PH 220

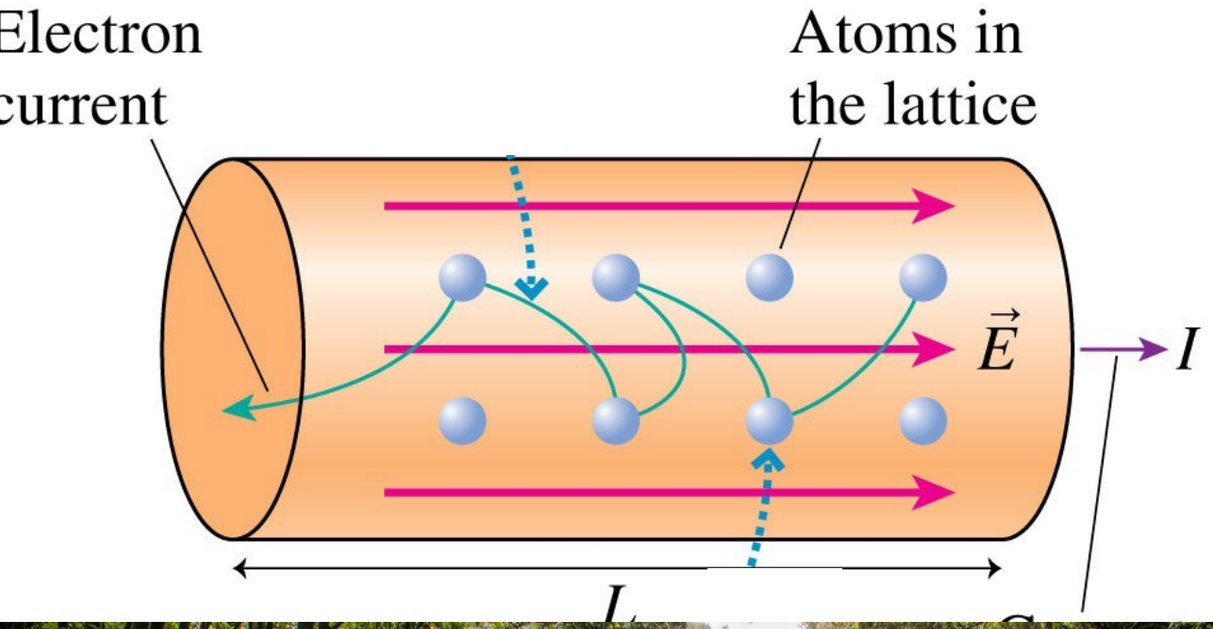
Lance Nelson

Demo Ideas:

1 - Blow a fuse: Connect a fuse to group of lightbulbs all wired in parallel. One by one, add lightbulbs (in parallel) until the fuse blows.

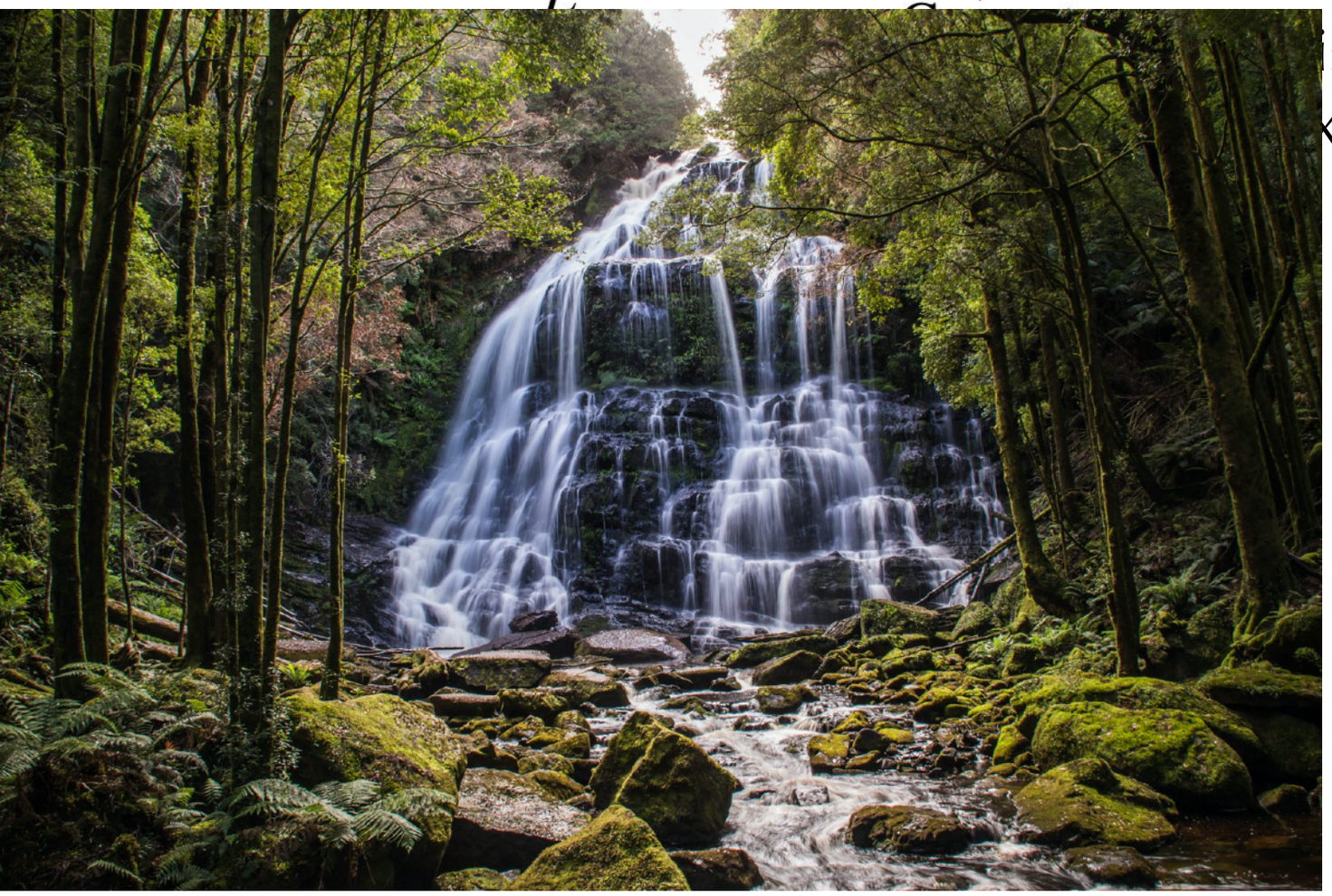
2- Temperature effects on the resistance of a wire. Wind a long wire around a glass rod (insulating) and connect it to a lightbulb. Turn on the power supply and observe that the light burns dimly. Then stick the rod in liquid nitrogen and observe the lightbulb burn brighter. (I found a metal rod with some copper wire wound around it that works ok. The resistance of the copper wire isn't very big so it's not a dramatic effect, but it works.

Deeper Thinking

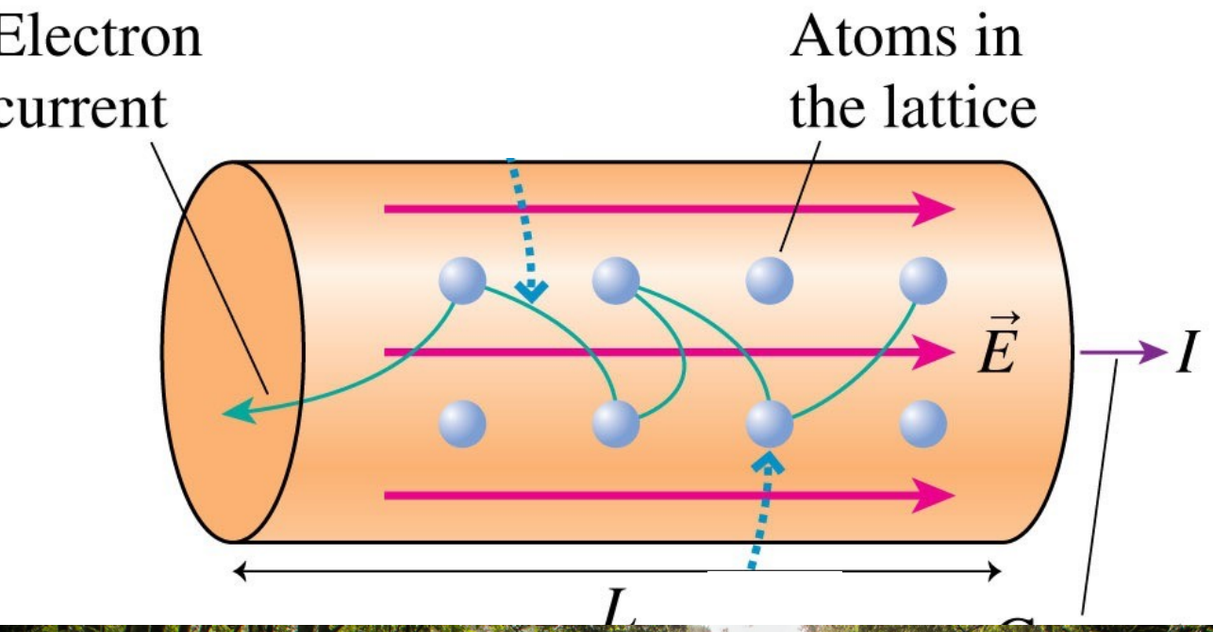


$$P_{\text{res}} = I\Delta V = I^2 R = \frac{\Delta V^2}{R}$$

Explain how an increase/decrease of the variable will affect the power dissipated. (Don't just follow the math, explain it conceptually too)

