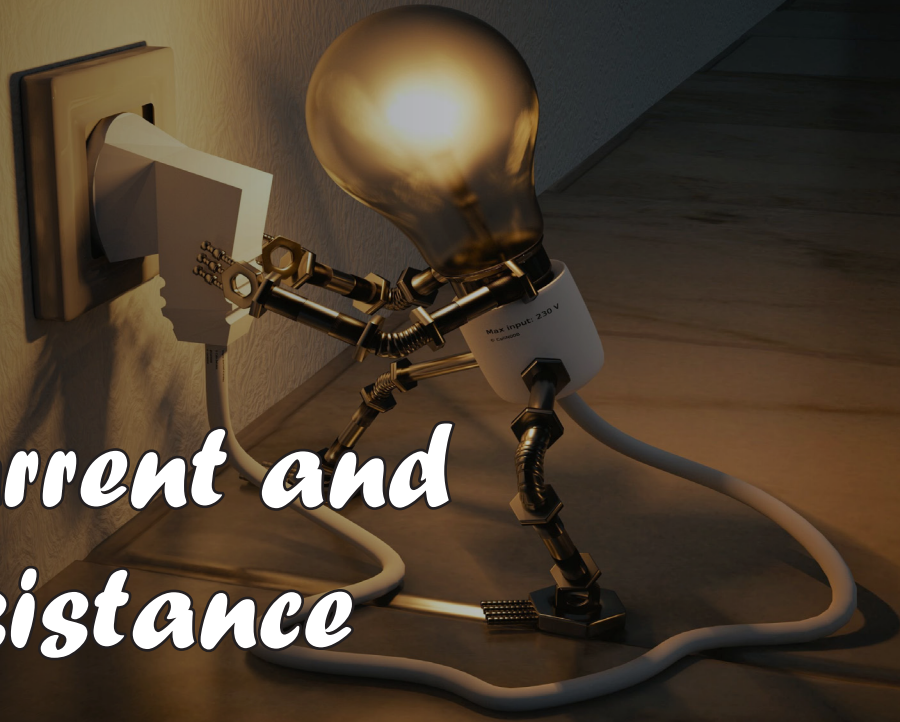




Unit

Current and resistance



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Energy and Power in Electric Circuits



Electric Current

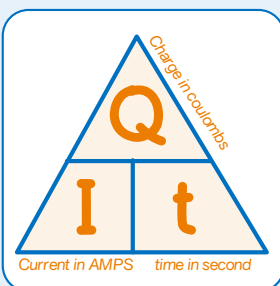
Electric current (I)

is the net flow of charge (dq) passes a point during time interval (dt).

$$I = \frac{dq}{dt}$$

The ampere (A)

is the unit of current, equal to 1 coulomb per second ($1 \text{ A} = 1 \text{ C/s}$).



so electrical charge can be determined by:

$$q = \int dq = \int_0^t i dt'$$

- Electrical charge is an integral multiplication of electron charge: $Q = N \times e$ — $e = -1.602 \times 10^{-19} \text{ C}$

Charge Conservation

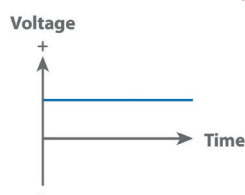
The total charge entering a conductor equals the total charge leaving it. Charge is never lost.

Types of Electric Current

1

Direct Current (DC)

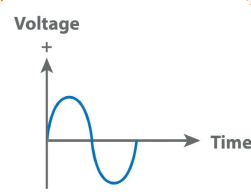
The current flows in one direction only. Sources include batteries.



2

Alternating Current (AC)

The current periodically changes direction. Sources include generators.

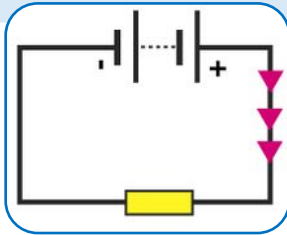




current direction: Conventional vs. Electron Current

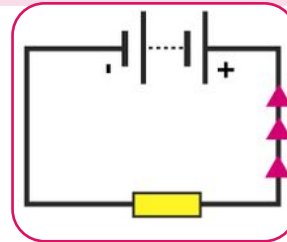
Electron Current

The actual flow of electrons (from negative to positive).



Conventional Current

The historical convention, where we assume positive charge flows (from positive to negative).



Questions

1 Which of the following is correct about the conventional direction of the current?

- A In the same direction of the electron flow.
- B In the opposite direction of the electric field that causes the charges to flow.
- C Always from the negative to the positive terminals of the battery.
- D Has the same direction as the current density.

2 3.8×10^{21} electrons pass a specific point of a uniform conductor during 240 s, what is the current represented by this charge?

- A 0.54 A
- B 1.58 A
- C 2.536 A
- D 3.16 A

3 Determine the current flowing through a conductor at $t=3$ s if the charge flow is given by $q(t)=(6t^2+3t-4)\text{C}$.

- A 15 A B 27 A
C 39 A D 48 A

4 A current flowing through a conductor is given by $i(t)=(3t^2+4)\text{A}$, how much charge passes through a point of this conductor during the interval $t=0$ s to $t=3$ s?

- A 18.2 C B 24.8 C
C 39.0 C D 41.0 C

5 A nurse wants to administer $80\text{ }\mu\text{g}$ of dexamethasone using an iontophoresis device that applies a current of 0.14 mA . If the application rate is $650\text{ }\mu\text{g/C}$, how long does the administration take?

