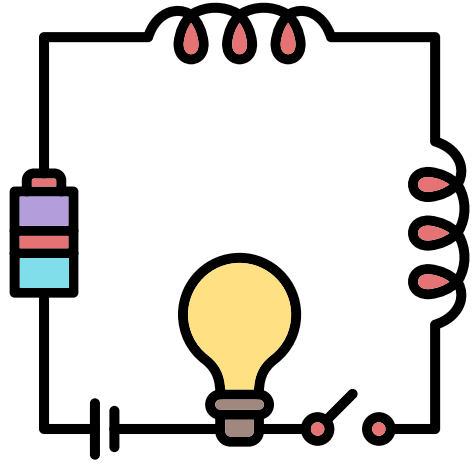
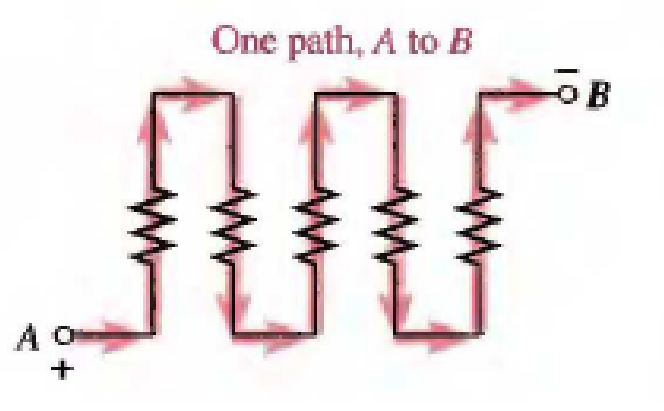
SERIES CIRCUIT

SERIES CIRCUIT

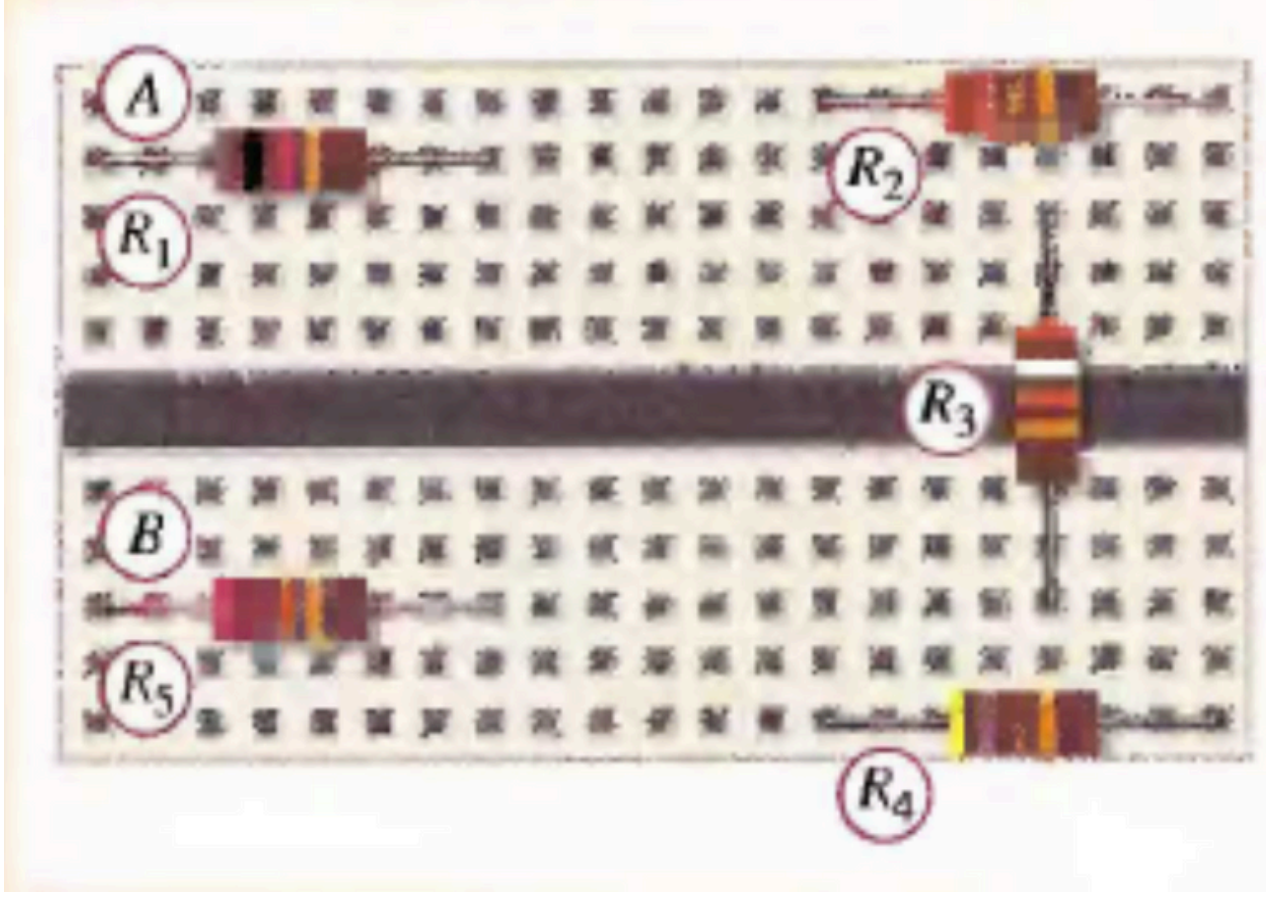
- A **series circuit** provides only one path for current between 2 points so that the current is the same through each series resistor.(no matter how they appear)





