Nishant Jindal

(☆)

Power in Case of bulb

→ Bulb.

Rated Value [∵ Bulb Safely work if voltage and power of the bulb is less than or equal to rated value]

↳ (Power, Voltage)

⇒ R ⇒ Resistance of the bulb calculated w.r.t rated Value.

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

V → Rated Voltage

P → Rated power.

Nishant Jindal

#

Power dissipiated across the bulb :→

V_r & P_r → (Rated Value)

$$R = \left(\frac{V_r^2}{P_r}\right)$$

$$R = \frac{(220)^2}{(100)}$$

$$I = \left(\frac{110}{R}\right)$$

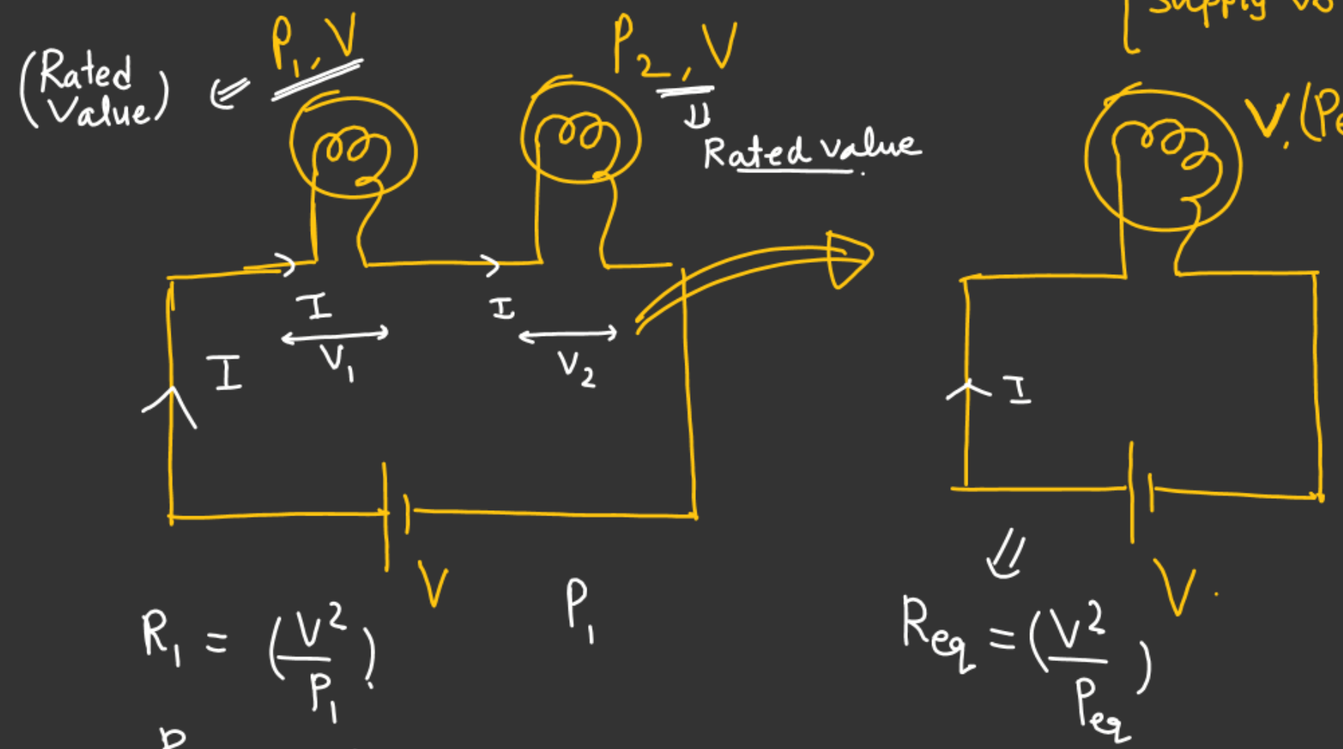
$$P = I^2 R = \frac{(110)^2}{R^2} \times R = \frac{(110)^2}{R} = \frac{(110)^2}{(220)^2} \times 100$$

$$\boxed{P = 25 \text{watt}}$$

Nishant Jindal

Q8. **Series Combination of bulb :-**

Condition :- [Rated voltage and Supply voltage same]



