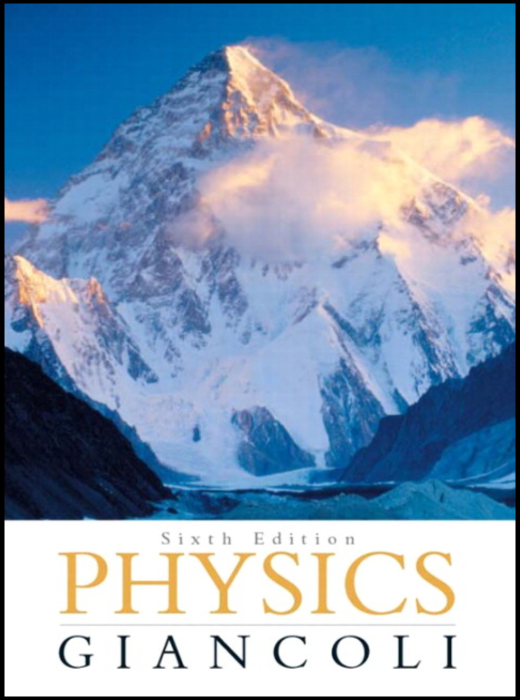


ConcepTest PowerPoints

Chapter 19

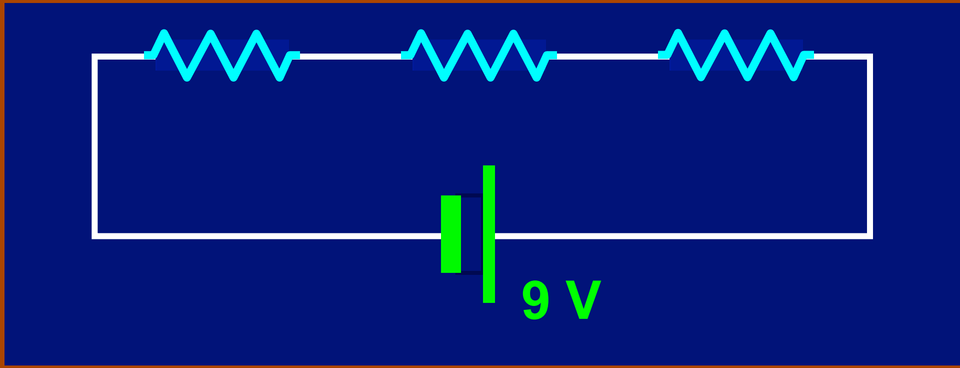
Physics: Principles with Applications, 6th edition

Giancoli

ConcepTest 19.1a Series Resistors I

Assume that the voltage of the battery is **9 V** and that the three resistors are **identical**. What is the potential difference across each resistor?

1) 12 V
2) zero
3) 3 V
4) 4 V
5) you need to know the actual value of *R*

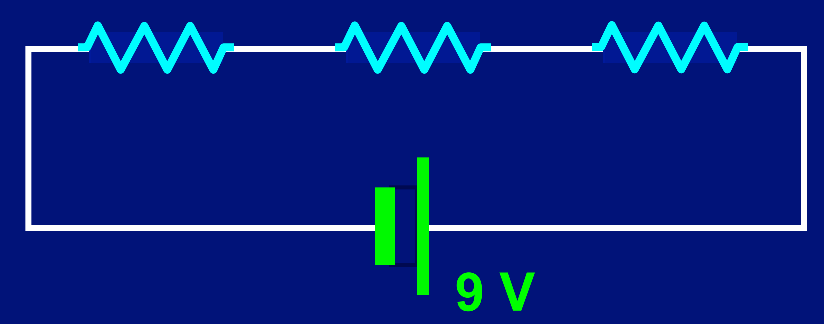


ConcepTest 19.1a Series Resistors I

Assume that the voltage of the battery is **9 V** and that the three resistors are **identical**. What is the potential difference across each resistor?

1) 12 V
2) zero
3) 3 V
4) 4 V
5) you need to know the actual value of *R*

Since the resistors are all **equal**, the voltage will drop **evenly** across the 3 resistors, with 1/3 of 9 V across each one. So we get a **3 V drop** across each.

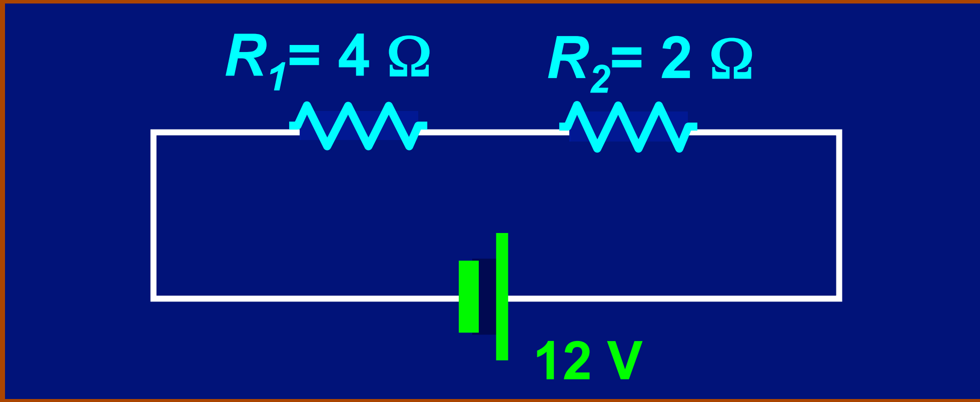


Follow-up: What would be the potential difference if *R* = 1 Ω, 2 Ω, 3 Ω

ConcepTest 19.1b Series Resistors II

In the circuit below, what is the voltage across R_1?

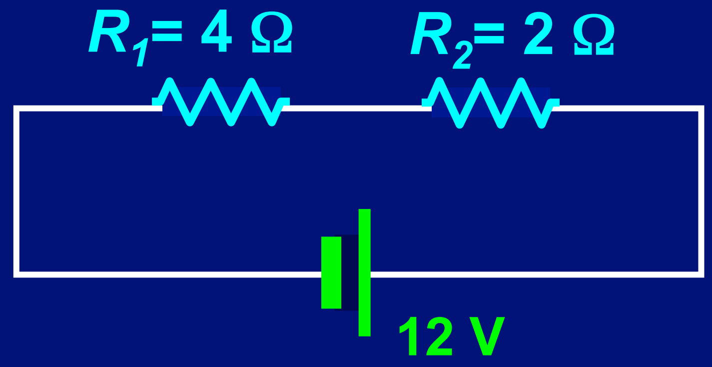
1) 12 V
2) zero
3) 6 V
4) 8 V
5) 4 V



ConcepTest 19.1b Series Resistors II

In the circuit below, what is the voltage across R_1?

1) 12 V
2) zero
3) 6 V
4) 8 V
5) 4 V



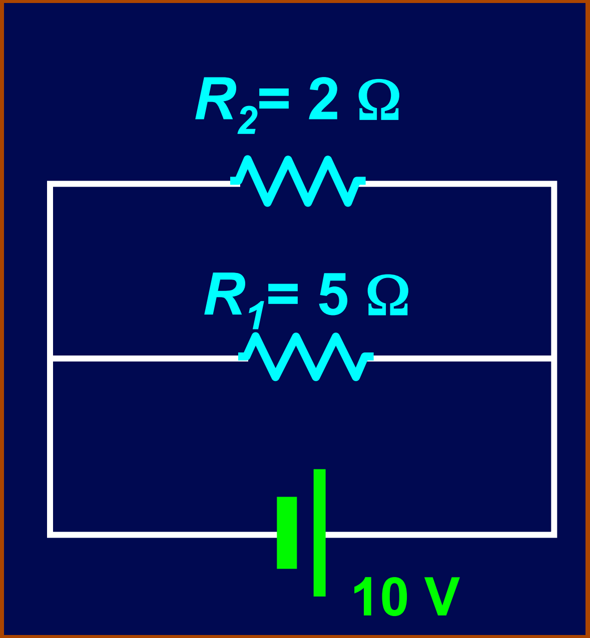
The voltage drop across R_1 has to be twice as big as the drop across R_2. This means that $V_1 = 8$ V and $V_2 = 4$ V. Or else you could find the current $I = V/R = (12\text{ V})/(6\ \Omega) = 2$ A, then use Ohm's Law to get voltages.