- A 0.879 s B 1.19 s
C 1.59 s D 2.09 s

6 How many protons are in a beam carrying 11 mA of current, traveling close to the speed of light around the 6.3 km circumference of the Tevatron ring?

.....
.....



Current Density

Current density (J)

is the amount of electric current (I) flowing per unit cross-sectional area (A) of a conductor.

$$J = \frac{I}{A}$$

- The direction of J is the same as the direction of the flow of positive charges .
- unit Amperes per square meter (A/m^2).
- the relation between current density and current intensity can also be written as an integration form

$$i = \int \vec{J} \cdot d\vec{A}$$

7

An aluminum wire with a diameter of 0.85 mm carries a constant current of 2.10 A. What is the current density?

- A $3.67 \times 10^6 A/m^2$ B $1.08 \times 10^6 A/m^2$
 C $2.10 \times 10^{-3} A/m^2$ D $1.83 \times 10^7 A/m^2$

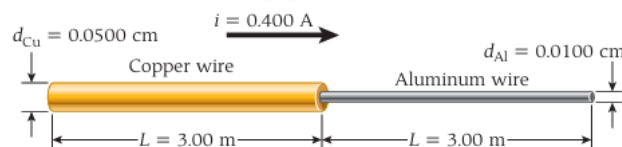
8

Which of the following is the best definition of current density?

- A The total amount of charge flowing through a conductor.
 B The rate at which charge flows through a conductor.
 C The amount of current flowing per unit cross-sectional area of a conductor.
 D The electric potential difference across a conductor.

9

A copper wire has a diameter $d_{Cu} = 0.05 \text{ cm}$, is 3.0 m long, the copper wire is attached to an equal length of aluminium wire with a diameter $d = 0.01 \text{ cm}$. A current of 0.4 A flows through the copper wire.



- What is the ratio of the current densities in the two wires, $\frac{J_{Cu}}{J_{Al}}$?

.....

.....

10

Same current flows through two conductors. The area of the first conductor is equal to one-third of the second one, What is the ratio of their current density J_1/J_2 ?

A $J_1/J_2=3$

B $J_1/J_2=1/3$

C $J_1/J_2=9$

D $J_1/J_2=1/9$

11

The total charge (q) passing through a conductor with a circular cross-section of radius 0.5 mm is given by the equation $q = 2t^3 + 5t$, where q is in coulombs and t is in seconds. What is the magnitude of the current density (J) in the conductor at $t = 2$ seconds?

.....

12

Which of the following is **not true** for current density (j) and current (i)?

A $i = \int \vec{j} \cdot d\vec{A}$

B Unit of current density equal to Ampere per Meter

C $j = i/A$

D in the same direction of current intensity.

.....



Section 3 : Resistivity and Resistance

Resistance (R):

The opposition to the flow of electric current in a specific object or device. It depends on both the material and the object's geometry (length and cross-sectional area).

- **Units:** ohms (Ω).
- For a conductor with uniform resistivity, the resistance is:

$$R = \frac{\rho L}{A}$$

Diagram illustrating the formula for Resistance (R):

- R is Resistance (Ω)
- ρ is Resistivity ($\Omega \cdot m$)
- L is the length (m)
- A is the cross-sectional area (m^2)

Conductance (G):

The reciprocal of resistance. It measures how easily current flows through a material or device.

- **Units:** siemens (S)

$$G = \frac{1}{R}$$

Resistivity (ρ):

A measure of how strongly a material opposes the flow of electric current. It depends on the material itself.

- **unit:** is ($\Omega \cdot m$)

Conductivity (σ):

The reciprocal of resistivity.

- **Units:** siemens per meter (S/m) or $\Omega^{-1} \cdot m^{-1}$

$$\sigma = \frac{1}{\rho}$$



Note

- Good conductors have low resistivity (and high conductivity).
- Insulators have high resistivity (and low conductivity).
- Both ρ , σ depend on the material type and temperature.
- Resistance increases with length and decreases with cross-sectional area.

Unit 5

1 What is the resistance of a 100.0 m copper wire with a diameter of 2.053 mm? (Resistivity of copper = $1.72 \times 10^{-8} \Omega\text{m}$)³

A 0.18 Ω

B 0.28 Ω

C 0.52 Ω

D 0.48 Ω

2 A particular wire has a diameter of 1.7 mm and a length of 1.3 m. If its resistance is 15 m Ω , what is the resistivity of the metal from which it is made?

A $1.0 \times 10^{-7} \Omega\text{m}$

B $2.6 \times 10^{-8} \Omega\text{m}$

C $4.4 \times 10^{-6} \Omega\text{m}$

D $1.8 \times 10^{-5} \Omega\text{m}$

3 If the diameter of the wire in is doubled, its resistance will

A increase by a factor of 4.

B increase by a factor of 2.

C stay the same.

D decrease by a factor of 4.

4 If the area of a wire decrease to half, its resistance will:

A Increase by a factor of 4

B Increase by a factor of 2

C Stay the same

D Decrease by a factor of 4

5 Which of the following wires has the greatest resistance, assuming they are all made of the same material and are at the same temperature?

