the current flows from one components to another | b |

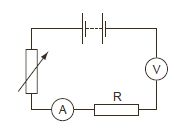
1. The multimeter sets to measure the total resistor in the circuit. The total resistor is....
2. 9 Ohm
3. 11 Ohm
4. 900 Ohm
5. 110 Ohm
6. Kresna connects the circuit as shown.

Which switches must be closed to make the bell ring without lighting the lamp ?

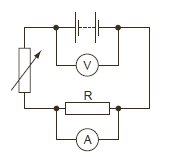
1. 1 and 2 only
2. 1 and 3 only
3. 1, 3 and 4 only
4. 2, 3 and 4 only
5. Kamil connect a lamp in a circuit as shown as bellow.

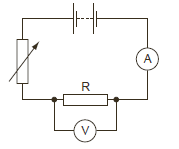
If Kamil wants to increase the current through the lamp, what should be done by him ?

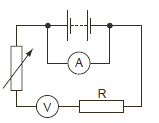
1. adding another resistor in parallel with the installed resistor in the circuit
2. adding another resistor in series with the installed resistor in the circuit
3. decreasing the electromotive force (e.m.f.) of the battery in the circuit
4. moving the lamp to point P in the circuit
5. Farrell will make a circuit, which one from the following circuit that can be arranged by him to determine the resistance of resistor R ?

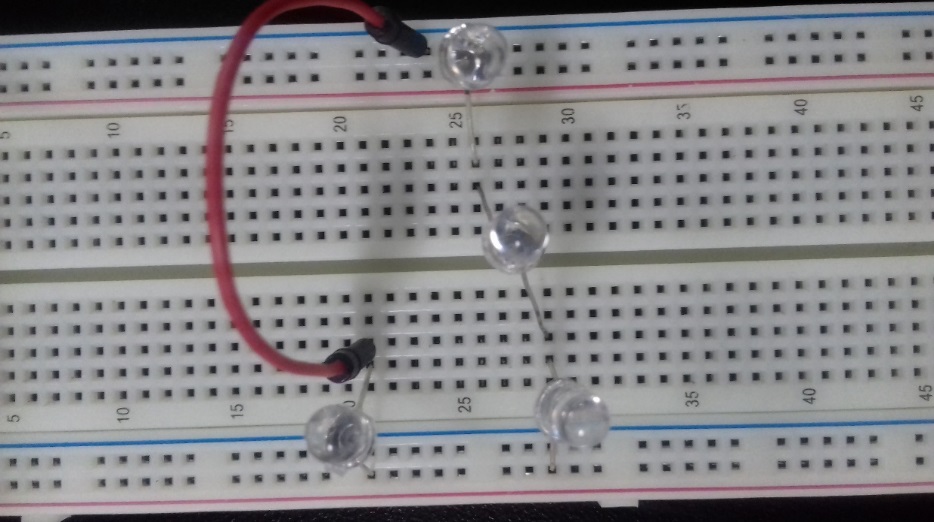










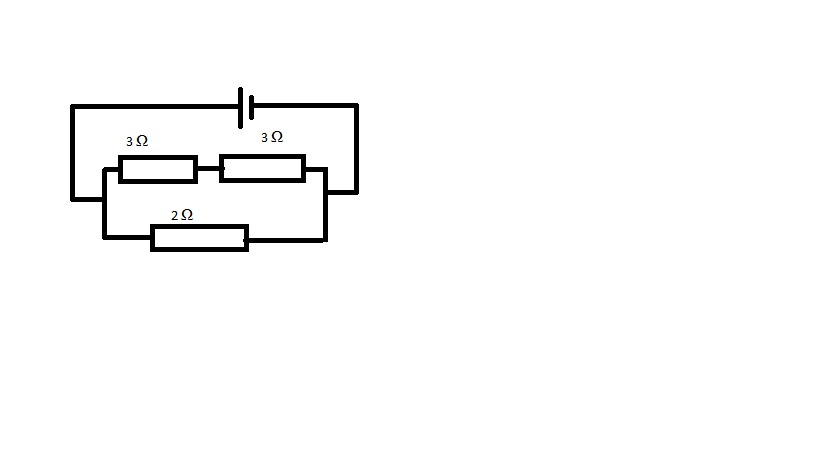
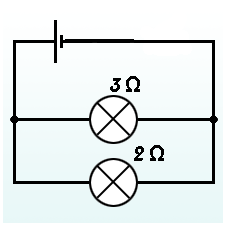
1. 4 lamp is connected in circuits like the figure below. Which lamp that will glow brightest?
2. A
3. B
4. C
5. D

