شرح وأوراق عمل دروس Circuits and Current Electric التيار والدارات الكهربائية

موقع المناهج ⇦ المناهج الإماراتية ⇦ الصف العاشر المتقدم ⇦ فيزياء ⇦ الفصل الثاني ⇦ أوراق عمل ⇦ الملف

تاريخ إضافة الملف على موقع المناهج: 2024-12-28 11:28:08

المزيد من مادة فيزياء:	ملفات ا كتب للمعلم ا كتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس
	إعداد: عبد الرحمن عصام

التواصل الاجتماعي بحسب الصف العاشر المتقدم

صفحة المناهج الإماراتية على فيسبوك					
المواد على تلغرام	التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات	

المزيد من الملفات بحسب الصف العاشر المتقدم والمادة فيزياء في الفصل الثاني

1	دليل تصحيح الامتحان النهائي بريدج
2	أسئلة الامتحان النهائي الورقي انسباير
3	حل مراجعة الجزء الورقي وفق الهيكل الوزاري
4	حل مراجعة الجزء الالكتروني وفق الهيكل الوزاري

المزيد من الملفات بحسب الصف العاشر المتقدم والمادة فيزياء في الفصل الثاني

مراجعة الجزء الالكتروني وفق الهيكل الوزاري	5

اسم الطالب: .....

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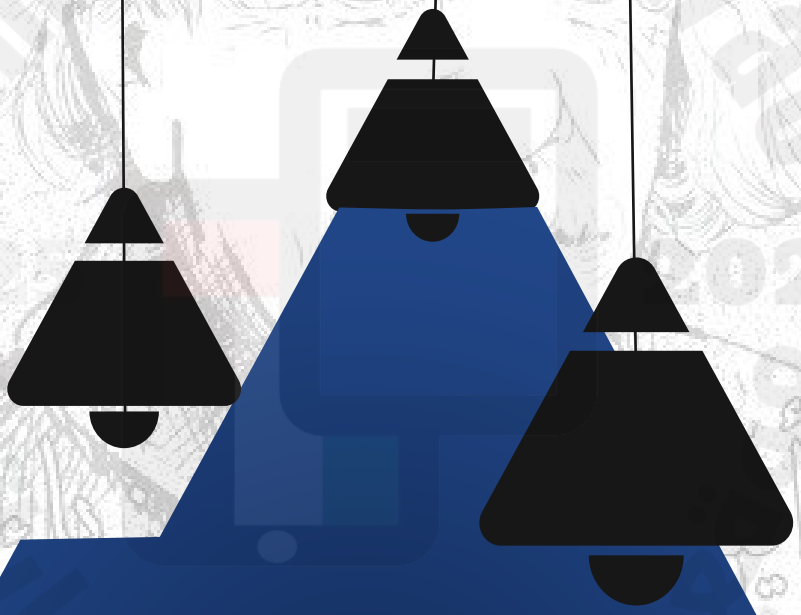
In Physics



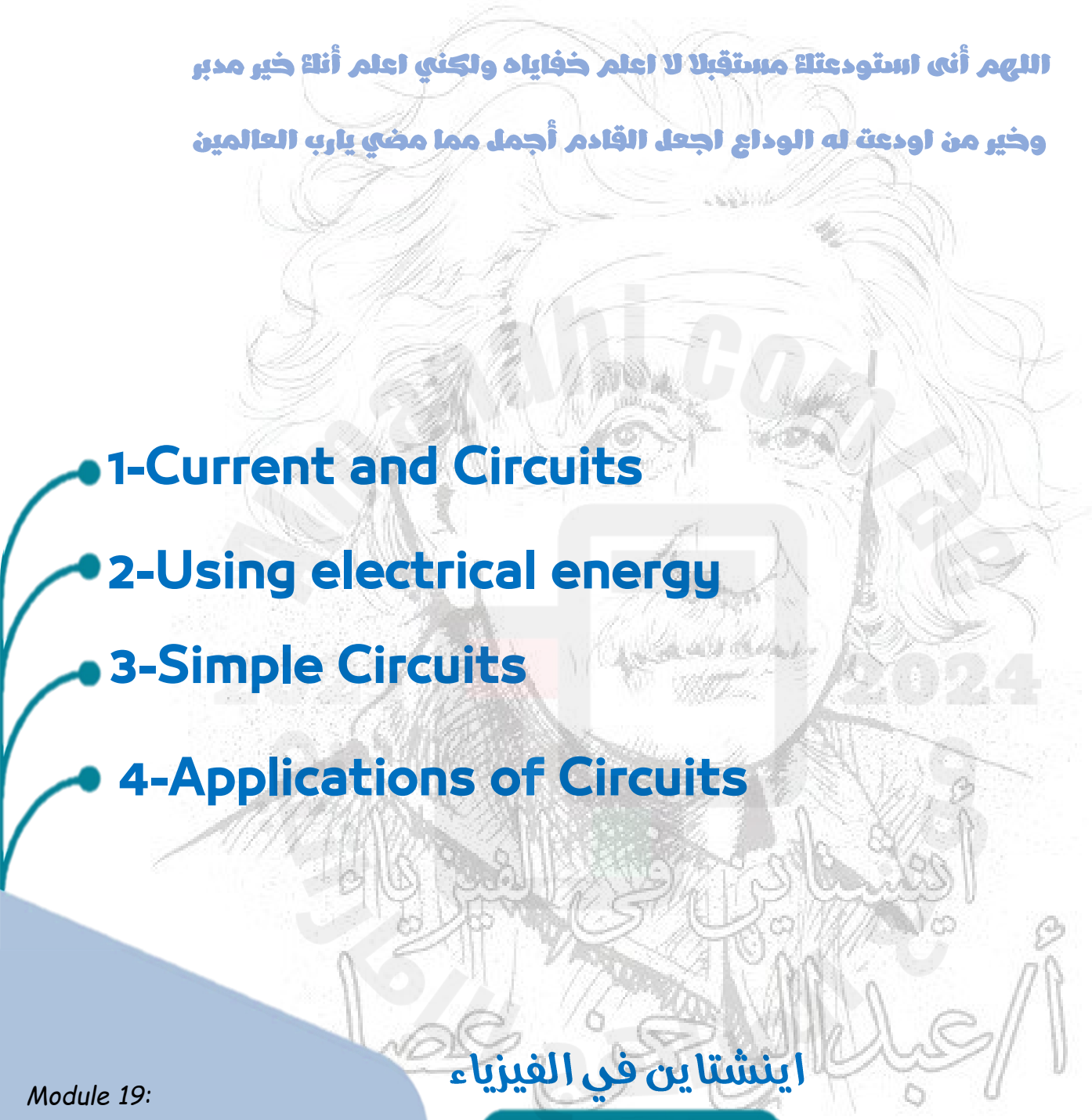
قديما كانت تمثل الفيزياء رعبا للطالب أما الآن

اسلوب جديد لعرض الفيزياء بعيدا عن التعقيد

10ADV TERM 2

اللهم أني استودعتك مستقبلا لا اعلم خفاياه ولكني اعلم أنك خير مدبر

وخير من اودعت له الوداع اجعل القادم أجمل مما مضي يارب العالمين



- 1-Current and Circuits
- 2-Using electrical energy
- 3-Simple Circuits
- 4-Applications of Circuits

اينشتاين في الفيزياء

2025

Module 19:
Electric Current and Circuits

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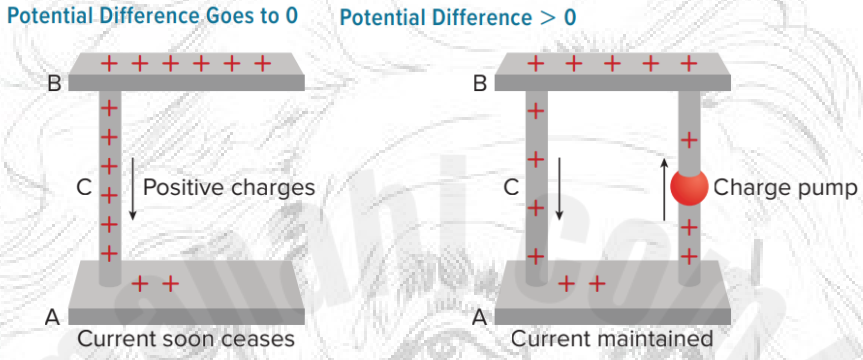
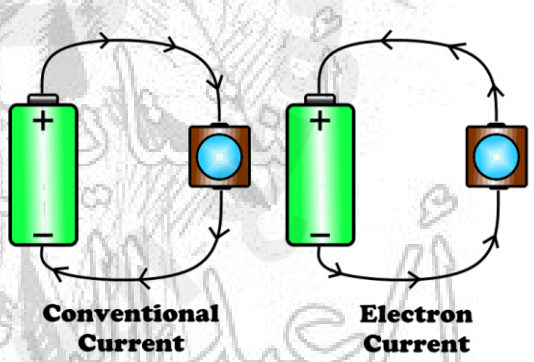
Current and Circuits 1

Producing Electric Current: *An electric current is a flow of charge (In metals, current is the movement of negative charge, i.e. electrons)*
In ***Figure,*** *two conductors, A and B, are connected by a wire conductor, C.*
charges flow from the higher *potential difference of B to A through C. This flow of positive charge is called conventional current.*
When two conducting spheres touch, charges flow from the sphere at higher potential to the one at a lower potential. The flow continues until there is no potential difference between the two spheres.



- *Positive charges flow from the higher potential at B through the conductive wire C to A, which has a lower potential than B.*
- *When the potential difference between B and A is zero, the flow stops.*
- *The flow continues in the diagram on the right because a charge pump maintains the potential difference between conductors A and B.*

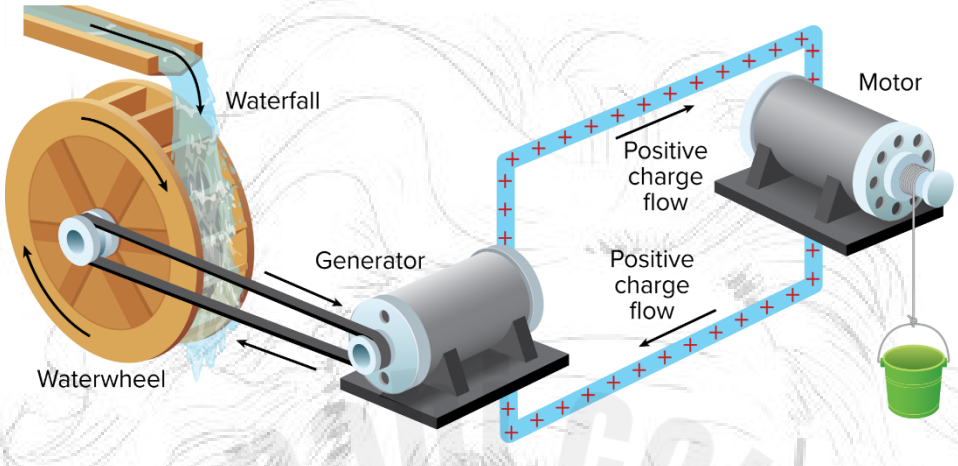
Electric current
➢ *The rate of flow of electric charge,* $i = q/t$
called electric current, is measured in coulombs per second.
➢ *A flow of electric charge equal to one coulomb per second is called an ampere(A)*
➢ *It is represented by I.*
➢ *The unit of current is Ampere (A)*
➢ *It is a scalar quantity.*
➢ *It is given by the relation* $I = q/t$
Where:
I= Current (A)
q= charge (1C=A.s) $q = I.t$
T=time (sec)

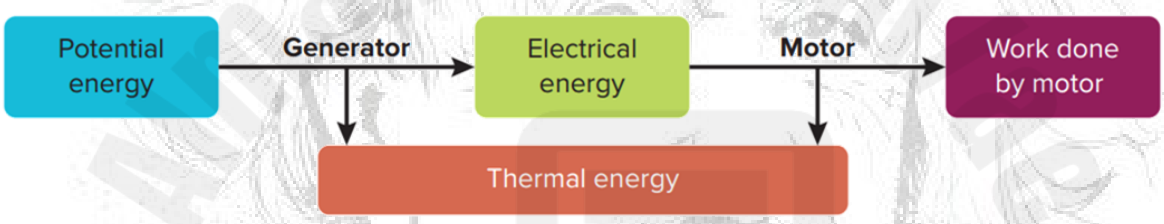


Conventional current *is the direction in which a positive charge moves.*
The flow of electrons and the direction of conventional current are in opposite directions.