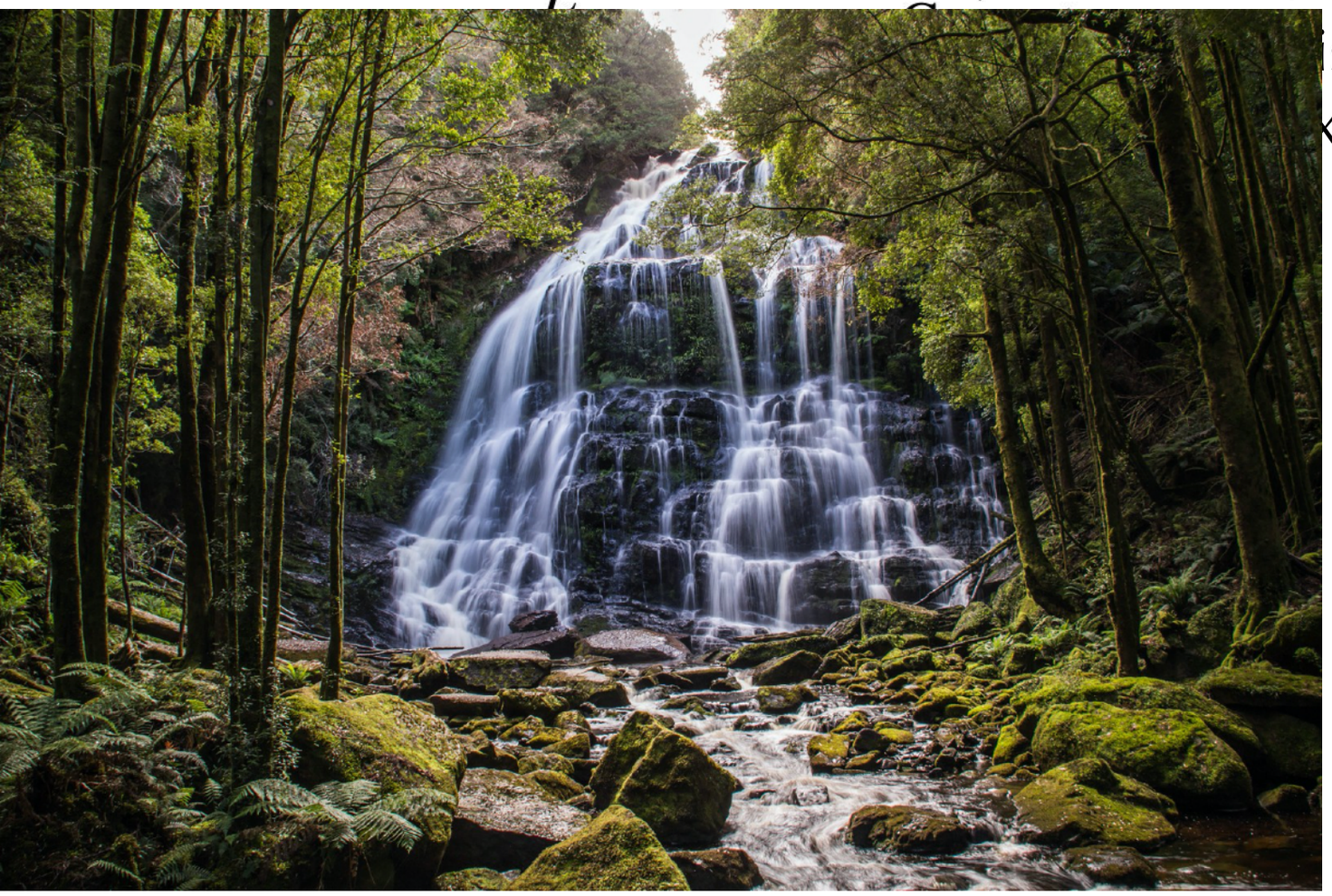


Deeper Thinking



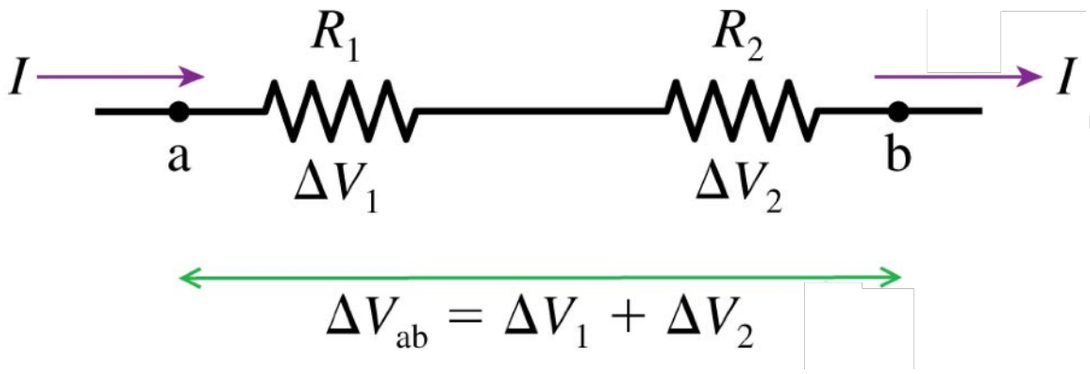
$$P_{\text{res}} = \boxed{1} I\Delta V = I^2 \boxed{3} R = \frac{\boxed{2} \Delta V^2}{R}$$

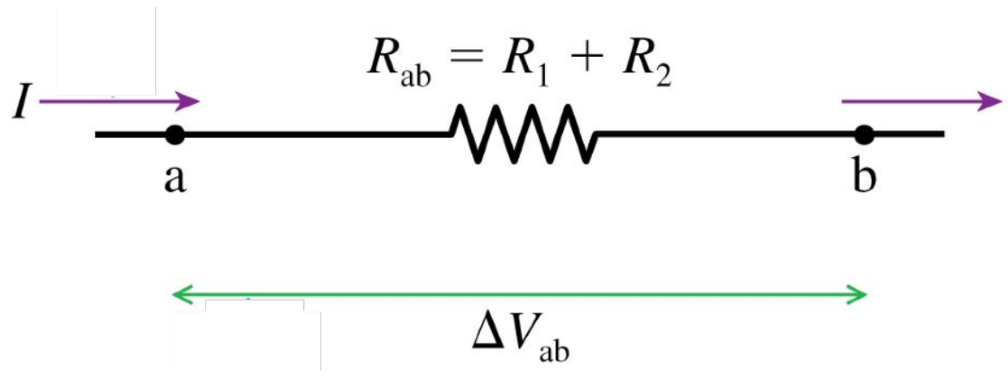
Explain how an increase/decrease of the variable will affect the power dissipated. (Don't just follow the math, explain it conceptually too)



Series Resistors

Write the potential difference between a and b in terms of current and resistance.





Series Resistors

$$\Delta V_{ab} = \Delta V_1 + \Delta V_2 = IR_1 + IR_2 = I(R_1 + R_2)$$

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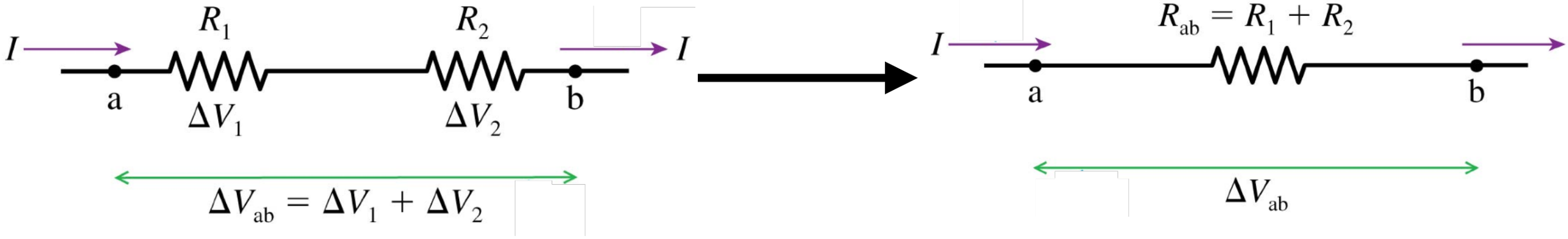
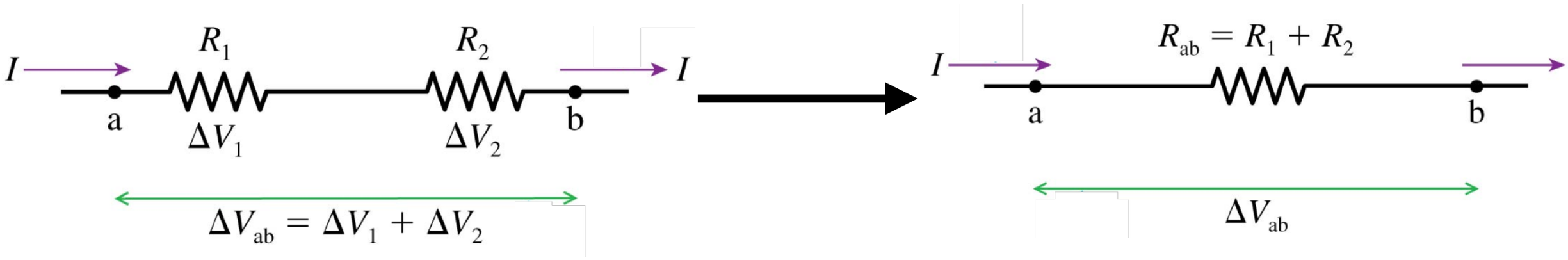


Series Resistors

$$\Delta V_{ab} = \Delta V_1 + \Delta V_2 = IR_1 + IR_2 = I(R_1 + R_2)$$

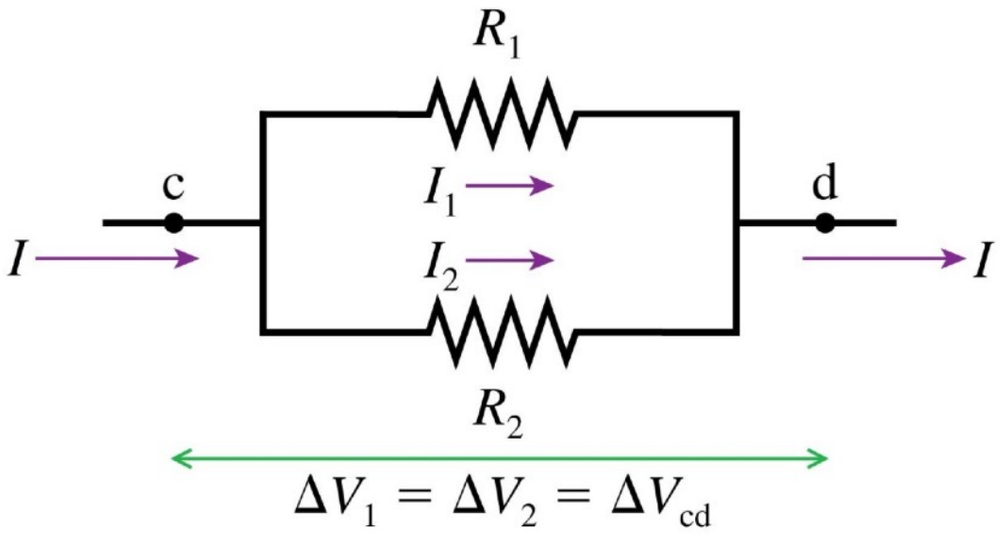
$$R_{ab} = \frac{\Delta V_{ab}}{I} = \frac{I(R_1 + R_2)}{I} = R_1 + R_2$$

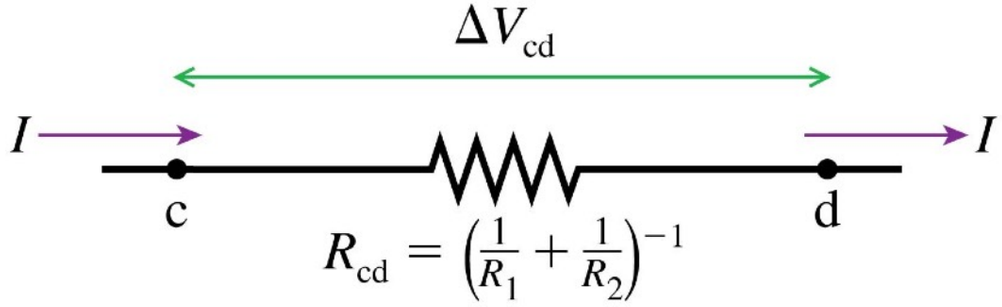
Write the potential difference between a and b in terms of current and resistance.