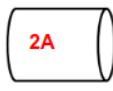
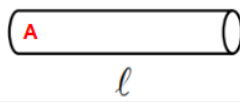
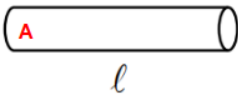
A 

B 

C 

D 

- 6 Rank the following wires from 1 to 4 based on their resistance, with 1 being the wire with the lowest resistance

$\frac{\ell}{2}$ 	$\frac{\ell}{2}$ 		
Cu	Cu	Fe	Cu

- 7 Two conductors are made of the same material and have the same length L . Conductor A is a hollow tube with inside diameter 2.00 mm and outside diameter 3.00 mm; conductor B is a solid wire with radius R_B . What value of R_B is required for the two conductors to have the same resistance measured between their ends?

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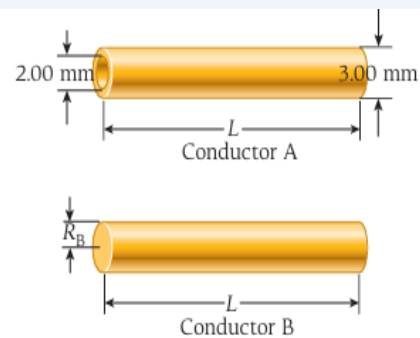
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- 8 A rectangular wafer of pure silicon, with resistivity $\rho = 2300 \Omega \cdot \text{m}$, measures 2.00 cm by 3.00 cm by 0.0100 cm. Find the maximum resistance of this rectangular wafer between any two faces.

.....

- 9 Two cylindrical wires have the same resistance. If the length of wire 2 is twice that of wire 1, what is the ratio of their cross-sectional areas (A_1/A_2)?

A 2

B 4

C 0.5

D 0.25

10 How will the resistance of a copper wire change if its length is tripled (without changing in its cross-sectional area)?

- A The resistance will decrease by $1/3$
- B The resistance will increase by 3 times
- C The resistance will decrease by $1/9$
- D The resistance will not change.

11 A 100.0 m long copper wire has a resistance of 0.28Ω . The resistivity of copper is $1.72 \times 10^{-8} \Omega m$. What is the radius of the wire?

.....

.....

12 What is the resistance of the 80.0 m standard copper wire with section area $A = 5.2612 \times 10^{-6} m^2$ $\rho = 1.72 \times 10^{-8} \Omega m$

- | | |
|-----------------|-----------------|
| A 0.26Ω | B 0.62Ω |
| C 0.88Ω | D 0.77Ω |

13 Which of the following wires has the greatest resistance, assuming they are all made of the same material and are at the same temperature?

- A Long and thin wire
- B Medium length and medium thickness wire
- C Short and thick wire
- D Long and thick wire



Section 4 : Electromotive Force (emf) and Ohm's Law

Emf (electromotive force)

is NOT a force, but a **potential difference** created by a device like a battery. Emf is measured in volts (V).



Ohm's Law

- For a simple circuit with an emf source and a resistor, Ohm's Law states

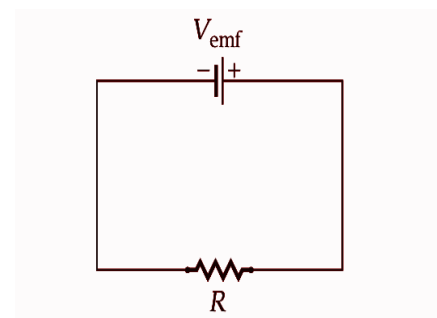
$$\text{the emf (potential difference)} \quad V_{\text{emf}} = i \times R \quad \text{is the resistance}$$

is the current flowing through the circuit



Circuits

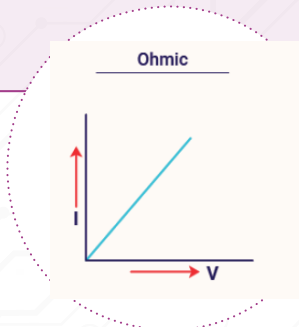
- An electric circuit needs at least one emf source to drive the current.
- The potential difference provided by the emf source creates a potential drop across the resistor.
- The total potential difference in any closed loop within a circuit must be zero (due to conservation of energy).



Ohmic vs. Non-ohmic Resistors

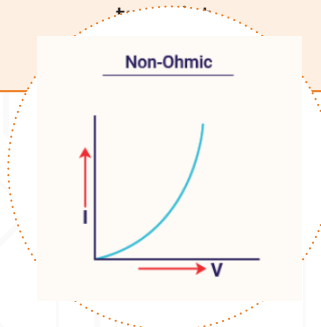
1 Ohmic resistors

Obey Ohm's Law (current is directly proportional to voltage)



2 Non-ohmic resistors

Do not obey Ohm's Law (current is not directly proportional to voltage e.g.,



Unit 5

1 A resistor with $R = 10.0 \, \Omega$ is connected across a source of emf with potential difference $V_{\text{emf}} = 1.50 \, \text{V}$. What is the current flowing through the circuit?

- A** 0.15 A **B** 1.5 A **C** 6.67 A **D** 15 A

2 A rechargeable battery is rated at (3.0 mAh). What is the total charge in Coulombs (C) that the battery can deliver when fully charged? (mAh means milliamperere-hour)

- A** 10.8 C **B** 3.6 C **C** 3.0 C **D** 1.6 C

3 Which of the following wires has the largest current flowing through it? ($\rho_{\text{copper}} = 1.72 \times 10^{-8} \, \Omega\text{m}$)

- A** 1 m long copper wire of diameter 1 mm connected to a 10-V battery
B 0.5-m long copper wire of diameter 0.5 mm connected to a 5-V battery
C 2-m long copper wire of diameter 2 mm connected to a 20-V battery
D 1 m long copper wire of diameter 0.5 mm connected to a 5-V battery

4 A 20 m long and 1.0 mm diameter copper wire of resistivity $1.7 \times 10^{-8} \, \Omega\text{m}$ is connected across a 3.0 V battery. What is the current through the?