A battery :*cell (a common dry cell), transforms chemical energy to electrical energy.*
Several galvanic cells connected together.
Electrical energy may be stored in a battery.

COMPARING WATER FLOW AND CURRENT





In Generator

- *The gravitational potential energy of the water is transformed into kinetic energy, then to electrical energy and thermal energy.*
- *Energy transformations are not 100 percent efficient. Loss energy in Thermal energy is produced by the splashing water, friction, and electric resistance.*
- ***The Generator** transformed into kinetic energy, then to electrical energy*
- *The **motor** transforms electrical energy to kinetic energy*

Conservation of charge *Charges cannot be created or destroyed, but they can be separated. Thus, the total amount of charge the number of negative electrons and positive ions in the circuit does not change.*
If one coulomb flows through the generator in 1 s, then one coulomb also will flow through the motor in 1 s. Thus, charge is a conserved quantity. Energy also is conserved.

The change in electrical energy $(\Delta E) = q\Delta V$. *Because q is conserved, the net change in potential energy of the charges going completely around the circuit must be zero.*
Because The increase in potential difference produced by the generator equals the decrease in potential difference across the motor.

POWER: P

It is the rate at which energy is transferred or transformed.

If a generator transfers 1J of kinetic energy to electrical energy each second

$$P = \frac{E}{t}$$

Where E= energy transformed,

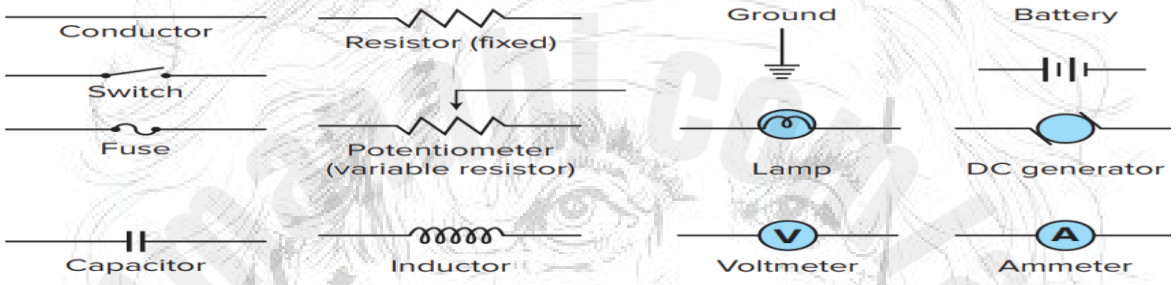
t= time duration

The unit of power is Watts (W): $1W = 1J/s$.

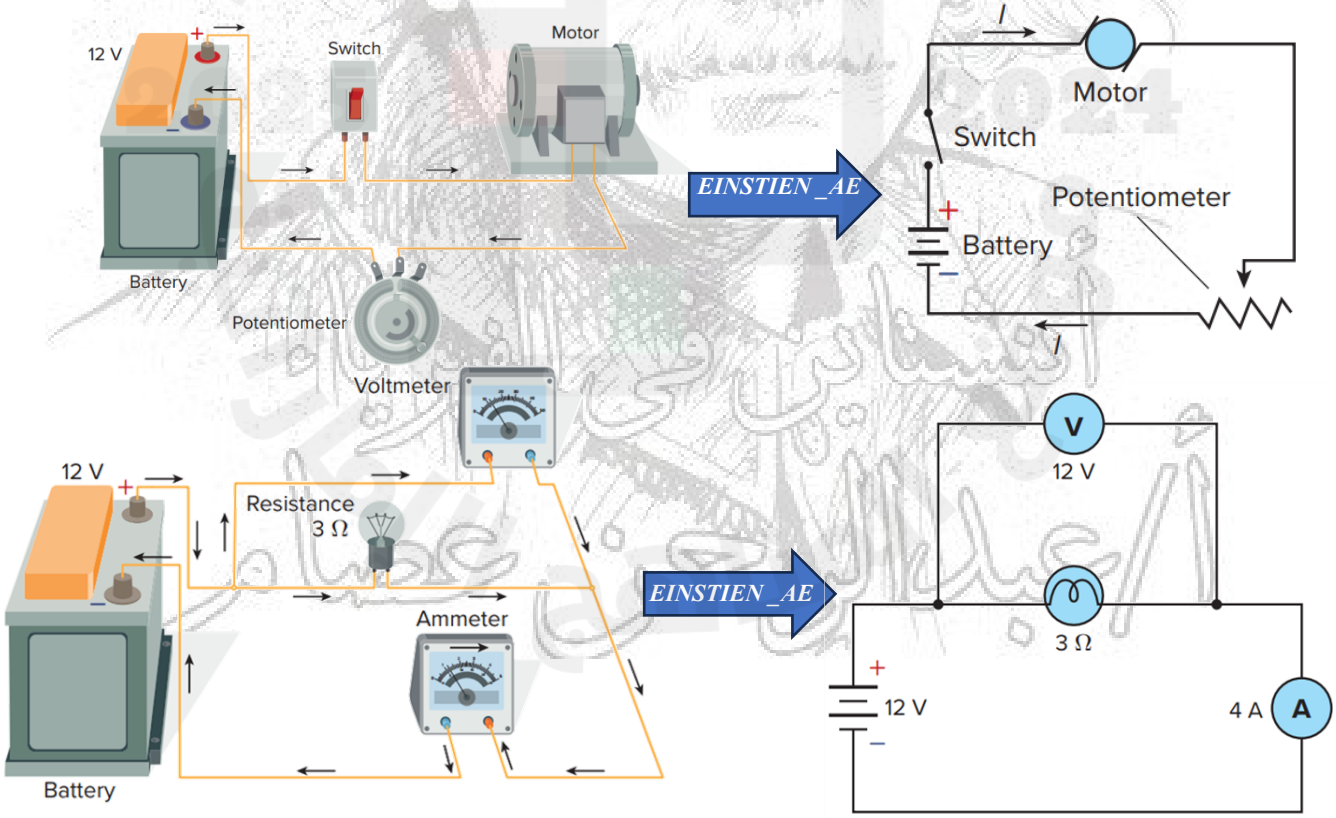
Power It is equal to the current times the potential difference $P = I\Delta V$

Simple circuit diagrams can be represented pictorially and schematically.

electric circuit diagrams are commonly drawn using these symbols.



Example



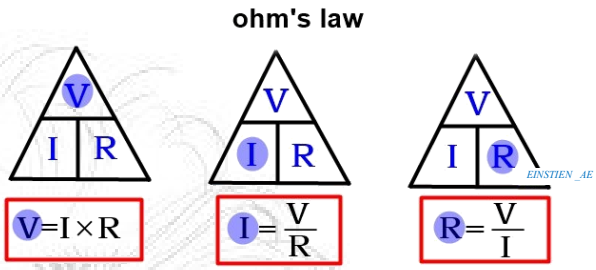
Resistance and Ohm's Law

Resistance: The property determining how much current will flow

Resistance is measured by placing a potential difference across a conductor and dividing the voltage by the current.

The resistance, R, is defined as the ratio of electric potential difference V, to the current I.

$$I = \frac{\Delta V}{R}$$



Where:

R: resistance unit ohm Ω

V: electric potential difference unit volt V

I: the current unit Amper A = volt / ohms

I current unit is (A or c/s or V/ Ω)

V electric potential difference unit is (V or A. Ω or J/C or watt/A)

R: resistance unit is (ohm Ω or V/A)

NOTES

Current depends on electric potential difference and resistance

- ***directly proportional*** *to the electric potential difference*
- ***inversely proportional*** *to the total resistance*
- *but resistance* ***NOT depends*** *on electric potential difference and Current*
- *resistance* ***depends*** *on length and aera and temperature*
- ***directly proportional*** *to the length and temperature*
- ***inversely proportional*** *to the cross-sectional area of the material.*

Resistivity

The factor in the resistance which takes into account the nature of the material is the resistivity.

It is temperature dependent.

The SI unit of electrical resistivity is the ohm meter (Ω·m)

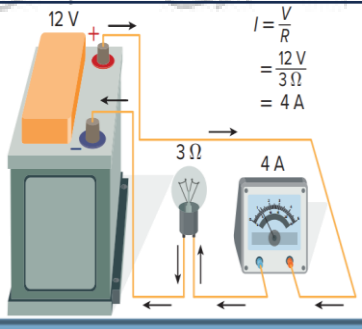
A resistor *is a device designed to have a specific resistance.*

Resistors may be made of carbon, semiconductors, or wires that are long and thin.

➢ *Changing Resistance*

Factor	How Resistance Changes	Example
Length	Resistance increases as length increases.	L_1, L_2 — $R_{L1} > R_{L2}$
Cross-sectional area	Resistance increases as the cross-sectional area decreases.	A_1, A_2 — $R_{A1} > R_{A2}$
Temperature	Resistance usually increases as temperature increases.	T_1, T_2 — $R_{T1} > R_{T2}$
Material	Keeping length, cross-sectional area, and temperature constant, resistance varies with the material used.	silver, copper, gold, aluminum, iron, platinum — R increases

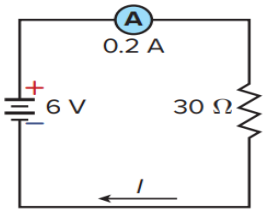
Reading The ammeter is the current



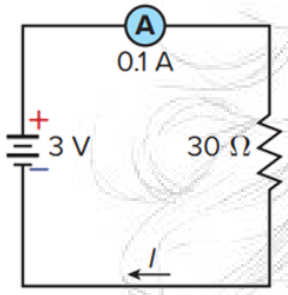
two ways to control the current flowing through a simple circuit.

