1

1. EFFECTS OF ELECTRIC CURRENT

Video Lesson.1

Electric energy can easily be converted to other forms of energy using suitable devices. That is why we prefer electric energy to any other sources of energy. It is given a list of familiar devices in which electric energy is converted to required form of energy and effects of current made in use .

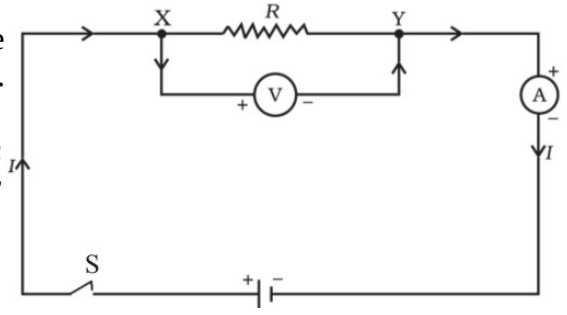
Device	Conversion	Effect
Electric stove	Electric energy to heat energy	Heating effect
Electric bulb	Electric Energy to light Energy	Lighting effect
Electric Fan& motor	Electric Energy to mechanical energy	Mechanical
Battery (charging)	Electric Energy to chemical Energy	Chemical Effect
Induction Cooker	Electric energy to heat energy	Heating effect
Electric Oven	Electric energy to heat energy	Heating effect

Electric current Intensity(I): It is the quantity of charge flows through a conductor per second.
That is, I = Q/t
If current in a circuit is I ampere, the quantity of charge flows through the conductor in t second is, ***Q = It***

In order to have an electric current through a conductor, a potential difference is to be maintained across its ends. The unit of potential difference is **volt**.

The potential difference between two points will be one volt if one joule of work is done to move one coulomb charge from one point to other.

In this circuit, R is a nichrome wire. The nichrome wire becomes hot red while electric current passing through the circuit. That is, heat is generated in the nichrome wire.



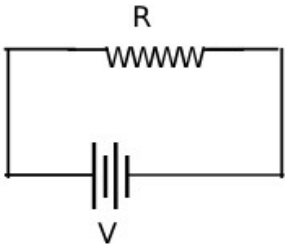
The process by which heat is developed in a conductor on passing current through it is known as Joule heating or Ohmic heating.

Heat generated by Joule heating will be, **H = VIt.**
According to Ohm's law we have, V = IR .
Then heat is also equal to, H = (IR)It = $\mathbf{I^2Rt}$

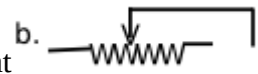
Joule's Law:

The heat generated (H) in a current carrying conductor is directly proportional to the product of the square of the current (I) in the conductor, the resistance of the conductor (R) and the time (t) of flow of current.
That is, $\mathbf{H = I^2Rt}$
According to Joule's Law Heat generated in a current carrying conductor can also be calculated by **H = VIt and H = $\mathbf{V^2t/R}$.**
It is noted that the time should be taken in second.
Factors influencing Joule Heating Effect.
* Current passing through the conductor. (I) : Heat increases with Voltage.
* Resistance of the conductor. R : i. If the voltage is same, heat increases with decrease in Resistance.
: ii. If the current is same, heat increases with increase in Resistance.
* Time through which current passes.(t)

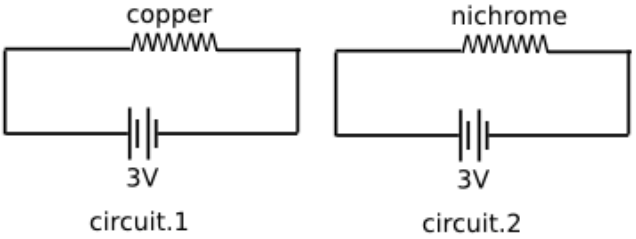
PRACTICE QUESTIONS & ANSWERS



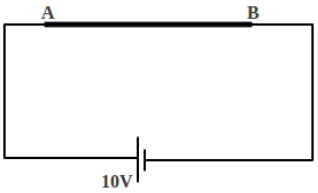
1. Heat generated in one second in this circuit is 100J.
a. Heat generated in a current carrying conductor is known as …...
b. What will be the change in the heat if the resistance in the circuit is halved (R/2)?
c. What about it if voltage is halved?
2. Basheer is demonstrating an experiment to find out the relation between current, resistance,time and heat.
a. What might be the device he used to regulate the current ?
b. Draw the symbol of the device.
c. What will be the change in heat if current through a conductor is tripled?



