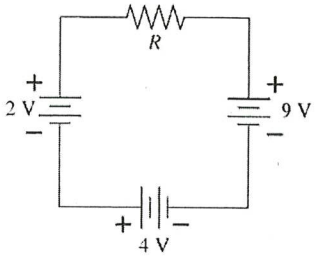
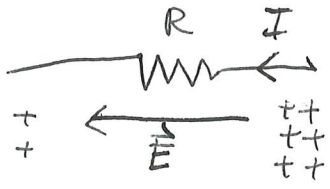
1.

a. In which direction does current flow through resistor R?

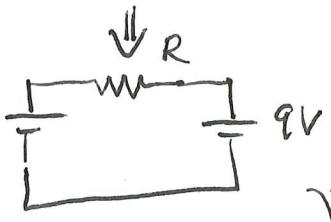


I goes ccw (from right to left through R)

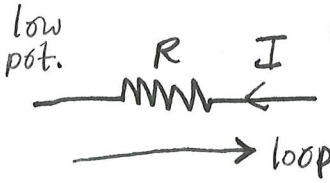
b. Which end of R is more positive? Explain.



$\vec{E}$ points pos. to neg (less pos.) ∴ right end more pos.

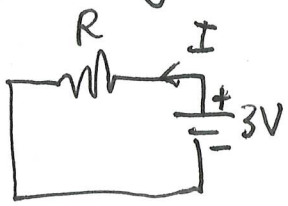


c. If this circuit were analyzed in a clockwise direction, what numerical value would you assign to ΔV_{res}? Why?



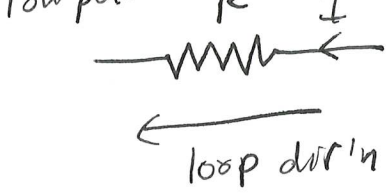
$\vec{E}$ pts. from high to low pot. ∴ in cw dir'n move from low to high pot.

$\Delta V_R = +IR = +3V$



d. What value would ΔV_{res} have if the circuit were analyzed in a counterclockwise direction?

in ccw dir'n, move from high to low pot.



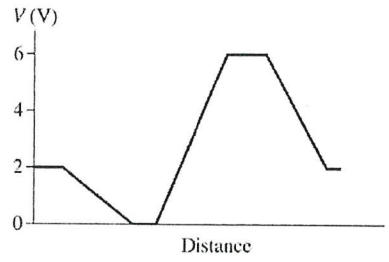
$\therefore \Delta V_R = -IR$

$I = \frac{3V}{R}$

$\therefore \Delta V_R = -\left(\frac{3V}{R}\right)R = -3V.$

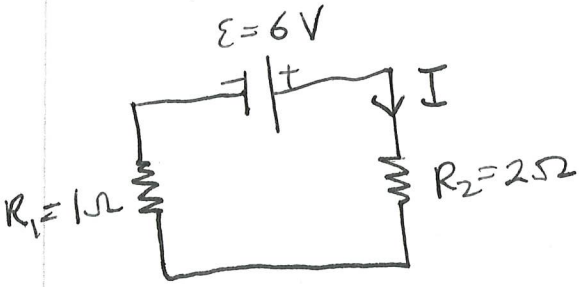
2.

The current in a circuit is 2.0 A. The graph shows how the potential changes when going around the circuit in a clockwise direction, starting from the lower left corner. Draw the circuit diagram.

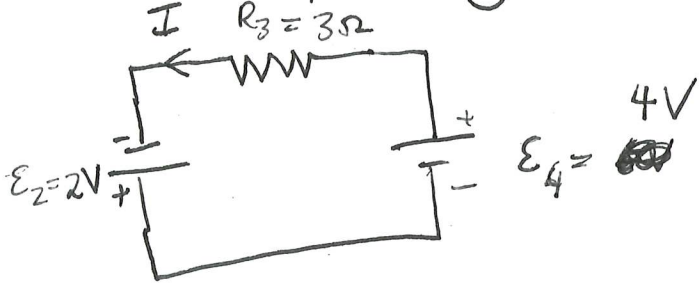


$\sum \Delta V_i = -2V + 6V - 4V = 0$

one possible circuit:

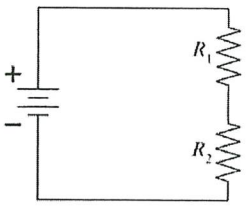


another possibility



3.

This circuit has two resistors, with $R_1 > R_2$. Which of the two resistors dissipates the larger amount of power? Explain.



$I_1 = I_2 \equiv I$

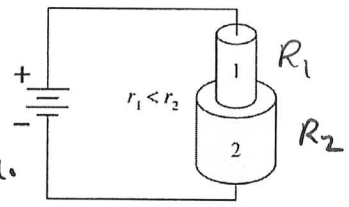
$P_1 = I^2 R_1 \quad P_2 = I^2 R_2$

$R_1 > R_2$

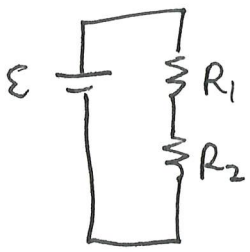
$\therefore P_1 > P_2$

4.

