شرح وأوراق عمل الوحدة الرابعة circuits parallel and series

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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

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المزيد من الملفات بحسب الصف الثاني عشر العام والمادة فيزياء في الفصل الثاني

1	أسئلة مراجعة الوحدة الرابعة Circuits Parallel and Series الدارات التسلسلية والتفرعية
2	أسئلة مراجعة القسم الأول circuits Simple الدارات البسيطة من الوحدة الرابعة
3	أسئلة امتحان نهائي وزاري سابق
4	أسئلة الامتحان النهائي الورقي بريدج
5	حل تجميعة أسئلة وفق الهيكل الوزاري بريدج

UNIT 4

Series and Parallel Circuits

Content

1. Simple Circuits
2. Applications of Circuits

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1 Simple Circuits

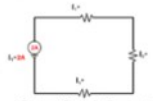
Resistors in Series

A Series Circuit describes

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

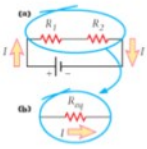
- Resistors in Series carry the Same current.

$$i_1 = i_2 = i_3 = i_{total}$$


Series Circuit Current

The total potential equals the sum of the individual potential.

$$\Delta V_{total} \text{ (series group)} = \Delta V_1 + \Delta V_2 + \Delta V_3 + \cdots$$



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

- The equivalent resistance equals the sum of the individual resistance.

$$R_{eq} = R_1 + R_2 + R_3 + \cdots \quad \text{or} \quad R_{eq} = \frac{\Delta V_{total}}{i_{total}}$$

- For identical resistance in series: $R_{eq} = R \times n$ (n: number of resistance)

- Current $i_{total} = \frac{\Delta V_{total}}{R_{eq}}$ - Potential difference battery $\Delta V_{total} = R_{eq} \times i_{total}$

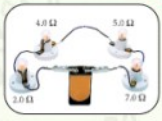
? When add resistor series in circuit

The equivalent resistance will Increase.

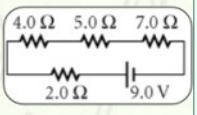
Current will decrease.

Check your understanding

1. 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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❷ 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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❸ 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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❹ Calculate the equivalent resistance of these series connected resistors:

680 Ω, 1.1 kΩ and 11 kΩ.

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❺ A series circuit has two voltage drops: 5.50 V and 6.90 V.

What is the supply voltage?

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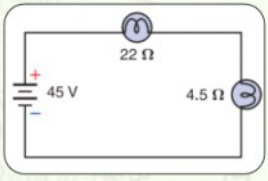
❻ A 22 Ω lamp and a 4.5 Ω lamp are connected in series and placed across a potential difference of 45 V as shown in Figure



ⓐ What is the equivalent resistance of the circuit?

ⓑ What is the current in the circuit?

ⓒ Find the potential difference across each lamp.

ⓓ What is the power used in each lamp?

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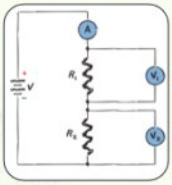
7 Two resistors, 47 Ω and 82 Ω, are connected in series across a 45 V battery.

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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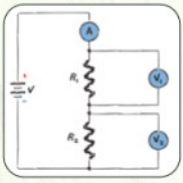
8 Suppose the circuit shown in Example Problem 1 has these values: $R_1 = 255\Omega$, $R_2 = 290\Omega$, and $\Delta V_1 = 17$ V.

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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9 The figure represents a circuit.

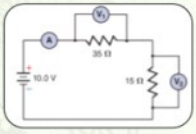
What is the equivalent resistance in the circuit?

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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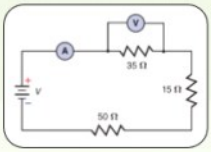
⑩ The figure represents a circuit the voltmeter reads 70.0 V.



ⓐ What will the ammeter read?

ⓑ What is the power supplied by the battery?

ⓒ Which resistor is the hottest and coolest?

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⑪ 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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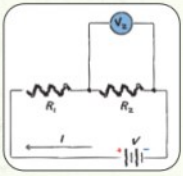
⑫ A 9.0 V battery and two resistors, 390 Ω and 470 Ω, are connected as a voltage divider.
What is the potential difference across the 470Ω resistor?