$R_1 = \left(\frac{V^2}{P_1}\right)$

$R_2 = \left(\frac{V^2}{P_2}\right)$

$R_{eq} = \left(\frac{V^2}{P_{eq}}\right)$

$P_{eq} = ??$

$V = V_1 + V_2$

$I R_{eq} = I R_1 + I R_2$

$\Downarrow$

$R_{eq} = R_1 + R_2$

$\frac{V^2}{P_{eq}} = \frac{V^2}{P_1} + \frac{V^2}{P_2}$

** $\frac{1}{P_{eq}} = \frac{1}{P_1} + \frac{1}{P_2}$ $\Rightarrow$ [Apply when rated Voltage is same as source voltage]

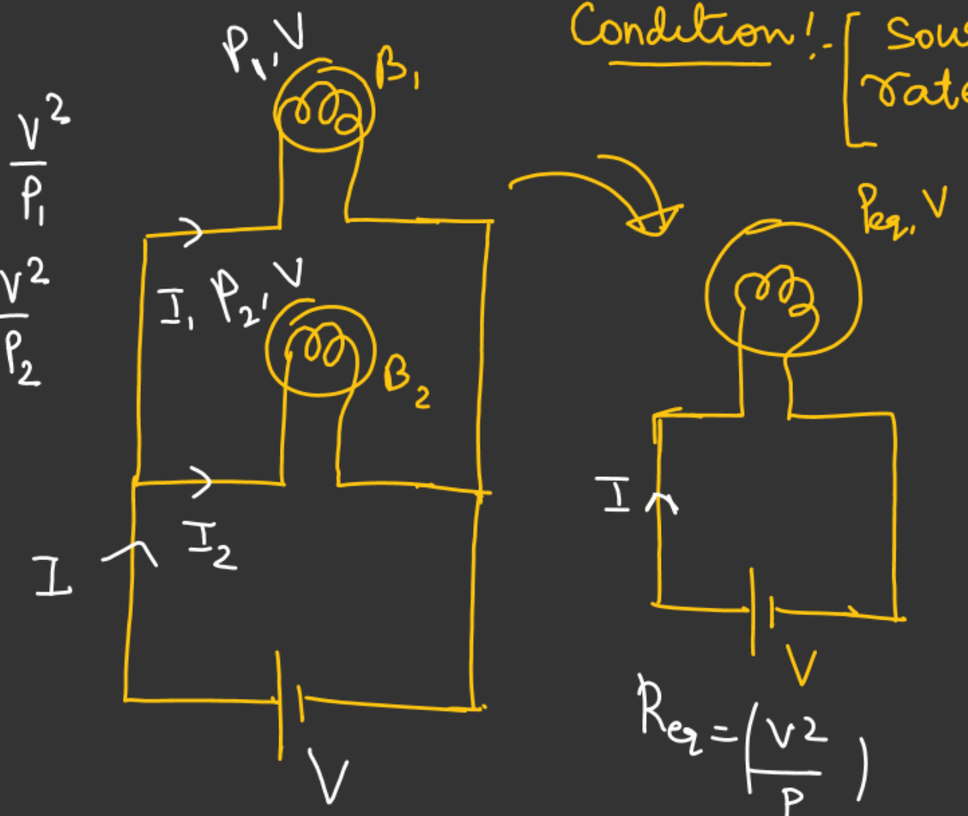
Nishant Jindal

(A) Bulbs in parallel Combination

Condition!- [Source voltage and rated voltage same]

$R_1 = \frac{V^2}{P_1}$

$R_2 = \frac{V^2}{P_2}$



$I = I_1 + I_2$

$\Downarrow$

$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2}$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$