- ***to decrease the current through a simple circuit.***
  - *A. The voltage can be reduced*
  - *B. the resistance can be increased.*
- ***to increase the current through a simple circuit.***
  - *A. The voltage can be increased*
  - *B. the resistance can be reduced (decrease)*

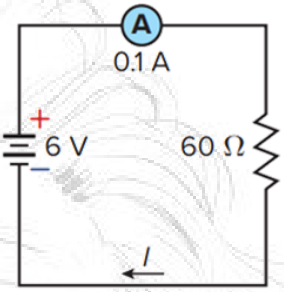
Initial Circuit

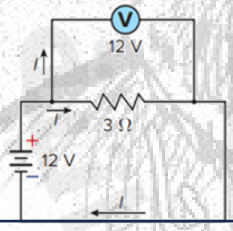
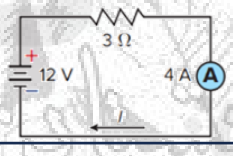


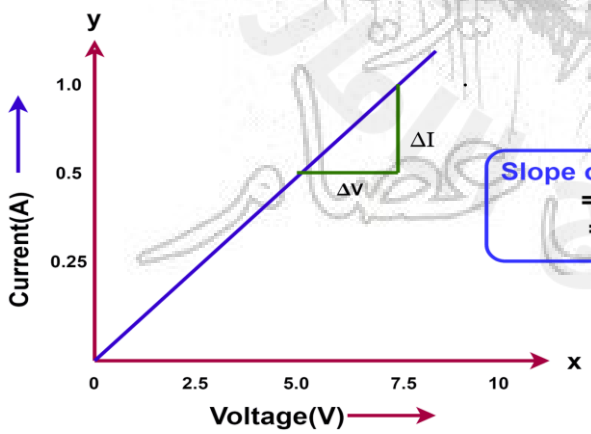
Reduce Voltage



Increase Resistance



voltmeter	***ammeter***
*a **voltmeter** measures electric potential difference*	*An **ammeter** measures the current through a circuit component.*
voltmeter is connected across another component; it is called a parallel connection	*The same current going through the component must go through the ammeter, so there can be only one current path.*
because the circuit component and the voltmeter are aligned parallel to each other in the circuit.	*A connection with only one current path, called a series connection*
Parallel Connection 	Series Connection 



Slope of line
= ΔI/ΔV
= 1/R

1. *16C of charge flows in a conductor for 4s, find the current flowing in a conductor.*

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2. *A current of 5A flows in a circuit for 6s,*
   A. *find the amount of charge flowing through it*
   B. *How many electrons have passed through it*

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3. *In a circuit current of 2A flows for 5min, find the amount of charge flowing in a circuit.*

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4. *3A of current flows in a circuit for 8s, how many electrons are flowing in a circuit.*

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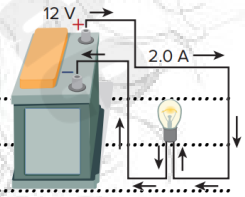
5. *A car battery causes a current through a lamp and produces 12 V across it as shown in Figure What is the power used by the lamp?*



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6. *What is the current through a 75-W lightbulb that is connected to a 125-V outlet?*

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7. *The current through a lightbulb connected across the terminals of a 125-V outlet is 0.50A. At what rate does the bulb transform electrical energy (power) to light?*

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8. *The current through the starter motor of a car is 210 A. If the battery maintains 12 V across the motor, how much electrical energy is delivered to the starter in 10.0 s?*

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9. *A 75-V generator supplies 3.0 kW of power. How much current can the generator deliver?*

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10. *A flashlight bulb is rated at 0.90 W. If the lightbulb produces a potential drop of 3.0 V, how much current goes through it?*

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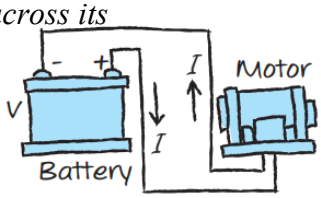
11. *A 6.0-V battery delivers a 0.50-A current to an electric motor connected across its terminals.*
    a. What power is delivered to the motor?
    b. If the motor runs for 5.0 min, how much electrical energy is delivered?



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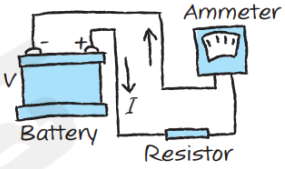
12. *A 30.0-V battery is connected to a 10.0-Ω resistor. What is the current in the circuit?*



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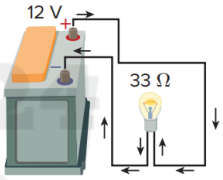
13. *An automobile panel lamp with a resistance of 33 Ω is placed across the battery shown in Figure. What is the current through the circuit?*



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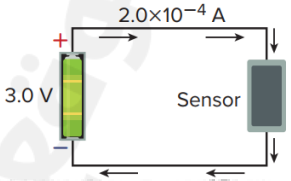
14. *A sensor uses 2.0×10^{-4} A of current when it is operated by the battery shown in Figure. What is the resistance of the sensor circuit?*



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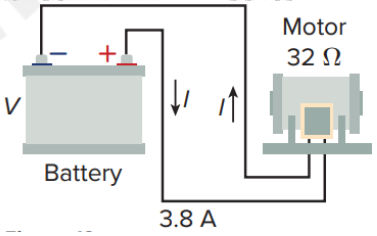
15. *A motor with the operating resistance of 32 Ω is connected to a voltage source as shown in Figure. What is the voltage of the source?*



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16. *A lamp draws a current of 0.50 A when it is connected to a 120-V source.*

a. *What is the resistance of the lamp?*

b. *What is the power consumption of the lamp?*

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17. *A 75-W lamp is connected to 125 V.*

a. What is the current through the lamp?

b. What is the resistance of the lamp?

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18. *A lamp draws a 66 mA current when connected to a 6.0 V battery. When a 9.0 V battery is used, the lamp draws 75 mA.*

A. Does the lamp obey Ohm's law?

B. How much power does the lamp use when it is connected to the 6.0 V battery?

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19. *A resistor is added to the lamp in the previous problem to reduce the current to half its original value.*

A. What is the potential difference across the lamp?

B. How much resistance was added to the circuit?

C. At what rate does the lamp transform electrical energy (power) into radiant and thermal energy?

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20. *A circuit has 12 Ω of resistance and is connected to a 12-V battery. Determine the change in power if the resistance decreases to 9.0 Ω*

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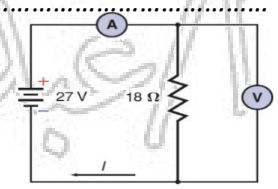
21. *Refer to the figure to answer the following questions.*



a. What should the ammeter reading be?

b. What should the voltmeter reading be?

c. How much power is delivered to the resistor?

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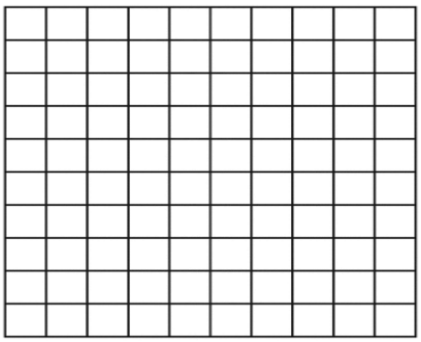
22. The table below shows the voltage across and the current through a material.

Voltage (V)	2.0	5.0	8.0
Current (A)	8.0	20	32

a. Draw and label the voltage-current graph for the material
b. State with a reason if the material obeys Ohm's Law.
c. Calculate the resistance of the material.



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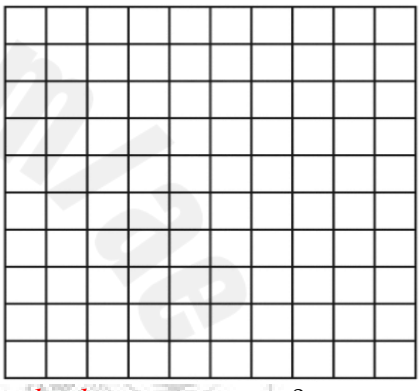
23. The table below shows the voltage across and the current through a material.

Voltage (V)	1.0	2.0	3.0
Current (A)	3.0	6.0	9.0

a. Draw and label the voltage-current graph for the material
b. State with a reason if the material obeys Ohm's Law.
c. Calculate the resistance of the material.



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24. The graph in Figure shows the current through a device What is the device resistance?

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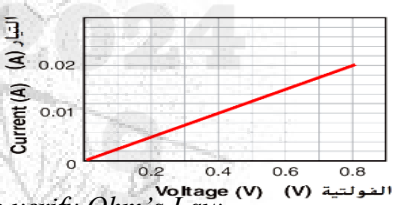


25. Draw a circuit diagram of the experimental set up that you would use to verify Ohm's Law. Your circuit should include:

A. A device to measure the current
B. A device to measure the voltage
C. A device to change the current in the circuit
D. Clearly marked direction of the conventional current

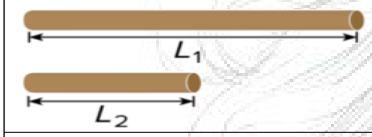
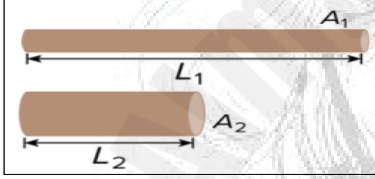
26. Draw a single labelled circuit diagram in the following steps:

A. Two light bulbs, L1 and L2, connected in series to a battery.
B. One light bulb, L3, connected in parallel across L1.
C. An ammeter that measures the current through L2.
D. A voltmeter that measures the voltage across L3.

27. *Draw a circuit diagram that you would use to find the resistance of a resistor R. Your diagram should include the following:*

A. *A battery with its terminals marked clearly*
B. *A device connected to measure the current through the resistor*
C. *A device connected to measure the potential difference across the resistor*
D. *The direction of the conventional current marked on the diagram*

28. *The table below shows two sets of wires of different dimensions. Compare the* ***resistance*** *and the* ***resistivity*** *of the two wires in each set.*

	Resistance	Resistivity
$L_2 = \frac{1}{2}L_1$ and $A_2 = A_1$ 		
$L_2 = L_1$ and $A_2 = 2A_1$ 		
$L_2 = \frac{1}{2}L_1$ and $A_2 = 2A_1$ 		

29. *Describe the energy transformations that occur in each of the following devices.*

a. an incandescent lightbulb

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b. a clothes dryer

.....

c. a digital clock radio

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d. a handheld flashlight

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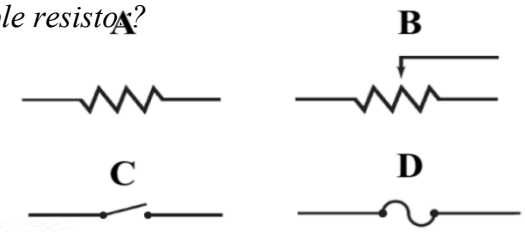
30. *True or false*

A. *In order for current electricity to flow, electrons need a good conductor to allow them to move.*
B. *In a typical household wire, the metal interior (is copper) is a good conductor and the coating (is plastic) is an insulator.*
C. *Current is a vector quantity.*
D. *The correct equation for calculating current is I = Q x t*
E. *Conventional current is the direction in which electrons flow.*
F. *The correct units for current are joules per coulomb.*
G. *Batteries convert chemical to electrical energy.*
H. *Conductors have a high or low resistance.*
I. *In terms of electricity, DC stand for direct current.*
J. *You can extend battery life by storing batteries at a low temperature.*

31. The figure below shows four electrical components.
Which of the circuit symbols represent a switch and a variable resistor?