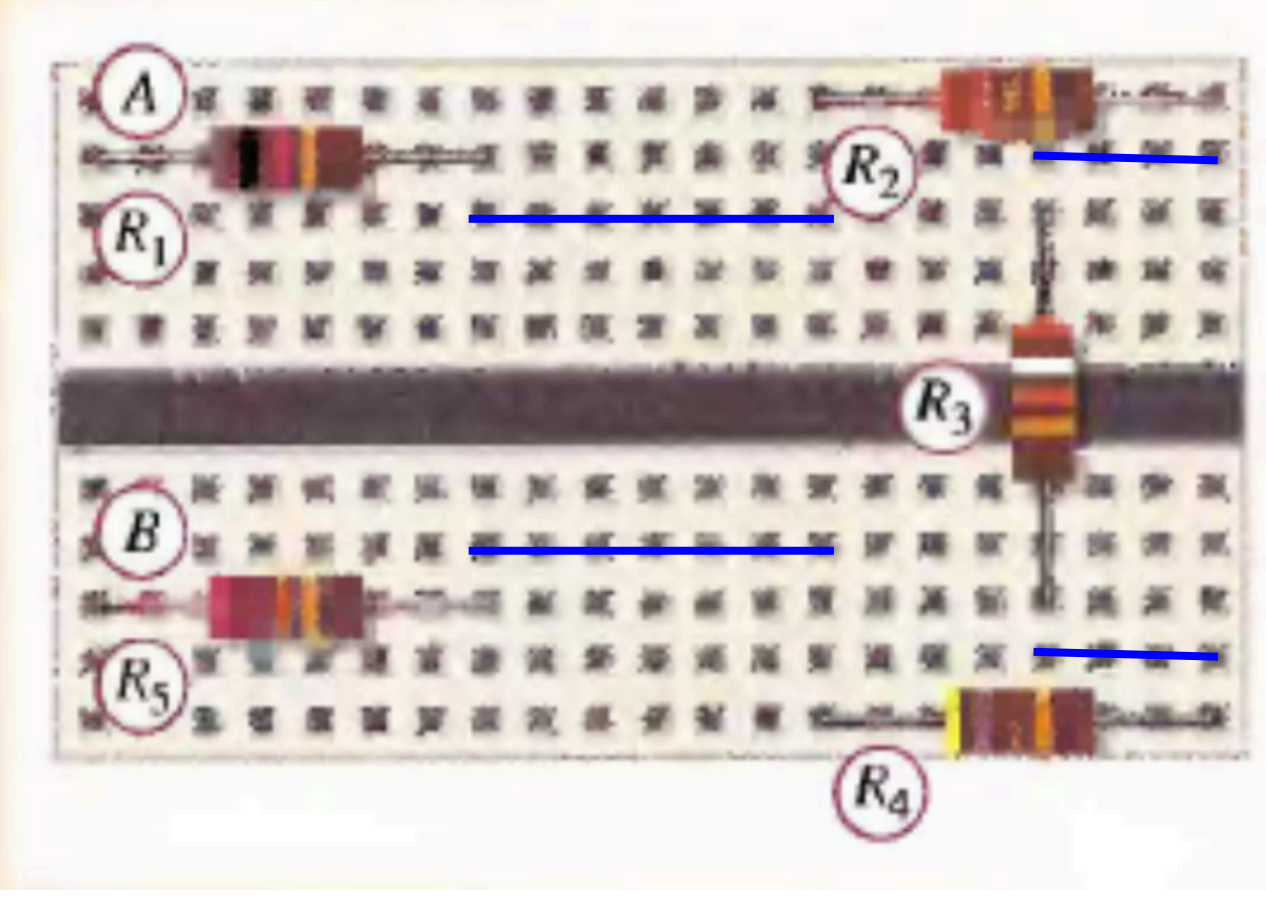
Series Circuit

How to make those resistor series?

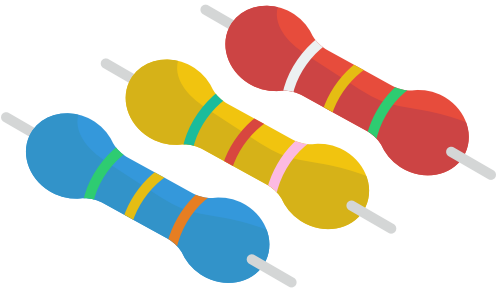


Series Circuit

How to make those resistor series?



use jumper wire to connect & make it series circuit



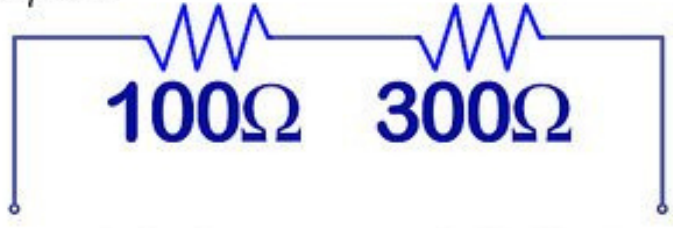
Total of Series Resistance