Resistors in Parallel

Write the current flowing through point c in terms of resistor voltages and resistances.

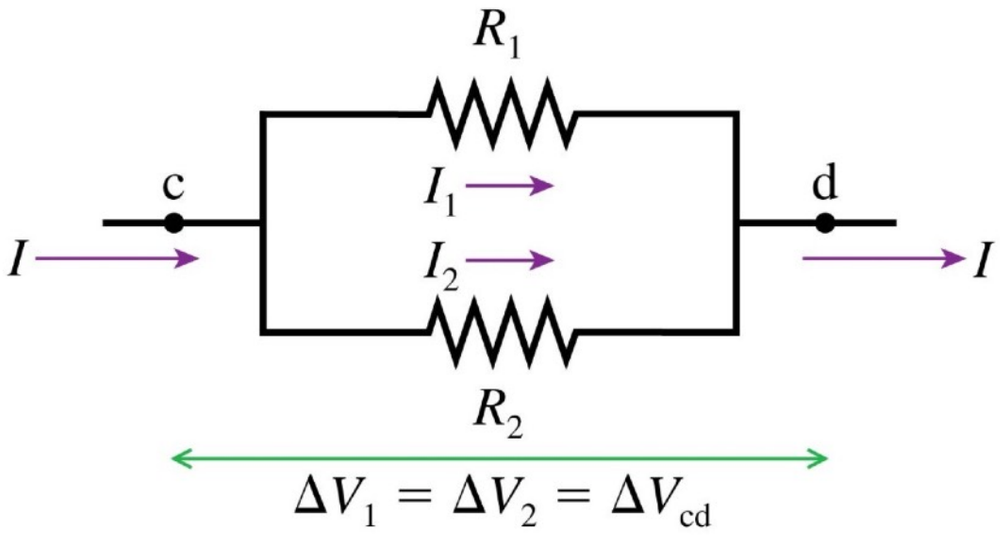


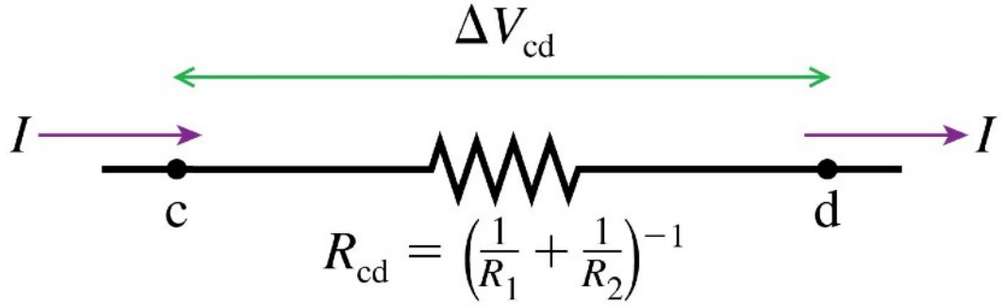


Resistors in Parallel

Write the current flowing through point c in terms of resistor voltages and resistances.

$$I = \frac{\Delta V_1}{R_1} + \frac{\Delta V_2}{R_2} = \frac{\Delta V_{cd}}{R_1} + \frac{\Delta V_{cd}}{R_2} = \Delta V_{cd}\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$





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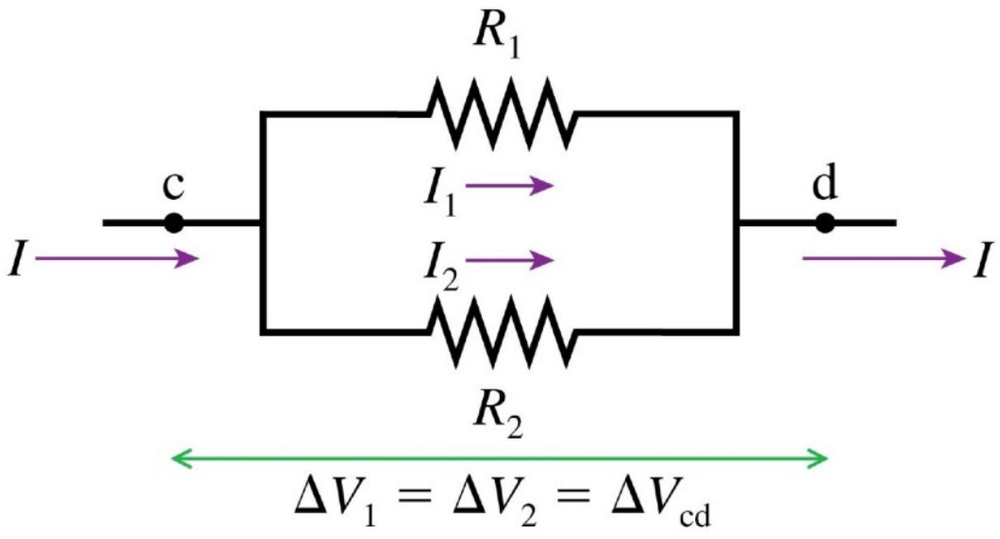
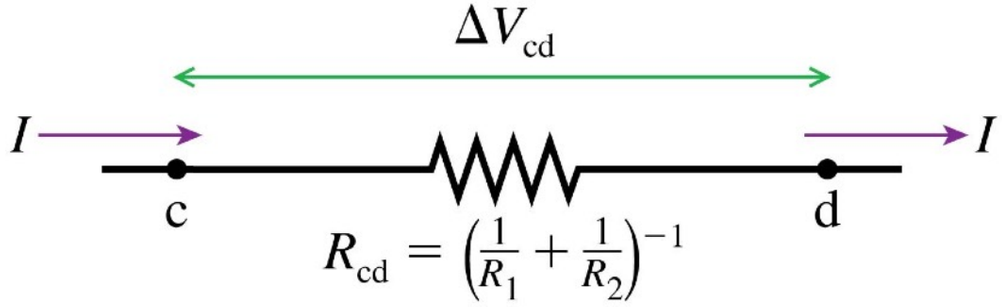
$$R_{cd} = \frac{\Delta V_{cd}}{I} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1}$$





Circuit analysis tools

Describe the tool and the math needed to use the rule!

Kirchoff's loop rules

Power delivered to a resistor

Kirchoff's junction rules

Resistors in series

Resistors in parallel

Power delivered by a source

$$P_{\text{res}} = I\Delta V = I^2 R = \frac{\Delta V^2}{R}$$

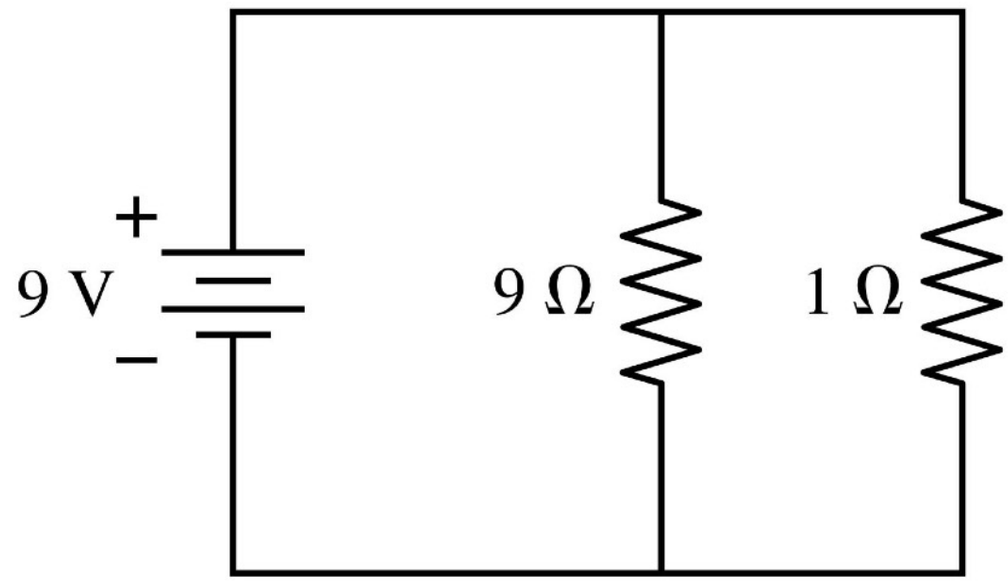
Question #8

Which resistor dissipates more power?

A. The 9 Ω resistor.

C. The 1 Ω resistor.

D. They dissipate the same power.



Question #8

$$P = \frac{(\Delta V)^2}{R}$$

Which resistor dissipates more power?