Two conductors of equal lengths are connected to a battery by ideal wires. The conductors are made of the same material but have different radii r. Which of the two conductors dissipates the larger amount of power? Explain.



Equiv. circuit is:



Just like previous problem.

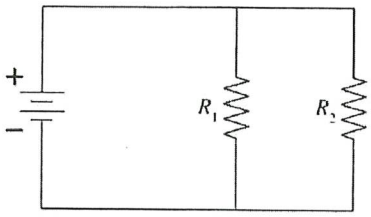
Larger resistor dissipates more power

$R = \frac{1}{\sigma}\frac{\ell}{A} \quad A_1 < A_2 \therefore R_1 > R_2$

$\therefore R_1$ (wire 1) dissipates more power.

5.

The circuit shown has a battery and two resistors, with $R_1 > R_2$. Which of the two resistors dissipates the larger amount of power? Explain your reasoning.



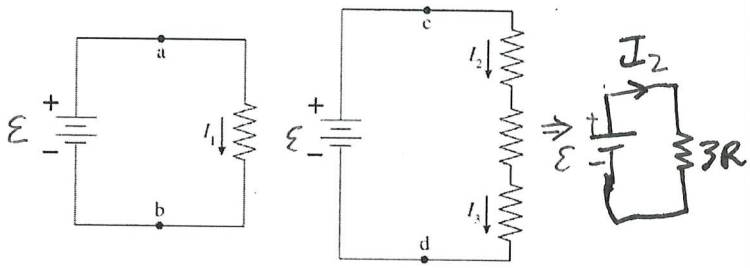
For parallel combo $\Delta V_1 = \Delta V_2 \equiv \Delta V$

$P_1 = \frac{(\Delta V_1)^2}{R_1} = \frac{(\Delta V)^2}{R_1}$ $\quad P_2 = \frac{(\Delta V)^2}{R_2}$

$R_1 > R_2 \quad \therefore P_2 > P_1$ $\quad R_2$ dissipates more power.

6.

The figure shows two circuits. The two ideal batteries are identical and the four resistors all have exactly the same resistance.



a. Is ΔV_{ab} larger than, smaller than, or equal to ΔV_{cd}? Explain.

$\Delta V_{ab} = \Delta V_{cd}$

both across same battery. $\therefore \Delta V_{ab} = \Delta V_{cd} = \mathcal{E}$.

b. Rank in order, from largest to smallest, the currents I_1, I_2, and I_3.

Order: $I_1 > I_2 = I_3$

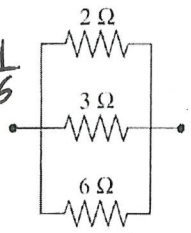
Explanation: I_2 in series w/ I_3 $\therefore I_2 = I_3$

$I_1 = \frac{\mathcal{E}}{R}$ $\quad I_2 = I_3 = \frac{\mathcal{E}}{3R}$ $\quad \therefore I_1 > I_2, I_3$

7.

What is the equivalent resistance of each group of resistors?

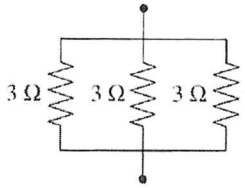
a.



$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{6}{6}$

$\therefore R_{eq} = 1\Omega$ $\quad R_{eq} =$ 1Ω

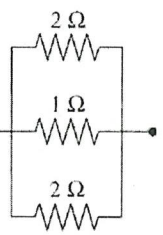
b. $\frac{1}{R_{eq}} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3}$



$\therefore R_{eq} = 1\Omega$

$R_{eq} =$ 1Ω

c.



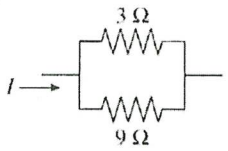
$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{1} + \frac{1}{2} = 2$

$\therefore R_{eq} = 0.5\Omega$

$R_{eq} =$ 0.5Ω

8.

a. What fraction of current I goes through the 3 Ω resistor?