Follow-up: What happens if the voltage is doubled?

ConcepTest 19.2a Parallel Resistors I

In the circuit below, what is the current through R_1?

1) 10 A
2) zero
3) 5 A
4) 2 A
5) 7 A

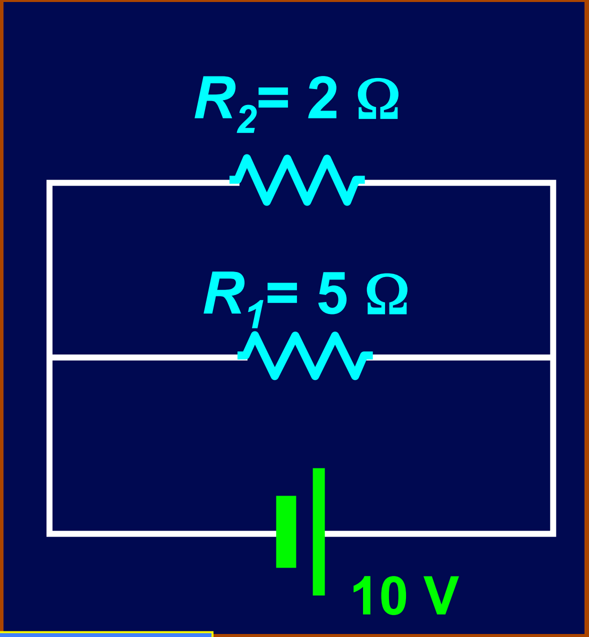


ConcepTest 19.2a Parallel Resistors I

In the circuit below, what is the current through R_1?

1) 10 A
2) zero
3) 5 A
4) 2 A
5) 7 A

The ***voltage*** is the ***same*** (10 V) across each resistor because they are in parallel. Thus, we can use Ohm's Law, $V_1 = I_1 R_1$ to find the current $I_1 = 2$ A.

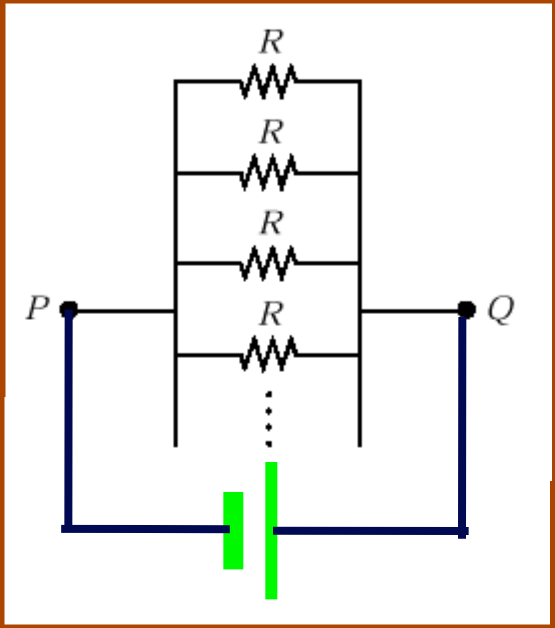


Follow-up: What is the total current through the battery?

ConcepTest 19.2b Parallel Resistors II

Points P and Q are connected to a battery of fixed voltage. As more resistors *R* are added to the parallel circuit, what happens to the **total current** in the circuit?

1) increases
2) remains the same
3) decreases
4) drops to zero

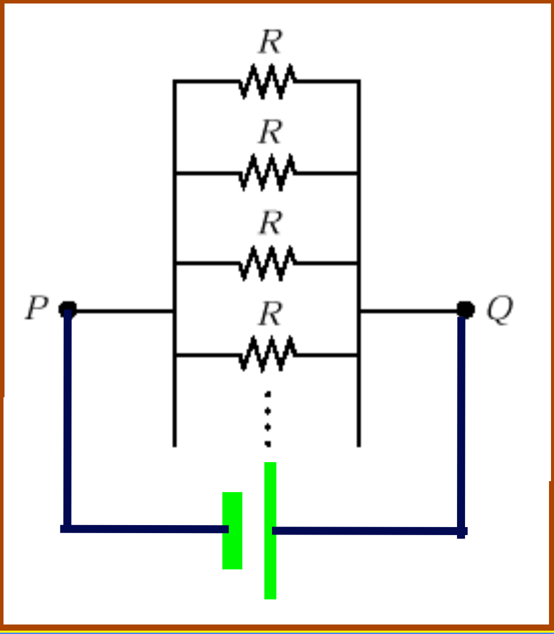


ConcepTest 19.2b Parallel Resistors II

Points P and Q are connected to a battery of fixed voltage. As more resistors *R* are added to the parallel circuit, what happens to the **total current** in the circuit?

1) increases
2) remains the same
3) decreases
4) drops to zero

As we add parallel resistors, the overall **resistance of the circuit drops**. Since $V = IR$, and V is held constant by the battery, when **resistance decreases**, the **current must increase**.



Follow-up: What happens to the current through each resistor?

ConcepTest 19.3a Short Circuit

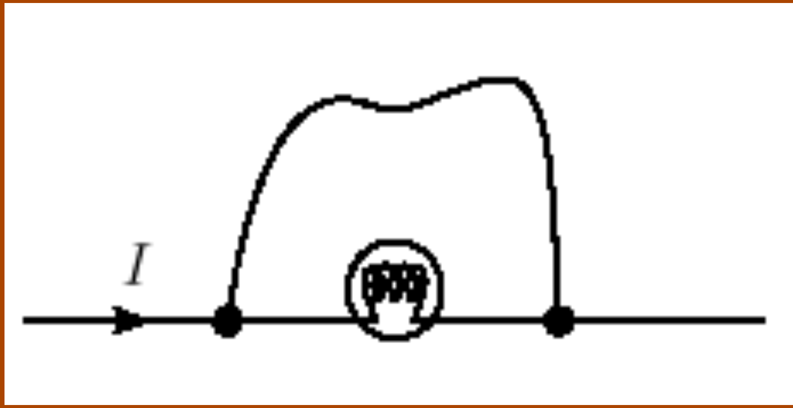
Current flows through a lightbulb. If a wire is now connected across the bulb, what happens?

1) all the current continues to flow through the bulb

2) half the current flows through the wire, the other half continues through the bulb

3) all the current flows through the wire

4) none of the above

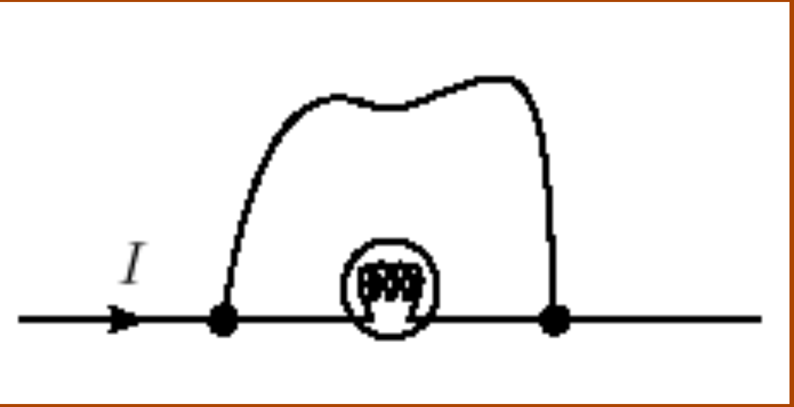


ConcepTest 19.3a Short Circuit

Current flows through a lightbulb. If a wire is now connected across the bulb, what happens?

