

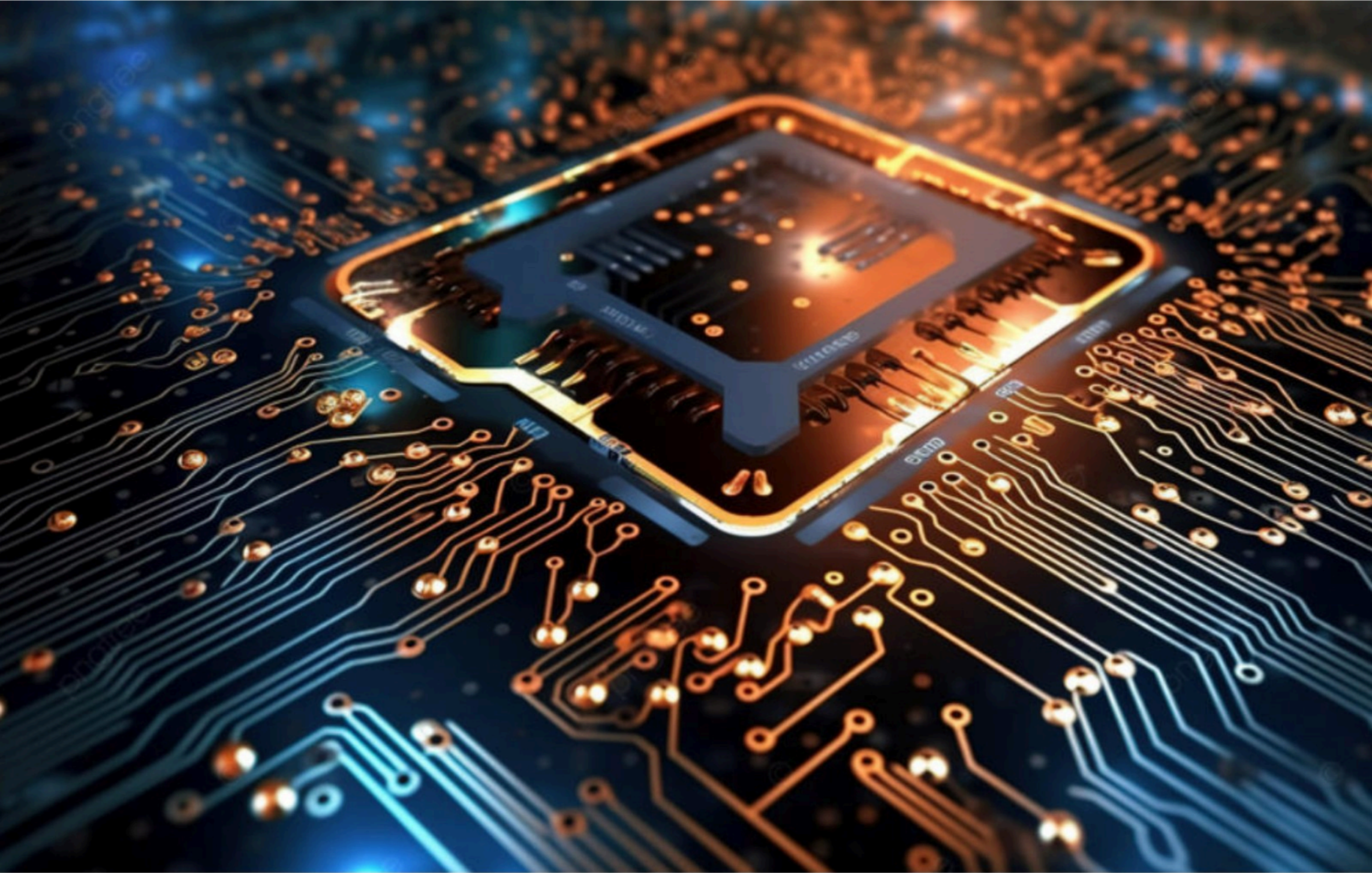
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GEN12ERAL

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CHAPTER 4

Series and Parallel Circuits

SECTIONS

1 Simple Circuits

الدوائر الكهربائية البسيطة

2 Applications of Circuits

تطبيقات الدوائر الكهربائية

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What do we mean by **simple electrical circuit**?

