PHYSICS - X-PART-5 CLASS 05

Heating effect of electric current

* If heat energy generated in a current carrying conductor is $H = I^2Rt$, Complete the following table

Resistance of the conductor R	Current intensity I	Time of flow of current t	Heat generated H
10	(a)	5	50 J
5	2	(b)	200 J
(c)	0.5	2.5	12.5 J
2.5	4	5	(d)

a) I = ?

$H = I^2Rt$

$I^2 = H / Rt = 50 / (10 \times 5) = 50 / 50 = 1$

I = 1 A

b) t = ?

$H = I^2Rt$

$t = H / I^2R = 200 / (2^2 \times 5) = 200 / 20 = 10$

t = 10 s

c) R = ?

$H = I^2Rt$

$R = H / I^2t = 12.5 / (0.5^2 \times 2.5) = 12.5 / 0.625 = 20$

R = 20 Ω

c) H = ?

$H = I^2Rt$

$R = 4^2 \times 2.5 \times 5 = 200$

R = 200 J

2. If 3 A current flows through an electric iron which is designed to work at 230 V for 10 s, calculate heat energy generated using the following equations.

a) $H = I^2Rt$
b) $H = (V^2/R)t$
c) $H = VIt$. Compare your answer

a) $H = I^2Rt$ $V = 230$ V, $I = 3$ A, $t = 10$ s
$R = V / I = 230 / 3$
$H = 3^2 \times (230/3) \times 10 =$ 6900 J

b) $H = (V^2/R)t$
$H = \{230^2 / (230/3)\} \times 10$
$H = 230 \times 10 \times 3 =$ 6900 J

c) $H = VIt$
$H = 230 \times 3 \times 10 =$ 6900 J

Assignment

Let's solve some mathematical problems which are related to Joules Law.

1. How much will be the heat developed if 0.2 A current flows through a conductor of resistance 200 Ω for 5 minute?

2. Let's find out the heat developed in 3 minute by a device of resistance 920 Ω working under 230 V.

3. Let's calculate the heat developed when 3 A current flows through an electric iron box designed to work under 230 V for half an hour?