**A**

**C**

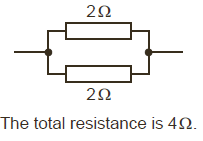
**B**

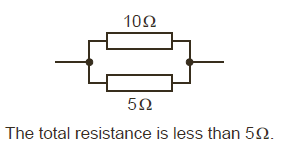
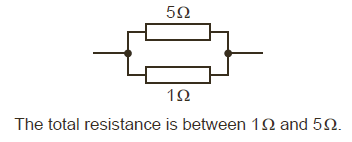
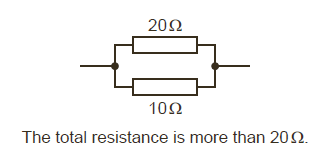
**D**

1. When a refrigerator is plugged into the potential source of 240 V, the current that flows through it’s filament is 12.0 A. What is the resistance of it’s filament?
2. 50 Ω
3. 40 Ω
4. 30 Ω
5. 20 Ω
6. Calculate the total resistance of these three resistors in the circuit!
7. 3 Ω
8. 3,5Ω
9. 1,5 Ω
10. 8 Ω
11. If potential different across the circuit is 6 V what is the current across the resistor?

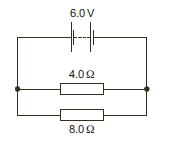
**6 V**

1. 1 A
2. 1.2 A
3. 5 A
4. 30 A
5. Radifsya connects the pair of resistors in parallel. The following diagrams show the schematic circuit and the total resistance of each pair of resistors. Which one of this statement is correct ?



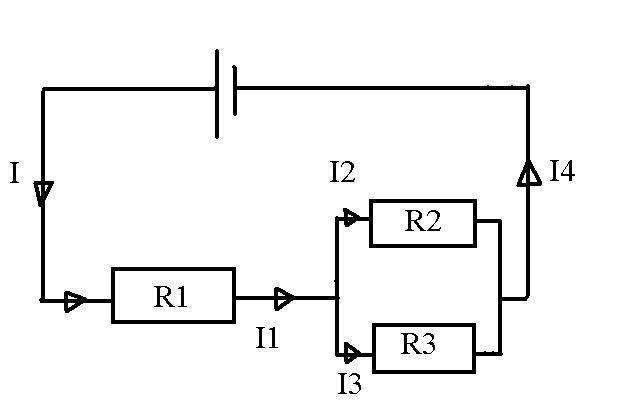
* 1. 
  2. 
  3. 

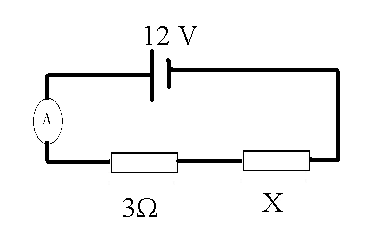
1. The circuit diagram shows a 8.0 Ω and 4.0 Ω resistor connected to a 12 V battery.