ماذا نعني بالدائرة الكهربائية البسيطة ؟

(the components)

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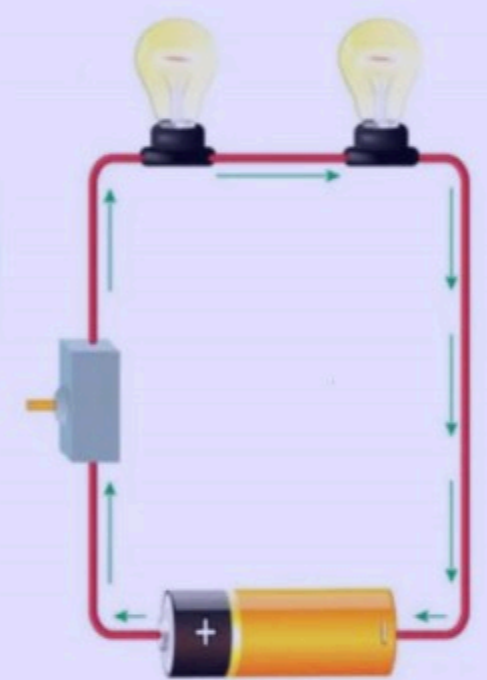
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Series Circuits

the electrical circuits that have a single path for the current to flow

الدوائر الكهربائية التي يكون فيها مسار وحيد لمرور التيار

دوائر التوالي



1

THE CURRENT



2

POTENTIAL DIFFERENCE



3

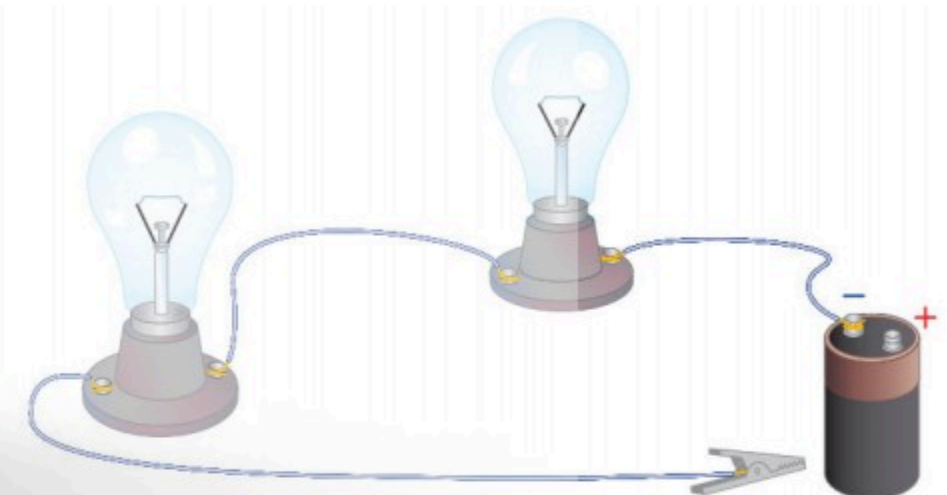
EQUIVALENT RESISTANCE



Number of resistors with the same value



the equivalent resistance is greater than the largest individual resistance



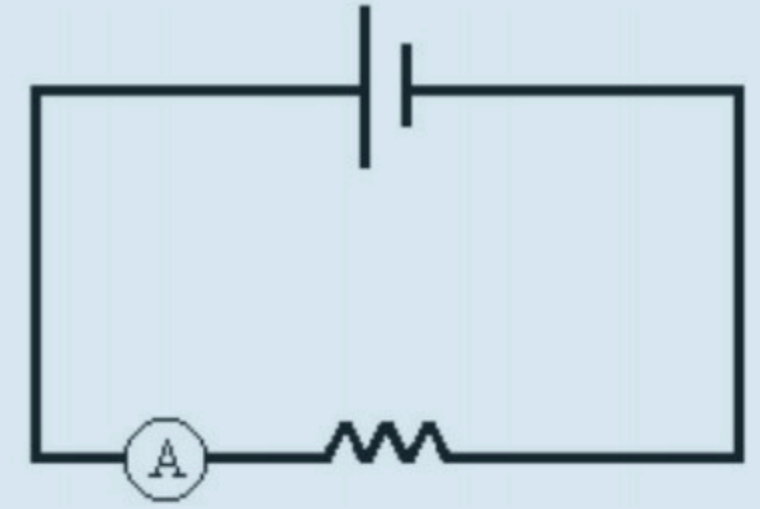
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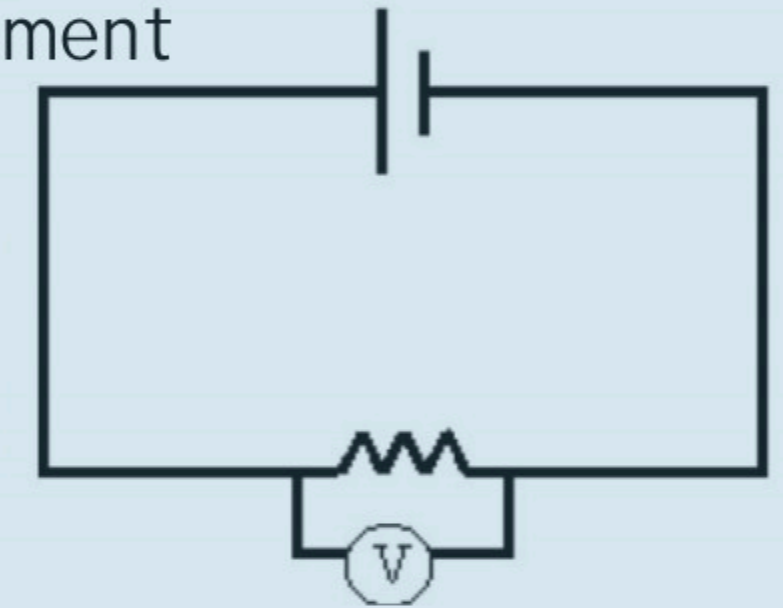
Ammeters are always wired in series to the circuit.

