

## **Vision**

**To be the centre of excellence in the field of technical education.**

**Program Code:-** First Semester – All Program

**Course Name:-** Basic Science (PHYSICS)

**Course Code :** - BSC (22102)

**Course coordinator:** Mr. S. K. Rawat

# Course Name:- Basic Science (PHYSICS)

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**Unit No:2**

**Unit Name:** Heating effect of electric current.

**Unit Outcomes (UO2c):** Explain the heating effect of the given electric current.

**Learning Outcomes (LOs):**

**LO4:** Student will be able to explain the heating effect of electric current.



# CONTENT

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- ▶ Heating effect of electric current
- ▶ Joule's law
- ▶ Applications of heating effect of electric current



# LEARNING OBJECTIVES

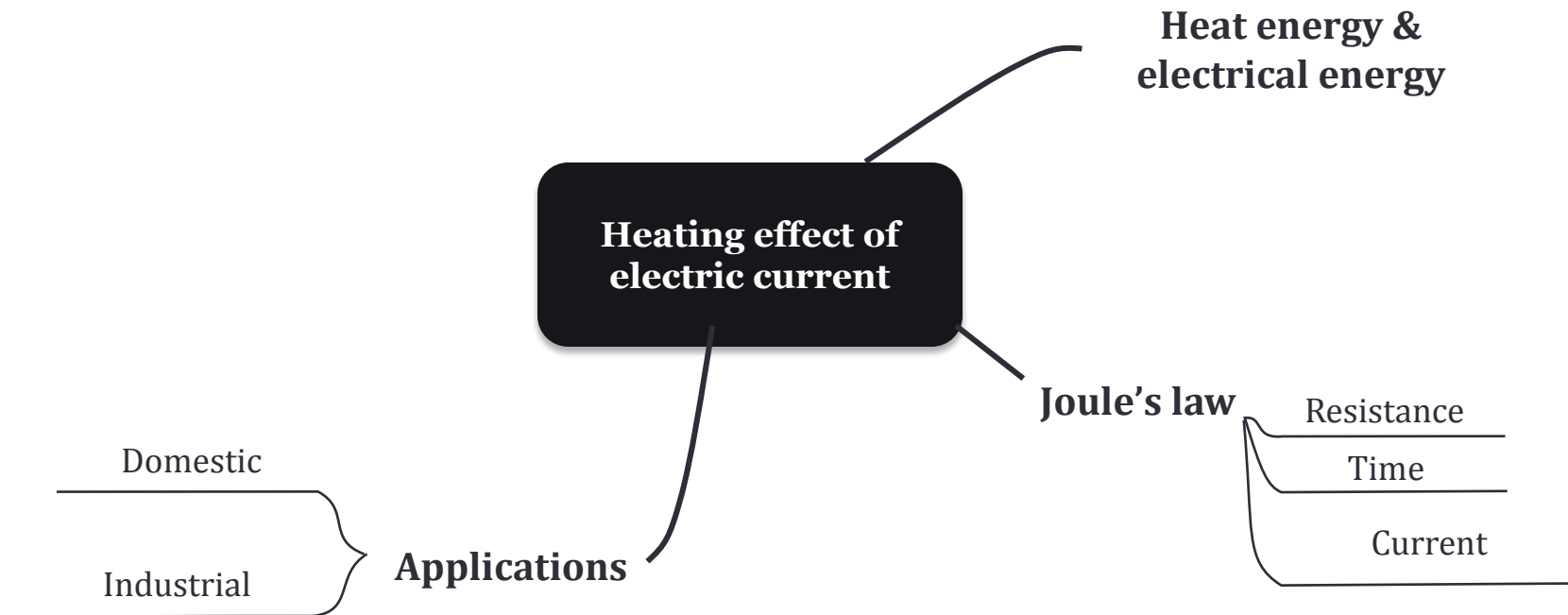
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- ▶ Student will be able to explain the heating effect of electric current.



# Concept Map



# Heating effect of electric current

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- ▶ When an electric current is passed through a conductor, the conductor becomes hot after some time and produces heat.
- ▶ This happens due to the conversion of some amount of electric energy into heat energy.
- ▶ This effect of electric current is called heating effect of electric current.
- ▶ Heating effect of electric current is also referred as Joule's law.

