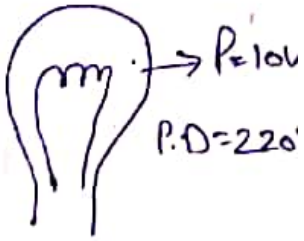
Q=12. Several electric bulbs designed to be used on a 220V electric supply line, are rated 10W. How many lamps can be connected in parallel with one another across the two wires of 220V line if the maximum allowable current is 5A?

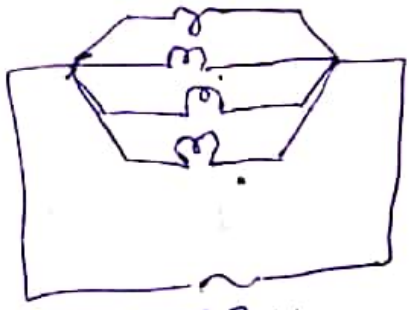
Sol:- $P = 10W$, $V = 220V$



If R is the resistance of each bulb, then

$$P = \frac{V^2}{R}$$

$$R = \frac{V^2}{P} = \frac{220 \times 220}{10} = 4840\,\Omega$$



Let n no of lamps has resistance 4840 Ω connected in parallel, then equivalent Resistance R_p is

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{---n times}$$

$$\frac{1}{R_p} = \frac{1}{4840} + \frac{1}{4840} + \text{---n times}$$

$$\frac{1}{R_p} = \frac{n}{4840} \Rightarrow R_p = \frac{4840}{n} \quad \text{(1)}$$

If V = 220V and current I = 5A then equivalent resistance of n lamps is

by ohm's law

$$V = I R_p$$

$$R_p = \frac{V}{I} = \frac{220}{5} = 44\,\Omega$$

Put the value of R_p in eq. (1)

$$R_p = \frac{4840}{n} \Rightarrow n = \frac{4840}{R_p} = \frac{4840}{44} = 110$$

Q=13: A hot plate of an electric oven connected to a 220V line has two resistance coils A and B, each of 24Ω resistance, which may be used separately, in series or in parallel. What are the current in three cases?

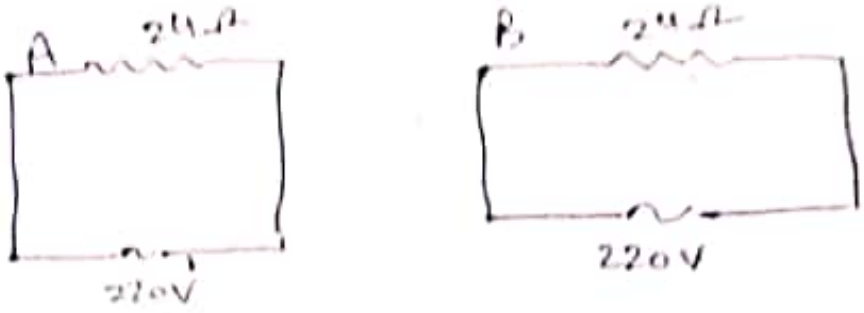
Sol:-

Resistance of each coils = 24Ω

P.D. V = 220 V

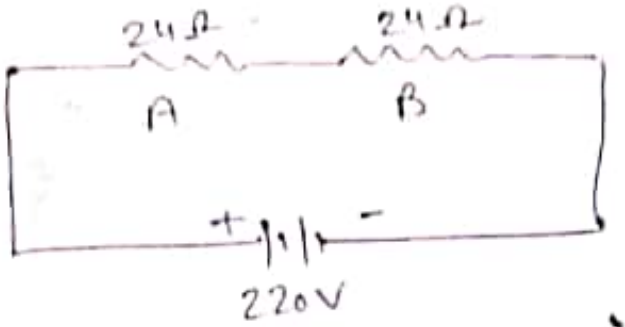
(i) When two coils connected separately

Then current in each coil



By ohm's law
$V = IR \Rightarrow I = \frac{V}{R} = \frac{220}{24} = 9.2\,A$ (flows in each coil)

(ii) When two coils connected in series



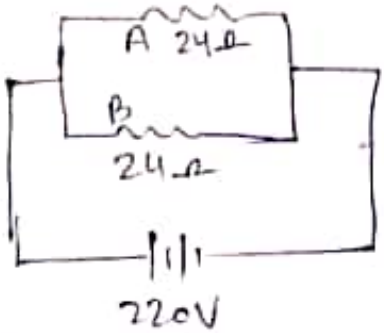
Total Resistance
$= R_1 + R_2$
$= 24 + 24 = 48\,\Omega$

$V = 220V$

By ohm's law
$V = IR$

$I = \frac{V}{R} = \frac{220}{48} = 4.6\,A$

(iii) When two coils connected in parallel



Total Resistance first find

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R}$

$\frac{1}{R} = \frac{1}{24} + \frac{1}{24} = \frac{2}{24}$

$\frac{1}{R} = \frac{2}{24} \Rightarrow R = \frac{24}{2} = 12\,\Omega$

By ohm's law
$V = IR$

$I = \frac{V}{R} = \frac{220}{12} = 18.3\,A$