	Switch	Variable resistor
ⓐ	A	D
ⓑ	B	A
ⓒ	C	B
ⓓ	D	C



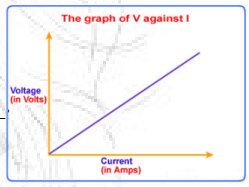
32. 2. A net charge of 5.0 C passes a point on a conductor in 0.050 s. The is the current

ⓐ 8.0×10^{-8} A ⓑ 1.0×10^{-2} A ⓒ 2.5×10^{-1} A ⓓ 1.0×10^{2} A

33. A conductor carries a current of 4.0 A. How long will it take 20 C of charge to flow through it?
ⓐ 0.2 s ⓑ 5.0 s ⓒ 24 s ⓓ 80 s

34. A conductor carries a current of 2.0 A. What is the charge flowing through it in 10 s?
ⓐ 0.2 C ⓑ 20 C ⓒ 5.0 C ⓓ 12 C

35. The figure shown below shows the voltage current graph of a(n) _____

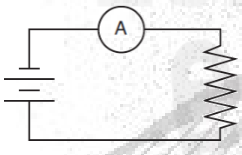


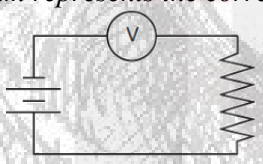
ⓐ ohmic resistor ⓑ lightbulb ⓒ semi-conductor ⓓ super conductor

36. A current of 1.5 A flows through a 4.0 Ω resistor. What is the voltage across the resistor?
ⓐ 0.38 V ⓑ 2.7 V ⓒ 6.0 V ⓓ 9.0 V

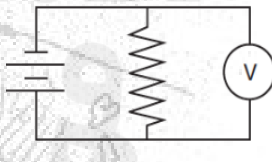
37. A 75 V battery is connected across a 150 Ω resistor. What is the current through the resistor?
ⓐ 0.5 A ⓑ 2.0 A ⓒ 75 A ⓓ 11250 A

38. Which circuit diagram represents the correct way to measure the voltage across a resistor?

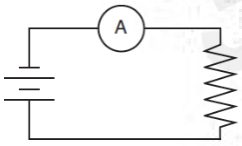
ⓐ 

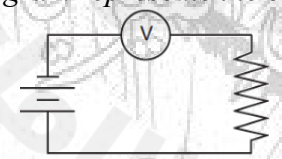
ⓑ 

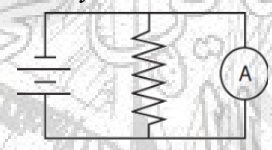
ⓒ 

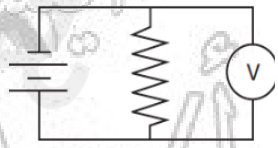
ⓓ 

39. Which circuit diagram represents the correct way to measure the current in a resistor?

ⓐ 

ⓑ 

ⓒ 

ⓓ 

40. What is the effect on the current in a simple circuit if both the voltage and the resistance are reduced by half?

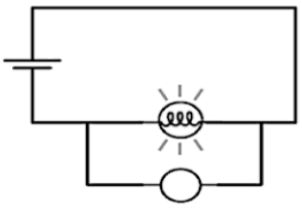
ⓐ divided by 2 ⓑ no change ⓒ multiplied by 2 ⓓ multiplied by 4

41. What is the effect on the current in a simple circuit if the resistance are reduced by half?

ⓐ divided by 2 ⓑ no change ⓒ multiplied by 2 ⓓ multiplied by 4

42. In the circuit shown below, a(n) _____ is connected in parallel to the lightbulb to measure its _____. In addition, the arrow represents the direction of the _____ current through the circuit.

ⓐ	ammeter	current	conventional
ⓑ	ammeter	Potential difference	electronic
ⓒ	voltmeter	current	electronic
ⓓ	voltmeter	Potential difference	conventional



12. A voltmeter has a _____ resistance and should be connected in _____ with an electrical component.

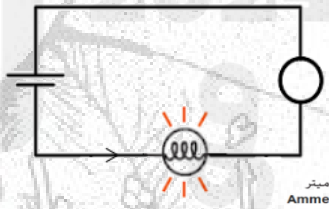
ⓐ	low	parallel
ⓑ	low	series
ⓒ	high	series
ⓓ	high	parallel

43. A ammeter has a _____ resistance and should be connected in _____ with an electrical component.

ⓐ	low	parallel
ⓑ	low	series
ⓒ	high	series
ⓓ	high	parallel

44. In the circuit shown below, a(n) _____ is connected in series to the lightbulb to measure _____ the lightbulb. In addition, the arrow represents the direction of the _____ current through the circuit.

ⓐ	ammeter	Current through	electronic
ⓑ	ammeter	Potential difference across	electronic
ⓒ	voltmeter	Current through	electronic
ⓓ	voltmeter	Potential difference across	conventional

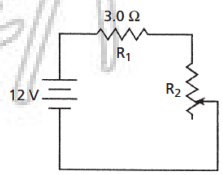


45. Which of the following cannot be used to change the electric current in the electric circuit shown in the figure.

ⓐ the Ammeter ⓑ the switch ⓒ the battery ⓓ the potentiometer

46. The diagram below represents an electric circuit consisting of a 12 V battery, a 3.0 Ω resistor, R1, and a variable resistor, R2. At what value must the variable resistor be set to produce a current of 1.0 A through R1?

ⓐ 3.0 Ω ⓑ 6.0 Ω ⓒ 9.0 Ω ⓓ 12.0 Ω



47. A heater operates at 120 V with a current of 12 A flowing through it. What is the power of the heater?

ⓐ 0.10 W ⓑ 10 W ⓒ 1200 W ⓓ 1440 W

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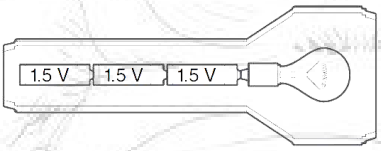
48. A lamp draws a 2.00 A of current when connected to a 60.0 V battery. What is the power dissipated in the lamp?

ⓐ 30.0 W ⓑ 58.0 W ⓒ 62.0 W ⓓ 120 W

49. A 1.5 A of current passes through a resistor which dissipates energy at a rate of 45 W. What is the potential difference across the resistor?

ⓐ 20 V ⓑ 30 V ⓒ 45 V ⓓ 68 V

50. The current in the flashlight shown below is 0.50 A, and the voltage is the sum of the voltages of the individual batteries. What is the power delivered to the bulb of the flashlight?



ⓐ 0.11 W ⓑ 1.1 W ⓒ 2.3 W ⓓ 4.5 W

51. The resistance of a cylindrical conductor is 80 Ω. What is the resistance of the conductor if its length is reduced by half?

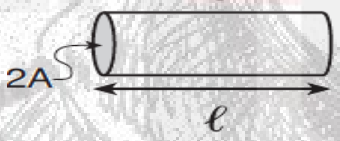
ⓐ 20 Ω ⓑ 40 Ω ⓒ 80 Ω ⓓ 160 Ω

52. The diagrams below represent four pieces of copper wire at 20°C. For each piece of wire, ℓ represents a unit of length and A represents a unit of cross-sectional area. Which piece of wire has the greatest (the least) resistance?

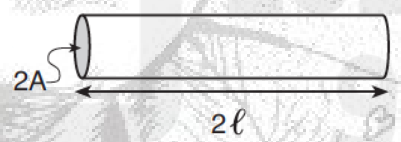
ⓐ

ⓑ

ⓒ



ⓓ



53. All of the following wires are made of the same material but have different sizes. Which of the copper wires shown in the figure has lowest resistance.?

ⓐ

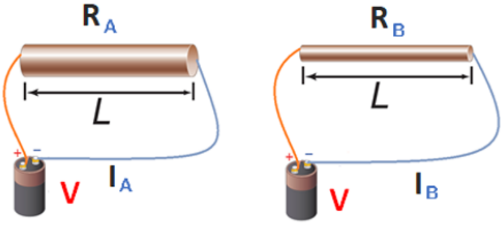
ⓑ

ⓒ

ⓓ

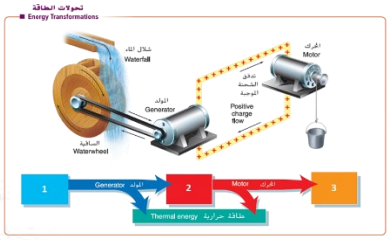
54. Two copper wires with the same length and their resistances are RA and RB. Each wire is connected to a battery with voltage V, so that a current I passes across it, as shown in the figure. Which of the following statements is correct?

ⓐ RA<RB, IA>IB ⓑ RA=RB, IA=IB ⓒ RA>RB, IA<IB ⓓ RA<RB, IA<IB



55. In the shown diagram, energy transforms between different forms, which of the following table rows shows the correct forms of energy in 1, 2and 3?

	1	2	3
ⓐ	Potential energy	Work done by motor	Electric energy
ⓑ	Electric energy	Potential energy	Work done by motor
ⓒ	Electric energy	Work done by motor	Potential energy
ⓓ	Electric energy	Electric energy	Work done by motor

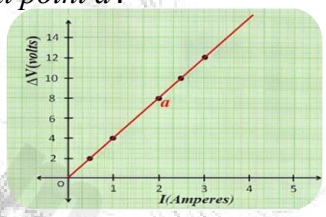


56. An air fryer with a power of 1800 W is connected to source producing a potential difference of 230V. What is the current through the fryer?

ⓐ 7.8 A ⓑ 2.8 A ⓒ 0.13 A ⓓ 4.1 A

57. Depending on the graph, what values of current and voltage at point a?

ⓐ (I=2 A , V =8 volt) ⓑ (I=8 A, V = 2 volt)
ⓒ (I 2.5 A, V=9 volt) ⓓ (I=1.5 A, V= 7 volt)

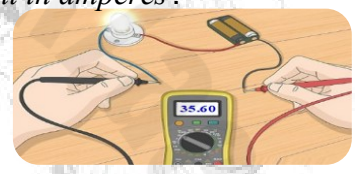


58. Depending on the graph, what is the resistance?

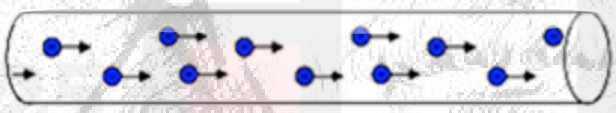
ⓐ 2 Ω ⓑ 4 Ω ⓒ 8 Ω ⓓ 1/2 Ω

59. If the ammeter reading shown in 35.60 mA. What is the current in amperes?

ⓐ 3.56×10^{-2} A ⓑ 3.56×10^{-6} A
ⓒ 3.56×10^{-4} A ⓓ 3.56×10^{-3} A



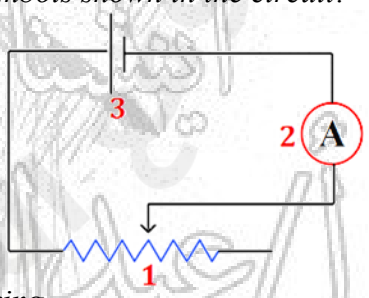
60. Which one of the following represents the electric current unit?



ⓐ C/s ⓑ C.s ⓒ s/C ⓓ C/s^2

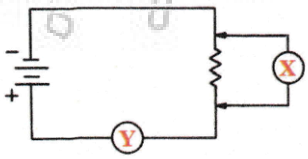
61. In the physics lab, Mr. Abdulrahman Esam, connected an electrical circuit as in figure. Which of the following rows in the table is correct for the symbols shown in the circuit?

	1	2	3
ⓐ	Variable Resistor	Ammeter	Battery
ⓑ	Ammeter	Variable Resistor	Battery
ⓒ	Variable Resistor	Battery	Ammeter
ⓓ	Battery	Ammeter	Variable Resistor



62. Depending on the circuit in which an electric current is flowing. Which of the following is correct?

	X	Y
ⓐ	ammeter	ammeter
ⓑ	ammeter	voltmeter
ⓒ	voltmeter	voltmeter
ⓓ	voltmeter	ammeter

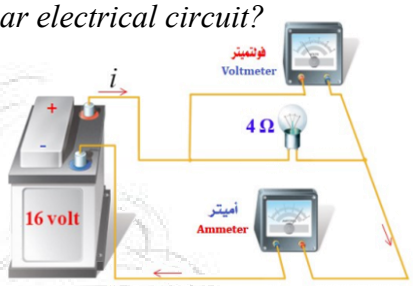


63. Which of the following equations is a correct formula for electric charge q, knowing that I and t represent current and time, respectively?