- Since the current in a series circuit is the same all the way, the current you measure with the ammeter is also the current flowing through the resistor.
- If the ammeter **was wired in parallel**, part of the current would branch off into the ammeter, part into the resistor, **You will have a wrong reading.**
- Since the ammeter is in series in the circuit you need to make sure **that it has the lowest resistance possible.**



Voltmeters are always wired in parallel to the circuit.

- A voltmeter measures the **voltage** across a circuit element
- It must be connected in parallel with the element
- The voltmeter should have a very **high resistance**



why is series connection used ?

لماذا يتم استخدام التوصيل علي التوالي ؟

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Series and Parallel Circuits

SECTION 1 Simple Circuits

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series circuit.

It connects two resistance A and B in series

the resistance of this group will be..

- (A) Less than the total of the two resistances
- (B) greater than resistance resistance A
- (C) Less than resistance resistance b
- (D) It is not possible to specify

A $12\ \Omega$, a $15\ \Omega$, and a $5\ \Omega$ resistor are connected in a series circuit with a 75 V battery. What is the **equivalent resistance** of the circuit? **What is the current** in the circuit?

ثلاث مقاومات $12\ \Omega$ و $15\ \Omega$ و $5\ \Omega$ موصلة في دائرة على التوالي مع بطارية فرق الجهد لها 75 V . ما مقدار المقاومة المكافئة للدائرة؟ ما شدة التيار المار في الدائرة الكهربائية؟

CURRENT

The current through a series circuit is equal to the potential difference across the power source divided by the equivalent resistance.

$$I = \frac{\Delta V_{\text{source}}}{R}$$



Calculate **the potential differences** across three resistors

احسب قيم فرق الجهد عبر المقاومات الثلاث

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In the following figure. **Current resulting battery...**

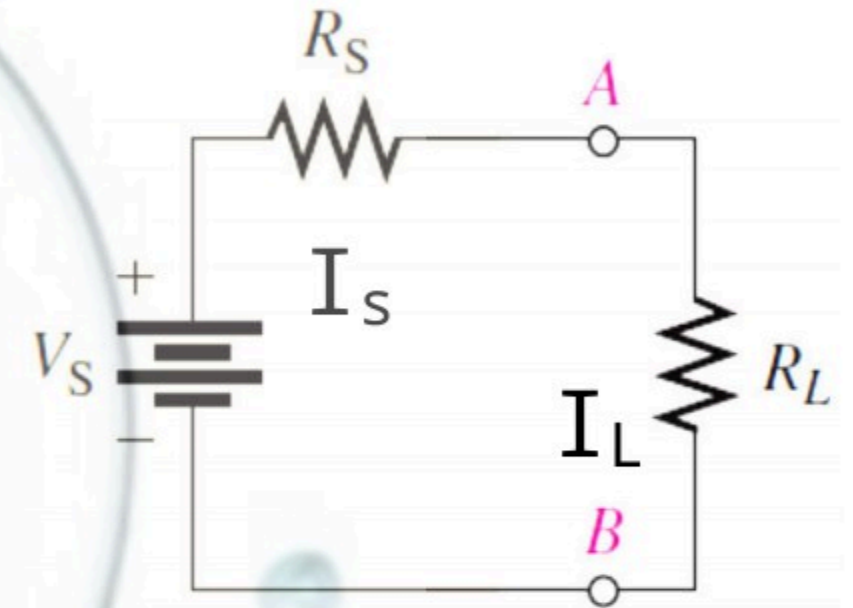
A) $I_T = 2 I_S$

B) $I_T = 2 I_L$

C) $I_T = I_S = I_L$

D) It is not possible to specify

في الشكل المقابل التيار الناتج عن البطارية ...