- The total resistance of series circuit is equal to sum of the resistance of each individual series resistor.

- Example:

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

Example:



$$= 100\Omega + 300\Omega$$

$$= \boxed{400\Omega}$$

Voltage Measurement

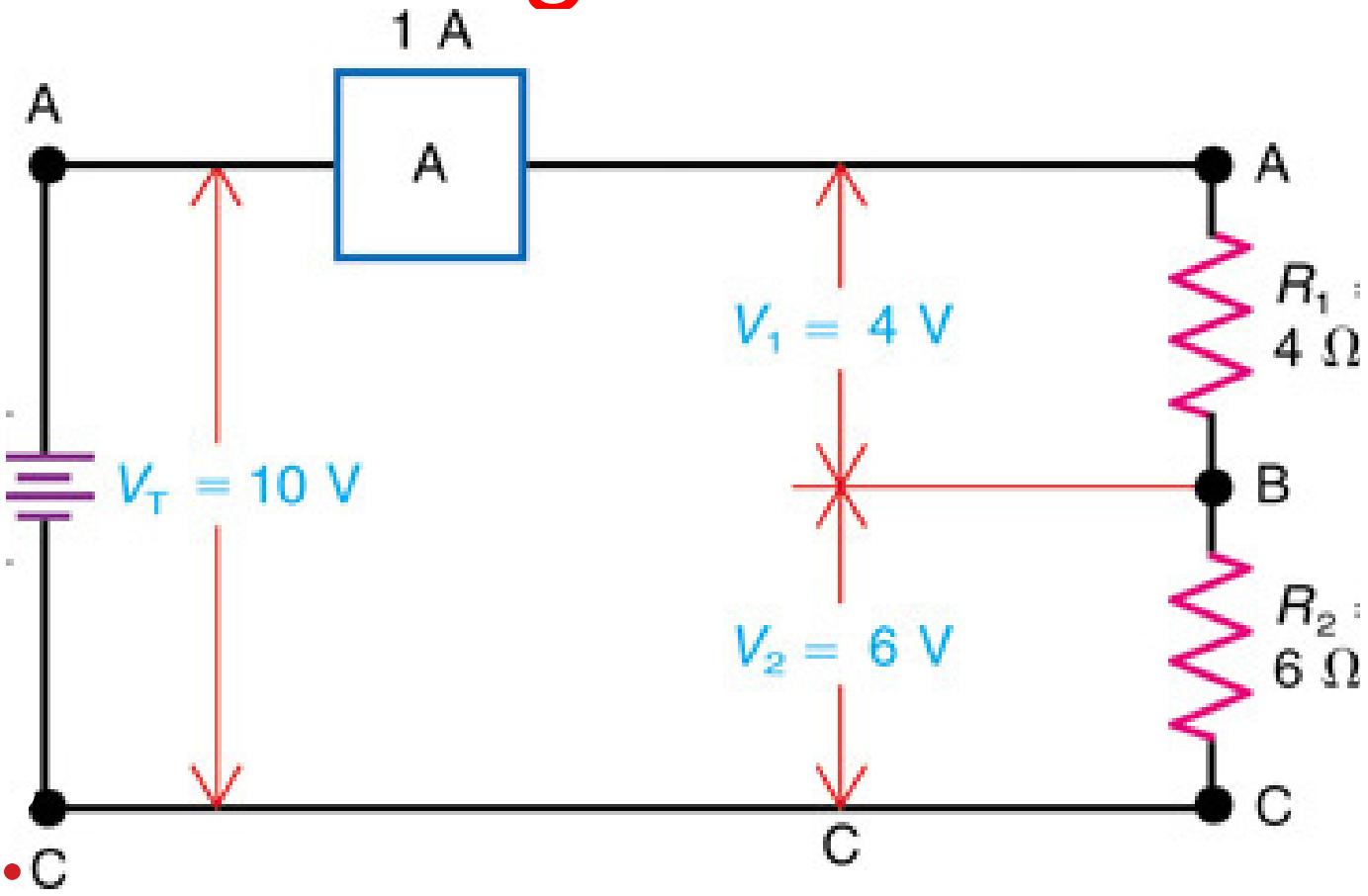
1. Total Voltage in series circuit is also count as sum of the voltage in each resistor