ⓐ $q=I.t$ ⓑ $q=I/t$ ⓒ $q= t/I$ ⓓ $q=I^2.t$

64. What is the reading of the ammeter and voltmeter in the near electrical circuit?

	ammeter	voltmeter
ⓐ	4A	16 volts
ⓑ	8A	12 volts
ⓒ	16A	16 volts
ⓓ	4A	8 volts



65. You have four conducting wires (copper-gold-silver-platinum), equal in length, with the same cross-sectional area, and at the same temperature. Each wire was connected in a closed electric circuit to same protentional difference. The current in each wire is shown in the table. Which of the four wires has the smallest resistance?

	Current intensity	Wire material used
ⓐ	0.72 A	Copper
ⓑ	0.98 A	Silver
ⓒ	0.28 A	Platinum
ⓓ	0.54 A	Gold

66. When the switch is closed in electric circuit, an electric charge (3 C) flows within (1.5 s) in the ammeter shown in the figure.
What is the potential difference across the battery?

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67. In the following table, write the name of the element used to represent the electrical circuit under the symbol that represents it.

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USING ELECTRICAL ENERGY 2

Energy that is supplied to a circuit can be transformed in many useful ways. For example, a lamp changes electrical energy into radiant energy. Unfortunately, not all the energy delivered to a lamp ends up in a useful form. Lightbulbs, especially incandescent lightbulbs, become hot. Some of the electrical energy is transformed into thermal energy

Why the appliances heat up when they are turned on?

Current moving through a resistor causes it to heat up because flowing electrons bump into the atoms in the resistor. These collisions increase the atoms' kinetic energy and, thus, the temperature of the resistor. A space heater, a hot plate, and the heating element in a hair dryer all are designed to convert electric energy into thermal energy

Power is equal to current squared times resistance. $\boldsymbol{Power\ P = I^2R}$

Thus, the power dissipated in a resistor is proportional both to the square of the current passing through it and to the resistance. If you know V and R, but not I, you can substitute $\boldsymbol{I = V/R}$ *into* $\boldsymbol{P = IV}$ *to obtain the following equat on.*

$\boldsymbol{Power\ P = \frac{V^2}{R}}$

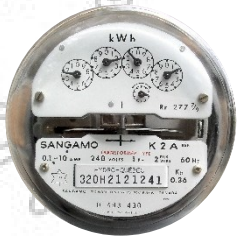
Power is equal to the voltage squared divided by the resistance.
The power is the rate at which energy is converted from one form to another. Energy is changed from electric to thermal energy, and the temperature of the resistor rises.
If power continues to be dissipated at a uniform rate, then after time t, the energy converted to thermal energy will be

THERMAL ENERGY

- *Thermal energy is equal to the power dissipated multiplied by the time.* $\boldsymbol{E = Pt}$
- *It is also equal to the current squared multiplied by resistance and time as well as* $\boldsymbol{E = I^2R.t}$
- *the voltage squared divided by resistance multiplied by time.* $\boldsymbol{E = \frac{V^2}{R}.t}$

Superconductors *A* ***superconductor*** *is a material with zero resistance.*
There is no restriction of current in superconductors, so there is no potential difference, V, across them. Because the power that is dissipated in a conductor is given by the product IV, a superconductor can conduct electricity without loss of energy.

Transmission of Electric Energy



Electric companies measure energy sales in a unit of a large number of joules called a kilowatt-hour, kWh.
A ***kilowatt-hour*** *is a unit of energy.*
A ***kilowatt-hour*** *is equal to 1000 watts delivered continuously for 3600 s (1 h),*

To convert KWh to joule x 3.6 x10^6

68. *A heater has a resistance of 10.0 Ω. It operates on 120.0 V.*
   a. *What is the power of the heater?*
   b. *What thermal energy is supplied by the heater in 10.0 s?*

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69. *A 15-Ω electric heater operates on a 120-V outlet.*
   a. *What is the current through the heater?*
   b. *How much energy is used by the heater in 30.0 s?*
   c. *How much thermal energy is liberated in this time?*

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70. *A 39-Ω resistor is connected across a 45-V battery.*
   a. *What is the current in the circuit?*
   b. *How much energy is used by the resistor in 5.0 min?*

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71. *The resistance of an electric stove element at operating temperature is 11 Ω.*
   a. *If 220 V are applied across it, what is the current through the stove element?*
   b. *How much energy does the element transform to thermal energy in 30.0 s?*

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72. *A 120-V water heater takes 2.2 h to heat a given volume of water to a certain temperature. How long would a 240-V unit operating with the same current take to accomplish the same task?*

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$$The consumer's electric bill = E_{Unit(KWh)} \times The\ utility\ company\ charges$$

$$The consumer's electric bill = P_{Unit(KW)} \times t_{Unit(h)} \times The\ utility\ company\ charges$$

73. an electric space heater draws 15.0 A from a 120-V source. It is operated on the average, for 5.0 h each day.

a. How much power does the heater use?

b. How much energy in kWh does it consume in 30 days?

c. At $0.12 per kWh, how much does it cost to operate the heater for 30 days?

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74. A digital clock has a resistance of 12,000 Ω and is plugged into a 115-V outlet.

a. How much current does it draw?

b. How much power does it use?

c. If the owner of the clock pays $0.12 per kWh, how much does it cost to operate the clock for 30 days?

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75. How much energy does a 150 V generator supply in 5.0 s if it delivers a current of 3.0 A?

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76. How much energy does a 60 V generator supply in 4.0 s when connected to a 30 Ω resistor?

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77. What is the current allowed in a 5.0-W, 220 Ω resistor?

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78. A 110 V electric iron draws 3.0 A of current. How much thermal energy does it output in an hour?

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79. A machine has a power rating of 4500 W. If the cost of each kWh unit in UAE is 0.20 AED, what is the cost of operating the machine for 2.5 hours?

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80. A 9.0 V battery costs $3.00 and will deliver 0.0250 A for 26.0 h before it must be replaced. Calculate the cost per kWh.

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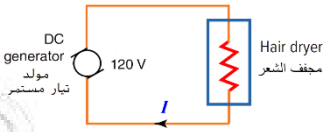
81. The diagram below shows a simple circuit containing a DC generator and a resistor. The table shows the resistances of several small electrical devices. If the resistor in the diagram represents a hair dryer,

A. what is the current in the circuit?

B. How much energy does the hair dryer use if it runs for **2.5** min?



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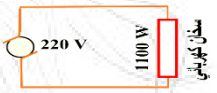
82. The figure represents an electrical source (220 V) is connected to a heater its power (1100 W)

A. Calculate the current.

B. Calculate the thermal energy produced by it Heater in 30 minutes



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83. The table contains a list for some electrical devices and resistance for each.

A. Calculate the current through the phone.

B. Calculate the power of the computer

C. Calculate the electrical for the mixer during half One hour.

electrical devices	resistance Ω	Voltage V
the phone	12	24
the computer	45	220
the mixer	30	30

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84. The table contains a list for some electrical devices and values of potential difference and current for each.

1- Calculate the resistance of the lamp.

2- Calculate the power of the TV

3- Calculate the energy used by the drill during one hour

electrical devices	current	potential difference
the lamp	0.5A	12V
the TV	7.5A	220V
the drill	2.5A	120V

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85. heater has a resistance of 10 Ω. It operates on 120 V. What is the power of the heater?

ⓐ 0.83 W ⓑ 1.2 W ⓒ 30 W ⓓ 1440 W

86. A 1.5 A of current passes through a 20 Ω resistor. What is the power dissipated by the resistor?

ⓐ 8.9 W ⓑ 13 W ⓒ 30 W ⓓ 45 W

87. A 5.00 W resistor is connected to a 10.0 V battery. What is the resistance of the resistor?

ⓐ 50.0 Ω ⓑ 2.00 Ω ⓒ 20.0 Ω ⓓ 12.0 Ω

88. What current passes through a 3.60×10^2 W resistor if it has a resistance of 10.0 Ω?

ⓐ 1.00 A ⓑ 4.00 A ⓒ 6.00 A ⓓ 7.00 A

89. There is a 5.00 mA current through a circuit with a resistance of 50.0 Ω.
What is the power in the circuit?

ⓐ 2.50×10^{-3} W ⓑ 1.00×10^{-3} W ⓒ 1.25×10^{-3} W ⓓ 1.00×10^{-2} W

90. A 4.00 Ω resistor is connected to a 8.00 V battery. What is the power dissipated in the resistor?

ⓐ 16.0 W ⓑ 20.0 W ⓒ 24.0 W ⓓ 36.0 W

91. A 2.00 A of current passes through a 5.00 Ω resistor. What is the power dissipated by the resistor?

ⓐ 5.00 W ⓑ 10.0 W ⓒ 15.0 W ⓓ 20.0 W

92. A 60.0 W lamp draws a current of 3.00 A when connected to a battery.
What is the potential difference across the lamp?

ⓐ 15.0 V ⓑ 20.0 V ⓒ 25.0 V ⓓ 30.0 V

93. 9A light bulb uses energy at a rate of 24 watts. If the current through the light bulb is 2.00A, what is the resistance of the bulb?

ⓐ 0.08 Ω ⓑ 6.0 Ω ⓒ 12 Ω ⓓ 48 Ω

94. A 5.0 Ω resistor is connected to a 9.0 V battery. How much energy is transformed in 7.5 min?

ⓐ 1200 J ⓑ 1300 J ⓒ 3000 J ⓓ 7300 J

95. If a flashlight with a voltage of 4.5 V and a current of 0.50 A is on for 3.0 min, how much electrical energy is delivered to the bulb?

ⓐ 410 J ⓑ 200 J ⓒ 14 J ⓓ 6.9 J

96. There is a current of 2.0 A through a circuit containing a motor with a resistance of 12 Ω. How much energy is transformed if the motor runs for one minute?

ⓐ 48 J ⓑ 20 J ⓒ 2900 J ⓓ 170000 J

97. How much energy is used by a 30.0 W toaster when it works for 10 minutes?

ⓐ 3.00 J ⓑ 1.80×10^1 J ⓒ 3.00×10^2 J ⓓ 1.80×10^4 J

98. How much electrical energy is delivered to a 60.0 W lightbulb if the bulb is left on for 2.5hours?

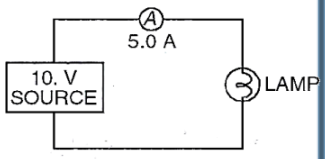
ⓐ 2.4×10^1 W ⓑ 4.2×10^{-2} W ⓒ 1.5×10^2 W ⓓ 5.4×10^5 W

99. How long must a 50.0 W toaster works to consume 150.0 J of energy?

ⓐ 3.00 s ⓑ 5.00 s ⓒ 25.0 s ⓓ 75.0 s

100. A lamp and an ammeter are connected to a source as shown below.
What is the electrical energy used up in the lamp in 3.0 s?

ⓐ 15 J ⓑ 30 J ⓒ 50 J ⓓ 150 J



101. Which of the following quantities is measured in the unit kilowatt-hour?

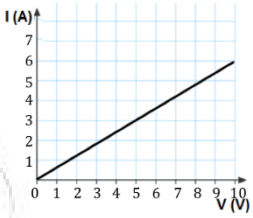
ⓐ Time ⓑ Work ⓒ Energy ⓓ Power

102. Which of the following correctly represents the equivalent of the unit kWh?

ⓐ $1\ kWh = 3.6\ J$ ⓑ $1\ kWh = 3600\ J$ ⓒ $1\ kWh = 3.6 \times 10^6\ J$ ⓓ $1\ kWh = 3.6 \times 10^8\ J$

103. Which of the following represents the unit of energy?

ⓐ Joules ⓑ Kilowatt-hour ⓒ watt ⓓ A and B



104. The graph shows the current as a function of voltage in a resistor. What is the power dissipated in the resistor when the applied voltage is 5 V?