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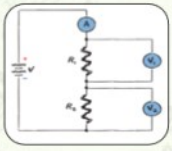
⑬ A R_1 = 22 Ω resistor and a R_2 = 33 Ω resistor are connected in series and are connected to a 120 V power source.



ⓐ What is the equivalent resistance of the circuit?

ⓑ What is the current in the circuit?

ⓒ What is the potential difference across each resistor?

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14 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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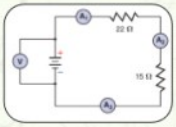
15 Ammeter 1 in the Figure reads 0.20 A.



a What should ammeter 2 indicate?

b What should ammeter 3 indicate?

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16 A series circuit has an 8.0-V battery and four resistors, $R_1 = 4.0\ \Omega$, $R_2 = 8.0\ \Omega$, $R_3 = 13.0\ \Omega$, and $R_4 = 15.0\ \Omega$.

Calculate the current and the power in the circuit.

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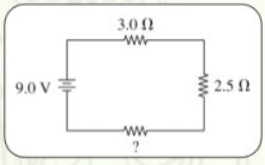
17 There is a current of 1.0 A in the following circuit.

What is the resistance of the unknown circuit element?



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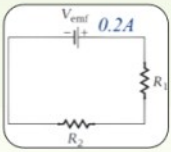
18 If Vemf = 8V and $R_1=3R_2$ and the current is 0.2A what is the resistance of R_1

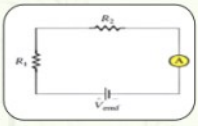


ⓐ 20Ω ⓑ 40Ω
ⓒ 30Ω ⓓ 10Ω

19 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?

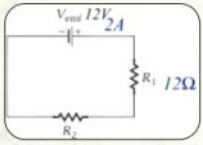
ⓐ Decrease ⓑ Becomes infinity ⓒ Increase ⓓ Stays the same

20 Two resistors, R_1 = 3.00 Ω and R_2 = 5.00Ω, are connected in series with a battery with Vemf = 8.00V, as shown in the figure. What is the current measured by the ammeter?



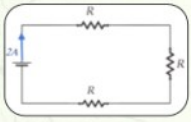
ⓐ 1.0A ⓑ 0.2A
ⓒ 0.1A ⓓ 2.0A

21 For the electric circuit shown in the figure, find the value of (R_2)



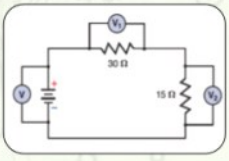
ⓐ 6Ω ⓑ 3Ω
ⓒ 2Ω ⓓ 4Ω

22 Based on the circuit that shows value of R=3Ω, 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

23 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 V_1 and V_2?



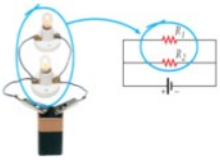
	V_1(V)	V_2(V)
ⓐ	20	40
ⓑ	40	20
ⓒ	30	30
ⓓ	60	60

1 Simple Circuits

Resistors in Parallel

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)

$$V_1 = V_2 = V_3 = V_{total}$$

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

$$i_{tot}(\text{parallel group}) = i_1 + i_2 + i_3$$

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:

$$R_{eq} = \frac{R}{n}$$

(n: number of resistance)

Important Notes

When adding a new lamp in parallel

1. the brightness of any lamp is not affected,
2. the value of the current passing through each lamp is not affected.
3. the total current passing through the circuit increases.
4. the equivalent resistance decreases

If one of the lamps burns out or is removed from its place, the brightness of the rest of the lamps will not be affected.

5. Lights wired in parallel have more than one path for current.
6. Parallel circuits do not require all elements to conduct.

Check your understanding

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

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2. 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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3. 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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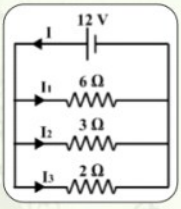
4. Three resistors $R_1 = 6.00\ \Omega$, $R_2 = 3.00\ \Omega$, and $R_3 = 2.00\ \Omega$, are connected in parallel. The parallel connection is attached to a 12.00V voltage source.



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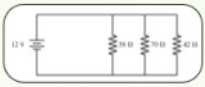
5 The three resistors of the figure are connected to a 12 V battery. What current is provided by the battery?