.....

.....

5 A voltage difference of (12.0 V) was applied between the two ends of a wire whose length is (1000 m) and its cross-sectional area is 4.5mm^2 , a current of $(3.20 \times 10^{-3} \, \text{A})$ flow through it, find the resistivity of the wire.

- A** $1.72 \times 10^{-8} \, \Omega\text{m}$ **B** $1.68 \times 10^{-5} \, \Omega\text{m}$
C $7.12 \times 10^{-8} \, \Omega\text{m}$ **D** $6.18 \times 10^{-8} \, \Omega\text{m}$

6 A potential difference of 12.0 V is applied across a wire of cross-sectional area 4.50 mm^2 and length 1000. km. The current passing through the wire is $3.20 \times 10^{-3} \text{ A}$

A What is the resistance of the wire?

.....

B What is the resistivity of wire?

.....

7 A copper wire has radius $r = 0.0250 \text{ cm}$, is 3.00 m long, has resistivity $\rho = 1.72 \times 10^{-8} \Omega \text{ m}$, and carries a current of 0.400 A.

A What is the resistance, R , of the wire?

.....

B What is the electric potential difference, ΔV , across the wire?

.....

8 A potential difference of 2.0 V is applied across a wire. The current through the wire is 1mA. What is the resistance of the wire?

A 2Ω

B $2 \times 10^2 \Omega$

C $2 \text{ K}\Omega$

D $20 \text{ K}\Omega$

9 Which wire has the highest current when applying the same potential difference?



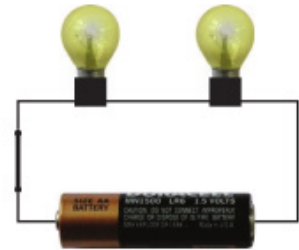


Section 5 : Series Connection



Current in Series Circuits:

- Electric charge in the circuit has **only one path** to take
- the same amount of charge entering the first lamp must exit that lamp and go to the other.
- The current has one value in each part of the electrical circuit.**



$$I_{\text{source}} = I_1 = I_2$$



Voltage Difference in Series Connection:

1

The potential difference across any source of energy (source ΔV) is equal to the sum of the potential differences across lamp 1 and lamp 2. This is represented by the following equation:

$$V_{\text{emf}} = \Delta V_1 + \Delta V_2$$

2

The potential difference across the resistor is the product of the current and the electrical resistance.

$$\text{First lamp } \Delta V_1 = IR_1$$

$$\text{second lamp } \Delta V_2 = IR_2$$

3

Where total voltage :

$$\Delta V_{\text{source}} = IR_1 + IR_2$$

4

The current passing through the circuit is represented by the following equation:

$$I = \frac{\Delta V}{(R_1 + R_2)} \quad \text{or} \quad I = \frac{\Delta V_{\text{emf}}}{R_{\text{eq}}}$$



Equivalent Resistance of a Series Circuit:

- The equivalent resistance of resistors connected in series is equal to the sum of the individual electrical resistance values

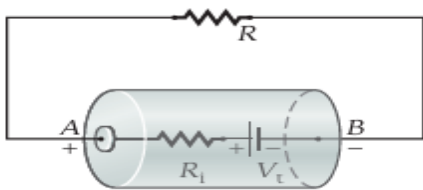
$$R_{\text{eq}} = R_1 + R_2 + \dots + R_n$$

$$R_{\text{eq}} = \sum_{i=1}^n R_i$$

**Note****When connect resistors in series**

- The equivalent resistance of resistors connected is always **greater** than the value of any individual resistance.
- If the battery voltage does not change, adding **more resistors** in **series** will **always reduce the current value**.
- If one of the resistors is damaged or disconnected from the circuit, the current in the circuit will become zero.
- For N equal resistors with a value of R, the equivalent resistance is: $R_{eq} = N.R$
- The current passing through a series circuit is equal to the potential difference of the power source divided by the equivalent resistance:

$$I = \Delta V_{emf} / R_{eq}$$

**Internal Resistance of a Battery**

Batteries have internal resistance, which can be modelled as a resistor in series with the circuit. This causes the battery's terminal voltage to drop when current flows:

$$V_t = iR_{eq} = i(R + R_i)$$

Batteries

- nonideal with internal resistance
- ideal zero internal resistance

1

A battery has a voltage of 48 V. When a 15Ω resistor is connected to the battery, the terminal voltage drops to 45.4 V. What is the internal resistance of the battery?

A 0.86Ω B 1.0Ω C 1.2Ω D 1.3Ω

2 Consider a battery that has $V_t = 12.0 \text{ V}$ when it is not connected to a circuit. When a 10Ω resistor is connected with the battery, the potential difference across the battery's terminals drops to 10.9 V . What is the internal resistance of the battery?

- A 0.11Ω B 0.91Ω
 C 1.1Ω D 9.1Ω

3 When a battery is connected to a 100Ω resistor, the current is 4.00 mA . When the same battery is connected to a 400Ω resistor, the current is 1.01 mA . Find the emf supplied by the battery and the internal resistance of the battery.

.....