1) all the current continues to flow through the bulb
2) half the current flows through the wire, the other half continues through the bulb
3) all the current flows through the wire
4) none of the above

The current divides based on the ratio of the resistances. If one of the resistances is **zero**, then ***ALL*** of the current will flow through that path.

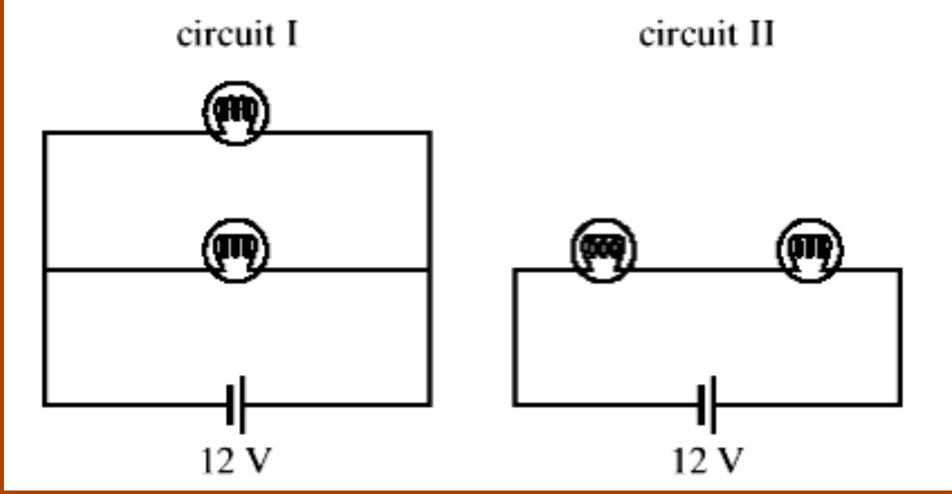


Follow-up: Doesn't the wire have SOME resistance?

ConcepTest 19.4a Circuits I

The lightbulbs in the circuit below are identical with the same resistance *R*. Which circuit produces more light? (brightness $\Longleftrightarrow$ power)

1) circuit 1
2) circuit 2
3) both the same
4) it depends on *R*

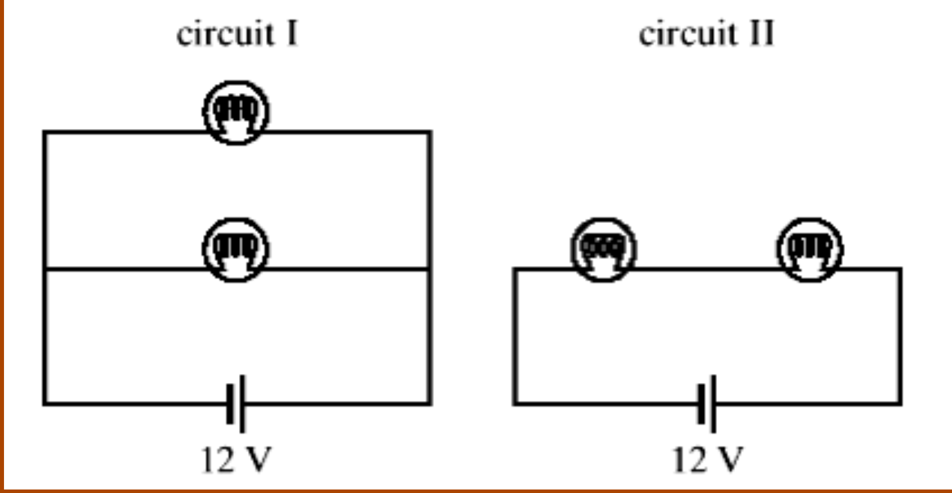


ConcepTest 19.4a Circuits I

The lightbulbs in the circuit below are identical with the same resistance *R*. Which circuit produces more light? (brightness ⟸⟹ power)

1) circuit 1
2) circuit 2
3) both the same
4) it depends on *R*

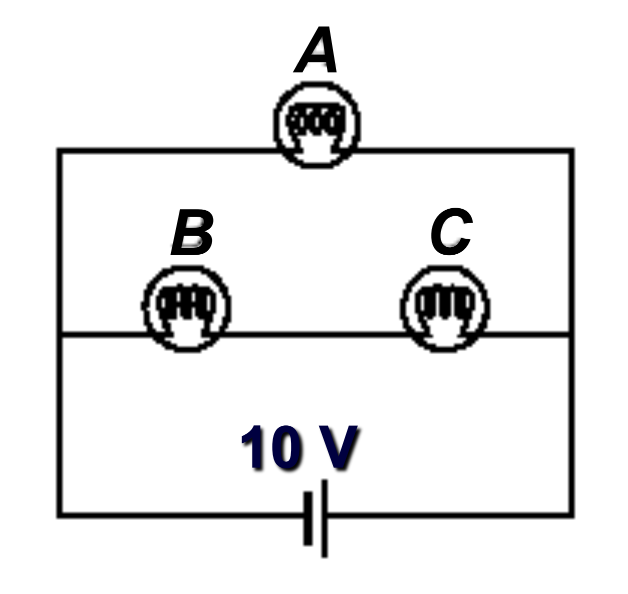
In #1, the bulbs are in **parallel**, **lowering the total resistance** of the circuit. Thus, circuit **#1 will draw a higher current**, which leads to more light, because $P = I V$.



ConcepTest 19.4b Circuits II

The three lightbulbs in the circuit all have the same resistance of 1 Ω. By how much is the brightness of bulb B greater or smaller than the brightness of bulb A? (brightness ⟺ power)

1) twice as much
2) the same
3) 1/2 as much
4) 1/4 as much
5) 4 times as much



ConcepTest 19.4b Circuits II

The three light bulbs in the circuit all have the same resistance of 1 Ω. By how much is the brightness of bulb B greater or smaller than the brightness of bulb A? (brightness ⟺ power)

1) twice as much
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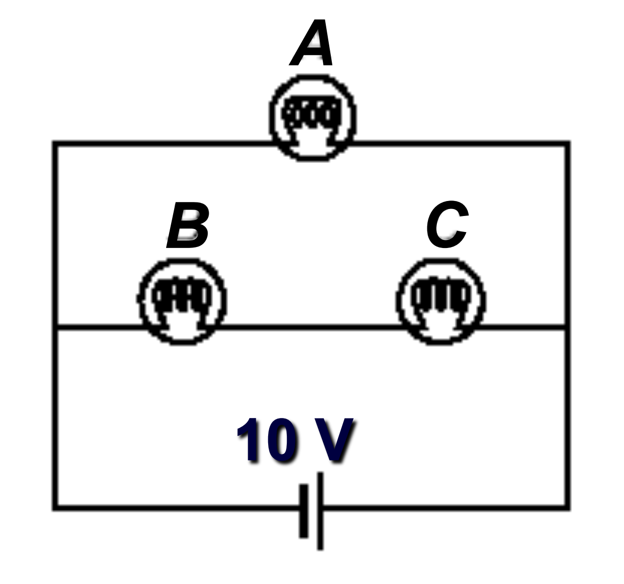


We can use $P = V^2/R$ to compare the power:

$P_A = (V_A)^2/R_A = (10\text{ V})^2/1\ \Omega = 100\text{ W}$

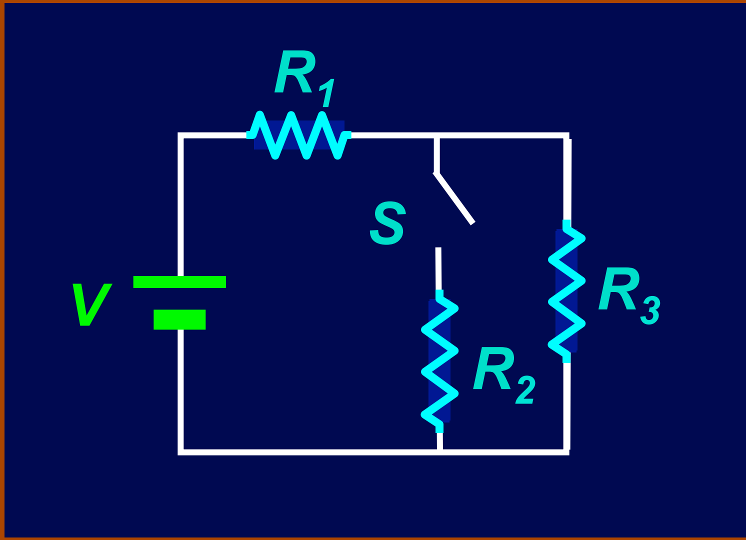
$P_B = (V_B)^2/R_B = (5\text{ V})^2/1\ \Omega = 25\text{ W}$

Follow-up: What is the total current in the circuit?