3. 3A current is passed through an Iron box that works on 230V. Calculate the heat produced in it in ½ hour.
4.Light,heat,sound and electricity are various forms of energy. Give one major feature of electricity over other forms of energy.
5. A copper wire and nichrome wire of same length and cross section area are connected in two circuits as shown.
a. Identify the circuit having more current.
b. Find out the wire in which more heat is generated.

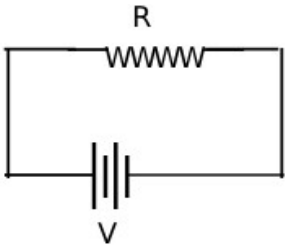


6. 0.4A current passes through a bulb when it works on 230V.
a. Calculate the charge flowing through the circuit in 2 minute.
7. The coil of a heater is cut into equal halves and one is used in the heater.
a. What happened to resistance of the coil? b. What will be the change in heat produced?
8. Which of the following device is to be connected in parallel in a circuit?
Voltmeter, Ammeter, Galvanometer.
9.A wire AB of 20Ω resistance is included in a circuit as shown in the figure.
a. Find the current in the circuit.
b.If the wire is folded into half and included in the same circuit, what will be the current ?
c. Calculate the heat produced in the circuit in one second then.

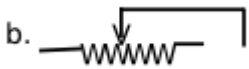


10. 230V is applied to a coil of resistance 92 Ω.
a. Find the current in the circuit.
b. Calculate the heat produced in it when it works for 10 minutes.
c.If the coil is folded into half and applied the same voltage, how much heat will be produced in the same time?
11. 0.2 A current flows through a resistor of resistance 100 Ω for 2 minute.
a. Calculate the heat generated.
b. What will be the heat if resistance is changed to 200 Ω keeping I and t remain the same?
c. What will be the heat if current is doubled keeping R and t remain the same?
12. Three ampere current flows through an iron box working under 230 V for half an hour. Calculate the heat generated in the Iron box.
13. A heating appliance is connected to a 230V supply line. If the current is 2A , calculate the heat produced in 5 minutes.

PRACTICE QUESTIONS & ANSWERS

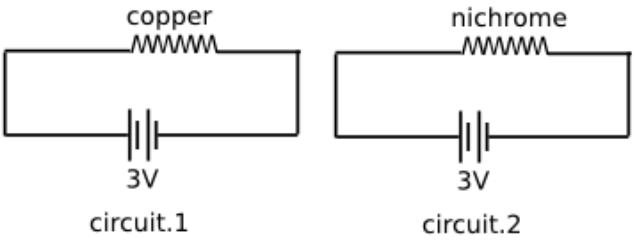


1. Heat generated in one second in this circuit is 100J.
a. Heat generated in a current carrying conductor is known as …...
b. What will be the change in the heat if the resistance in the circuit is halved (R/2)?
c. What about it if voltage is halved?
Ans.a. Joule heating effect.
b. Since $H = V^2t/R$, when resistance is halved heat will be doubled.
c. Since $H = V^2t/R$, heat becomes $1/4^{th}$ when V is halved.
2. Basheer is demonstrating an experiment to find out the relation between current, resistance,time and heat.
a. What might be the device he used to regulate the current ?
b. Draw the symbol of the device.
c. What will be the change in heat if current through a conductor is tripled?