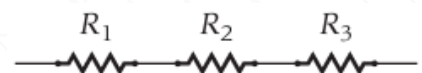
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4 A light bulb is connected to a source of emf. There is a 6.20 V drop across the light bulb and a current of 4.10 A flowing through the light bulb.

- A What is the resistance of the light bulb?
-
-

5 Three identical resistors R_1 , R_2 , and R_3 are wired together as shown in the figure. The current through R_2 :

- A Is the same as the current through R_1 and R_3
 B Is a third of the current through R_1 and R_3
 C Is twice the sum of the current through R_1 and R_3
 D Is three times the current through R_1 and R_3



6 You make a series combination using a resistor (A) having a very large resistance and a resistor (B) having a very small resistance. The equivalent resistance of this combination will be:

- A Slightly greater than the resistance of resistor A
- B Slightly less than the resistance of resistor A
- C Slightly greater than the resistance of resistor B
- D Slightly less than the resistance of resistor B

7 A resistor of unknown resistance and a 35Ω resistor are connected across a 120V emf device in such a way that an 1A current flows from battery. What is the value of the unknown resistance?

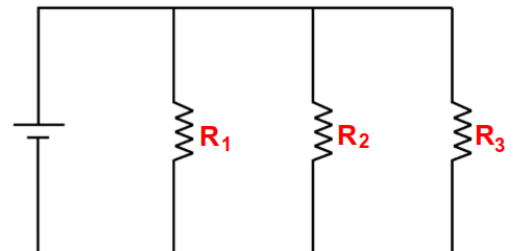
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Section 6 : Parallel Circuits

- Observe the illustrated electrical circuit, you'll find that the voltage difference remains constant while the current is distributed across the paths.



Voltage Difference in Parallel Connection

- The branches are connected in parallel with the battery, so the voltage difference across each branch is equal to the voltage difference of the source (battery).



Current in Parallel Circuits

- The total current in a parallel circuit is equal to the sum of the currents passing through each path, while the voltage difference is the same in each path.
- Each resistor has its own current because, in the case of constant voltage, the current is inversely proportional to the resistance. The current of each resistor can be obtained by:

$$I_{\text{source}} = I_1 + I_2 + I_3$$

$$I_1 = \frac{\Delta V}{R_1}$$

$$\frac{\Delta V}{R} = \frac{\Delta V}{R_1} + \frac{\Delta V}{R_2} + \frac{\Delta V}{R_3}$$

Equivalent Resistance of a Parallel Circuit

The equivalent resistance (R_{eq}) of resistors connected in parallel is the inverse of the sum of the inverses of the individual resistances.

$$\frac{1}{(R_{eq})} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

OR

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

- In the case of two parallel resistors R_1 and R_2 , this relationship can be used:

$$R_{eq} = \frac{R_1 \times R_2}{R_1 + R_2}$$

- For equal resistors with a value of R , the equivalent resistance is:

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



Note

in parallel connection:

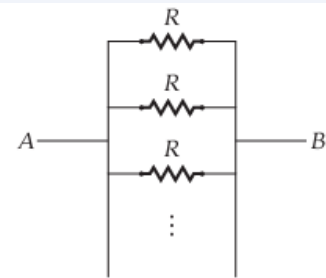
- The value of the equivalent resistance is less than the value of any individual resistor.
- Adding more resistors in parallel will always increase the value of the current coming from the battery because each new resistor provides an additional path for the current.
- The current passing through a parallel circuit is equal to the voltage difference of the power source divided by the equivalent resistance.
- If one of the resistors is damaged or disconnected from the circuit, the current in the remaining branches will not be affected, but it will reduce the total current through the power source.

8 You make a parallel connection between two resistors, resistor A having a very large resistance and resistor B having a very small resistance. The equivalent resistance for this combination will be

- A slightly greater than the resistance of resistor A
- B slightly less than the resistance of resistor A.
- C slightly greater than the resistance of resistor B.
- D slightly less than the resistance of resistor B

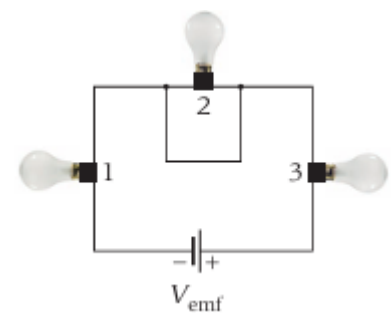
9 As more identical resistors, R , are added to the circuit shown in the figure, the resistance between points A and B will

- A increase.
- B stay the same.
- C decrease.
- D change in an unpredictable manner.

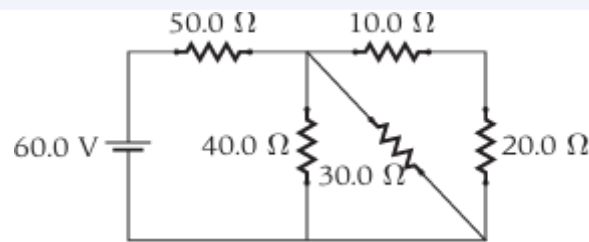


10 Three light bulbs are connected in series with a battery that delivers a constant potential difference, V_{emf} . When a wire is connected across light bulb 2 as shown in the figure, light bulbs 1 and 3

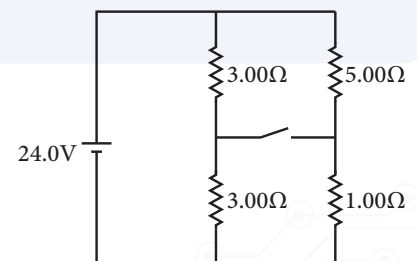
- A burn just as brightly as they did before the wire was connected.
- B burn more brightly than they did before the wire was connected.
- C burn less brightly than they did before the wire was connected.
- D go out



- 11 What is the equivalent resistance of the five resistors in the circuit in the figure?