ConcepTest 19.5a More Circuits I

What happens to the voltage across the resistor R_1 when the switch is closed? The voltage will:

1) increase
2) decrease
3) stay the same

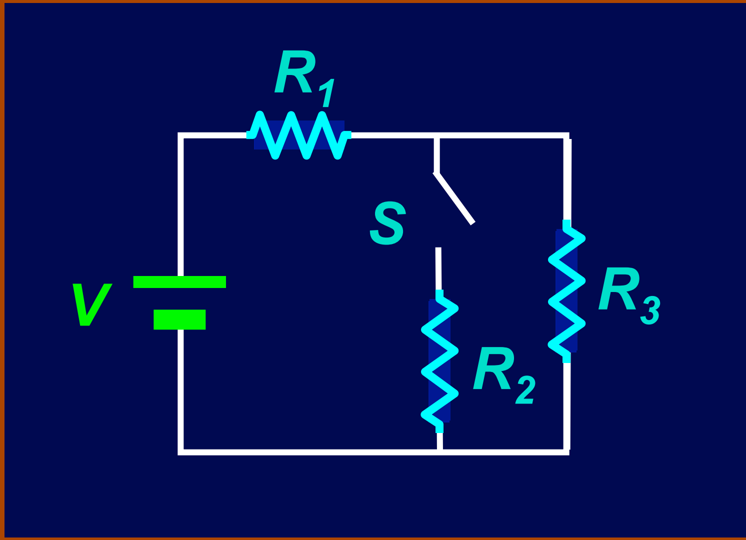


ConcepTest 19.5a More Circuits I

What happens to the voltage across the resistor R_1 when the switch is closed? The voltage will:

1) increase
2) decrease
3) stay the same

With the switch closed, the addition of R_2 to R_3 **decreases the equivalent resistance**, so the **current from the battery increases**. This will cause an **increase in the voltage across R_1**.

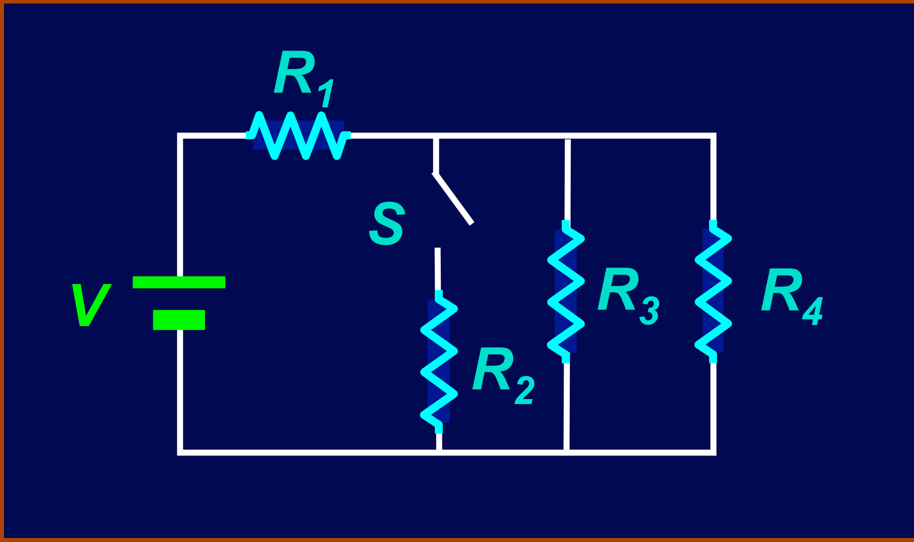


Follow-up: What happens to the current through R_3?

ConcepTest 19.5b More Circuits II

What happens to the voltage across the resistor R_4 when the switch is closed?

1) increases
2) decreases
3) stays the same

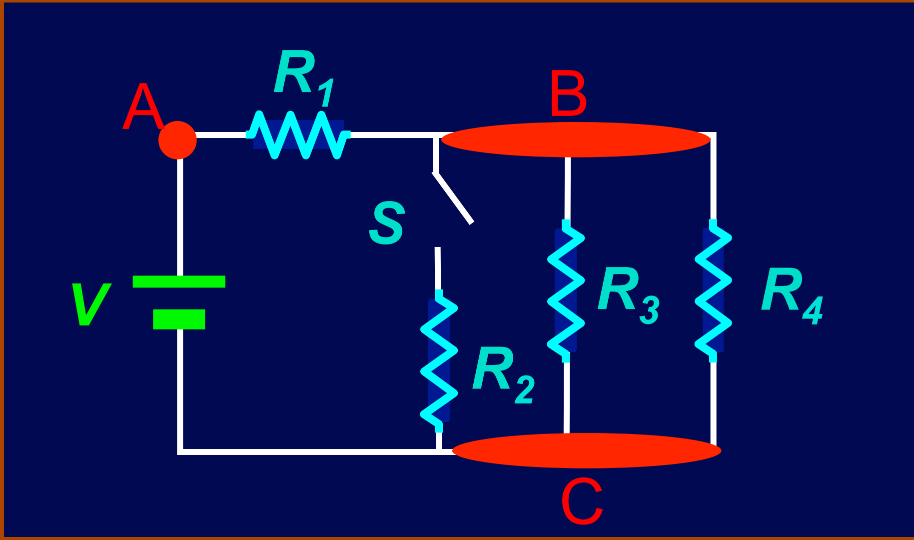


ConcepTest 19.5b More Circuits II

What happens to the voltage across the resistor R_4 when the switch is closed?

1) increases
2) decreases
3) stays the same

We just saw that closing the switch causes an **increase in the voltage across R_1** (which is V_{AB}). The voltage of the battery is <u>constant</u>, so if V_{AB} **increases**, then V_{BC} **must decrease**!

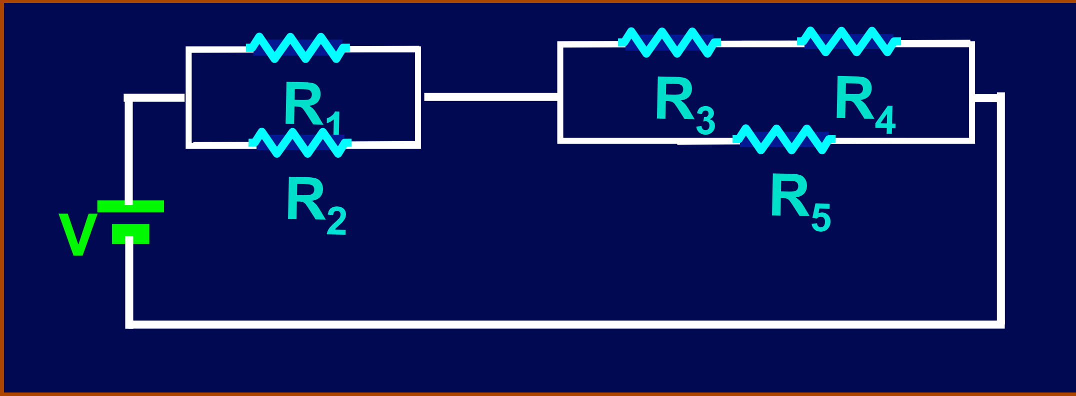


Follow-up: What happens to the current through R_4?