$$VT = V_1 + V_2 + V_3 + \ldots\ldots + VN$$

2. Voltage drop at each resistor:

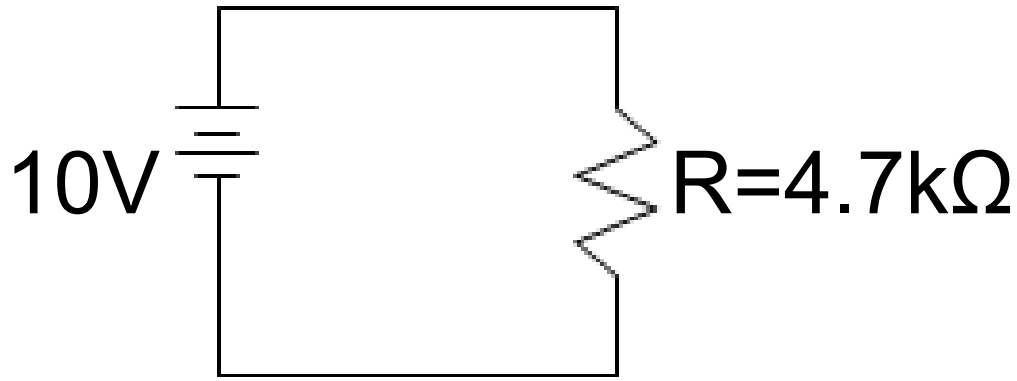
$$VN = IT \times RN$$

Voltage Measurement



Linear Relationship of Current & Voltage

Example 1: Show that if the voltage in the circuit of figure below is increased to three times its persistent value, the current will triple in value.



Linear Relationship of Current & Voltage

Answer:

Concept:
Direct Proportionality in a Circuit
Ohm's Law defines the relationship between Voltage (V), Current (I), and Resistance (R).

Formula:

I=V/R

Key Fact: For a fixed resistance (R), Current (I) is directly proportional to Voltage (V).
If we change V by a factor, I changes by the same factor.

Linear Relationship of Current & Voltage

Answer:

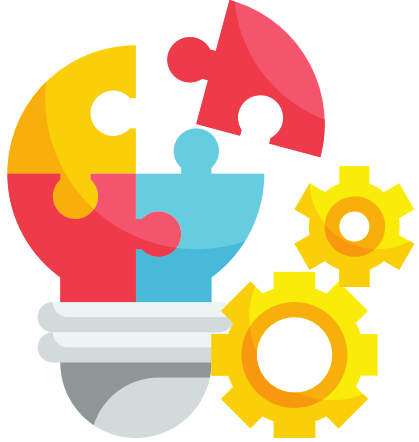
Let:
V1 be the original voltage.
I1 be the original current.
R be the constant resistance.
Step 1: Define Original Current (I1)
$I1=RV1$
Step 2: Define New Voltage (V2)
The voltage is increased to three times its persistent value:
$V2=3V1$