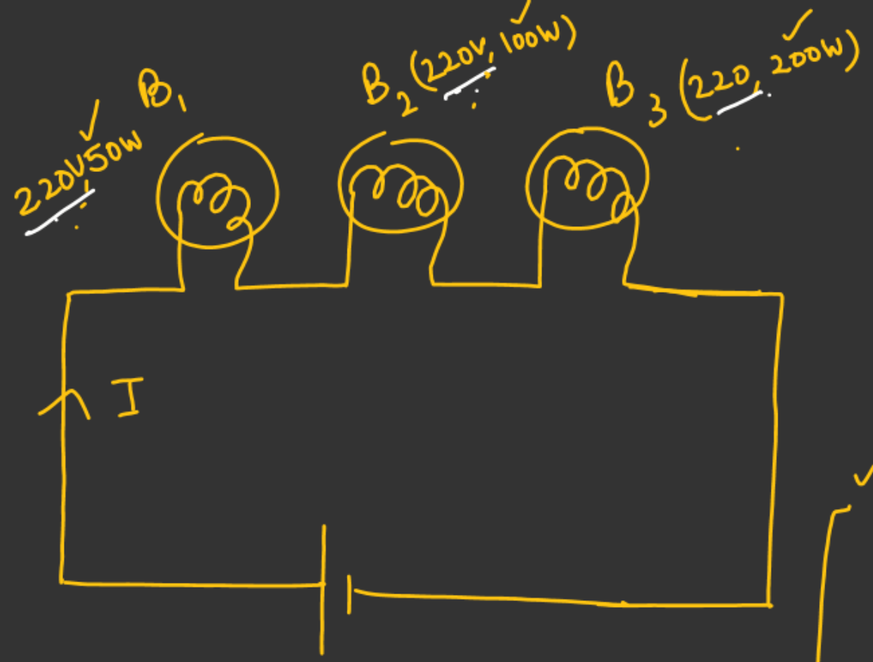
$\frac{1}{\left(\frac{V^2}{P_{eq}}\right)} = \frac{1}{\left(\frac{V^2}{P_1}\right)} + \frac{1}{\left(\frac{V^2}{P_2}\right)}$

$$P_{eq} = P_1 + P_2$$

$\Rightarrow$ Apply when rated and Supply voltage is same

Nishant Jindal

#



a) Total power dissipiated.

b) Which bulb's fuse or operate successfully.

For bulb to work successfully

$$P \leq P_{rated}$$

$$(P_1, P_2 \& P_3) > (P_{eq})$$

(All the bulb work sucessfully work)

$$\frac{1}{P_{eq}} = \frac{1}{P_1} + \frac{1}{P_2} + \frac{1}{P_3}$$

$$\frac{1}{P_{eq}} = \left(\frac{1}{50} + \frac{1}{100} + \frac{1}{200}\right)$$

$$\frac{1}{P_{eq}} = \frac{4+2+1}{200} = 7/200$$

$$P_{eq} = \left(\frac{200}{7}\right) \text{Watt}$$

$$= 28.55$$

$$I = \frac{220}{R_{eq}} = \frac{220}{R_1 + R_2 + R_3}$$

$$R_1 = \frac{(220)^2}{50}$$

$$R_2 = \frac{(220)^2}{100}$$

$$R_3 = \frac{(220)^2}{200}$$

$$(P_1)_{consume} = I^2 R_1$$

$$(P_2)_{consume} = I^2 R_2$$

$$(P_3)_{consume} = I^2 R_3$$

CURRENT ELECTRICITY

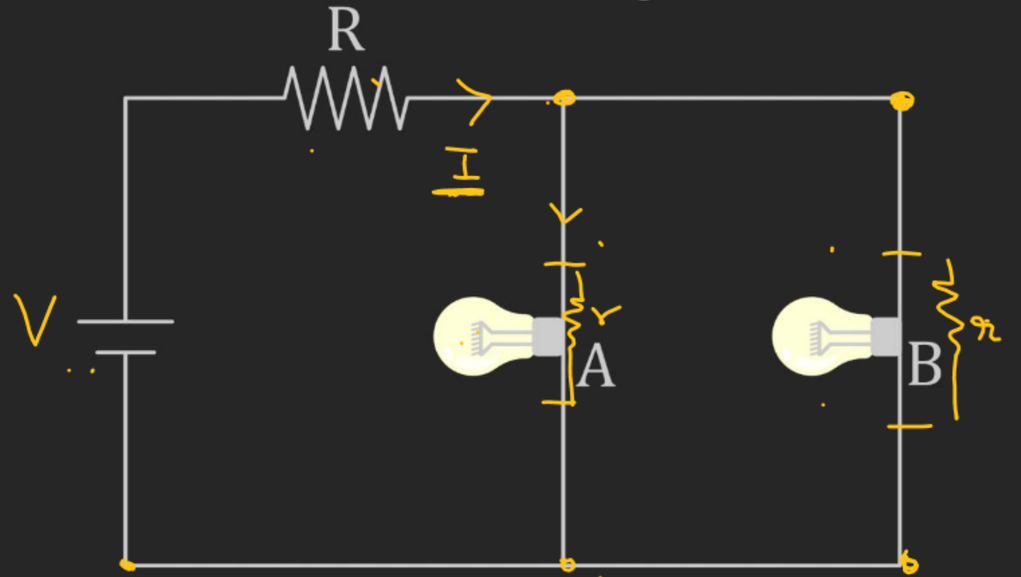
Q.1 A circuit consists of a battery, a resistor R and two light bulbs A and B as shown: If the filament in lightbulb A burns out, then the following is true for light bulb B :