ConcepTest 19.6 Even More Circuits

Which resistor has the greatest current going through it? Assume that all the resistors are equal.

1) R_1
2) both R_1 and R_2 equally
3) R_3 and R_4
4) R_5
5) all the same

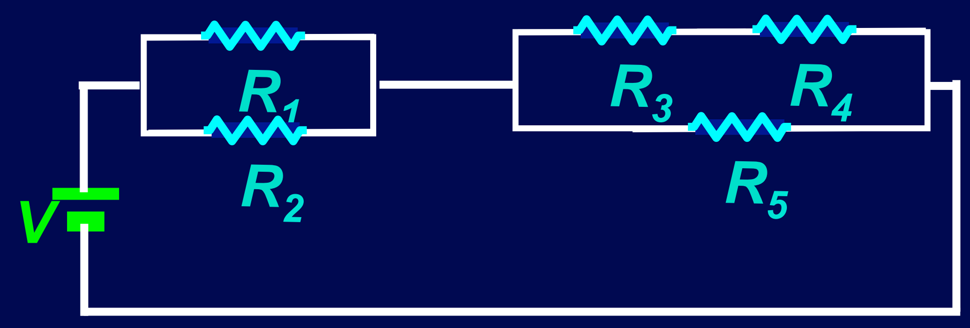


ConcepTest 19.6 Even More Circuits

Which resistor has the greatest current going through it? Assume that all the resistors are equal.

1) R_1
2) both R_1 and R_2 equally
3) R_3 and R_4
4) R_5
5) all the same

The same current must flow through left and right combinations of resistors. On the LEFT, the current splits equally, so $I_1 = I_2$. On the RIGHT, more current will go through R_5 than $R_3 + R_4$ since the branch containing R_5 has less resistance.

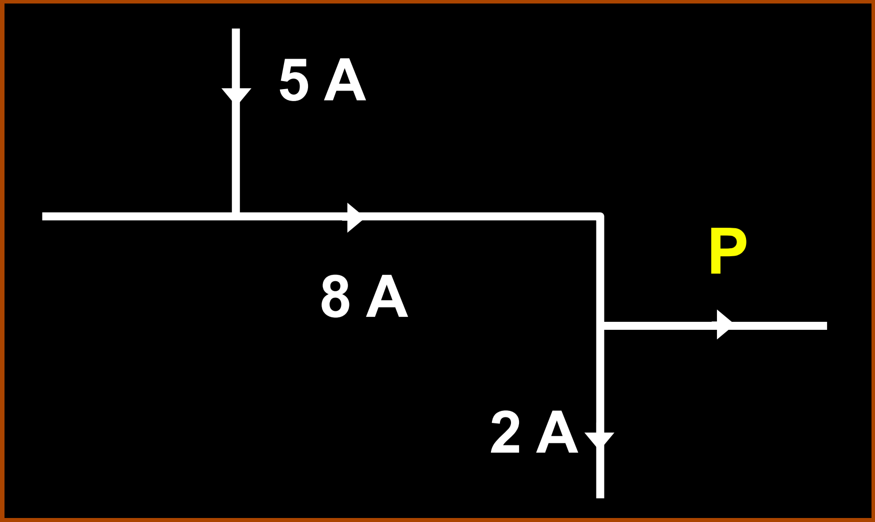


Follow-up: Which one has the smallest voltage drop?

ConcepTest 19.7 Junction Rule

What is the current in branch P?

1) 2 A
2) 3 A
3) 5 A
4) 6 A
5) 10 A

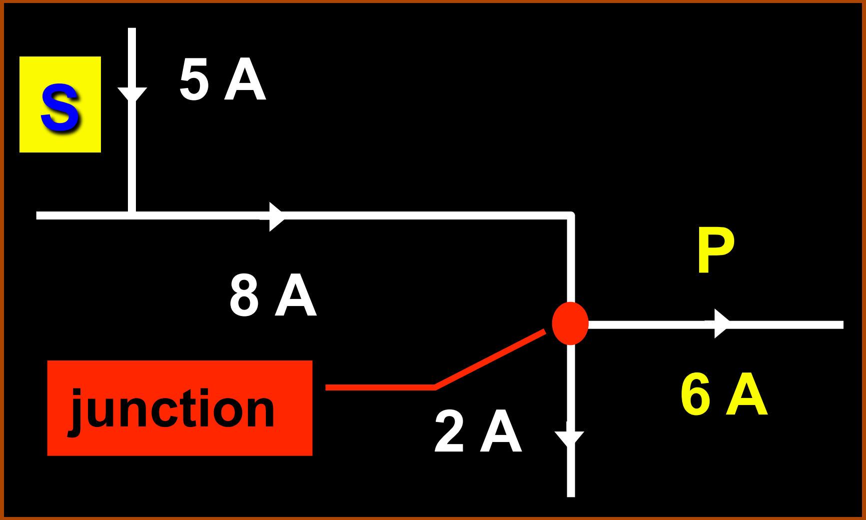


ConcepTest 19.7 Junction Rule

What is the current in branch P?

1) 2 A
2) 3 A
3) 5 A
4) 6 A
5) 10 A

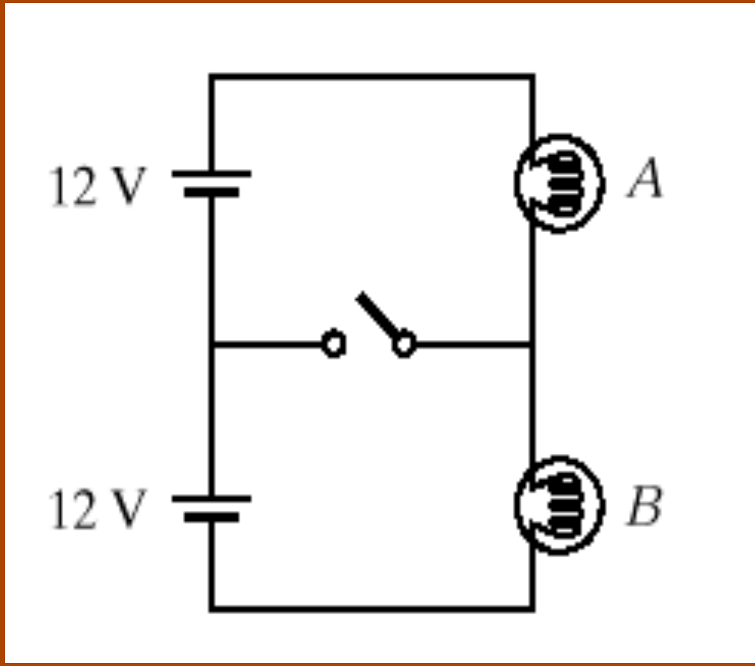
The current entering the junction in red is 8 A, so the current leaving must also be 8 A. One exiting branch has 2 A, so the other branch (at P) must have 6 A.



ConcepTest 19.8 Kirchhoff's Rules

The lightbulbs in the circuit are identical. When the switch is closed, what happens?