**12 V**

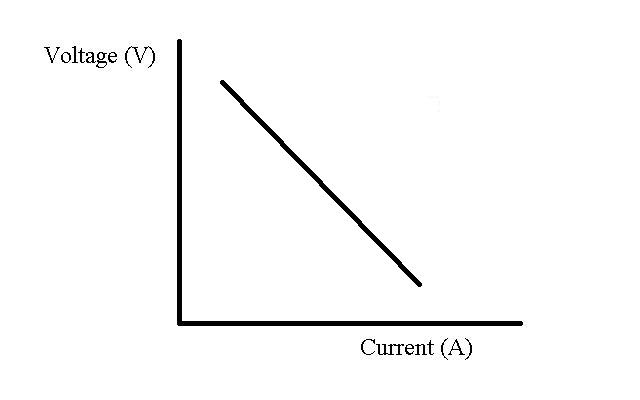
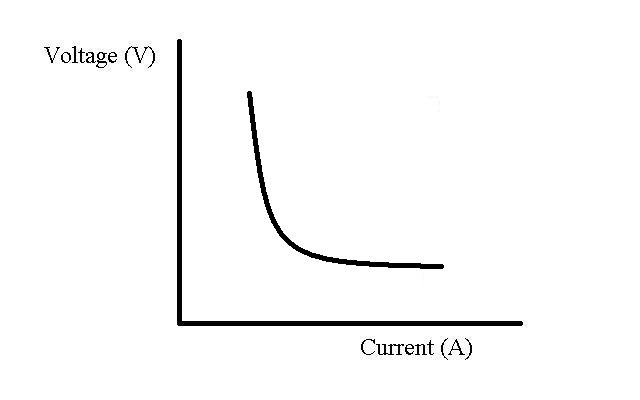
What is the potential difference (p.d) across 4.0 Ω resistor ?

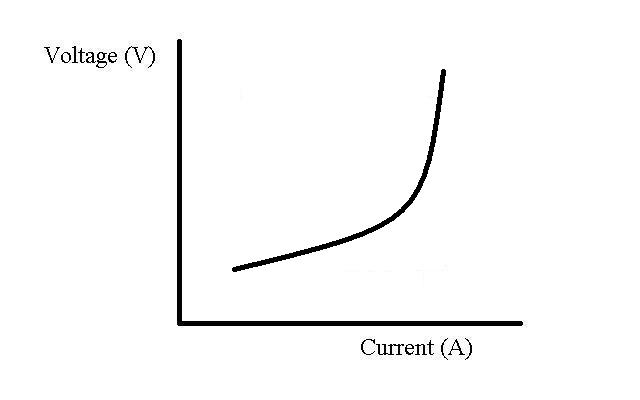
1. 0.5 V
2. 2.0 V
3. 6.0 V
4. 12 V
5. A 12-V battery is connected to the electric circuit which shown by the figure above. All of the resistor (R1. R2, R3) have identical resistance (4 Ω). Calculate the current across the circuit!
6. 2 A
7. 1 A
8. 4 A
9. 3 A

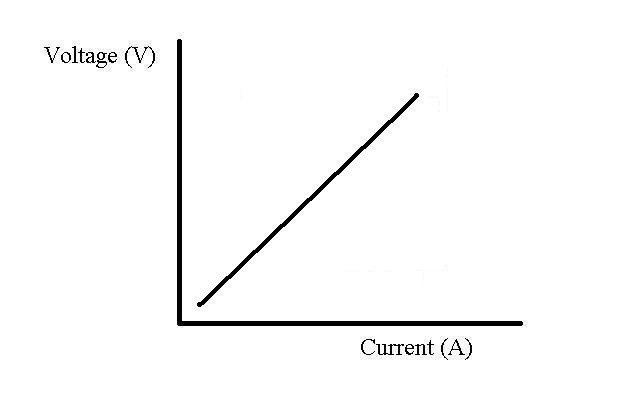


1. Caren has a power supply, two resistor, and an ammeter. She arranges it in series. When the circuit is switched on, the ammeter reads 2.0 A Could you predict the value of resistor X?
2. 4 Ω
3. 2 Ω
4. 6 Ω
5. 3 Ω
6. The graph shows potential difference/current characteristic of an ohmic conductor. Which graph shows the Ohm’s Law?

a. c.



b. d.