ⓐ 5 W ⓑ 10 W ⓒ 15 W ⓓ 20 W

105. An electric water heater consumes 72KJ electrical energy in one minute. How much power does the water heater's

ⓐ 2400 W ⓑ 1200 W ⓒ 72 KW ⓓ 2160 W

106. How much energy is dissipated by a device with a power of 1000 W through 3600 S

ⓐ 1J ⓑ 1N.m ⓒ 1W. s ⓓ 1Kwh

107. How much energy is dissipated by a device with a power of 1000 W through 2hour

ⓐ 2J ⓑ 2N.m ⓒ 2W. s ⓓ 2Kwh

108. What is 500 kWh expressed in Joules?

ⓐ $1.4 \times 10^{-4}\ J$ ⓑ $7.2\ J$ ⓒ $1.8 \times 10^9\ J$ ⓓ $1.8 \times 10^6 J$

109. A 60-watt light bulb is used to illuminate a display at Expo 2020. The voltage across the light bulb is 240 V. What is the resistance of the light bulb?

ⓐ 4 Ω ⓑ 960 Ω ⓒ 300 Ω ⓓ 15 Ω

110. Which of the following is not a valid unit for the measurement of the electric power?

ⓐ Ampere. volt ⓑ Newtons / Coulomb ⓒ Joule / second ⓓ Watt

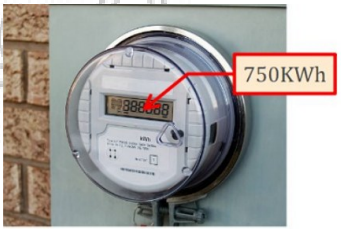
111. In a closed electric circuit, what physical quantity does the symbol X represent in the equation?

$$X = \frac{E}{\Delta V t}$$

ⓐ Square of the resistance in the circuit(R^2). ⓑ Resistance in the circuit(R).
ⓒ Square of the current in the circuit (i^2). ⓓ Current in the circuit (I).

112. The figure represents a smart electric meter in a house. The reading that the smart meter slums give the amount of electrical energy consumed in the house. how much this energy in joules?

ⓐ $2.7 \times 10^6\ J$ ⓑ $7.5 \times 10^9\ J$ ⓒ $7.5 \times 10^5\ J$ ⓓ $2.7 \times 10^9\ J$

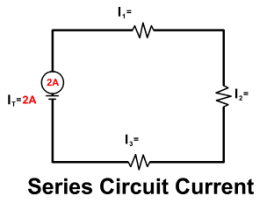


A Series Circuit describes

two or more components of a circuit that provide a single path for current.

❖*Resistors in Series carry the Same current.*

$$i1 = i2 = i3 = itotal$$



Series Circuit Current

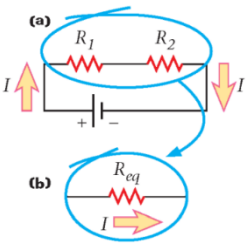
- The total potential equals the sum of the individual potential.

$$\Delta Vtotal(series\ group) = \Delta V1 + \Delta V2 + \Delta V3 + \cdots$$

$$\Delta V_1 = i \times R_1 \qquad \Delta V_2 = i \times R_2 \qquad \Delta V_3 = i \times R_3$$

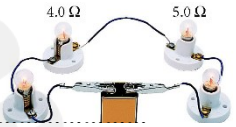
the equivalent resistance in a series circuit is the sum of the circuit's resistances

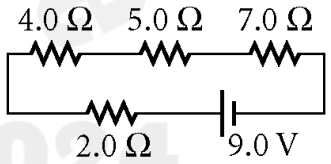
$$R_{eq} = R1 + R2 + R3 + \cdots \; or \; R_{eq} = \frac{\Delta Vtotal}{i_{total}}$$



- For identical resistance in series: R_{eq} =R x n (n: number of resistance)
- Current $i_{total} = \frac{\Delta Vtotal}{Req}$
- Potential difference battery $\Delta Vtotal = Req \times i_{total}$
- When three resistors are combined in series the total resistance of the combination is Greater than any of the individual resistance values
- **When add resistor series in circuit?**
  - The equivalent resistance will Increase.
  - Current will decrease.

113. A 9.0 V battery is connected to four light bulbs, as shown at right. Find the equivalent resistance for the circuit and the current in the circuit.





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114. Three 20 Ω resistors are connected in series across a 120 V generator. What is the equivalent resistance of the circuit? What is the current in the circuit?

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115. A 10 Ω, 15 Ω, and 5 Ω resistor are connected in a series circuit with a 90 V battery. What is the equivalent resistance of the circuit? What is the current in the circuit?

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116. *Calculate the equivalent resistance of these series connected resistors: 680 Ω, 1.1 kΩ, and 11 kΩ.*

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117. *A series circuit has two voltage drops: 5.50 V and 6.90 V. What is the supply voltage?*

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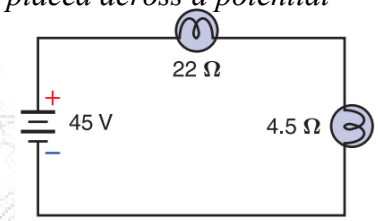
118. *A 22 Ω lamp and a 4.5 Ω lamp are connected in series and placed across a potential difference of 45 V as shown in Figure*



a. What is the equivalent resistance of the circuit?

b. What is the current in the circuit?

c. Find the potential difference across each lamp.

d. What is the power used in each lamp?

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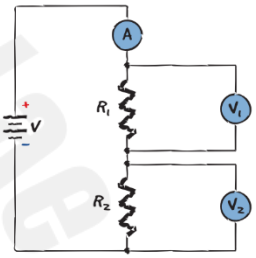
119. *Two resistors, 47 Ω and 82 Ω, are connected in series across a 45 V battery.*



a. What is the current in the circuit?

b. What is the potential difference across each resistor?

c. If you replace the 47 Ω resistor with a 39 Ω resistor, will the current increase, decrease, or remain the same?

d. What is the new potential difference across the 82 Ω resistor?

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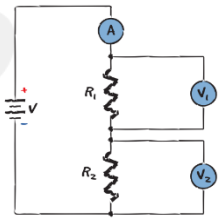
120. *Suppose the circuit shown in Example Problem 1 has these values: R1 = 255 Ω, R2 = 290 Ω, and ΔV1 = 17 V.*



a. What is the current in the circuit?

b. What is the potential difference across the battery?

c. What is the total power used in the circuit, and what is the power used in each resistor?

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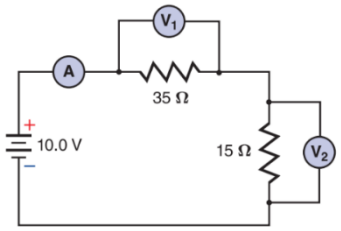
121. The figure represents a circuit.



What is the equivalent resistance in the circuit?
What should the ammeter read?
What should voltmeter 1 read?
What should voltmeter 2 read?
How much energy is supplied by the battery per minute?

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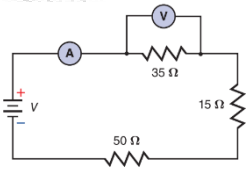
122. The figure represents a circuit *the voltmeter reads 70.0 V.*



A. *What will the ammeter read?*
B. *What is the power supplied by the battery?*
C. *Which resistor is the hottest and coolest?*

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123. *A series circuit is made up of a 12 V battery and three resistors. The potential difference across one resistor is 1.2 V, and the potential difference across another resistor is 3.3 V. What is the voltage across the third resistor?*

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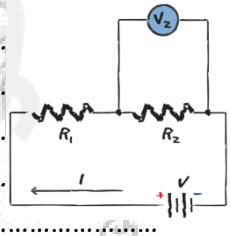
124. *A 9.0 V battery and two resistors, 390 Ω and 470 Ω, are connected as a voltage divider. What is the potential difference across the 470 Ω resistor?*



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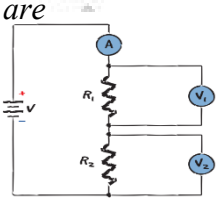
125. *A R1 = 22 Ω resistor and a R2 = 33 Ω resistor are connected in series and are connected to a 120 V power source.*



a. What is the equivalent resistance of the circuit?
b. What is the current in the circuit?
c. What is the potential difference across each resistor?

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126. *Three resistors of 3.3 kΩ, 4.7 kΩ, and 3.9 kΩ are connected in series across a 12 V battery.*
a. What is the equivalent resistance?
b. What is the current through the resistors?
c. Find the total potential difference across the three resistors.

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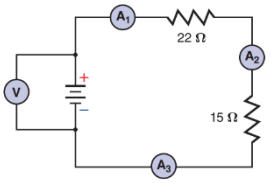
127. *Ammeter 1 in the Figure reads 0.20 A.*
a. What should ammeter 2 indicate?
b. What should ammeter 3 indicate?



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128. A series circuit has an 8.0-V battery and four resistors, R1 = 4.0 Ω, R2 = 8.0 Ω, R3 = 13.0 Ω, and R4 = 15.0 Ω.
Calculate the current and the power in the circuit.

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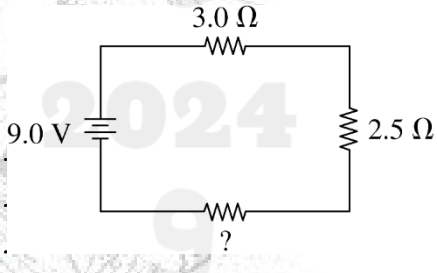
129. There is a current of 1.0 A in the following circuit.
What is the resistance of the unknown circuit element?



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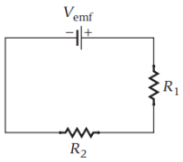
130. If $V_{emf} = 8V$ and $R_1 = 3R_2$ and the current is 0.2A what is the resistance of R_1

ⓐ 20Ω ⓑ 40Ω ⓒ 30Ω ⓓ 10Ω

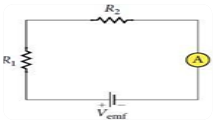


131. *According to the figure, when a third resistor is added in series to the two resistors connected in series. What happens to the the electric current passing through the circuit?*

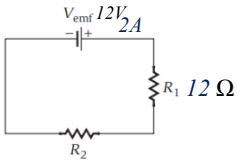
ⓐ Decrease ⓑ Becomes infinity ⓒ Increase ⓓ Stays the same

132. Two resistors, $R_1 = 3.00\ \Omega$ and $R_2 = 5.00\Omega$, are connected in series with a battery with $V_{emf} = 8.00V$, as shown in the figure. What is the current measured by the ammeter?

ⓐ 1.0A ⓑ 0.2A ⓒ 0.1A ⓓ 2.0A

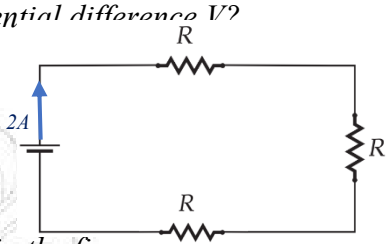


133. *For the electric circuit shown in the figure, find the value of* (R_2)



ⓐ 6Ω ⓑ 3Ω ⓒ 2Ω ⓓ 4Ω

134. *Based on the circuit that shows value of* $R = 3\Omega$, *and a battery of potential difference V. three resistors, each with What is the value of the battery potential difference V?*

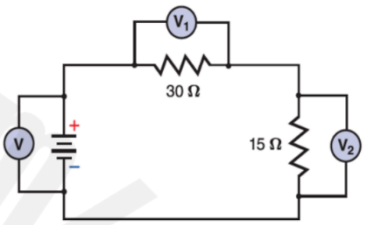


ⓐ 6V ⓑ 12V ⓒ 1.5V ⓓ 18V

135. *Two resistors are connected in an electric circuit, as shown in the figure. The voltmeter V is connected across the battery reads 60 V.*

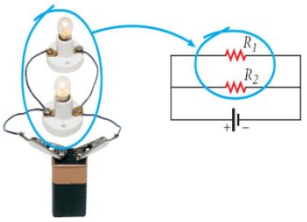
Which of the following table rows shows the readings of the voltmeters V1 and V2?