1) both bulbs go out
2) intensity of both bulbs increases
3) intensity of both bulbs decreases
4) A gets brighter and B gets dimmer
5) nothing changes

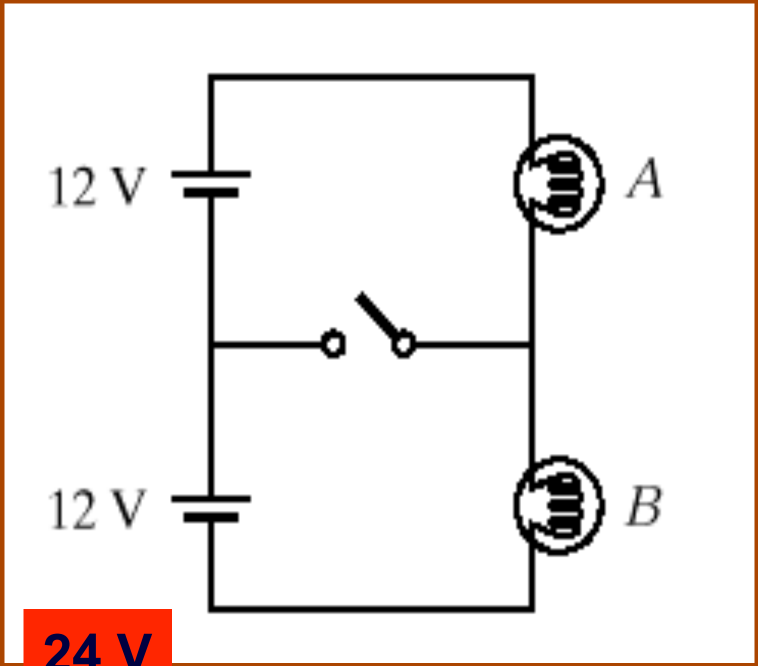


ConcepTest 19.8 Kirchhoff's Rules

The lightbulbs in the circuit are identical. When the switch is closed, what happens?

1) both bulbs go out
2) intensity of both bulbs increases
3) intensity of both bulbs decreases
4) A gets brighter and B gets dimmer
5) nothing changes

When the switch is open, **the point between the bulbs is at 12 V**. **But so is the point between the batteries**. If there is no potential difference, then no current will flow once the switch is closed!! Thus, nothing changes.



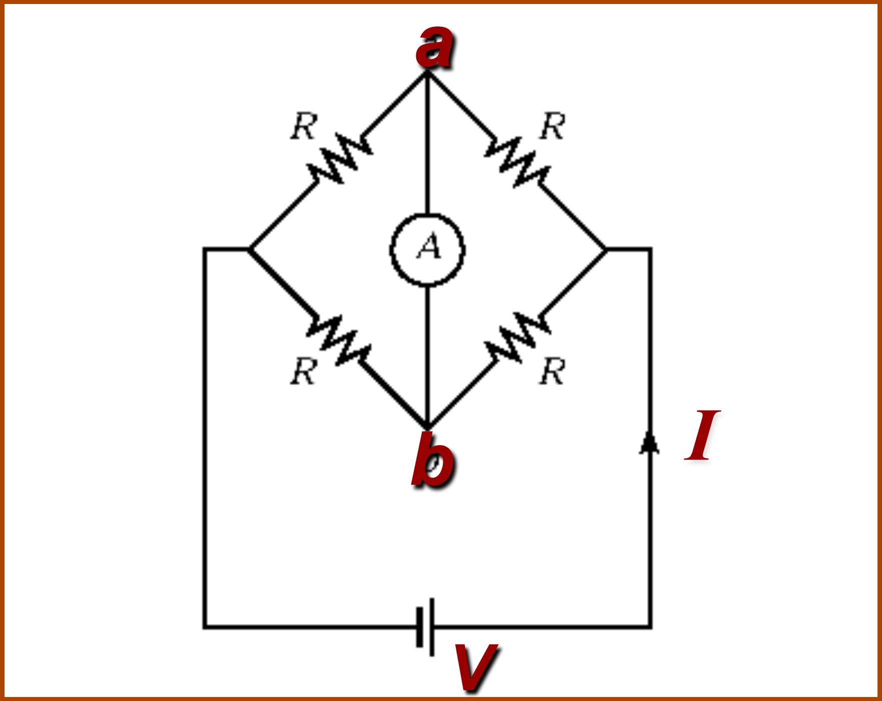
24 V

Follow-up: What happens if the bottom battery is replaced by a 24 V battery?

ConcepTest 19.9 Wheatstone Bridge

An ammeter A is connected between points *a* and *b* in the circuit below, in which the four resistors are identical. The current through the ammeter is:

1) *I*
2) *I*/2
3) *I*/3
4) *I*/4
5) zero

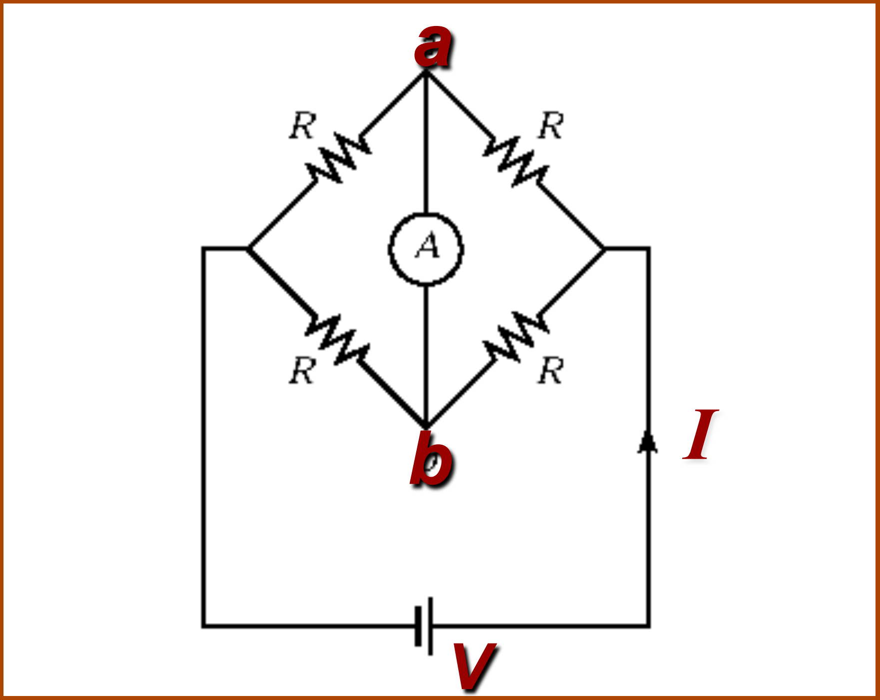


ConcepTest 19.9 Wheatstone Bridge

An ammeter A is connected between points *a* and *b* in the circuit below, in which the four resistors are identical. The current through the ammeter is:

1) *I*
2) *I*/2
3) *I*/3
4) *I*/4
5) zero

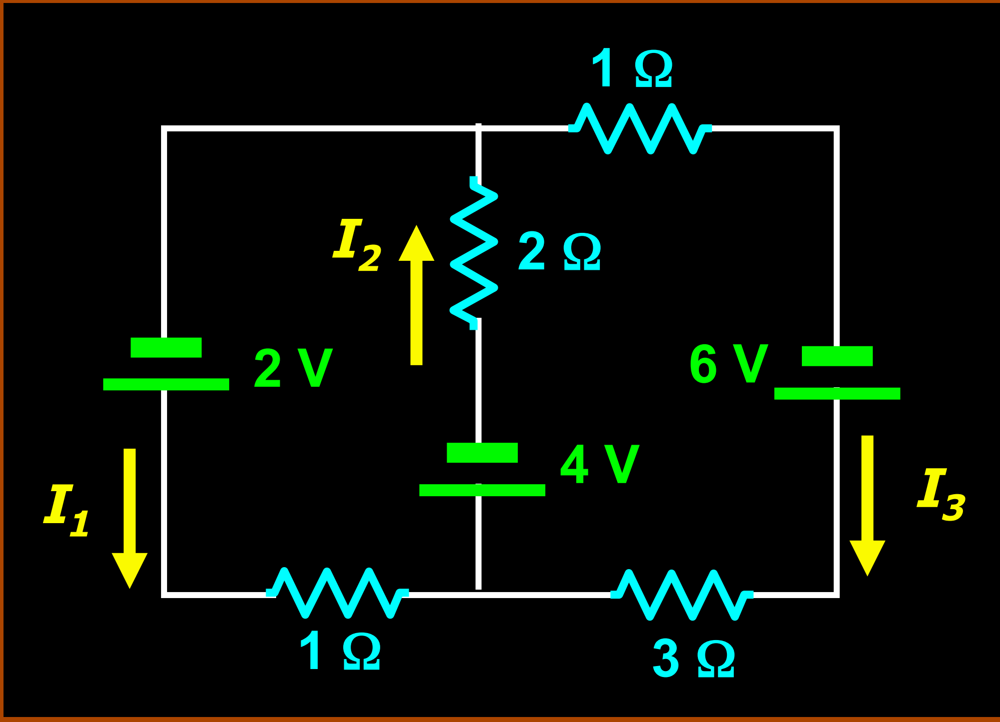
Since all **resistors are identical**, the **voltage drops are the same** across the upper branch and the lower branch. Thus, the **potentials** at points *a* and *b* are also the **same**. Therefore, no current flows.