A. The 9 Ω resistor.

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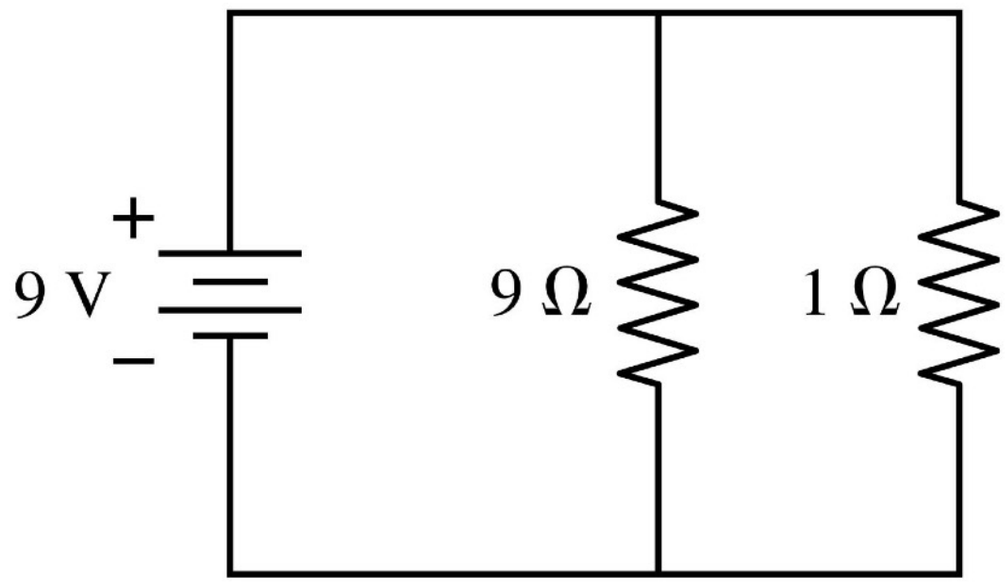
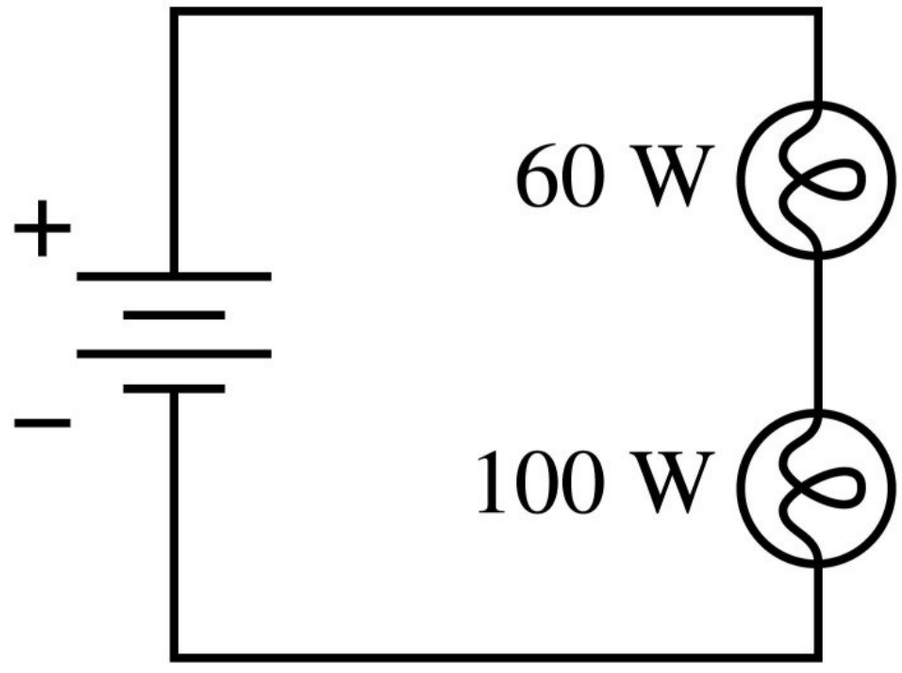


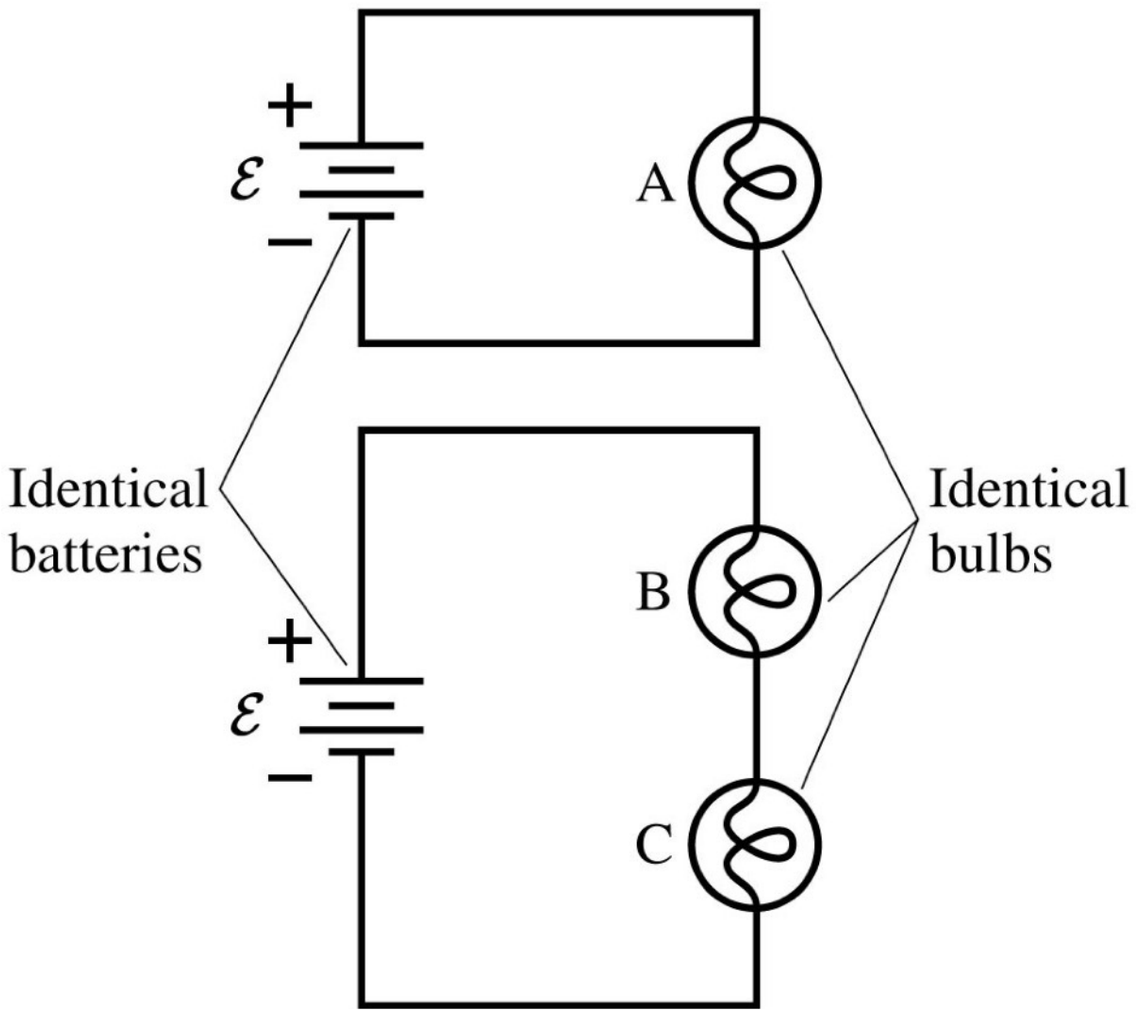
Question #9

Which bulb is brighter?