A 9 V battery is in a circuit with three resistors connected in series.

وحدة بطارية 9 V في دائرة كهربائية على التوالي بثلاث مقاومات:

a. If the resistance of one of the resistors increases, how will **the equivalent resistance change**?

إذا زادت مقاومة إحدى المقاومات، فكيف ستتغير المقاومة المكافئة؟

b. What will happen to the current?

ماذا سيحدث للتيار؟

c. Will there be any change in the battery voltage?

هل سيطرأ أي تغيير في جهد البطارية؟

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Three $22\ \Omega$ resistors are connected in series across a 125 V generator. **What is the equivalent resistance of the circuit?**

What is the current in the circuit?

ثلاث مقاومات قيمة كل منها $22\ \Omega$ وصلت على التوالي مع مصدر للطاقة الكهربائية بفرق جهد 125 V .

ما هي المقاومة المكافئة للدائرة؟

ثم احسب قيمة التيار المار في الدائرة

A string of lights has ten identical bulbs with equal resistances connected in series. When the string of lights is connected to a 117 V outlet, the current through the bulbs is 0.06 A . **What is the resistance of each bulb?**

سلك من المصابيح يحتوي على عشرة مصابيح متماثلة ذات مقاومة متساوية وموصلة على التوالي.

حينما يتم توصيل سلك المصابيح بمصدر كهربائي 117 V تكون شدة التيار المار في خلال الدائرة 0.06 A .

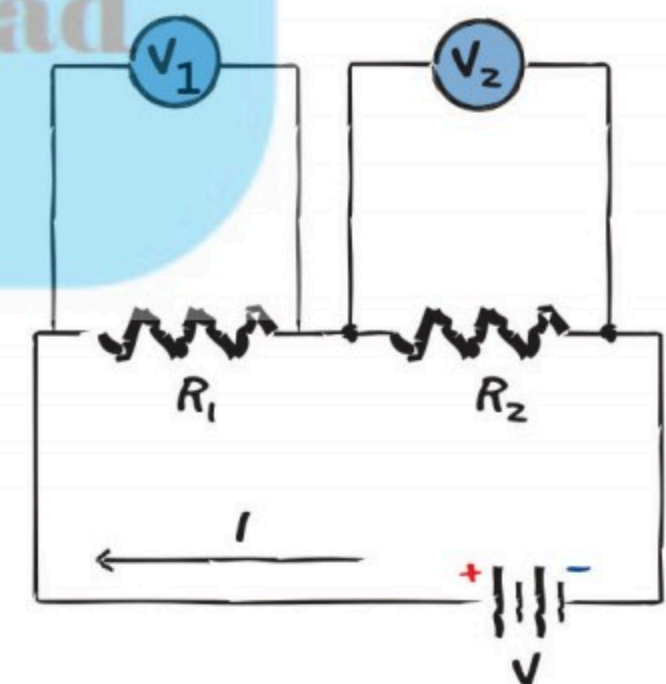
ما مقدار مقاومة كل مصباح؟

RESISTORS IN SERIES CIRCUITS

What happens to **voltage** across a resistor in a series circuit ?

ماذا يحدث لفرق الجهد داخل الدائرة الكهربائية ؟

- (A) $V_T = V_2$
- (B) $V_T = V_1$
- (C) $V_T = V_1 + V_2$
- (D) It is not possible to specify



Series and Parallel Circuits

SECTION 1 Simple Circuits

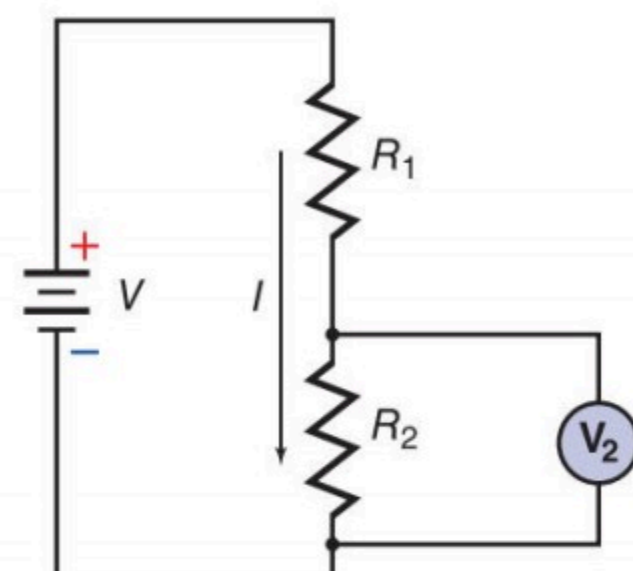
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Voltage dividers



voltage divider

produces a source of potential difference that is less than the potential difference across the battery



Two resistors, $47\ \Omega$ and $82\ \Omega$, are connected in series across a 45 V battery.