ConcepTest 19.10 More Kirchhoff's Rules

Which of the equations is valid for the circuit below?

1) $2 - I_1 - 2I_2 = 0$
2) $2 - 2I_1 - 2I_2 - 4I_3 = 0$
3) $2 - I_1 - 4 - 2I_2 = 0$
4) $I_3 - 4 - 2I_2 + 6 = 0$
5) $2 - I_1 - 3I_3 - 6 = 0$

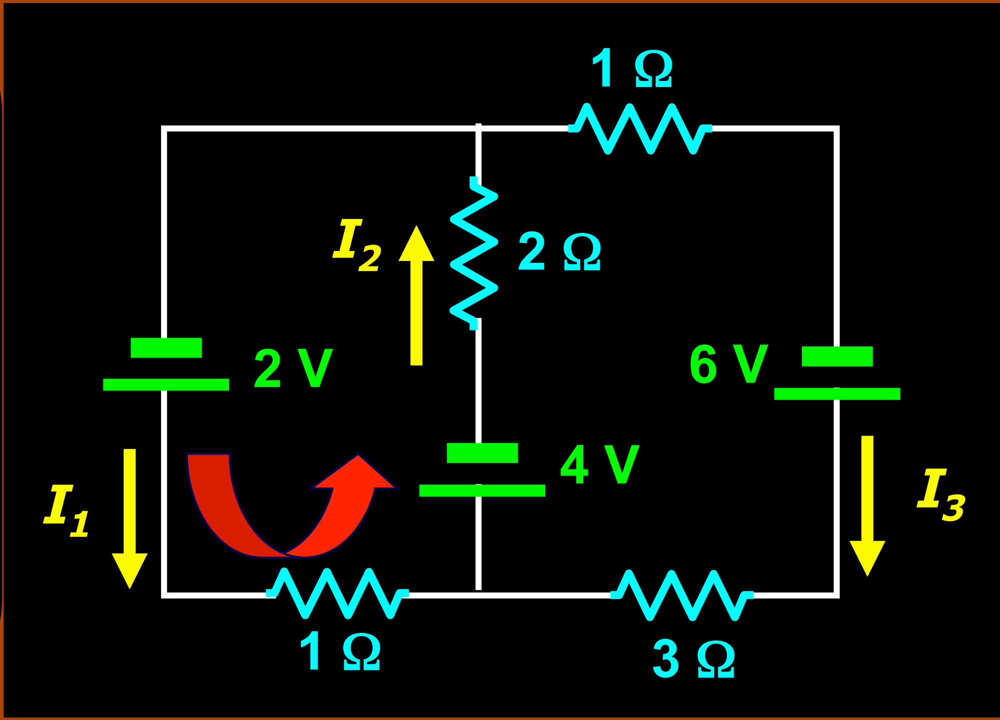


ConcepTest 19.10 More Kirchhoff's Rules

Which of the equations is valid for the circuit below?

1) $2 - I_1 - 2I_2 = 0$
2) $2 - 2I_1 - 2I_2 - 4I_3 = 0$
3) $2 - I_1 - 4 - 2I_2 = 0$
4) $I_3 - 4 - 2I_2 + 6 = 0$
5) $2 - I_1 - 3I_3 - 6 = 0$

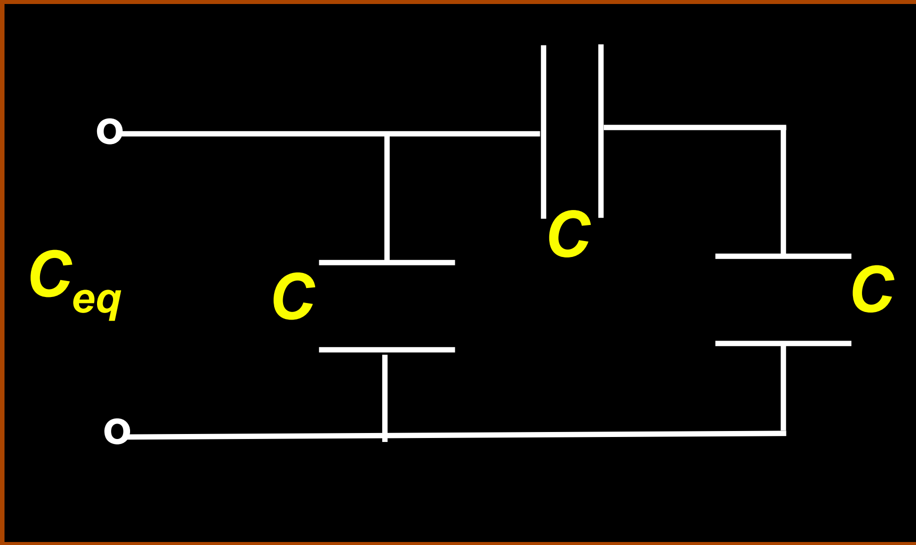
Eqn. 3 is valid for the left loop: The left battery gives +2V, then there is a drop through a 1Ω resistor with current I_1 flowing. Then we go through the middle battery (but from + to – !), which gives –4V. Finally, there is a drop through a 2Ω resistor with current I_2.



ConcepTest 19.11a Capacitors I

What is the equivalent capacitance, C_{eq}, of the combination below?

1) $C_{eq} = 3/2\ C$
2) $C_{eq} = 2/3\ C$
3) $C_{eq} = 3\ C$
4) $C_{eq} = 1/3\ C$
5) $C_{eq} = 1/2\ C$

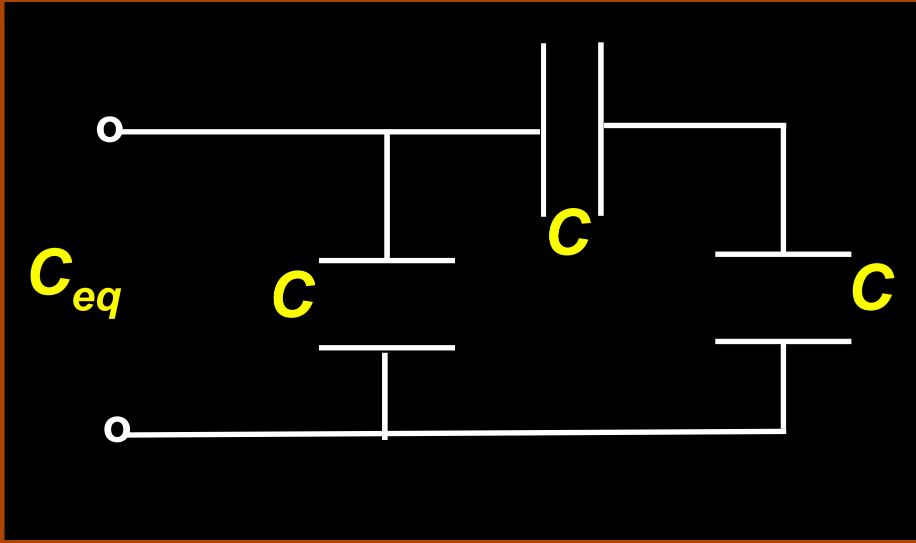


ConcepTest 19.11a Capacitors I

What is the equivalent capacitance, C_{eq} , of the combination below?

