Electric Power

Electric power is the electrical work done per unit time. The rate at which electrical work is done or the rate, at which electrical energy is consumed, is called electric power. The SI unit of power is the watt, joule per second. Electric power is usually produced by electric generators, but can also be supplied by sources such as electric batteries.

$$\textbf{Power} = \frac{\textbf{work done}}{\textbf{time taken}} = \frac{\textbf{energy consume}}{\textbf{time}}$$

OR $\quad \mathbf{P} = \frac{W}{T}$

SI Unit of power: SI unit of power is watt.

Bigger unit of power is Kilowatt.

1 Kilowatt = 1000 watt

1 Horsepower, HP = 746 Watt

1 Watt: When an electric appliance consumes electrical energy at the rate of 1 joule per second, its power is said to be 1 watt.

$$\textbf{1 watt} = \frac{1\ joule}{1\ second}$$

Formula for calculating electric power:

We know that, power $= \frac{\textbf{work done}}{\textbf{time taken}} = \frac{\mathbf{W}}{\mathbf{T}}$ ---------- (i)

Work done W by current I when it flows for time t under a potential difference V is given by:

$$W = V \times I \times t$$

Putting this value of W in equation (i), we get:

$$P = \frac{\mathbf{V \times I \times t}}{\mathbf{t}}$$

$$P = V \times I$$

Electric power = Potential difference x current

OR

Electric power = Voltage x current

Some other formulae for calculating electric power:

(i) Power P in terms of I and R.

We know that

$P = V \times I$ ---------- (1)

From Ohm's law we have,

$V = I \times R$ ---------- (2)

By putting equation (2) in (1)

$P = I \times R \times I$

$P = I^2R$

(ii) Power P in terms of V and R.

We know that,

$P = V \times I$ ---------- (1)

From Ohm's law we have,

$V = I \times R$

$I = \frac{V}{R}$ ---------- (2)

By putting equation (2) in (1)

$P = V \times \frac{V}{R}$

$P = V^2/R$

1. **First formula for power : $P = V \times I$**
2. **Second formula for power : $P = I^2R$**
3. **Third formula for power : $P = V^2/R$**

Power-Voltage rating of electrical appliances: A power rating of 100 watts on the bulb means that it will consume electrical energy at the rate of 100 joules per second.

Practice Question on Electric Energy and power

Q1. What is the speed of electricity?

Ans: Electricity travels at the speed of light that is more than 186,000 miles per second.

Q2. Write the SI unit of electric power.

Ans: The SI unit of electric power is watt.

Q3. Is electric power a scalar quantity or vector quantity?

Ans : Electric power is the scalar quantity.

Q4. A radiator works with a voltage of 20 V and has power of 150 W. Find the resistance and the current flowing through the radiator.

Solution: $P = VI$

$150 = 20 \times I$

$I = 150/20 = 7.5$ A

Now,

$R = V/I = 20/7.5 = 2.6\ \Omega$

Q5. Find the electric power of an electrical circuit which consumes 100 joules for 10 seconds.

Solution: Energy consumed, E = 100 joules

Time, t = 10 seconds

Power = Energy consumed/time

= 100/10 = 10 watts.