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6 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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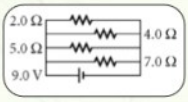

7 Calculate the equivalent resistance of these parallel connected resistors:

680 Ω, 1.1 kΩ, and 10.2 kΩ.

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8 A parallel circuit has two branch currents: 1.45 A and 1.00 A.

find the current in the source?

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9 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 15.0Ω resistors with a 10.0Ω resistor.

e what happen of the equivalent resistance change?

f what happen of the current through the entire circuit change?

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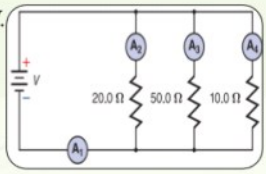
⑩ The figure represents a circuit the battery develops 110 V.



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

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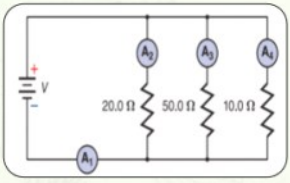
⑪ The figure represents ammeter 3 reads 0.40 A.



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

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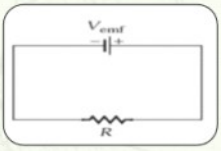
⑫ Three identical resistors connected together in parallel. If the equivalent of the three resistors is (6.0Ω). What is the resistance of any resistor of them?

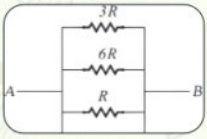
ⓐ 6Ω ⓑ 3Ω ⓒ 2Ω ⓓ 18Ω

⑬ 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

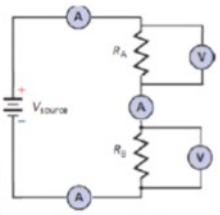
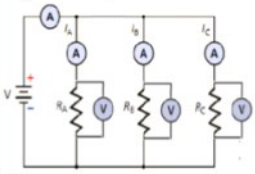
⑭ Resistors (R, 3R, 6R) are connected in parallel. What is the equivalent resistance or the three resistors?

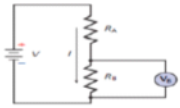
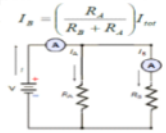


ⓐ $\frac{3}{2}$R ⓑ $\frac{2}{3}$R ⓒ $\frac{2}{3R}$ ⓓ $\frac{3}{2R}$

⑮ R_1 and R_2 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

	Parallel circuit	Series 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 distributed, 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	$I = \frac{V}{R}$ $R_{total} = R_A + R_B + R_C +$ The equivalent resistance is equal to the summation on individual resistances (and the equivalent resistance is greater than any of individual resistance)	$\frac{1}{R_t} = \frac{1}{R_A} + \frac{1}{R_B} + \frac{1}{R_C}$ $R_t = \left[\frac{1}{R_A} + \frac{1}{R_B} + \frac{1}{R_C}\right]^{-1}$ 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) $\frac{V_{tot}}{R_A + R_B} = \frac{V_B}{R_B}$ $V_B = \frac{R_B}{R_A + R_B} V_{tot}$ $V_B = \left(\frac{R_B}{R_B + R_A}\right) V_{tot}$ 	$V_{source} = I_{source} \cdot R_{eq} = I_{source} \cdot \left[\frac{1}{R_A} + \frac{1}{R_B}\right]^{-1}$ $= I_{source} \cdot \left[\frac{R_A + R_B}{R_A R_B}\right]^{-1}$ $V_{source} = V_B$ (In parallel circuit) $I_B = \frac{V_B}{R_B} = \frac{I_{source} \cdot \frac{R_A R_B}{R_A + R_B}}{R_B}$ $I_{source} \cdot \frac{R_A}{R_A + R_B}$ $I_B = \frac{R_A}{R_A + R_B} I_{tot}$ $I_B = \left(\frac{R_A}{R_B + R_A}\right) I_{tot}$ 

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

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

In series circuits:

the bulb brightness is increased when resistance is increase as this equation $P=I^2 R$ (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 resistanc

Kirchhoff'sRules

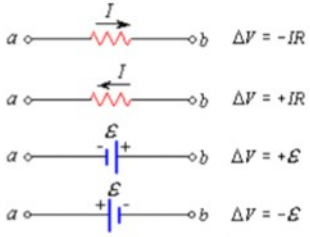
The Loop Rule:

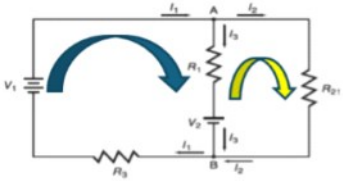
The loop rule is based on the law of conservation of energy

- 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



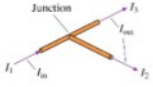


Blue loop: $V_1 - I_3R_1 - V_2 - I_1R_3 = 0$

yellow loop: $V_2 + I_3R_1 - I_2R_2 = 0$

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

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



Junction law: $I_1 = I_2 + I_3$

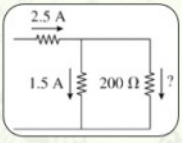
Check your understanding

❶ 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



❷ According to the figure if (i_1 = 0.5A) and (i_2 =0.2A).

what is the magnitude of (i_3)?

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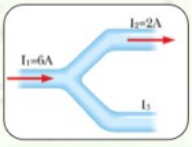
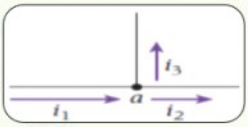


3 According to the figure if (i_1 = 6A) and (i_2 =2A). what is the magnitude of (i_3)?



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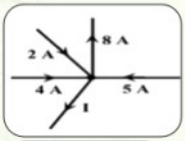
4 According to the figure find I.



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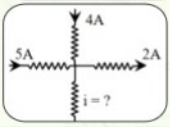
5 According to the figure find I and direction.



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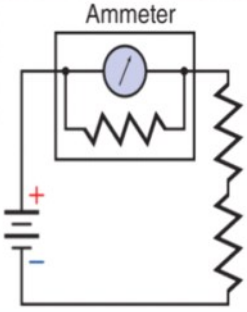
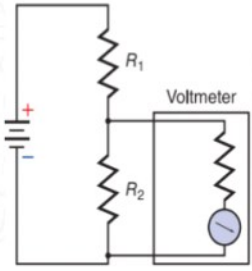
Ammeters and Voltmeters:

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

Check your understanding

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

ⓐ low parallel

ⓑ low series

ⓒ high series

ⓓ high parallel

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

ⓐ low parallel

ⓑ low series

ⓒ high series

ⓓ high parallel

3 If the ammeter reading shown in 35.60 mA.

What is the current in amperes?

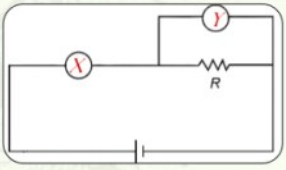
ⓐ 3.56×10^{-2} A

ⓑ 3.56×10^{-6} A

ⓒ 3.56×10^{-4} A ⓓ 3.56×10^{-3} A

4 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



5 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.

2 Applications of Circuits

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.

Check your understanding

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

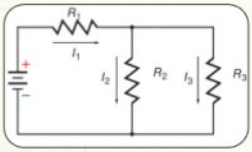
ⓐ ⓑ ⓒ ⓓ

2. 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

❶ 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.



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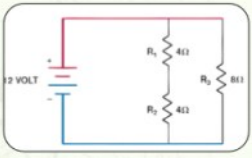
❷ The figure represents a circuit.

Calculate the equivalent resistance in the circuit.



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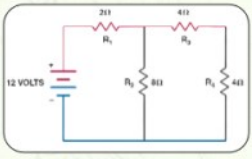
❸ The figure represents a circuit.

Calculate the equivalent resistance in the circuit.



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❹ The figure represents a circuit.

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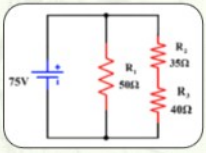

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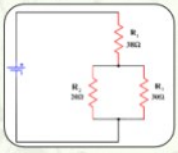
❺ The figure represents a circuit.

Calculate the equivalent resistance in the circuit.



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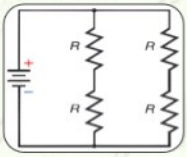
❻ The electric circuit shown in the figure contains four resistors each of 4Ω, connected to a battery

What is the equivalent resistance in the circuit?



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