1) C_{eq} = 3/2 C
2) C_{eq} = 2/3 C
3) C_{eq} = 3 C
4) C_{eq} = 1/3 C
5) C_{eq} = 1/2 C

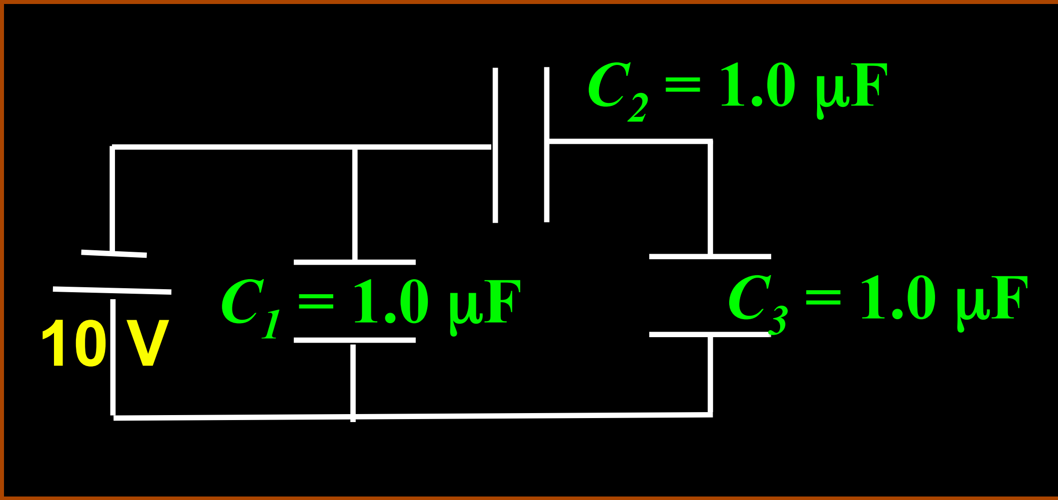
The 2 equal capacitors in **series** add up as **inverses**, giving **1/2 C**. These are **parallel** to the first one, which add up **directly**. Thus, the total equivalent capacitance is **3/2 C**.



ConcepTest 19.11b Capacitors II

How does the voltage V_1 across the first capacitor (C_1) compare to the voltage V_2 across the second capacitor (C_2)?

1) $V_1 = V_2$
2) $V_1 > V_2$
3) $V_1 < V_2$
4) all voltages are zero

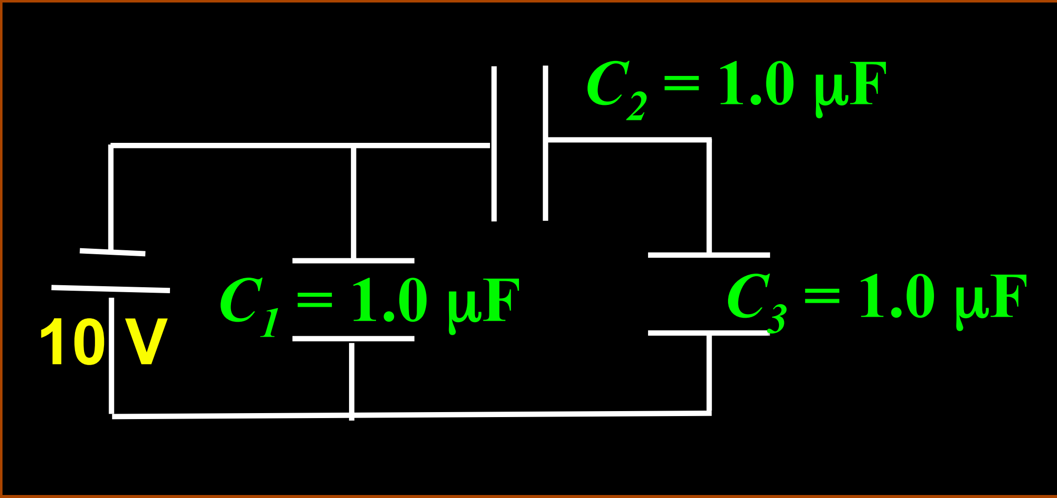


ConcepTest 19.11b Capacitors II

How does the voltage V_1 across the first capacitor (C_1) compare to the voltage V_2 across the second capacitor (C_2)?

1) $V_1 = V_2$
2) $V_1 > V_2$
3) $V_1 < V_2$
4) all voltages are zero

The voltage across C_1 is 10 V. The combined capacitors C_2+C_3 are parallel to C_1. The voltage across C_2+C_3 is also 10 V. Since C_2 and C_3 are in series, their voltages add. Thus the voltage across C_2 and C_3 each has to be 5 V, which is less than V_1.

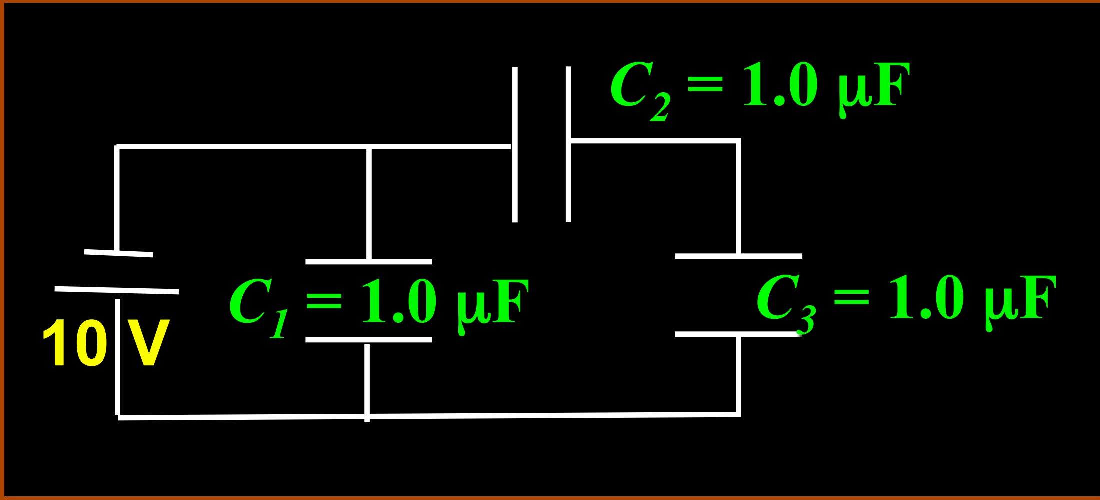


Follow-up: What is the current in this circuit?

ConcepTest 19.11c Capacitors III

How does the charge Q_1 on the first capacitor (C_1) compare to the charge Q_2 on the second capacitor (C_2)?

1) $Q_1 = Q_2$
2) $Q_1 > Q_2$
3) $Q_1 < Q_2$
4) all charges are zero



ConcepTest 19.11c Capacitors III

How does the charge Q_1 on the first capacitor (C_1) compare to the charge Q_2 on the second capacitor (C_2)?

1) $Q_1 = Q_2$
2) $Q_1 > Q_2$
3) $Q_1 < Q_2$
4) all charges are zero

We already know that the voltage across C_1 is 10 V and the voltage across C_2 and C_3 each is 5 V. Since $Q = CV$ and C is the **same** for all the capacitors, then **since** $V_1 > V_2$ therefore $Q_1 > Q_2$.