**STEM Learning Implementation Observation Sheet**

Observation Sheet of Teaching Activity

*STEM Learning on Electricity Using Arduino-Android Game Based Experiment To Improve 8th Grade Students’ STEM Literacy*

Meeting : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Class : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Topic : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\**Give checklist (√) sign in the yes/no column bellow.*

|  |  |  |  |
| --- | --- | --- | --- |
| Activity | Implementation | | Note |
|  | Yes | No |
| **Opening**  Recalling the previous materials; electrical quantities and how current is affected by resistors and potential differences |  |  |  |
| **Main Activity**   1. Students are divided into 8 groups ( 1 group consist of 2 people) 2. Students are asked to open the MGames Science in their phone.   **(Science and Technology Literacy )**   1. To introduce the game which will be used and recalling their previous materials, students are asked to complete the questions in the worksheet by opening “Learn About Circuit” page in MGames Science .   **(Science, Technology and Mathematics Literacy)**   1. Students are asked to play and finish the stage of MGames Science 2. Students are asked to make drawing scheme and result from each stage in their worksheet   Students are introduced to YWrobot, Arduino and how to use it with protoboard, lamp and wire |  |  |  |
| **Closing**   1. Students are challenged to finish the game at least two more levels. 2. Students are asked to submit their worksheet   **(Technology)**   1. Students are introduced to YWrobot, breadboard, resistor and lamp which relate with their experiment in the next meeting. |  |  |  |

Bogor, 25th of April 2017

Recommendation

Observer,

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observation Sheet of Teaching Activity

*STEM Learning on Electricity Using Arduino-Android Game Based Experiment To Improve 8th Grade Students’ STEM Literacy*

Meeting : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Class : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Topic : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\**Give checklist (√) sign in the yes/no column bellow.*

|  |  |  |  |
| --- | --- | --- | --- |
| Activity | Implementation | | Note |
| Yes | No |
| Duration: 3 periods ( 3 x 40 minutes)   1. **Opening ( 15 minutes)**    1. Students are explained about electrical components.    2. Teacher explain about Ywrobot |  |  |  |
| 1. **Main Activity: (90 minutes)** 2. Students are divided into 5 groups, each group consist of 3-4 students. 3. Students are given worksheet to guide in YWrobot experiments 4. Students are asked to try and arrange resistor or lamp in series or parallel circuit using YWrobot and protoboard by reading the worksheet. 5. Students are asked to measure the current and voltage by using multimeter. 6. Students are challenged to make series circuit with two lamps 7. Students are challenged to make combination circuit ( series and parallel with three lamps) 8. Students are asked to draw scheme of their circuit in their worksheet. |  |  |  |
| 1. **Closing: (15 minutes)**    1. Students are introduced about the using Arduino Uno with the video of traffic light by using Arduino Uno.    2. Students are asked to submit their worksheet |  |  |  |

Bogor, 10th May 2017

Recommendation

Observer,

\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observation Sheet of Teaching Activity

*STEM Learning on Electricity Using Arduino-Android Game Based Experiment To Improve 8th Grade Students’ STEM Literacy*

Meeting : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Class : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Topic : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\**Give checklist (√) sign in the yes/no column bellow.*

|  |  |  |  |
| --- | --- | --- | --- |
| Activity | Implementation | | Note |
| Yes | No |
| Duration: 3 periods ( 3 x 40 minutes)  **Opening ( 15 minutes)**   1. Student are asked to gathered with their previous group. 2. Students are asked make blink project by seeing the instruction on the screen. |  |  |  |
| 1. **Main Activity: (60 minutes)**     1. Students are asked to make traffic light project by reading their guidance book and worksheet.    2. Students are asked to make scheme of their traffic light.    3. Students are asked to modify their circuit ( changing lamp, resistor, “delayed” time, or even adding lamps)    4. Students are asked to make scheme of their modified traffic light circuit |  |  |  |
| 1. **Closing: (15 minutes)**    1. Students are asked to submit their worksheet.    2. Students are asked to do post test. |  |  |  |

Recommendation

Bogor, 24h May 2017

Observer,

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