A. The 100 W bulb.
B. The 60 W bulb.
C. Their brightnesses are the same.
D. There's not enough information to tell.

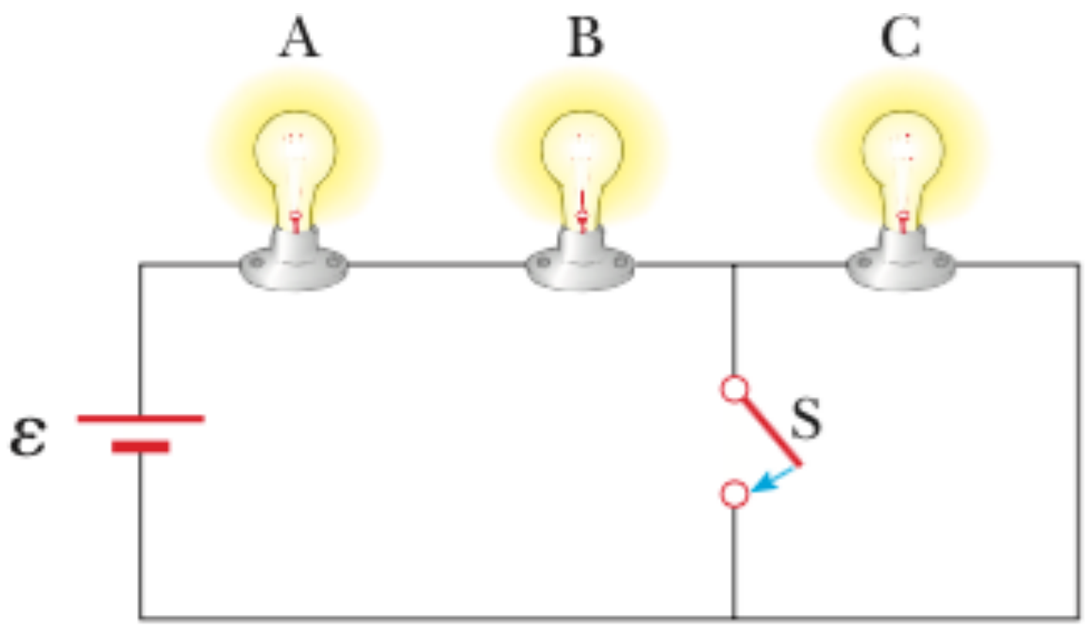


Lightbulb puzzle



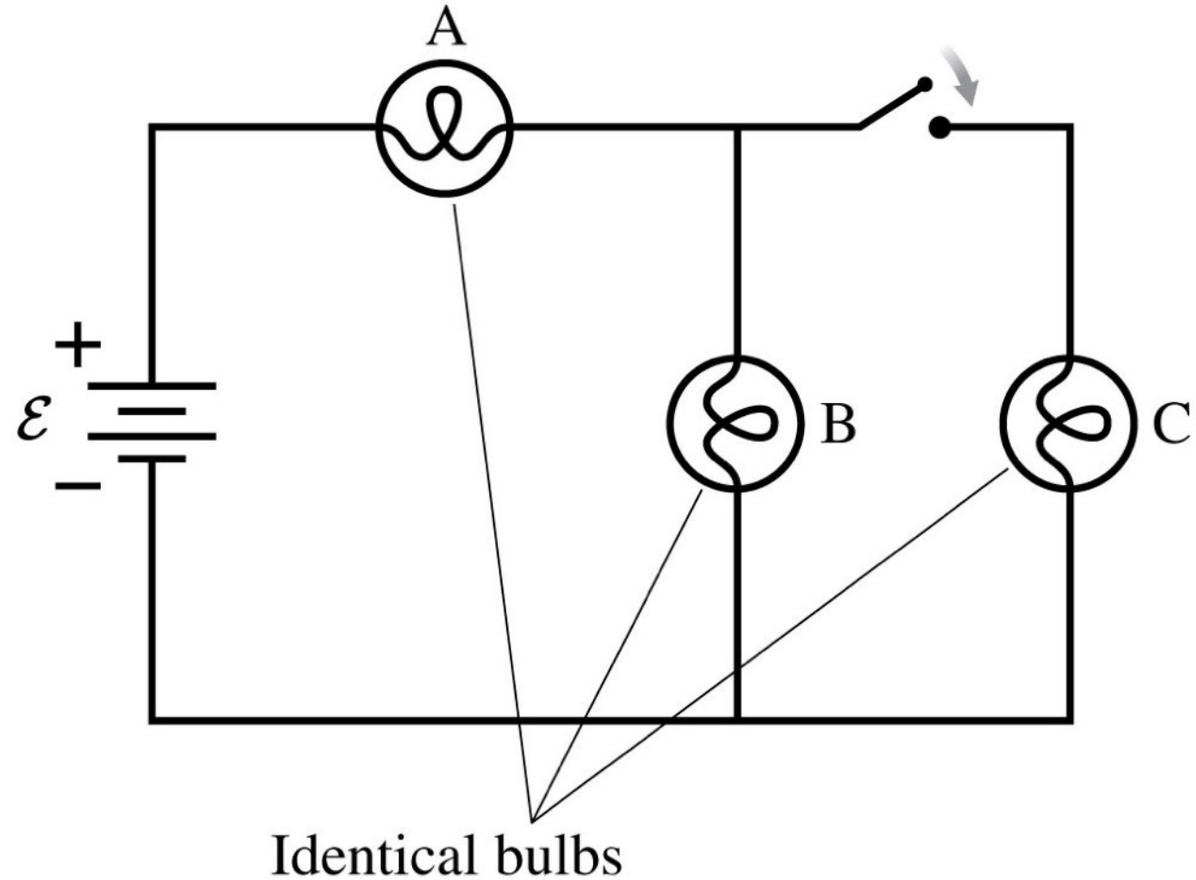
Rank the brightness of the bulbs

$$P_{\text{res}} = I\Delta V = I^2 R = \frac{\Delta V^2}{R}$$



What will happen to the brightness of the bulbs when the switch is closed

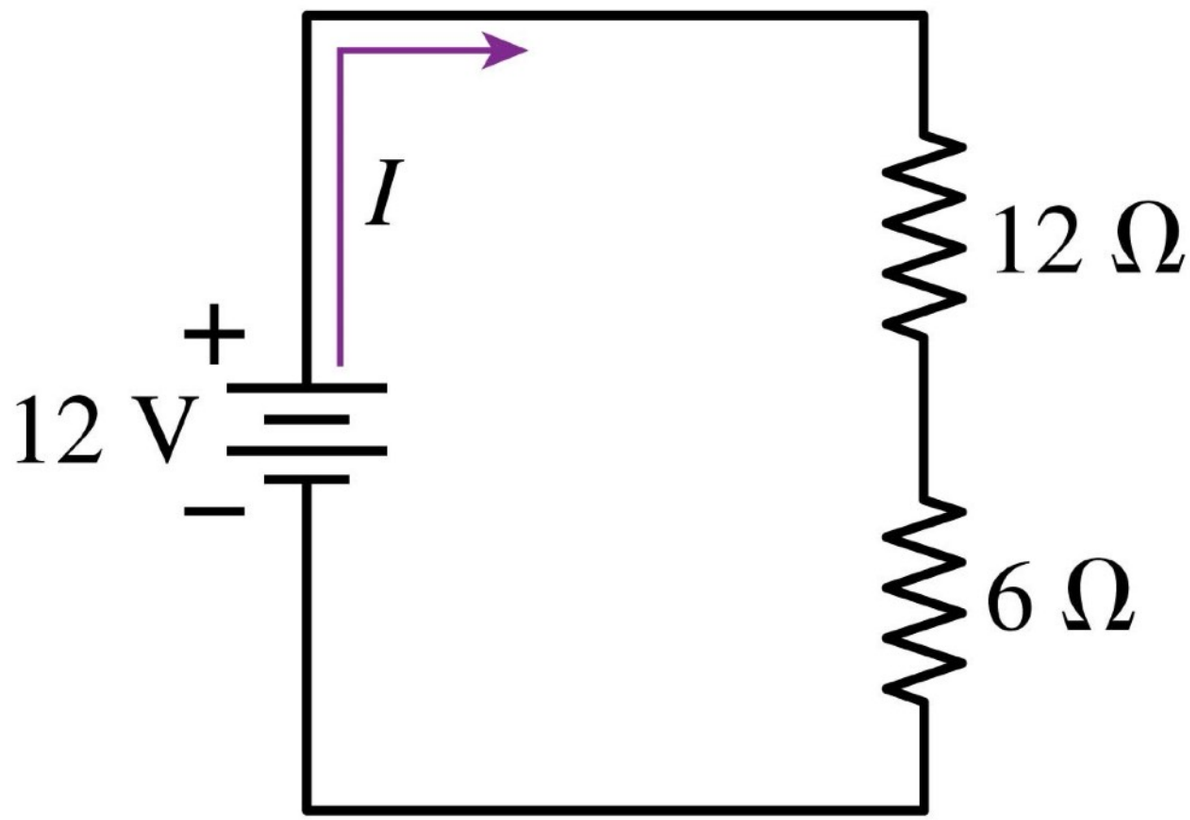
What happens to the brightness of the bulbs when the switch closes?



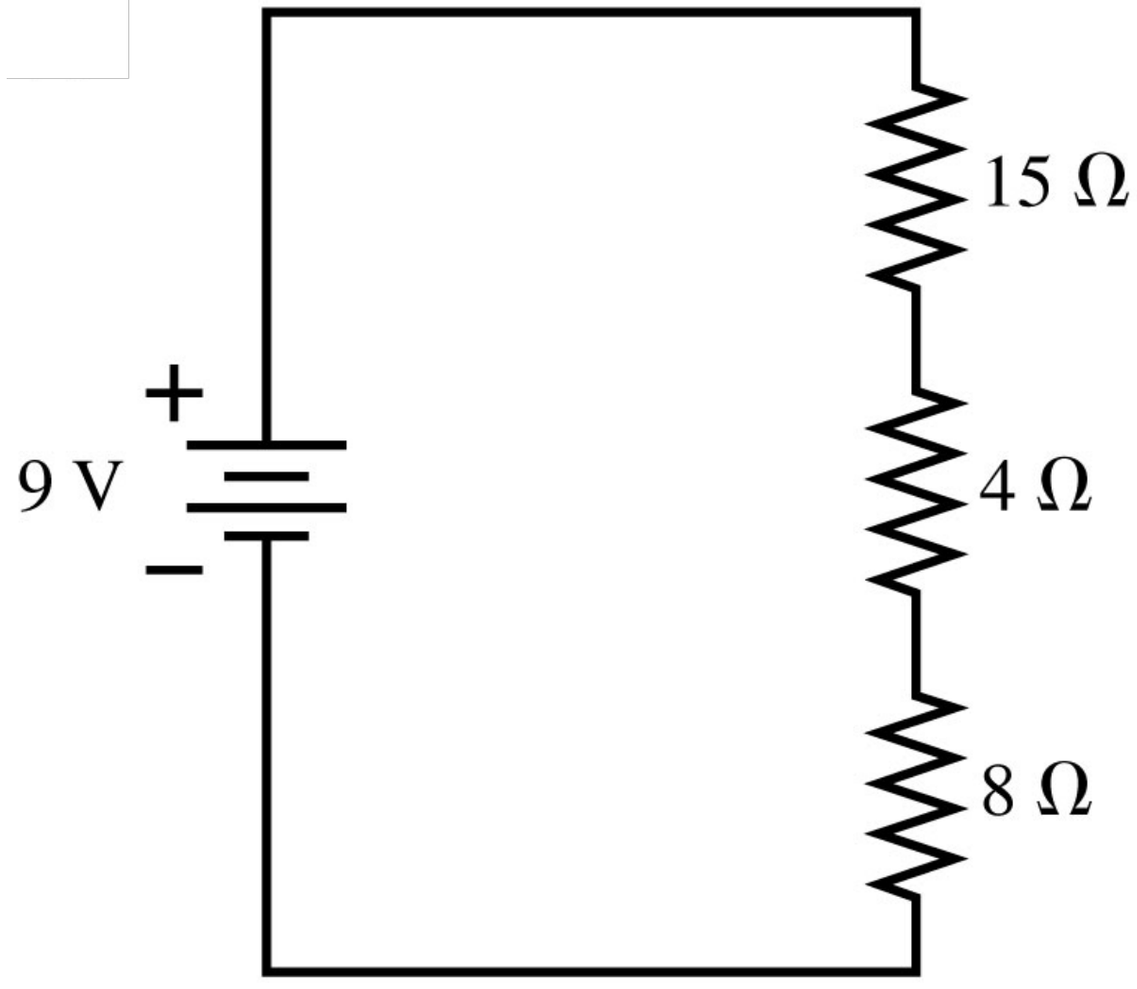
Question #10

The battery current *I* is

A. 3 A.
B. 2/3 A.
C. 1 A.
D. 2 A.
E. 1/2 A.



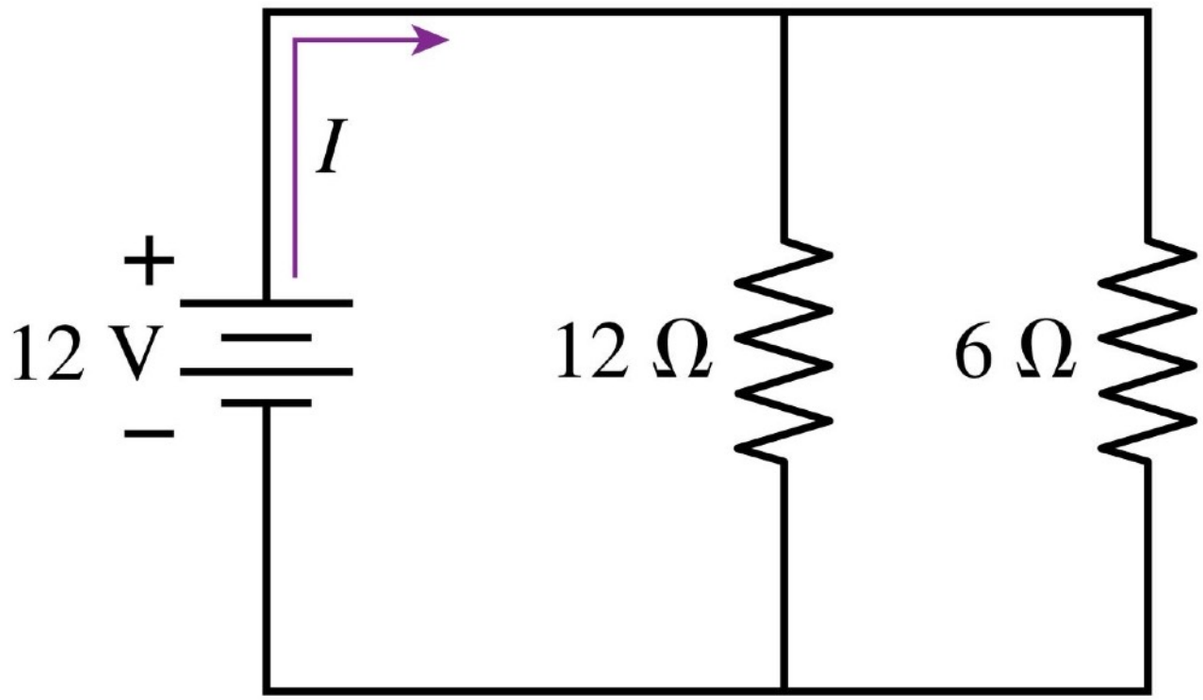
What will be the potential drop across each resistor?