# Attempt Set 1 MCQs

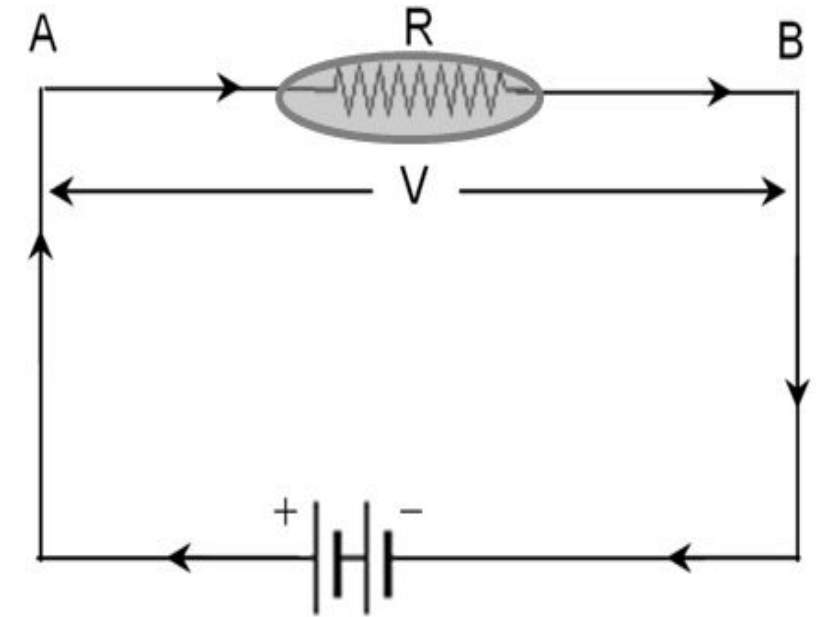
Question No	Question No. 1	Question No. 2	Question No. 3
Statement of Question	The capacity to do work is called as _____	According to Joule's law, electrical energy is converted to _____	Heating effect of electric current is used in _____.
Level of Question	Remembering	Understanding	Applications
Option (a)	Heat	mechanical energy	electric kettle
Option (b)	Energy	chemical energy	fan
Option (c)	Work	light energy	Freezer
Option (d)	Power	heat energy	TV
<b>Correct Option</b>	<b>Energy</b>	heat energy	electric kettle

**START**



# Joule's Law

- ▶ The amount of heat produced ( $H$ ) due to passage of electric current ( $I$ ) depends on three factors:
- ▶ Resistance: Heat is directly proportional to the resistance,  $R$  of the conductor. i.e.,  
 $H \propto R$
- ▶ Time: Heat is directly proportional to the time,  $t$  for which the current flows through conductor. i.e.,  $H \propto t$
- ▶ Current: Heat is directly proportional to the square of current,  $I$  flowing through conductor. i.e.,  $H \propto I^2$
- ▶ Therefore Joule's law equation is given as  $H = I^2 R t$ .





# Joule's Law

**An electric heater having resistance equal to  $5\Omega$  is connected to electric source. If it produces 180 J of heat in one second, find the potential difference across the electric heater.**

Solution: Given, Resistance (R) =  $5\Omega$ , Heat (H) produced per second by heater = 1800 J, time 't' = 1 s  
Potential difference (V) =?

To calculate the potential difference, we need to calculate electric current (I) first.

- ▶ We know that  $H = I^2 R t$
- ▶ Or,  $180J = I^2 \times 5\Omega \times 1s$
- ▶ Or,  $I^2 = 180 \div 5 = 36$
- ▶ Or,  $I = 6A$
- ▶ Now, potential difference  $V = IR$
- ▶ Or,  $V = 6A \times 5\Omega = 30V$

# Applications

- ▶ Some of the applications of heating effect of electric current are -
- ▶ Electric heating device: Electric iron, electric heater, electric toasters are some of the appliances that work on the principle of heating effect of current. In these appliances, Nichrome which is an alloy of nickel and chromium is used as the heating element for the following reasons. (i) It has high specific resistance (ii) It has high melting point (iii) It is not easily oxidized.
- ▶ Fuse wire: Fuse wire is an alloy of lead 37% and tin 63%. It is connected in series in an electric circuit. It has high resistance and low melting point. When large current flows through a circuit due to short circuiting, the fuse wire melts due to heating and hence the circuit becomes open. Therefore, the electric appliances are saved from damage.
- ▶ Electric bulb: Since the resistance of the filament in the bulb is high, the quantity of heat produced is also high. Therefore, the filament is heated to incandescence and emits light. Tungsten with a high melting point (3380°C) is used as the filament. The filament is usually enclosed in a glass bulb containing some inert gas at low pressure.
- ▶ Electric arc and electric welding also work on the principle of heating effect of current.



# Attempt Set 2 MCQs

Question No	Question No. 1	Question No. 2	Question No. 3
Statement of Question	Find the odd one out-	When current is passed through a coil, it gets heated up. This is due to _____ effect of electric current.	Heat produced by current in wire during 't' time is determined by _____
Level of Question	Understanding	Understanding	Understanding
Option (a)	electric toaster	mechanical	$H = I^2R$
Option (b)	electric fan	chemical	$H = Irt$
Option (c)	electric iron	heating	$H = I^2Rt$
Option (d)	room heater	magnetic	$H = I^2t$
<b>Correct Option</b>	<b>electric fan</b>	<b>heating</b>	<b><math>H = I^2Rt</math></b>

**START**