- 12 What is the current in the circuit shown in the figure when the switch is (a) open and (b) closed?



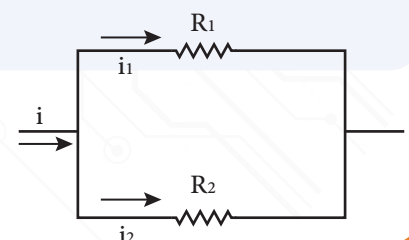
- 13 For the circuit shown in the figure, $R_1 = 6.00 \, \Omega$, $R_2 = 6.00 \, \Omega$, $R_3 = 2.00 \, \Omega$, $R_4 = 4.00 \, \Omega$, $R_5 = 3.00 \, \Omega$, and the potential difference is 12.0 V.

A What is the equivalent resistance for the circuit?

B What is the current through R_5 ?

C What is the potential drop across R_3 ?

- 14 For the connections shown in the figure, determine the current i_1 , in terms of the total current, i , and R_1 , and R_2 .



15

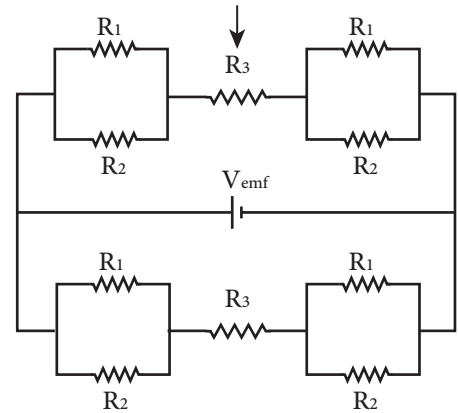
In the circuit shown in the figure, $R_1 = 3.00 \, \Omega$, $R_2 = 6.00 \, \Omega$, $R_3 = 20.0 \, \Omega$, and $V_{\text{emf}} = 12.0 \, \text{V}$

- A** Determine a value for the equivalent resistance.

.....

- B** Calculate the magnitude of the current flowing through R_3 on the top branch of the circuit (marked with a vertical arrow).

.....



16

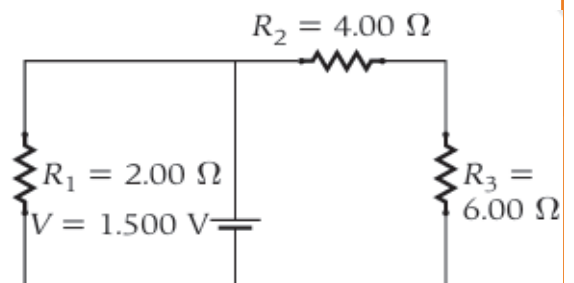
A battery with $V = 1.500 \, \text{V}$ is connected to three resistors as shown in the figure.

- A** Find the potential drop across each resistor.

.....

- B** Find the current in each resistor

.....



17

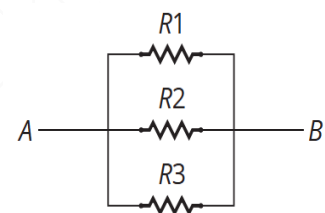
Three identical resistors, R_1 , R_2 , and R_3 , are wired together as shown in the figure. An electric current is flowing from point A to point B. The current flowing through R_2

- A** is the same as the current through R_1 and R_3 .

- B** is a third of the current through R_1 and R_3 .

- C** is twice the sum of the current through R_1 and R_3 .

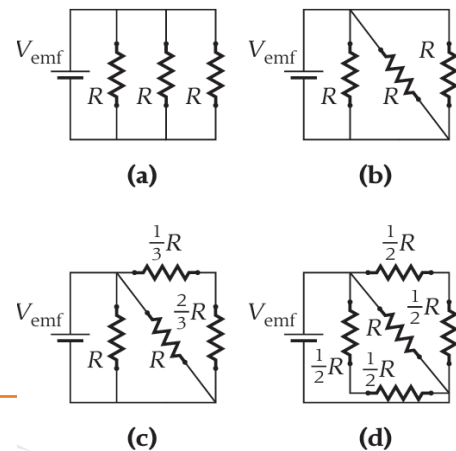
- D** is three times the current through R_1 and R_3 .



18

Which combination of resistors has the highest equivalent resistance?

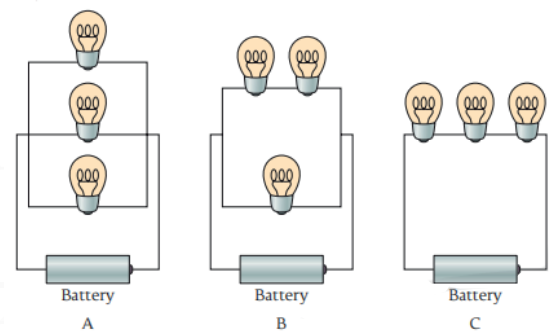
- A** combination (a)
- B** combination (b)
- C** combination (c)
- D** combination (d)
- e** The equivalent resistance is the same for all four.



19

Which of the arrangements of three identical light bulbs shown in the figure has the highest resistance?