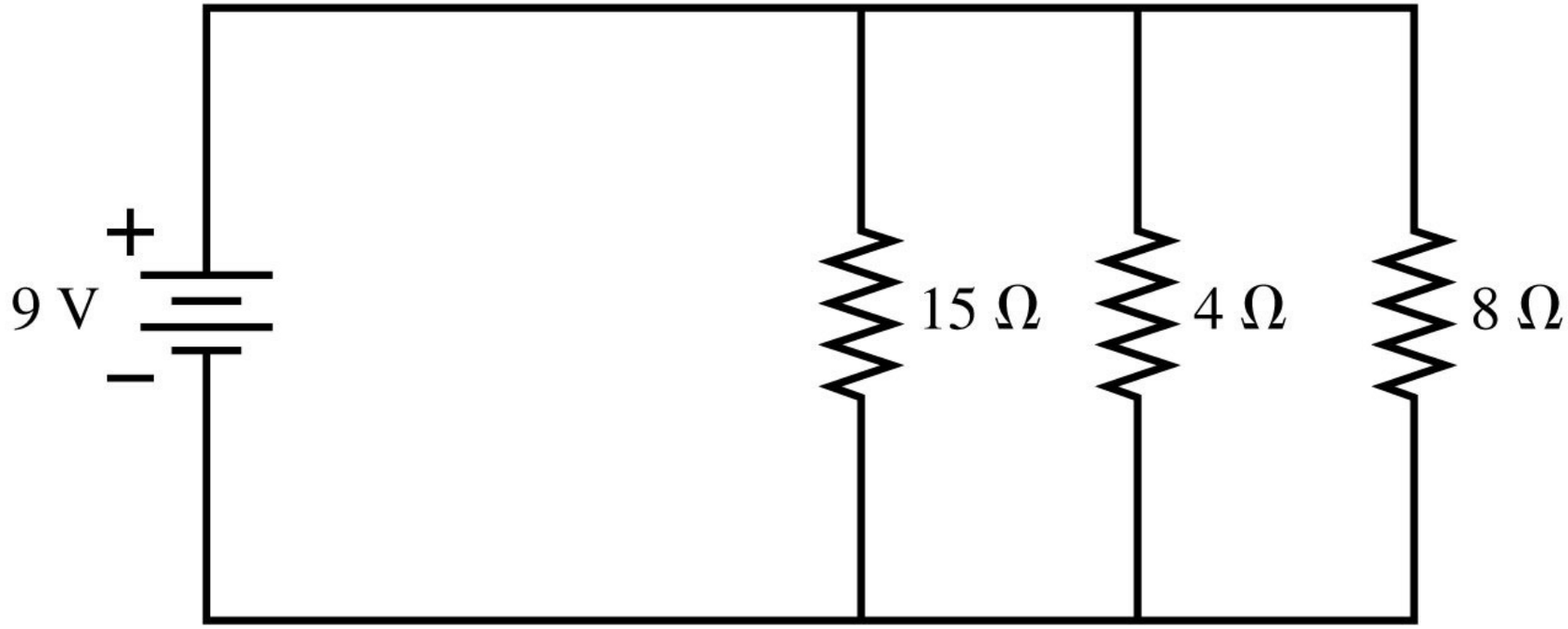
Question #11

The battery current *I* is

A. 3 A.
B. 2 A.
C. 1 A.
D. 2/3 A.
E. 1/2 A.

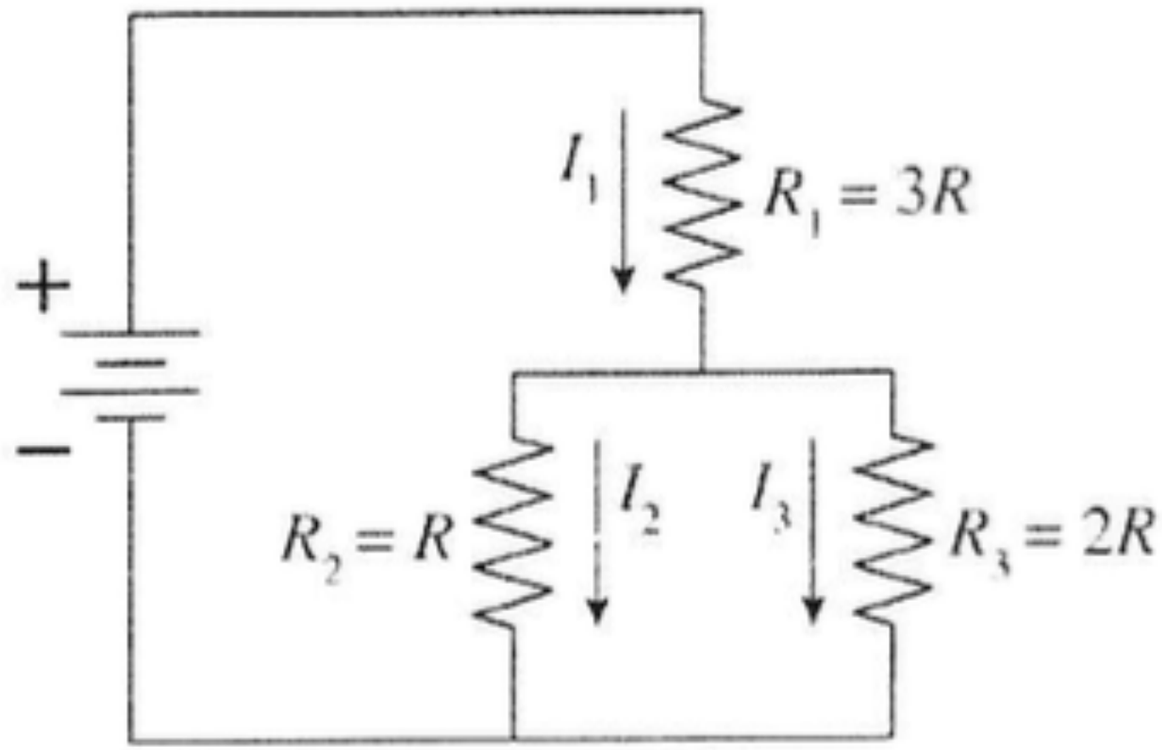


Find the current and voltage for each resistor.