Linear Relationship of Current & Voltage

Answer:

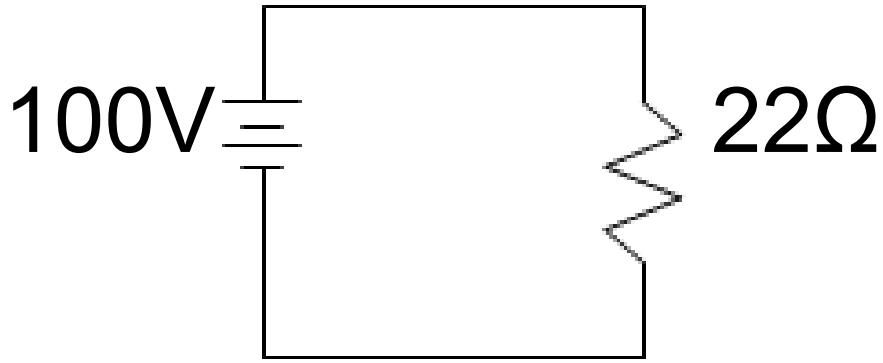
Use Ohm's Law with the new voltage
V2 and the constant resistance R:
$I2=RV2$
Substitute the value of V2 from Step 2:
$I2=R3V1$

Compare New Current (I2) to Original Current (I1):
Factor out the constant '3' from the expression for I2:
$I2=3\times(RV1)$
Since (RV1) is equal to the original current I1 (from Step 1), we conclude:
$I2=3I1$
Conclusion: When the voltage in the circuit is tripled (V2=3V1) and the resistance remains constant, the current flowing through the load triples in value.



Problem Solving

Calculate the current in this circuit



If R is changed to 33 Ω in the same circuit , what is the new value of current.

Problem Solving

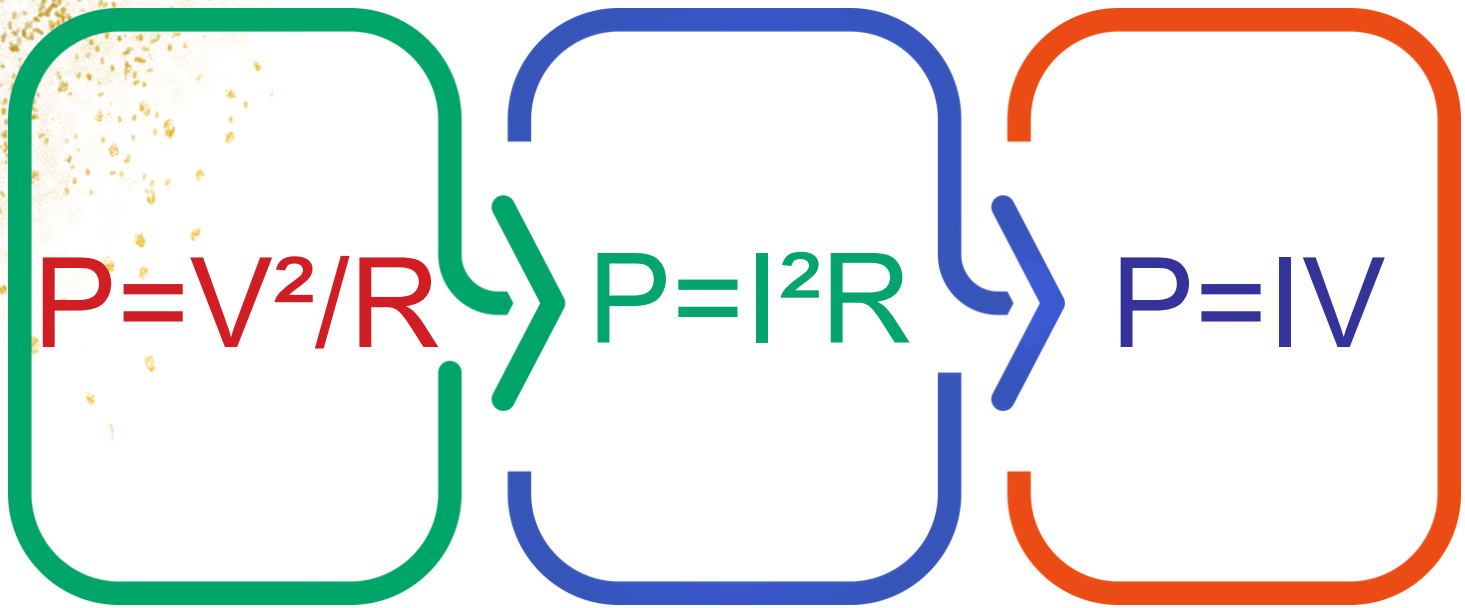
Objective: Find the New Current (I) in the circuit.