(A) it is turned off

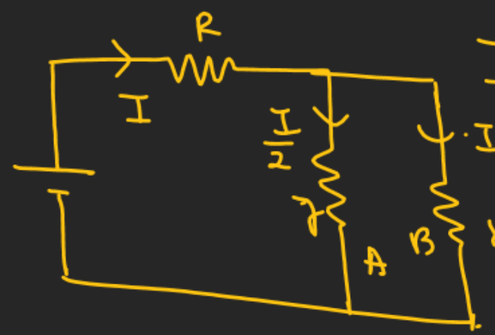
(B) its brightness does not change

(C) it gets dimmer

(D) it gets brighter



When bulb A operate



$(R_{eq})_{ckt} = \left(R + \frac{r}{2}\right)$

$I = \left(\frac{V}{R + \frac{r}{2}}\right) = \left(\frac{2V}{2R + r}\right)$

$P_B = (I/2)^2 \cdot r$

$P_B = \left(\frac{I^2 r}{4}\right)$

(when A bush out i.e fuse.)

Nishant Jindal

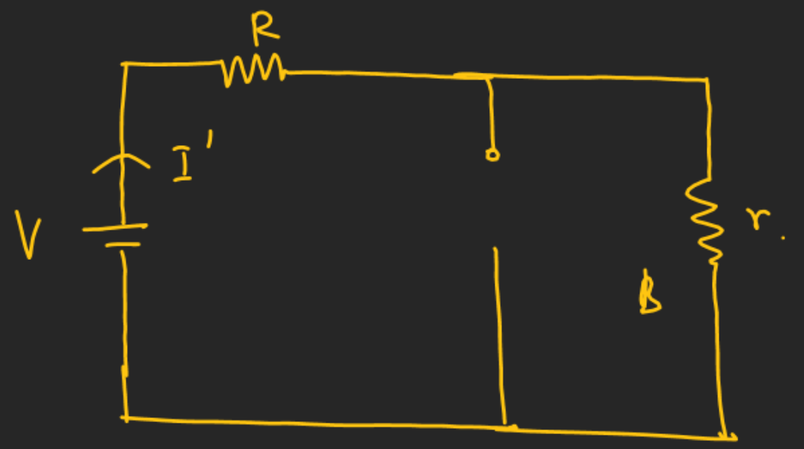
Power

CURRENT ELECTRICITY

$P_B = I^2 (r/4)$

$P_B = \left(\frac{2V}{2R+r}\right)^2 \times \left(\frac{r}{4}\right)$

When bulb A fuse :



$\frac{P_B}{P_B'} = \frac{4V^2}{(2R+r)^2} \times \frac{r}{4} \times \frac{(R+r)^2}{V^2 r}$

$I' = \frac{V}{R_{eq}} = \left(\frac{V}{R+r}\right)$

$\frac{P_B}{P_B'} = \left(\frac{R+r}{2R+r}\right)^2 \Rightarrow < 1$

$P_B' = (I')^2 r = \left(\frac{V}{R+r}\right)^2 r$

$\boxed{P_B < P_B'}$

CURRENT ELECTRICITY

Q.2 Two lamps, each with a resistance of 50Ω, are connected in series. The lamps will fuse if a power of more than $200\ W$ is dissipated in it. What is the maximum voltage that can be applied to the circuit?