- A** A
- B** B
- C** C
- D** All three have equal resistance.
- e** A and C are tied for having the highest resistance.



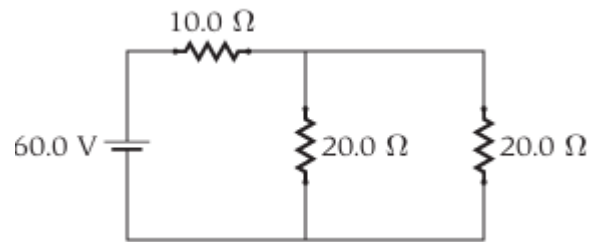
20

Which of the following is an incorrect statement?

- A** The currents through electronic devices connected in series are equal.
- B** The potential drops across electronic devices connected in parallel are equal.
- C** More current flows across the smaller resistance when two resistors are connected in parallel.
- D** More current flows across the smaller resistance when two resistors are connected in series.

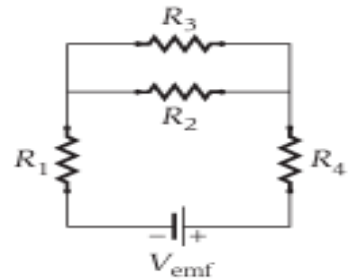
21

What is the current in the $10.0\ \Omega$ resistor in the circuit in the figure?



22

The circuit shown in Figure a has four resistors and a battery with $V_{\text{emf}} = 149\text{ V}$. The values of the four resistors are $R_1 = 17.0\ \Omega$, $R_2 = 51.0\ \Omega$, $R_3 = 114.0\ \Omega$, and $R_4 = 55.0\ \Omega$. What is the magnitude of the potential drop across R_2 ?



23

When a 40.0 V emf device is placed across two resistors in series, a current of 10.0 A flows through each of the resistors. When the same emf device is placed across the same two resistors in parallel, the current through the emf device is 50.0 A . What is the magnitude of the larger of the two resistances?



Electrical Power

Electrical energy

is transformed into other forms of energy within different devices. For example, it is transformed into light energy in a light bulb.

- It's measured in **watts (W)**, which are equivalent to **joules per second (J/s)**.
- Devices like batteries act as sources of power, while devices like light bulbs and heaters consume power.
- power is calculated as the product of the current (I) and the potential difference (ΔV):
- Using Ohm's Law ($\Delta V = IR$, where R is resistance), we can express power in a couple of other useful ways:

$$P = I \Delta V$$

$$P = I^2 R$$

$$P = \Delta V^2 / R$$

- These different formulations are helpful when comparing the power dissipated by resistors or light bulbs connected in series ($I^2 R$) or parallel ($\Delta V^2 / R$) circuits.



Key takeaways:

- Electrical energy consumption, like that measured on your electric bill, is typically measured in kilowatt-hours (**kWh**).
- Energy produced in devices can take different forms. A significant portion of the energy dissipated in bulbs is converted into heat.
- To calculate the cost first : **Watts = (amps) x (volts)**, second **Kilowatt-hours = (watts) x (time in hours)/1000**, last **Cost = (kilowatt-hours) x (electricity rate)**.

1

Two conductors of the same length and radius are connected to the same emf device .If the resistance of one is twice that of the other ,to which conductor is more power delivered?

- A** The conductor with the higher resistance
- B** The conductor with the lower resistance
- C** Both conductors receive the same amount of power
- D** Not enough information to determine

2 A hair dryer consumes 1600 W of power and operates at 110 V .Will the hair dryer trip a circuit breaker designed to interrupt the circuit if the current exceeds 15.0 A?

- A Yes ,the hair dryer will trip the circuit breaker.
- B No ,the hair dryer will not trip the circuit breaker.
- C Not enough information to determine.

What is the resistance of the hair dryer when it is operating?

- A 7.6 Ω
- B 14.5 Ω
- C 24.2 Ω
- D 0.13 Ω

3 Two resistors connected in series with an ideal battery dissipate 100 watts .When the two resistors are connected in parallel with the same battery ,the power dissipated will be:

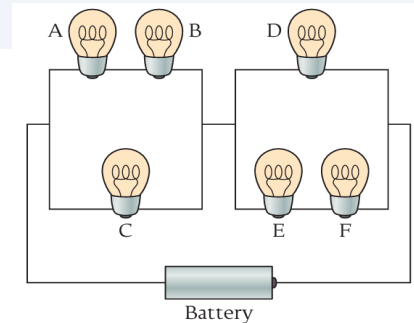
- A 25 W
- B 50 W
- C 400 W
- D 200 W

4 If the current through a resistor is increased by a factor of 2 how does this affect the power that is dissipated?

- A It decreases by a factor of 4.
- B It increases by a factor of 2
- C It decreases by a factor of 8
- D It increases by a factor of 4

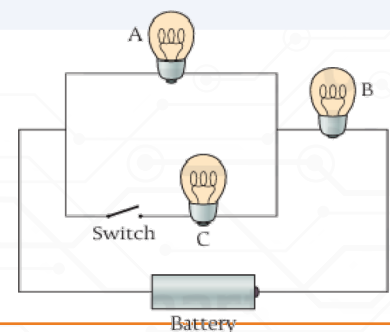
- 5 All of the six light bulbs in the circuit shown in the figure are identical. Which ordering correctly expresses the relative brightness of the bulbs? (Hint: The more current flowing through a light bulb, the brighter it is!)