Component Symbol Value Unit
Voltage V= 100 V
New Resistance R= 33 Ω
Formula to Use: Ohm's Law (for current)

V=IR

POWER FORMULA

The collision of the e- produce

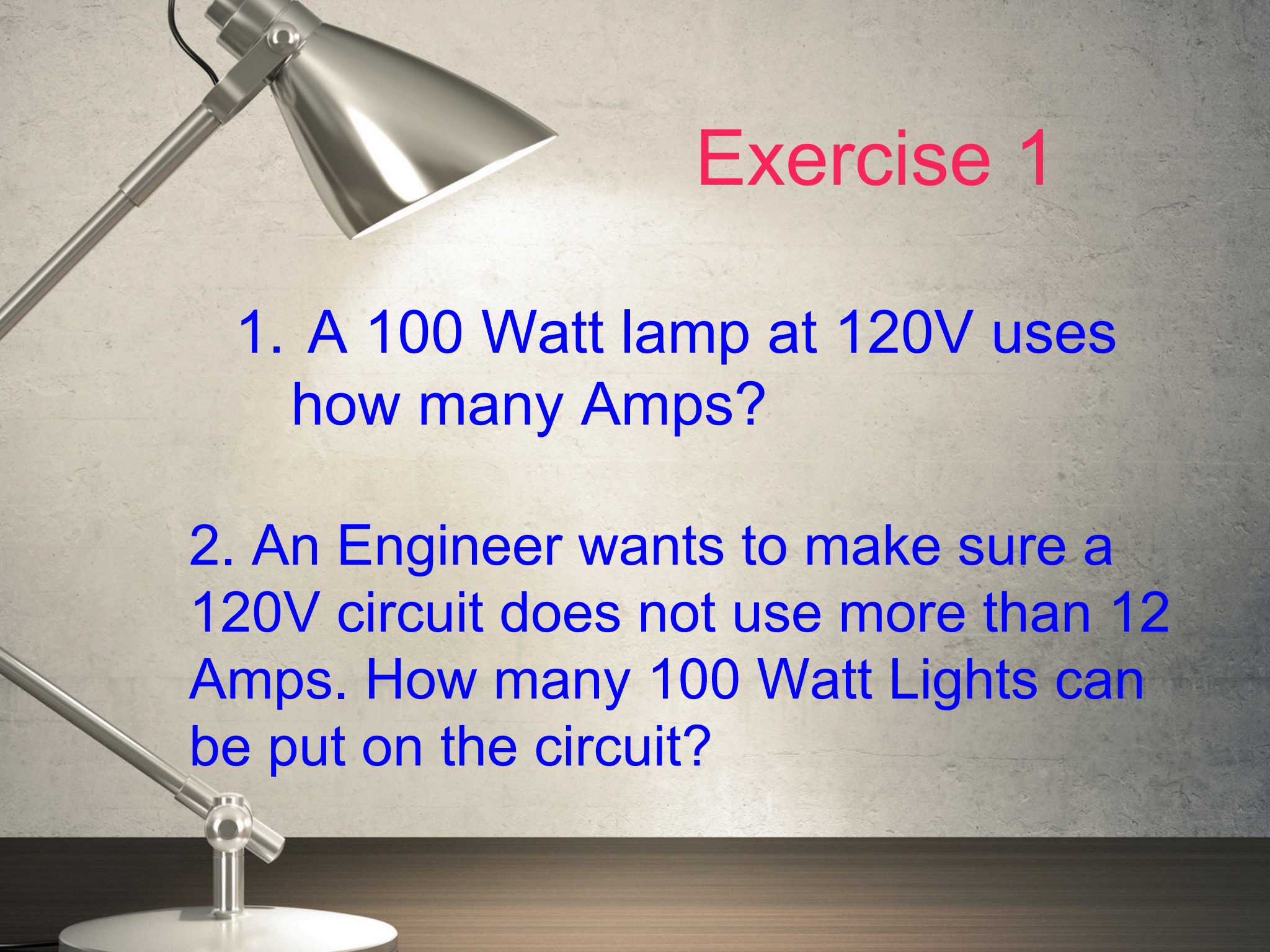


where,

I=current in amperes (A)

R=resistance in ohms (Ω)

V=voltage



Exercise 1

1. A 100 Watt lamp at 120V uses how many Amps?

2. An Engineer wants to make sure a 120V circuit does not use more than 12 Amps. How many 100 Watt Lights can be put on the circuit?