(A) 100 V

(B) 140 V

(C) 200 V ✓

(D) None

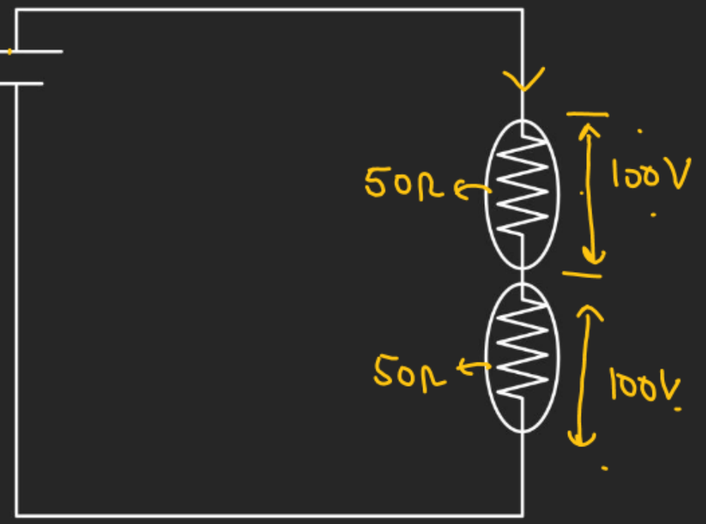
Rated voltage of the bulb. $200V = V$

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

$V^2 = (P \times R)$

$V^2 = (200 \times 50)$

$V = \sqrt{10000} = 100$ Volt.



CURRENT ELECTRICITY

Q.3 In the circuit diagram, all the bulbs are identical. Which bulb will be the brightest?

(A) A

(B) B

(C) C ✓

(D) D

$P_A : P_B : P_C : P_D = ??$

$I = \frac{3 \times 10}{5r} = \left(\frac{6}{r}\right)$ Amp

$I_1 + I_2 = I$

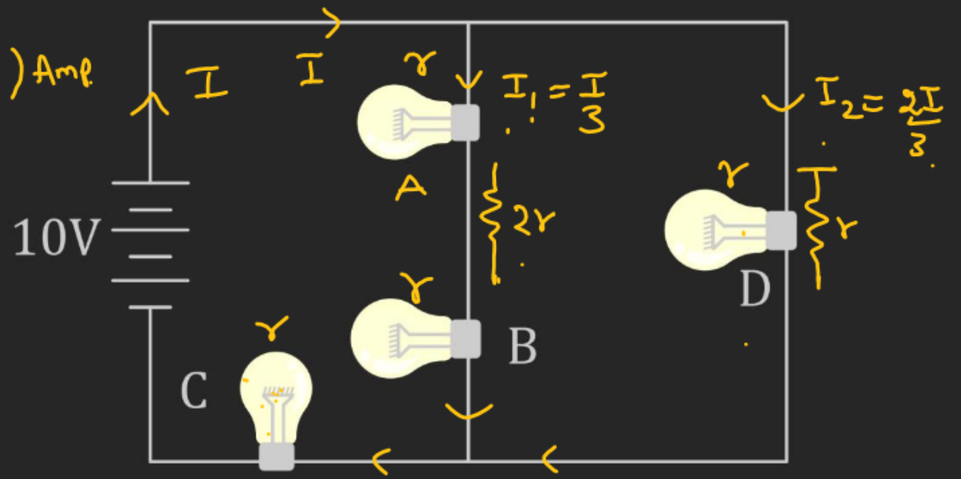
$I_1 (2r) = I_2 r$

$I_2 = (2I_1)$

$3I_1 = I$

$I_1 = (I/3)$

$I_2 = 2I/3$



$P_C = I^2 r$

$P_B = P_A = I_1^2 r$ ✓

$P_D = I_2^2 r$

Power

CURRENT ELECTRICITY

Q.4 A torch bulb rated as $4.5\ \text{W}, 1.5\ \text{V}$ is connected as shown in fig. the e.m.f. of the cell, needed to make the bulb glow at full intensity is :

(A) $4.5\ \text{V}$

(B) $1.5\ \text{V}$

Ans. (C) $2.67\ \text{V}$

(D) $13.5\ \text{V}$