Question #12

Rank the currents in the circuit



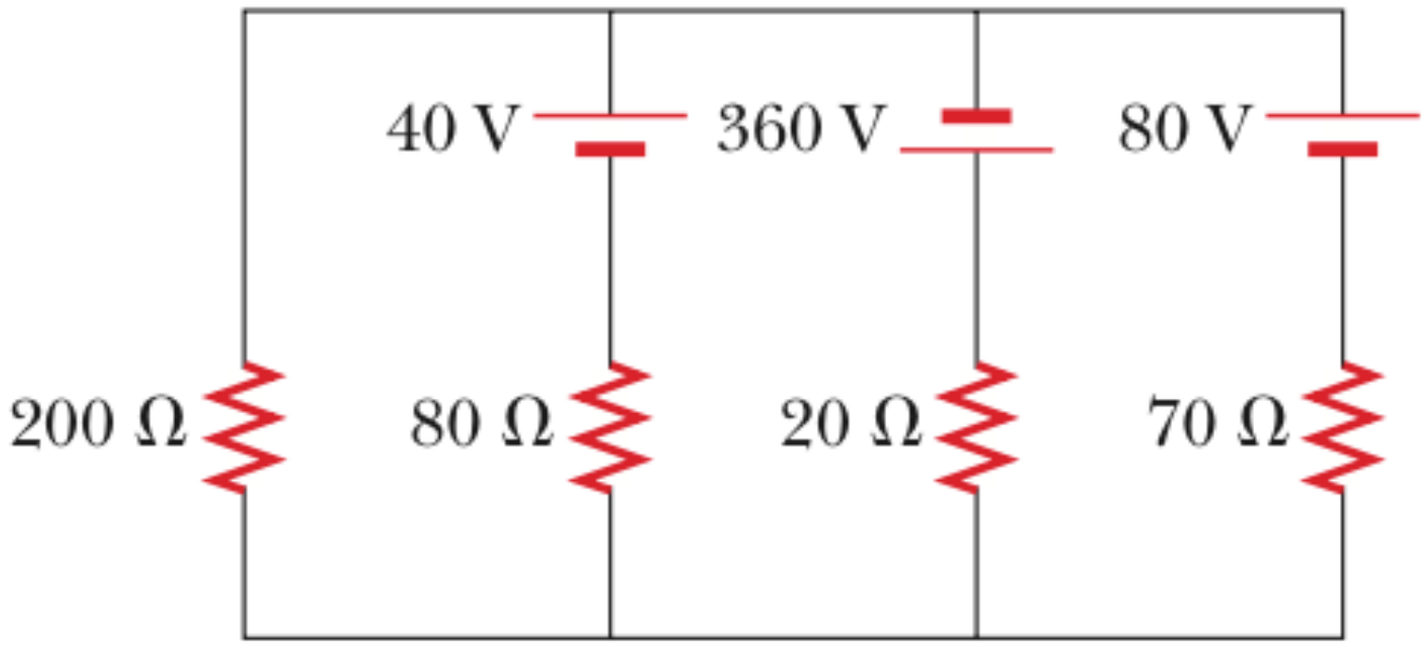
a) $I_1 = I_2 = I_3$

b) $I_1 > I_2 = I_3$

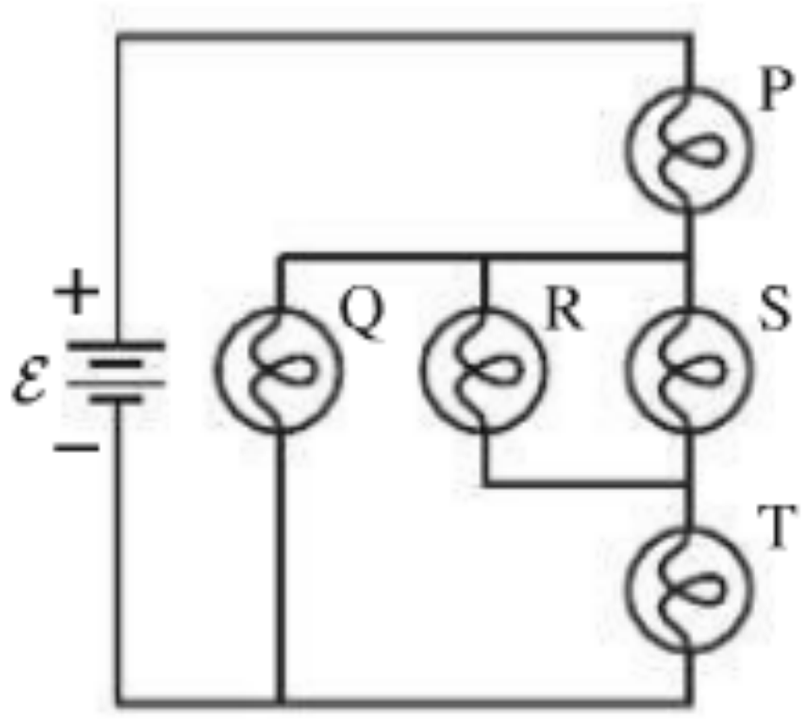
c) $I_1 < I_2 = I_3$

d) $I_1 > I_2 > I_3$

Find the current through each resistor and the voltage across the 200 Ohm resistor.

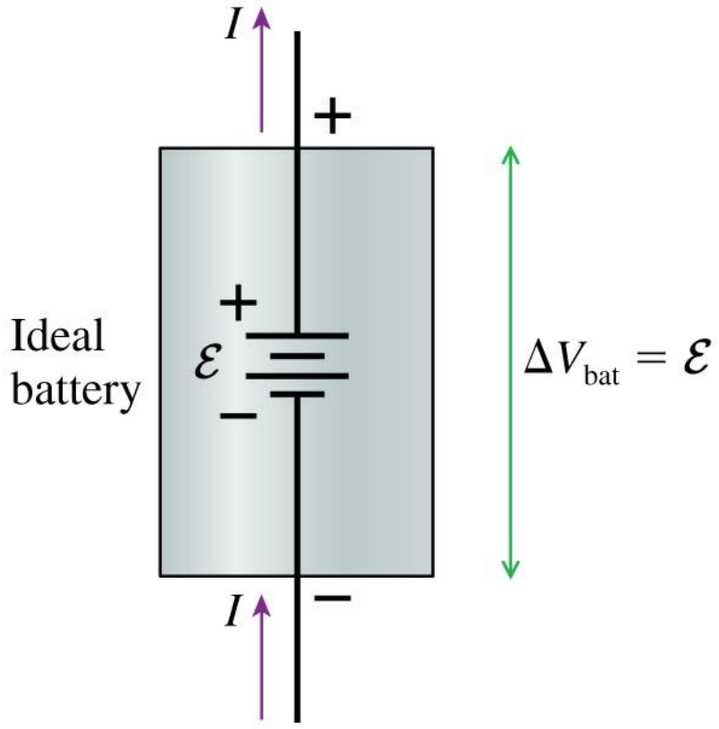


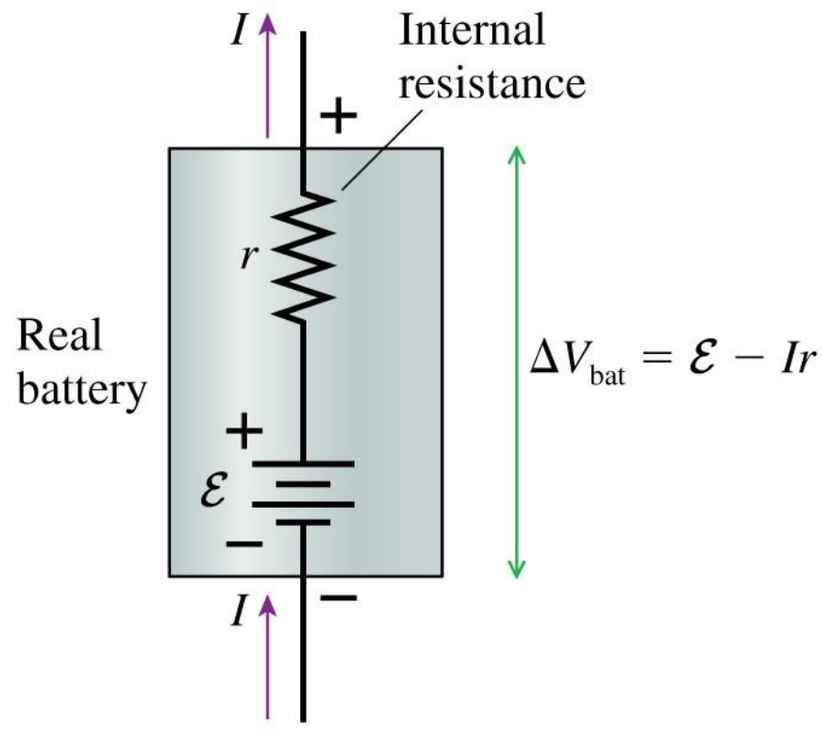
Rank the brightness of the bulbs



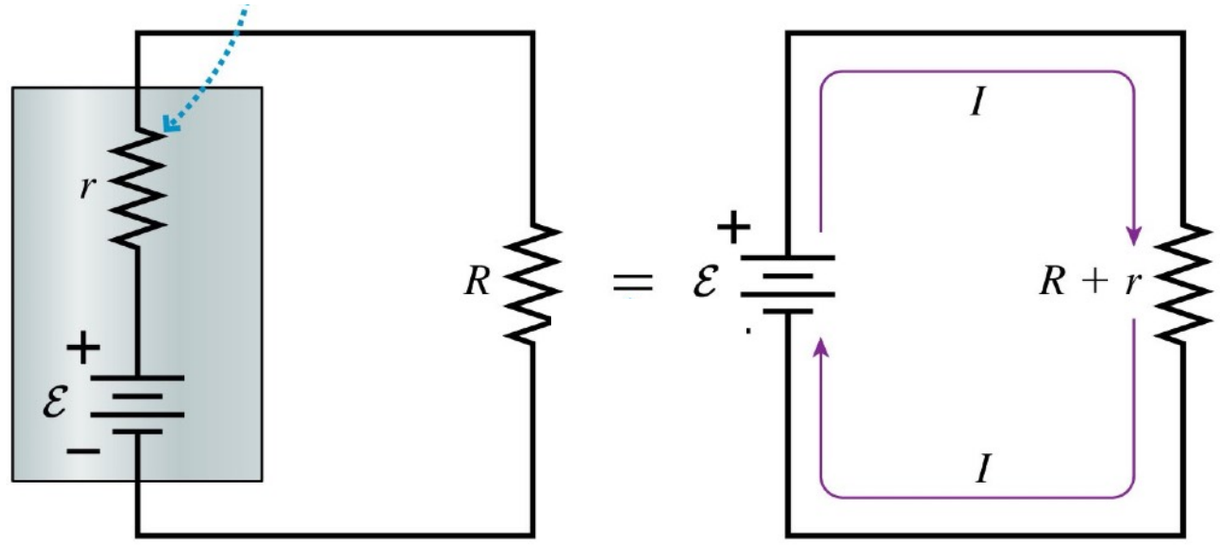
Real Batteries

The batterie's internal resistance limits the max current.





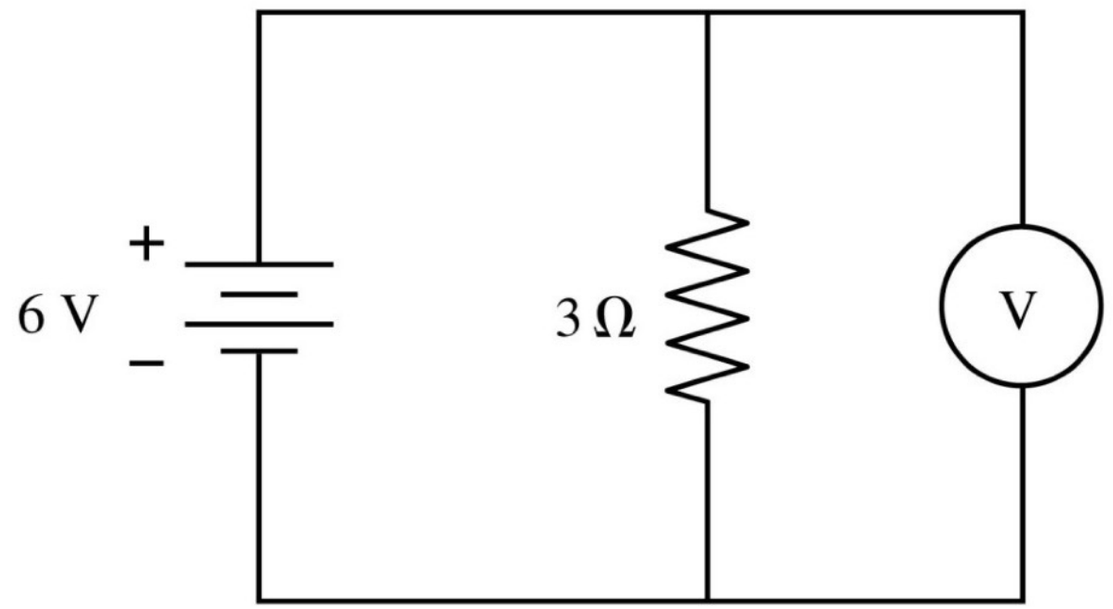
$$\Delta V_R = IR = \frac{\mathcal{E}}{R+r}R$$



Question #13

What does the voltmeter read?

A. 3 V.
B. 6 V.
C. 2 V.
D. Some other value.
E. Nothing because this will fry the meter.



Question #14

What does the ammeter read?