ENERGY

- **Energy** is ability to do work
- Measured in watt and time in second then the unit is watt-second or Joules(J)
- Electrical energy=power x time

$$E = Pt$$

or

$$T = Pt$$
$$T = VIt$$
$$T = V^2t/R$$
$$T = I^2Rt$$

BIOGRAPHY

James Prescott Joule 1818–1889

Joule, a British physicist, is known for his research in electricity and thermodynamics. He formulated the relationship that states that the amount of heat energy produced by an electrical current in a conductor is proportional to the conductor's resistance and the time. The unit of energy is named in his honor. (Photo credit: Library of Congress.)

Exercise 1

An amount of energy to 100J is used in 5s. What is the power in watts?

CORRECT

Formula:

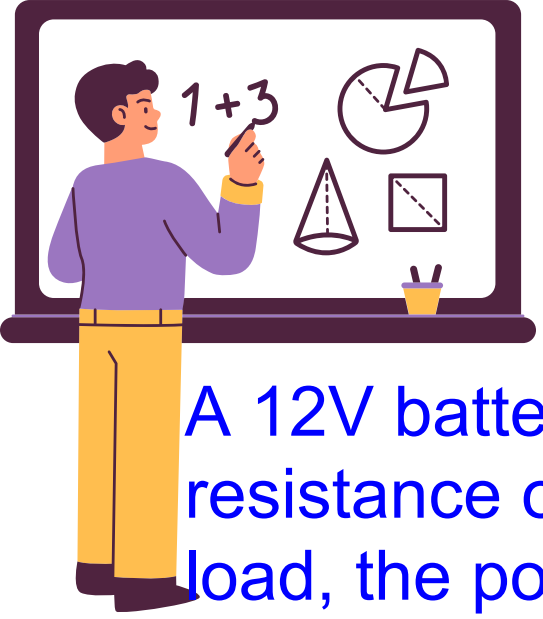
$$P=tE$$

Substitution:

$$P = 5s \times 100\ J$$

Result:

P = 20 W



Exercise 2

A 12V battery is connected across a load having a resistance of 40Ω. Determine the current flowing in the load, the power consumed and the energy dissipated in 2 minutes.

ANSWER

Formula:

$P=V\times I$

Substitution:

$P=12\ V\times 0.3\ A$

Result:

$P=3.6\ W$

ANSWER

Formula:

$E=P\times t$

Substitution:

$E=3.6\ W\times 120\ s$

Result:

$E=432\ J$

- If the power is measured in kilowatts & the time in hours then the unit of energy is kilowatt-hours
- Kilowatt is often called the ‘unit of electricity’
- A kilowatt-hour energy when one thousand watts of power being used for one hour

Problem solving:

How many watts are used when 7500 J of energy are consumed in 5h?

SOLUTION

1 Convert Time to Seconds

The time unit must be seconds for the final answer to be in Watts (J/s).

