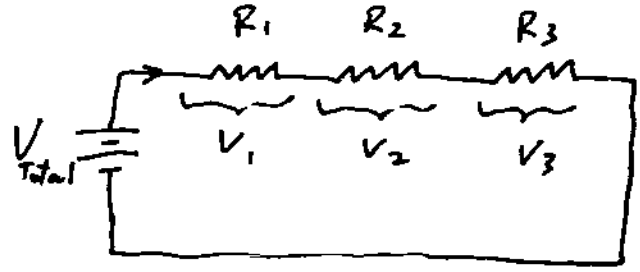
Physics 102.

Lecture 10.

Wed. Sept. 29. 2004

- Parallel and series connections:

1. Series:

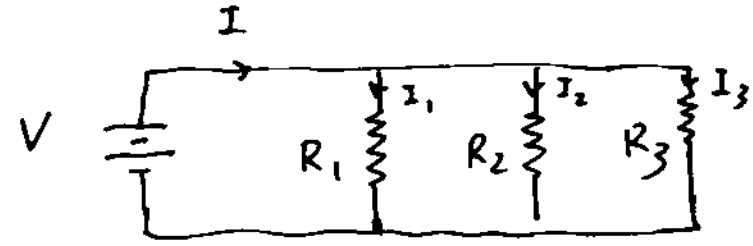


Same current: $I_1 = I_2 = I_3 = I$.

Voltages add: $V_{Total} = V_1 + V_2 + V_3$.

(Resistance: $R = R_1 + R_2 + R_3$)

2. Parallel:



Same voltage: $V_1 = V_2 = V_3 = V$

Currents add: $I = I_1 + I_2 + I_3$.

$\left(\text{Resistance}: \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right)$

~~Physics 102~~

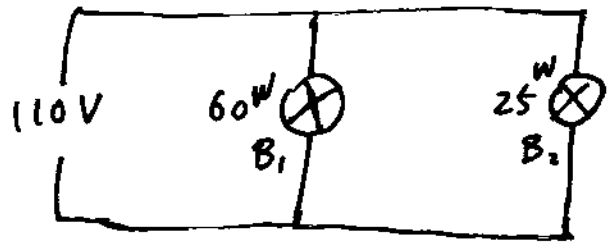
~~Lecture 10.~~

Demo: 60W and 25W light bulbs.

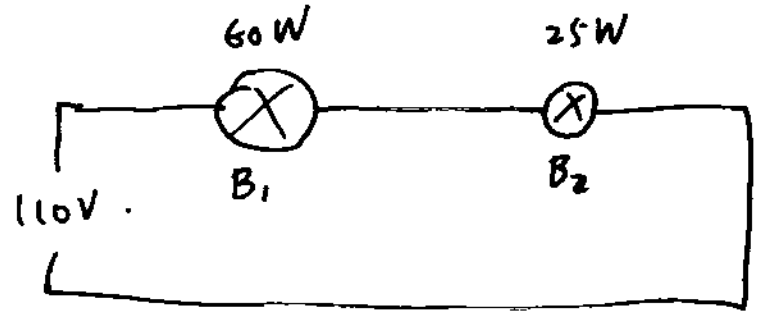
Question: which one is brighter?

when the voltage across each bulb is 110 V
the 60 W bulb is brighter.

e.g: parallel connection



what about series?



The 25 W bulb is brighter!

why?

what does the label "60 W, 110 V" mean?

$P = 60\ W$ when $V = 110\ V$.

Then $P = \frac{V^2}{R}$, $R_1 = \frac{V_1^2}{P_1} = \frac{(110V)^2}{60W} = 202\ \Omega$.

for the 25 W bulb:

$$R_2 = \frac{V_2^2}{P_2} = \frac{(110V)^2}{25W} = 484\ \Omega.$$

Now. when they are connected in series.

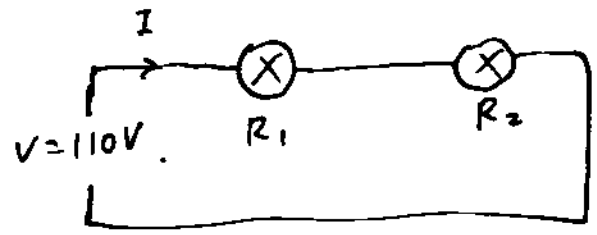
$V_1 \neq V$.

~~I~~ $\therefore V = V_1 + V_2$.

$V_1 < 110\ V$

$V_2 < 110\ V$.

$P_1 \neq 60\ W$, $P_2 \neq 25\ W$.



Total Resistance: $R = R_1 + R_2 = 686\ \Omega$.

Total current: $I = \frac{V}{R} = \frac{110V}{686\Omega} = 0.160\ A = I_1 = I_2$

Voltage $V_1 = R_1 I_1 = 202\Omega \times 0.160A = 32.3V$.

$V_2 = R_2 I_2 = 484\ \Omega \times 0.160A = 77.4V$.

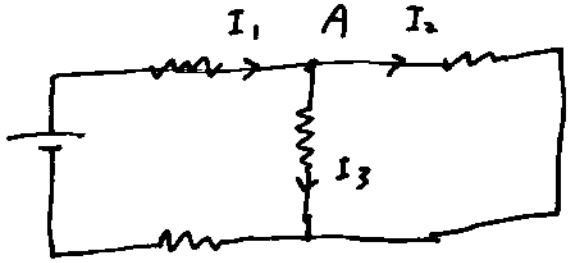
Power: $P_1 = I_1 V_1 = 0.160\ A \times 32.3V = 5.15W$.

$P_2 = I_2 V_2 = 0.160A \times 77.4V = 12.4\ W$

$\therefore P_2 > P_1$. The 25 W bulb is more powerful.

- Kirchoff's Rules.

1. The junction Rule.



for any point in a circuit. such as A.

current in = current out.

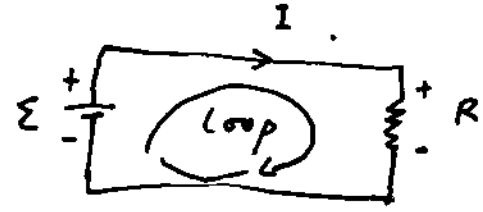
i.e. $I_1 = I_2 + I_3$. (charge conservation)

OR: $I_1 - I_2 - I_3 = 0$.

The algebraic sum of all currents meeting at any junction equal to zero.

Sign of current: in (+)
out (-).

2. The loop rule.



In any closed loop.

the algebraic sum of the voltages is equal to zero

↑ energy conservation.

Sign: up (+)
down (-).