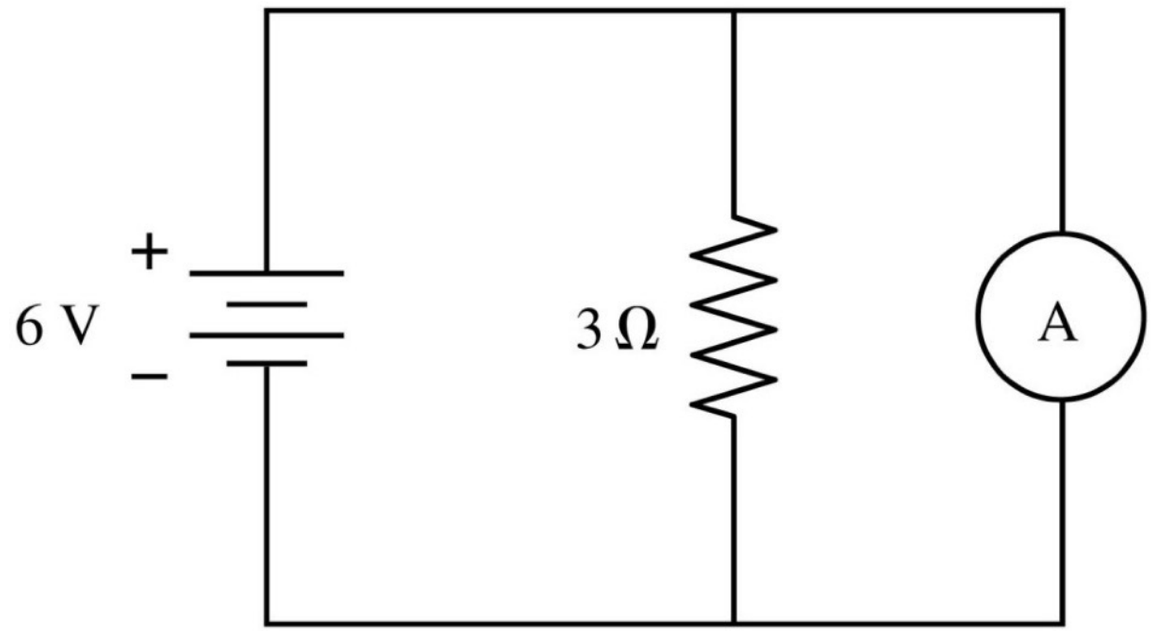
A. 6 A.

B. Nothing because this will fry the meter.

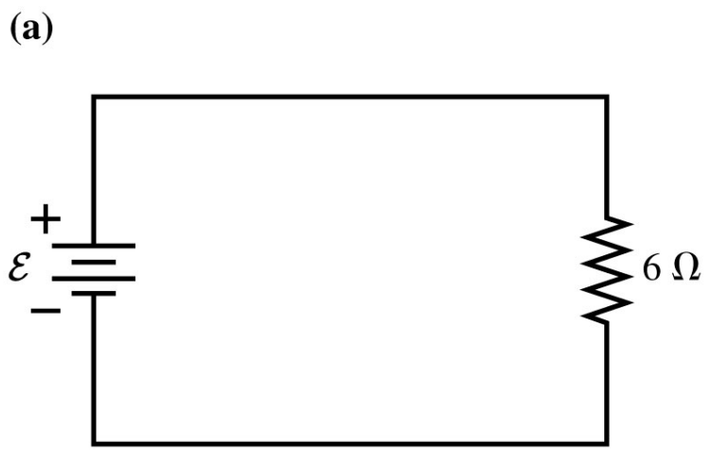
C. 2 A.

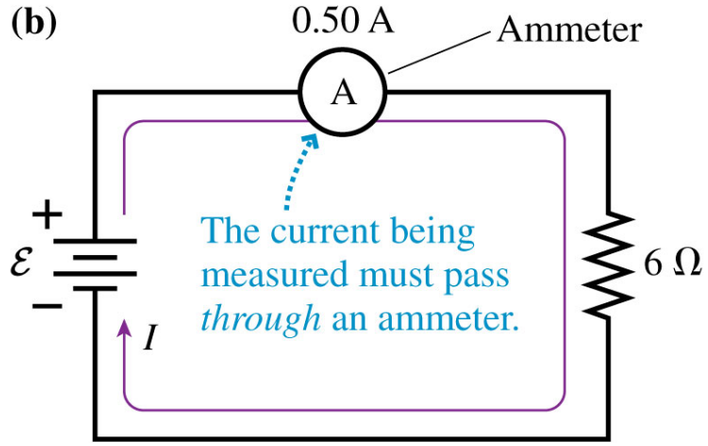
D. Some other value.

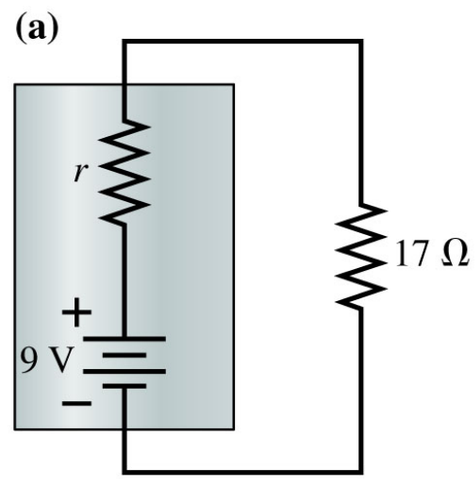
E. 3 A.

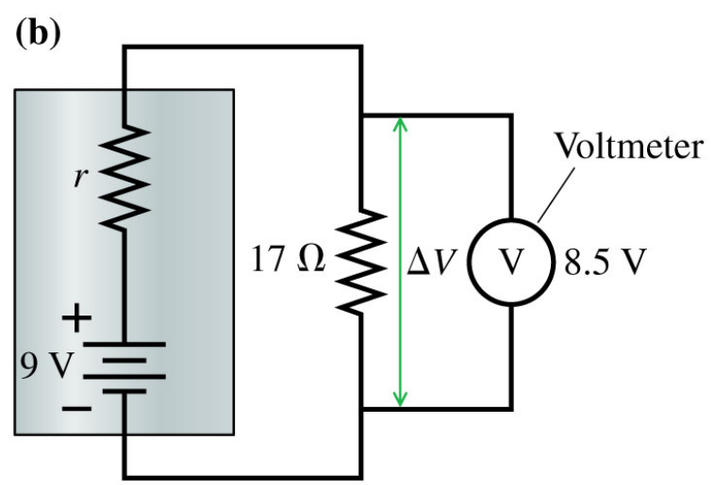


Ammeters and Voltmeters

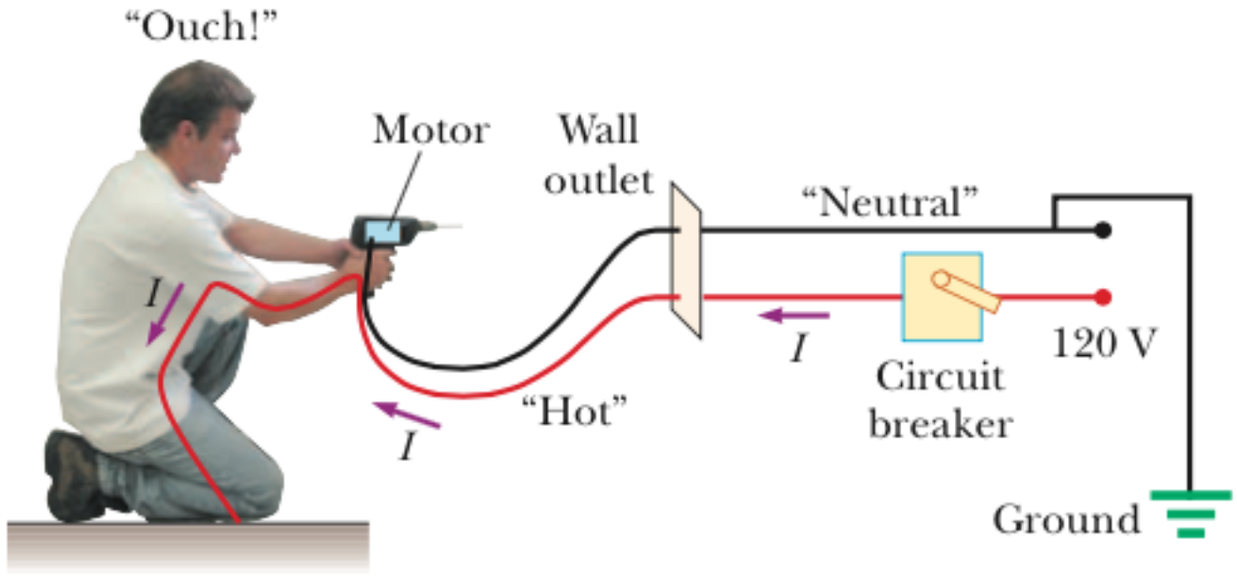




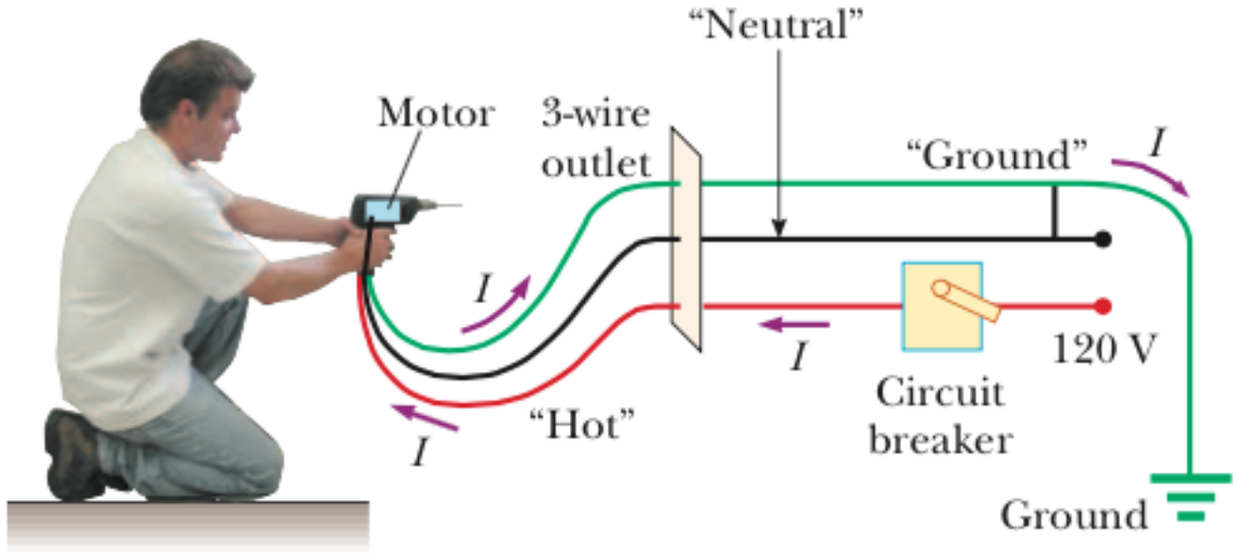




Getting Grounded



(a)



Grounding a circuit