1 hour=3600 seconds

Time (t) =5 h×3600hs

t=18000 s

2 Substitute the values into the formula: P=E/t.

Energy (E) =7500 J

Time (t) =18000 s

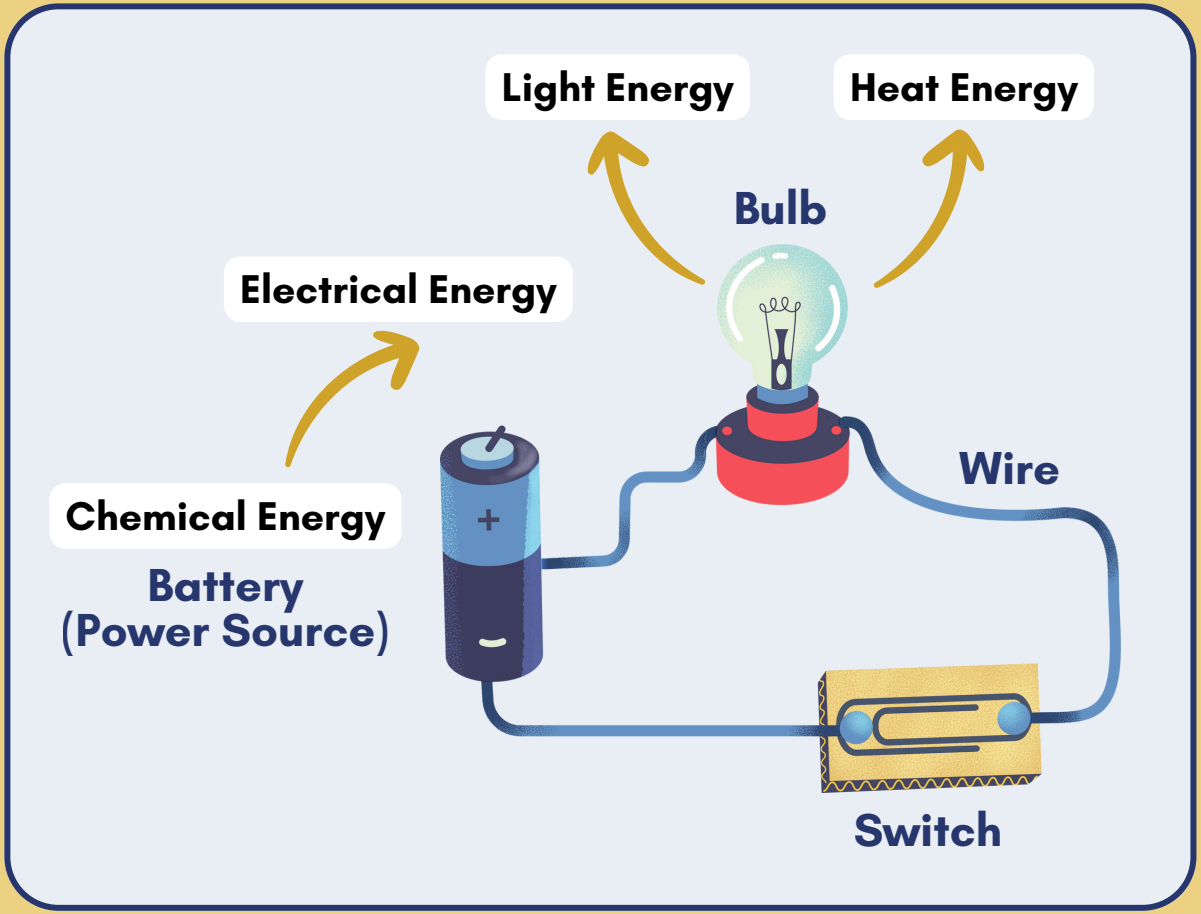
P=18000 s7500 J

P≈0.4167 W

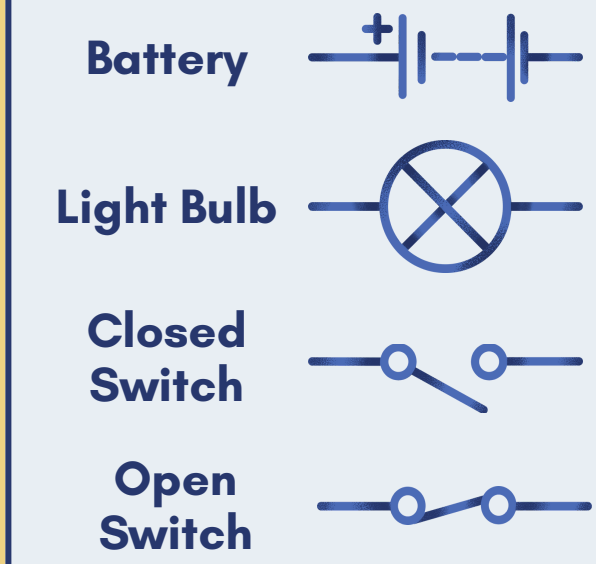
Energy Transformations in ELECTRICAL CIRCUITS

A SIMPLE ELECTRIC CIRCUIT HAS THREE PARTS:

- AN ENERGY SOURCE – EG. A BATTERY
- AN ENERGY RECEIVER – EG. A LIGHTBULB
- AN ENERGY PATHWAY – EG. WIRES



ELECTRICAL CIRCUIT SYMBOLS




THANK
YOU