- A $A = B < C = D < E = F$
- B $A = B = E = F < C = D$
- C $C = D < A = B = E = F$
- D $A = B = C = D = E = F$



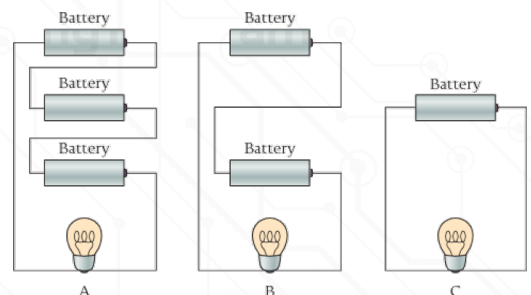
- 6 Three identical light bulbs are connected as shown in the figure. Initially the switch is closed. When the switch is opened, bulb C goes off. What happens to bulbs A and B?

- A Bulb A gets brighter, and bulb B gets dimmer.
- B Both bulbs A and B get brighter.
- C Both bulbs A and B get dimmer.
- D Bulb A gets dimmer, and bulb B gets brighter



- 7 Identical batteries are connected in three different arrangements to the same light bulb as shown in the figure. Assume that the batteries have no internal resistance. In which arrangement will the light bulb shine the brightest?

- A A
- B B
- C C
- D The bulb will have the same brightness in all three arrangements.



8 A circuit consists of a copper wire of length 10.0 m and radius 1.00 mm connected to a 10.0 V battery. An aluminum wire of length 5.00 m is connected to the same battery and dissipates the same amount of power. What is the radius of the aluminum wire?

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9 How much money will a homeowner owe an electric company if he turns on a 100.00 W incandescent light bulb and leaves it on for an entire year? (Assume that the cost of electricity is 0.12 AED/kWh and that the light bulb lasts that long.) The same amount of light can be provided by a 26.000 W compact fluorescent light bulb. What would it cost the homeowner to leave one of those on for a year?

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10 three resistors are connected across a battery as shown in the figure.

a. How much power is dissipated across the three resistors?

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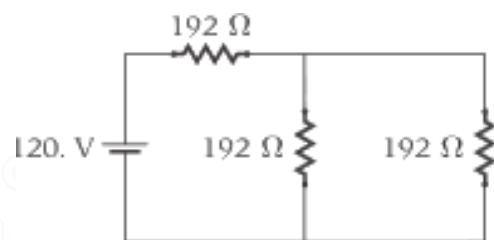
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b. Determine the potential drop across each resistor.

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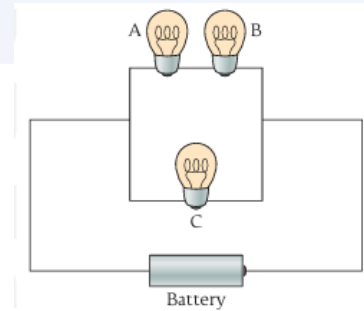
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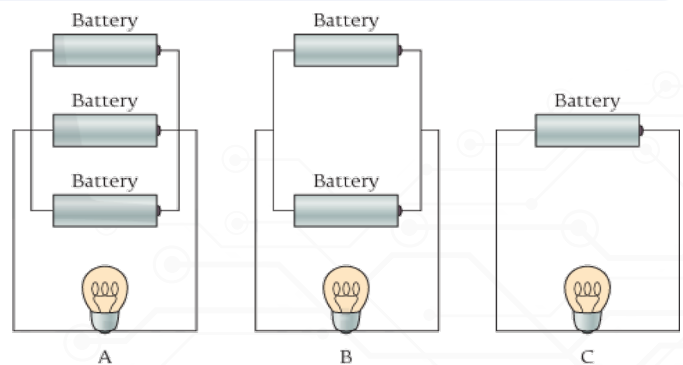
- 11 All three light bulbs in the circuit shown in the figure are identical . Which of the three shines the brightest?

- A A
- B B
- C C
- D A and B



- 12 Identical batteries are connected in three different arrangements to the same light bulb as shown in the figure .Assume that the batteries have no internal resistance .In which arrangement will the light bulb shine the brightest ?

- A A
- B B
- C C
- D The bulb will have the same brightness in all three arrangements.



- 13 Suppose an AAA battery is able to supply 625 mAh before its potential drops below 1.50 V .How long will it be able to supply power to a 5.00 W bulb before the potential drops below 1.50 V

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14

Two resistors with resistances $200\ \Omega$ and $400\ \Omega$ are connected (a) in series and (b) in parallel with an ideal 9.00V battery. Compare the power delivered to the $200\ \Omega$ resistor.

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15

A modern house is wired for 115 V , and the current is limited by circuit breakers to a maximum of 200A . For the purpose of this problem, treat these as DC quantities. Three resistors are connected to a power supply with $V = 110\text{V}$ as shown in the figure.

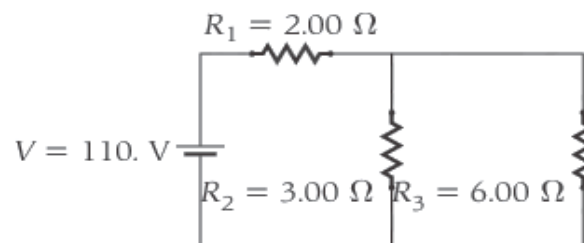
A Find the potential drop across R_3

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B Find the current in R_1 .

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C Find the rate at which thermal energy is dissipated from R_2

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