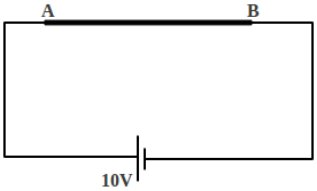


Answer: a. Rheostat.
c. Since the heat is proportional to the squire of current,
heat will be 3x3 =9 times greater.
3. 3A current is passed through an Iron box that works on 230V. Calculate the heat produced in it in ½ hour.
Answer: V = 230V, I = 3A t = ½ hr = ½ x 60x60 = 1800s.
H = VIt = 230x3x1800 = 1242000 joule.
4.Light,heat,sound and electricity are various forms of energy. Give one major feature of electricity over other forms of energy.
Answer: Electric energy can easily be converted to other forms using suitable device.

5. A copper wire and nichrome wire of same length and cross section area are connected in two circuits as shown.
a. Identify the circuit having more current.
b. Find out the wire in which more heat is generated.



Answer:a As resistance of copper wire is less than that of nichrome wire, more current will flow through circuit.1
b.For the same voltage heat is inversely proportional to resistance.($H=V^2t/R$). So more heat will be produced in copper as its resistance is small.
6. 0.4A current passes through a bulb when it works on 230V.
a. Calculate the charge flowing through the circuit in 2 minute.
Answer:a. Charge Q = Ixt = 0.4x2x60 = 48 coulomb
7. The coil of a heater is cut into equal halves and one is used in the heater.
a. What happened to resistance of the coil? b. What will be the change in heat produced?
Answer: a. Resistance is halved. (Because resistance of a conductor is directly proportional to its length)
b. We have Heat $H=V^2t/R$. Since heat is inversely proportional to resistance, heat will be doubled when resistance is halved.
8. Which of the following device is to be connected in parallel in a circuit?
Voltmeter, Ammeter, Galvanometer. **Answer**. Voltmeter.
9.A wire AB of 20Ω resistance is included in a circuit as shown in the figure.



a. Find the current in the circuit.
b.If the wire is folded into half and included in the same circuit, what will be the current ?
c. Calculate the heat produced in the circuit in one second then.
Answer: a. R= 20 Ω V = 10V I=V/R = 10/20= 0.5A
b. When it is folded, length is halved and thickness is doubled. So resistance becomes ¼ of the previous value.
Therefore new resistance $R^1 = 20/4 = 5\Omega$. Then current $I^1 = V/R^1 = 10/5 = 2A$.
c. Heat produced in one second,H = VIt = 10x2x1 = 20J.
10. 230V is applied to a coil of resistance 92 Ω.
a. Find the current in the circuit.

b. Calculate the heat produced in it when it works for 10 minutes.
c.If the coil is folded into half and applied the same voltage, how much heat will be produced in the same time?
Answer: a. I = V/R = 230/92 = 2.5A. b. H =VIt = 230x2.5x14x60 =483000 joule.
c. When it is folded, resistance becomes $1/4^{th}$.
So the new resistance $R^1 = 92/4 = 23\Omega$.
Then heat = $V^2xt/R^1 = 230x230x14x60/23 = 1932000$ J
11. 0.2 A current flows through a resistor of resistance 100 Ω for 2 minute.
a. Calculate the heat generated.
b. What will be the heat if resistance is changed to 200 Ω keeping I and t remain the same?
c. What will be the heat if current is doubled keeping R and t remain the same?
Ans.a. $H = I^2Rt = 0.2x0.2x100x2x60 = 480$ J
b. H = 0.2x0.2x200x2x60 = 960 J
c. H = 0.4x0.4x100x2x60 = 1920 J. When current is doubled, the heat is quadrupled.
12. Three ampere current flows through an iron box working under 230 V for half an hour. Calculate the heat generated in the Iron box.
Ans. H = VIt = 230x3x30x60 = 1242000 J
13. A heating appliance is connected to a 230V supply line. If the current is 2A , calculate the heat produced in 5 minutes.
Answer:
d. V = 230V, I = 2A, t = 5 minute = 5x60 = 300 seconds.
Heat,H = VIt = 230x2x300 = 138000J.