$\Delta V_3 = \Delta V_9$

$\therefore I_3 R_3 = I_9 R_9$

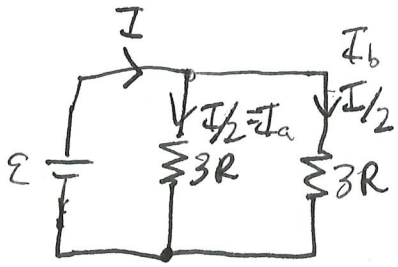
$\therefore I_3 = I_9 \frac{R_9}{R_3} = 3 I_9$

$I = I_3 + I_9 = 4 I_9$

$\therefore \boxed{I_9 = \frac{I}{4}}$ $\boxed{I_3 = \frac{3}{4} I}$

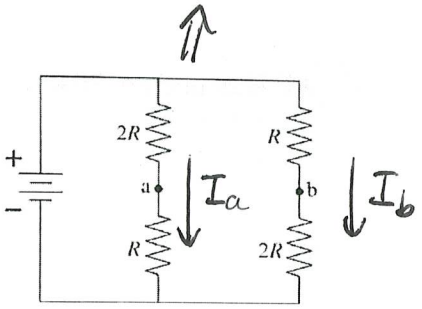
b. If the 9 Ω resistor is replaced with a larger resistor, will the fraction of current going through the 3 Ω resistor increase, decrease, or stay the same?

increase. More of the current takes the "low resistance" path.



9.

a. Consider the points a and b. Is the potential difference $\Delta V_{ab} = 0$? If so, why? If not, which point is more positive?



$\Delta V_{ab} \neq 0$. $I_a = I_b = I/2$

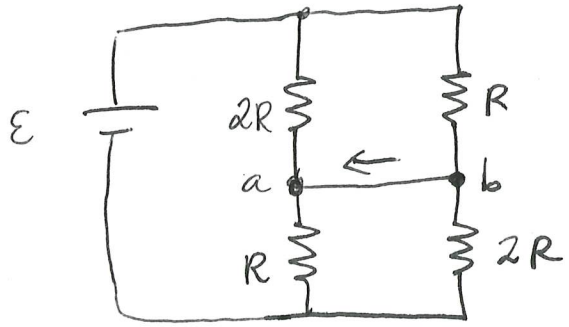
Track changes in volt. from pt. a to b.

$V_a - I_a R + I_b 2R = V_b$

$\therefore V_b - V_a = \Delta V_{ab} = -\frac{I}{2} R + \frac{I}{2} 2R = +\frac{IR}{2}$ $\therefore V_b > V_a$

b. If a wire is connected between points a and b, does a current flow through it? If so, in which direction—to the right or to the left? Explain.

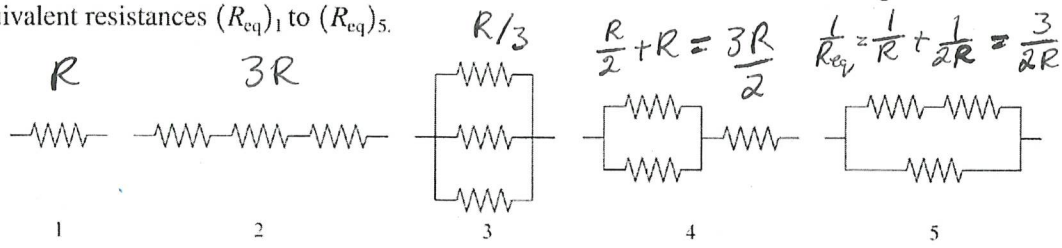
Yes, current flows from b → a.



b was at a higher pot. than a.

current flows from high to low pot.

10. The figure shows five combinations of identical resistors. Rank in order, from largest to smallest, the equivalent resistances $(R_{eq})_1$ to $(R_{eq})_5$.

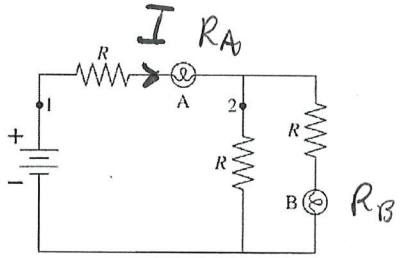


$\frac{R}{2}+R=\frac{3R}{2}$ $\frac{1}{R_{eq}}=\frac{1}{R}+\frac{1}{2R}=\frac{3}{2R}$ $\therefore R_{eq}=\frac{2R}{3}$

Order:

Explanation: 2, 4, 1, 5, 3

11. Bulbs A and B are identical. Initially both are glowing.



a. Bulb A is removed from its socket. What happens to bulb B? Does it get brighter, stay the same, get dimmer, or go out? Explain.

B goes out. When A is removed it causes an open circuit.

$\therefore I \to 0$

b. Bulb A is replaced. Bulb B is then removed from its socket. What happens to bulb A? Does it get brighter, stay the same, get dimmer, or go out? Explain.

A gets dimmer. When B is in place, have R in parallel with $R+R_B$ which makes a smaller R_{eq}. When B is removed $R_{eq} \to R$ & current decreases.

c. The circuit is restored to its initial condition. A wire is then connected between points 1 and 2. What happens to the brightness of each bulb?

A goes out.

B gets brighter.

A wire between 1 & 2 "short circuits" $R+R_A$. $\therefore$ no current through R_A.

Current through R_B increase b/c now don't have series resistance $R+R_A$.