	$V1(V)$	$V2(V)$
ⓐ	20	40
ⓑ	40	20
ⓒ	30	30
ⓓ	60	60



A Parallel Circuit describes

two or more components of a circuit that provide separate conducting paths for current because the components are connected across common points or junctions.



- Connection as shown in figure.
- All resistors in parallel group have the same electric potential (voltage)

$$V1 = V2 = V3 = \ldots\ldots = Vtotal$$

- The electric current in each resistor is inversely proportional to its resistance.
- The total current equals the sum of the individual currents

$$itot(parallel\ group) = i1 + i2 + i3$$

- The reciprocal of the equivalent resistance equals the sum of reciprocals of the individual resistances.

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$R_t = \left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]^{-1}$$

- For identical resistance:

$$R_{eq} = \frac{R}{n} \qquad (n: \text{number of resistance})$$

Notes:

- When adding a new lamp in parallel

a. *the brightness of any lamp is not affected,*
b. *the value of the current passing through each lamp is not affected.*
c. *the total current passing through the circuit increases.*
d. *the equivalent resistance decreases*
e. *If one of the lamps burns out or is removed from its place, the brightness of the rest of*
f. *the lamps will not be affected.*
g. *Lights wired in parallel have more than one path for current.*
h. *Parallel circuits do not require all elements to conduct.*

Check your understanding:

136. *Three 15.0 Ω resistors are connected in parallel and placed across a 30.0 V battery.*

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137. *Three 15.0 Ω resistors are connected in parallel and placed across a 30.0V battery.*

A. What is the current through the entire circuit?
B. What is the current through each branch of the circuit?

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138. *A 120.0 Ω resistor, a 60.0 Ω resistor, and a 40.0 Ω resistor are connected in parallel and placed across a 12.0 V battery.*
   a. *What is the equivalent resistance of the parallel circuit?*
   b. *What is the current through the entire circuit?*
   c. *What is the current through each branch of the circuit?*

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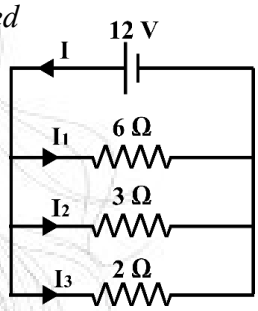
139. *Three resistors R_1 = 6.00 Ω, R_2 = 3.00 Ω, and R_3 = 2.00 Ω, are connected in parallel. The parallel connection is attached to a 12.00 V voltage source.*



A. What is the equivalent resistance?
B. Find the current supplied by the source to the parallel circuit.
C. Calculate the currents in each resistor and show that these add together to equal the current output of the source.

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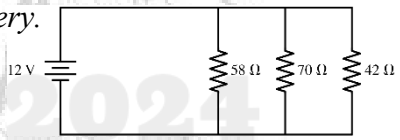
140. *The three resistors of the figure are connected to a 12 V battery. What current is provided by the battery?*



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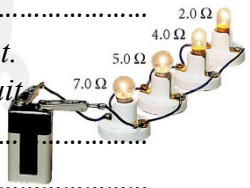
141. *A 9.0 V battery is connected to four resistors in parallel, as shown at right. Find the equivalent resistance for the circuit and the total current in the circuit.*



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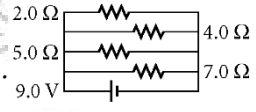
142. *Calculate the equivalent resistance of these parallel connected resistors: 680 Ω, 1.1 kΩ, and 10.2 kΩ.*



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143. *A parallel circuit has two branch currents: 1.45 A and 1.00 A. find the current in the source?*

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144. *Mr. Abdelrahman Esam connects three 15.0 Ω resistors in parallel across a 30.0 V battery.*

A. *What is the equivalent resistance of the parallel circuit?*
B. *What is the current through the entire circuit?*
C. *What is the current through each branch of the circuit?*
D. *When Mr. Abdelrahman Esam replaces one of the 15.0 Ω resistors with a 10.0 Ω resistor.*
E. *what happen of the equivalent resistance change?*
F. *what happen of the current through the entire circuit change?*

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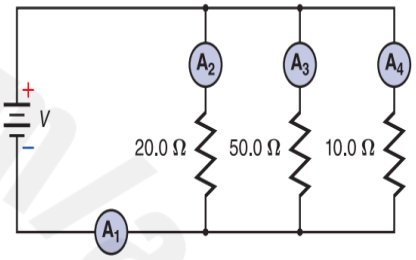
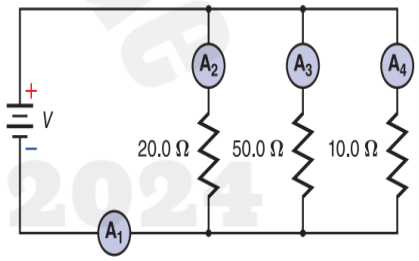
145. The figure represents a circuit *the battery develops 110 V.*

a. Which resistor is the hottest?
b. Which resistor is the coolest?
c. What will ammeter 1 read?
d. What will ammeter 2 read?
e. What will ammeter 3 read?
f. What will ammeter 4 read?



146. The figure represents *ammeter 3 reads 0.40 A.*

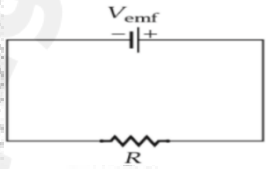
a. Find the potential difference across the battery.
b. What will ammeter 1 read?
c. What will ammeter 2 read?
d. What will ammeter 4 read?



147. *Three identical resistors connected together in parallel. If the equivalent of the three resistors is (6.0Ω). What is the resistance of any resistor of them?*

ⓐ 6Ω ⓑ 3Ω ⓒ 2Ω ⓓ 18Ω

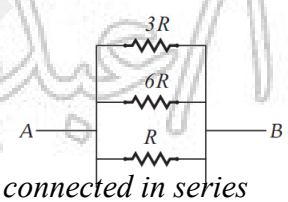
148. *For the circuit shown in the figure, if another resistor with equal resistance was connected with R in parallel*
what happens to the magnitude of the current flowing through the battery?



ⓐ Becomes twice ⓑ Stays the same ⓒ Becomes half ⓓ Becomes four times

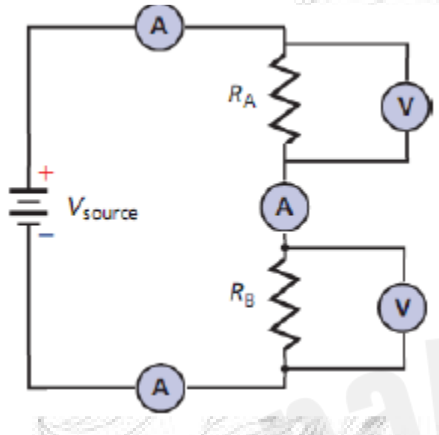
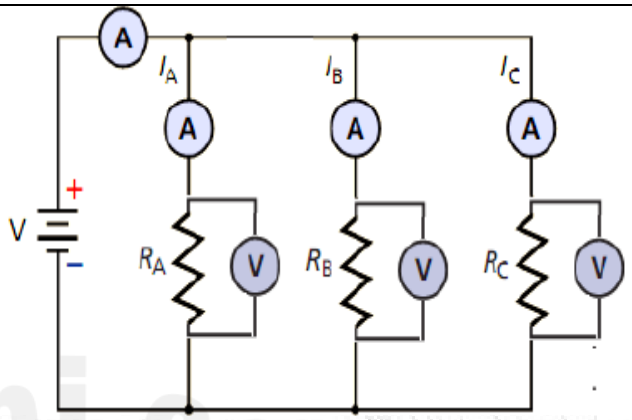
149. *Resistors (R, 3R, 6R) are connected in parallel.*
What is the equivalent resistance or the three resistors?

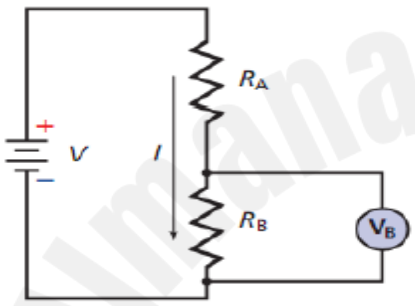
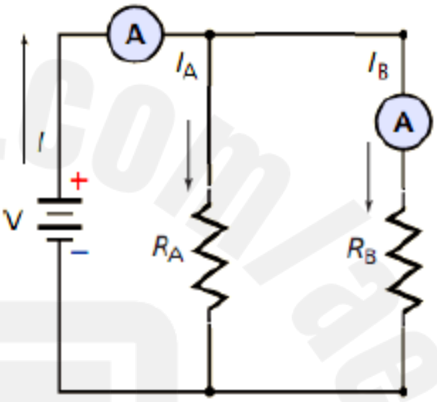
ⓐ $\frac{3}{2}R$ ⓑ $\frac{2}{3}R$ ⓒ $\frac{2}{3R}$ ⓓ $\frac{3}{2R}$



150. *R1 and R2 are resistors with equal resistances. When they are connected in series their equivalent resistance is 16 Ω.*
What is the equivalent resistance when the resistors are connected in parallel?

ⓐ 6Ω ⓑ 3Ω ⓒ 2Ω ⓓ 18Ω

	Series circuit	Parallel circuit
Definition	Electric circuit that current pass through every component is the same and the total voltage or potential equal to the source voltage or potential (Vincrease in source = V drop in resistors)	Electric circuit that has several paths for currents to flow , and the total currents in these path equal to the source current
diagraming		
Current	$I_{total}=I_A=I_B=I_c=....$ the current pass the resistors are the same and does not distribute, they are equal to source current	$I_{total}=I_A+I_B+I_c+....$ The current is distributed, ant the source current equal to the total currents pass resistors
Potential difference (voltage)	$V_{total}=V_A+V_B+V_c+....$ The potential is distributed in resistors, and the source potential is equal to the total of potentials in resistors	$V_{total}=V_A=V_B=V_c=....$ The potentials in resistors equal to the source potential
Resistance	$I=\frac{V}{R}$ $=\frac{V}{R_A+R_B}$ $R_{total}=R_A+R_B+R_c+...$ The equivalent resistance is equal to the summation on individual resistances (and the equivalent resistance is greater than any of individual resistance)	$\frac{1}{R_{total}}=\frac{1}{R_A}+\frac{1}{R_B}+\frac{1}{R_c}+..R_{eq}=(\frac{1}{R_A}+\frac{1}{R_B}+\cdots)^{-1}$ The reciprocal equivalent resistance is equal to the summation on reciprocal individual resistances. (and the equivalent resistance is less than the smallest individual resistance)

Law of divider	$I_{source} = \frac{V_{source}}{R_{eq}} = \frac{V_{tot}}{R_A+R_B} = I_B = \frac{V_B}{R_B}$ $I_{source} = I_B$ *(In sereis circuit)* $\frac{V_{tot}}{R_A+R_B} = \frac{V_B}{R_B}$ $V_B = \frac{R_B}{R_A+R_B} V_{tot}$ $V_B = \left(\frac{R_B}{R_B+R_A}\right) V_{tot}$ 	$V_{Source} = I_{source}.Req = I_{source}.(\frac{1}{R_A}+\frac{1}{R_B})^{-1}$ $= I_{source}.(\frac{R_A+R_B}{R_AR_B})^{-1}$ $V_{source} = V_B$ *(In parallel circuit)* $I_B = \frac{V_B}{R_B} = \frac{I_{source}.\frac{R_AR_B}{R_A+R_B}}{R_B} = I_{source}.\frac{R_A}{R_A+R_B}$ $I_B = \frac{R_A}{R_A+R_B} I_{tot}$ $I_B = \left(\frac{R_A}{R_B+R_A}\right) I_{tot}$ 