- a. What is the current in the circuit? مقاومتان $47\ \Omega$ و $82\ \Omega$ موصولتان على التوالي من خلال بطارية فرق الجهد 45 V . ما مقدار التيار الكهربائي المار في الدائرة؟

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- b. What is the potential difference across each resistor? ما فرق الجهد عبر كل مقاومة؟

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

إذا استبدلت المقاومة $47\ \Omega$ بمقاومة $39\ \Omega$ فهل سيزيد التيار أم سينقص أم سيظل كما هو؟

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- d. What is the new potential difference across the $82\ \Omega$ resistor?

ما فرق الجهد الجديد عبر المقاومة $82\ \Omega$ ؟

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The circuit shown in Example 1 is producing these symptoms:

the ammeter reads 0 A,
 ΔV_1 reads 0 V, and ΔV_2 reads 45 V. **What has happened?**

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The circuit in Example Problem 1 has unequal resistors. **Explain why the resistor with the lower resistance will operate at a lower temperature.**

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Suppose the circuit shown in Example Problem 1 has these values: $R_1 = 255 \, \Omega$, $R_2 = 290 \, \Omega$, and $\Delta V_1 = 17 \, \text{V}$. No other information is available.

a. What is the current in the circuit?

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b. What is the potential difference across the battery?

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

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d. Does the sum of the power used in each resistor in the circuit equal the total power used in the circuit? Explain.

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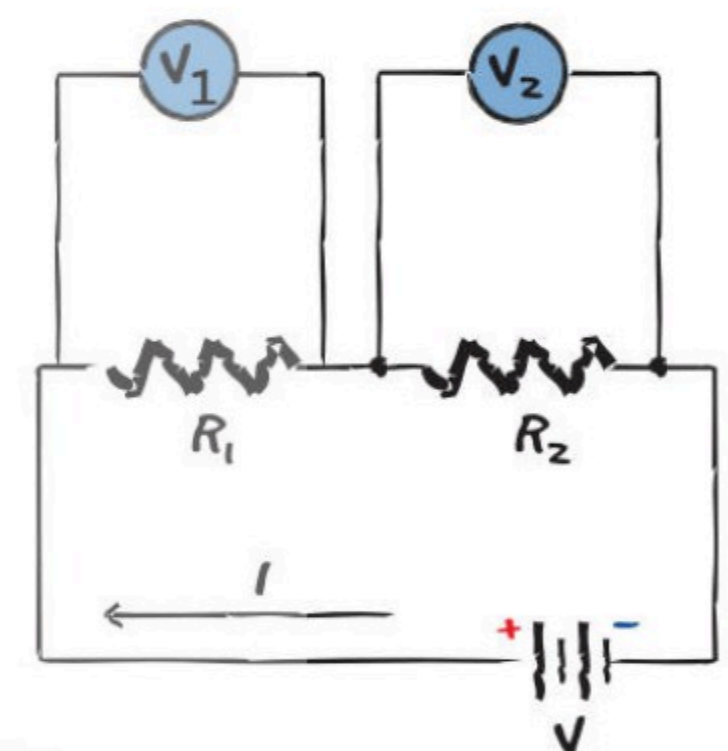
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A 9.0 V battery and two resistors, $390\ \Omega$ and $470\ \Omega$, are connected as a voltage divider. **What is the potential difference across the $470\ \Omega$ resistor?**



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you
can
do it



Series and Parallel Circuits

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A $22\ \Omega$ resistor and a $33\ \Omega$ resistor are connected in series and are connected to a $120\ \text{V}$ power source.

a. What is the equivalent resistance of the circuit?

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b. What is the current in the circuit?

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c. What is the potential difference across each resistor?

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Three resistors of $3.3\ \text{k}\Omega$, $4.7\ \text{k}\Omega$, and $3.9\ \text{k}\Omega$ are connected in series across a $12\ \text{V}$ battery.

a. What is the equivalent resistance?

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b. What is the current through the resistors?

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c. Find the total potential difference across the three resistors.

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