Brightness in series and parallel circuits

The bulb brightness is direct proportional to the dissipated power

(when the dissipated power is more the bulb brightness is more)

the heat of electrical resistors increases as the dissipated power increase through it like the electric bulb

$$P = I^2R \quad , P = \frac{V^2}{R}$$

In series circuits: the bulb brightness is increased when resistance is increase as this equation $P = I^2R$ (current is constant) so bulb brightness is direct proportional to the resistance

In parallel circuits: the bulb brightness is increased when resistance is decrease as this equation $P = \frac{V^2}{R}$ (potential or voltage is constant) so bulb brightness is inversely proportional to the resistance

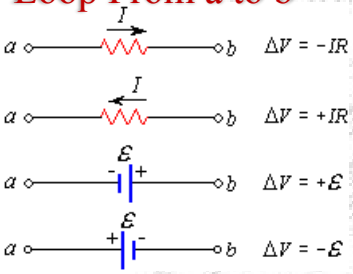
Kirchhoff's Rules

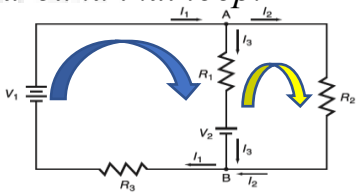
The Loop Rule:

The loop rule is based on the law of conservation of energy

- *Kirchhoff's Loop Rule states that the sum of the voltage differences around the loop must be equal to zero.*
- *The sum of increases in electric potential around a loop in an electric circuit equals the sum of decreases in electric potential around that loop.*

Loop From a to b



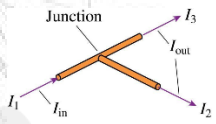


Blue loop: $V1 - I3R1 - V2 - I1R3 = 0$

yellow loop: $V2 + I3R1 - I2R2 = 0$

Kirchhoff's Junction Rule is a direct consequence of the **conservation of electric charges**.

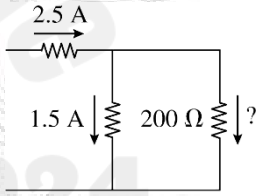
$$\sum I_{in} = \sum I_{out}$$



Junction law: $I_1 = I_2 + I_3$

The diagram below shows a segment of a circuit.
What is the current in the 200 Ω resistor?

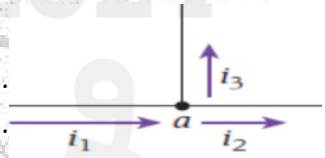
ⓐ 0.5 A ⓑ 1.5 A ⓒ 1.0 A ⓓ 2.0 A



151. According to the figure if (i_1 = 0.5A) and (i_2 =0.2A). what is the magnitude of (i_3)?

.....

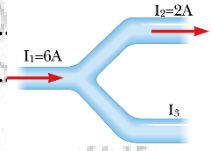
.....



152. According to the figure if (i_1 = 6A) and (i_2 =2A). what is the magnitude of (i_3)?

.....

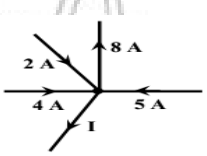
.....



153. According to the figure find I.

.....

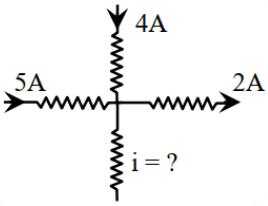
.....

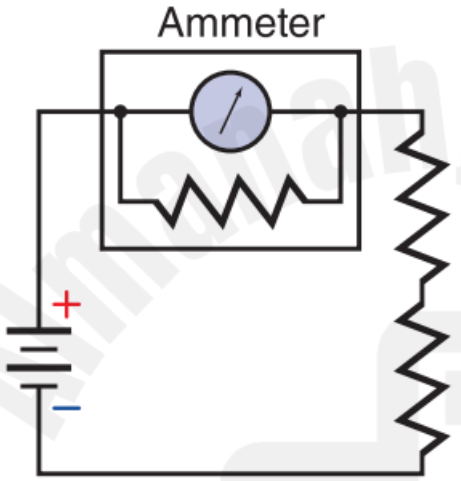
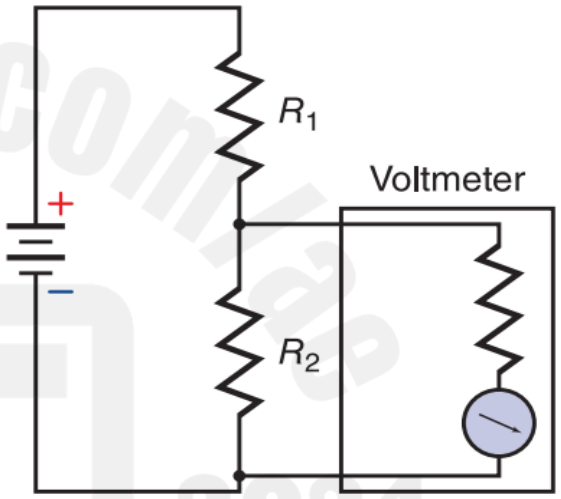


154. According to the figure find I and direction.

.....

.....



Ammeters and Voltmeters:		
	Ammeter	Voltmeters
Definition and uses	A device used to measure the current through any part of circuit س	A device used to measure the voltage drop through any part of circuit
Resistance in the device	small	big
Device design	A coil connected with small resistance in parallel	A coil connected with big resistance in series
Connected way	Connected in series with circuit.	Connected in parallel with circuit.
Schematic diagram		

12. A voltmeter has a _____ resistance and should be connected in _____ with an electrical component.

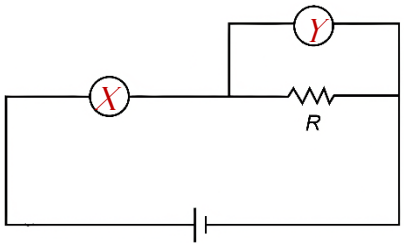
ⓐ	low	parallel
ⓑ	low	series
ⓒ	high	series
ⓓ	high	parallel

155. A ammeter has a _____ resistance and should be connected in _____ with an electrical component.

ⓐ	low	parallel
ⓑ	low	series
ⓒ	high	series
ⓓ	high	parallel

156. *Depending on the circuit in which an electric current is flowing. Which of the following is correct?*

	X	Y
ⓐ	ammeter	ammeter
ⓑ	ammeter	voltmeter
ⓒ	voltmeter	voltmeter
ⓓ	voltmeter	ammeter



157. *Which statement is true about ammeters and voltmeters?*

ⓐ *The resistance of the ammeter is very low.*
ⓑ *Ammeters are connected in parallel in the electric circuit.*
ⓒ *The resistance of a voltmeter is very low.*
ⓓ *Voltmeters are connected in series in the electric circuit.*

A short circuit:

In an electric circuit, circuit breakers and fuses prevent circuit overloads that can occur when too many appliances are turned on at the same time or when a short circuit occurs in one appliance. A short circuit occurs when a circuit with very low resistance is formed. When appliances are connected in parallel, each additional appliance placed in operation reduces the equivalent resistance in the circuit and increases the current through the wires. This additional current might produce enough thermal energy to melt the wiring's insulation, cause a short circuit, or even begin a fire.

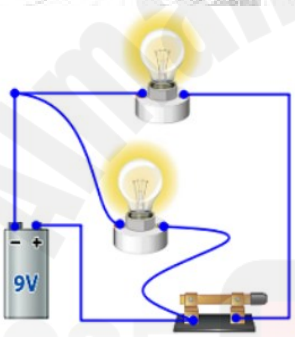
A fuse is a short piece of metal that acts as a safety device by melting and stopping the current when too large a current pass through it. Engineers design fuses to melt before other elements in a circuit are damaged.

A ground-fault interrupter (GFI) is a device that contains an electronic circuit that detects small current differences between the two wires in the cord connected to an appliance. An extra current path, such as one through water, could cause this difference. The GFI stops the current when it detects such differences. This often protects a person from electrocution.

A circuit breaker, is an automatic switch that acts as a safety device by stopping the current if the current gets too large and exceeds a threshold value.

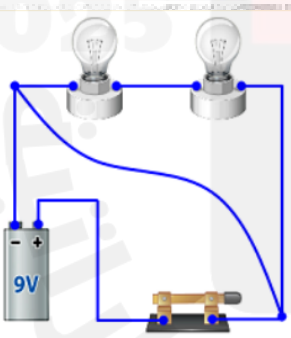
158. Which one of the following electric circuits, is short electric circuit?

ⓐ

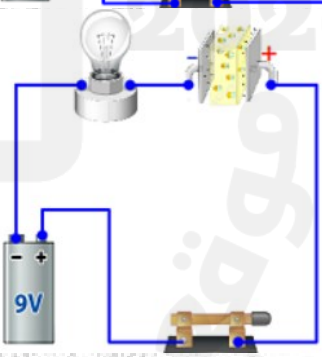


ⓑ

ⓒ



ⓓ



159. In which of the following cases a short circuit is most likely to occur in a household circuit?

ⓐ *When a circuit of very low resistance is formed.*

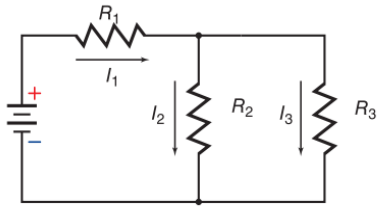
ⓑ *When a circuit of very large resistance is formed.*

ⓒ *When many appliances are connected in series.*

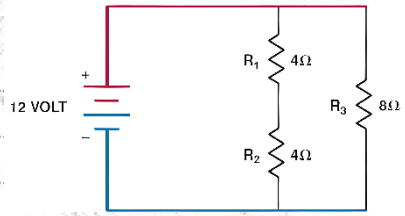
ⓓ *When a small current is passing through the wires.*

Combined Series-Parallel Circuits

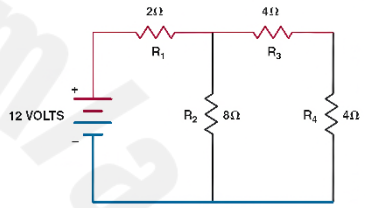
160. hair dryer with a resistance of 12.0 Ω and a lamp with a resistance of 125 Ω are connected in parallel to a 125 V source through a 1.50 Ω resistor in series. Find the current through the lamp when the hair dryer is on.



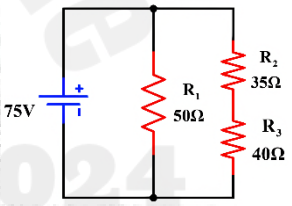
161. The figure represents a circuit.
Calculate the equivalent resistance in the circuit.



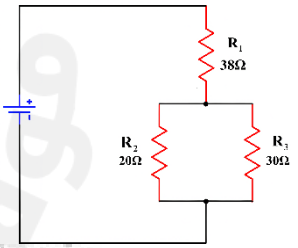
162. The figure represents a circuit.
Calculate the equivalent resistance in the circuit.



163. The figure represents a circuit.
Calculate the equivalent resistance in the circuit.



164. The figure represents a circuit.
Calculate the equivalent resistance in the circuit.



165. The electric circuit shown in the figure contains four resistors each of 4Ω connected to a battery What is the equivalent resistance in the circuit?