

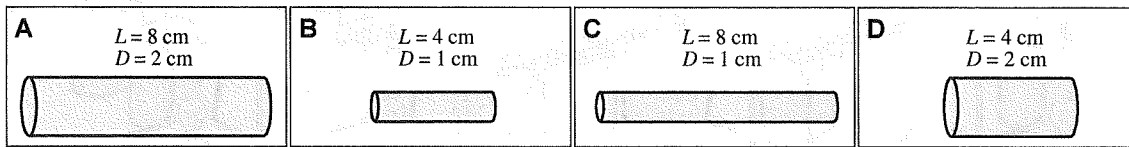
AP Physics 1: TIPERS Circuits

D2 CIRCUITS

Name: _____

D2-RT01: CARBON RESISTORS—RESISTANCE

Four different resistors are created from the same piece of carbon. The length and the diameter of each resistor are shown.



Rank the resistance of the four resistors.

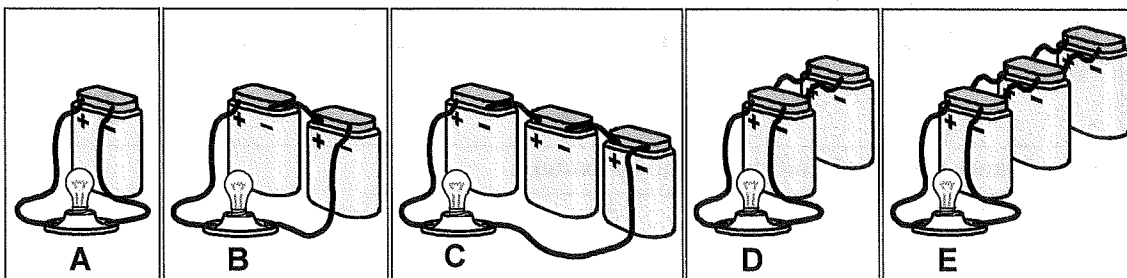
				OR			
1	2	3	4		All the same	All zero	Cannot determine
Greatest			Least				

Explain your reasoning.

D2-WWT02: BATTERIES AND LIGHT BULBS—BULB BRIGHTNESS

All of the batteries in the circuits shown are identical, as are the light bulbs. A student comparing the brightness of the bulbs in these circuits states:

“Bulbs E and C are the brightest since they have three batteries, then bulbs B and D since they have two batteries, and the least bright one is A, since there is only one battery. The more batteries, the brighter the bulb, and it does not matter how they are connected.”

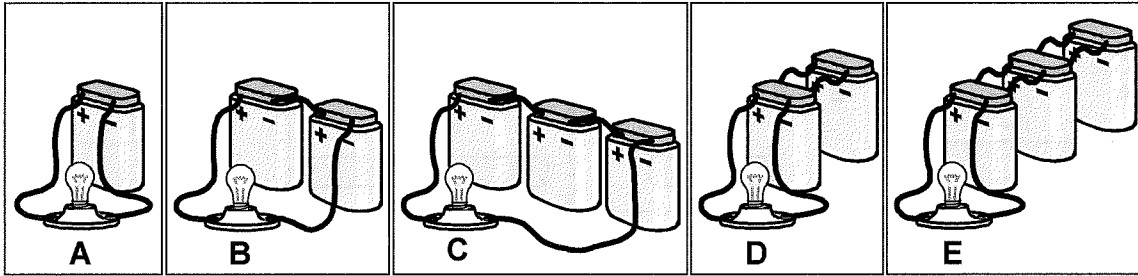


What, if anything, is wrong with this statement? If something is wrong, explain the error and how to correct it. If the statement is correct, explain why.

TIPERS

D2-RT03: BATTERIES AND LIGHT BULBS—BULB BRIGHTNESS

Identical ideal batteries are connected in different arrangements to identical light bulbs as shown.



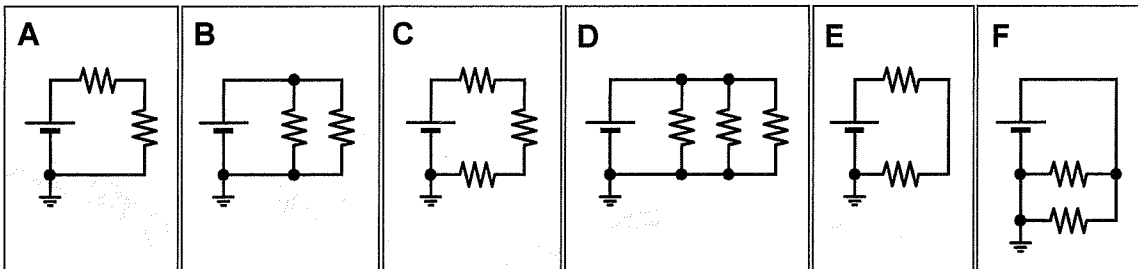
Rank the brightness of the light bulbs.

1	2	3	4	5	OR		
Greatest				Least		All the same	All zero
							Cannot determine

Explain your reasoning.

D2-RT04: SIMPLE RESISTOR CIRCUITS I—RESISTANCE

All of the resistors and batteries are identical in the circuits shown.



Rank the resistance that the circuits present to the battery.

1	2	3	4	5	6	OR		
Greatest					Least		All the same	All zero
								Cannot determine

Explain your reasoning.

D2-RT05: SIMPLE LIGHT BULB CIRCUITS I—BULB BRIGHTNESS

All of the bulbs in the circuits below are identical, as are all of the batteries.

For the three items below, rank the brightness of the bulb labeled X.

(a)

A	B	C
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>
1	2	3
Greatest		Least

OR

<input style="width: 30px; height: 20px;" type="checkbox"/>	<input style="width: 30px; height: 20px;" type="checkbox"/>	<input style="width: 30px; height: 20px;" type="checkbox"/>
All	All	Cannot
the same	zero	determine

Explain your reasoning.

(b)

A	B	C
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>
1	2	3
Greatest		Least

OR

<input style="width: 30px; height: 20px;" type="checkbox"/>	<input style="width: 30px; height: 20px;" type="checkbox"/>	<input style="width: 30px; height: 20px;" type="checkbox"/>
All	All	Cannot
the same	zero	determine

Explain your reasoning.

(c)

A	B	C
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>
1	2	3
Greatest		Least

OR

<input style="width: 30px; height: 20px;" type="checkbox"/>	<input style="width: 30px; height: 20px;" type="checkbox"/>	<input style="width: 30px; height: 20px;" type="checkbox"/>
All	All	Cannot
the same	zero	determine

Explain your reasoning.

TIPERS

D2-RT06: SIMPLE LIGHT BULB CIRCUITS II—BULB BRIGHTNESS

All of the bulbs in the circuits below are identical, as are all of the batteries.

In each of the items below rank the brightness of the bulb labeled X.

(a)

A	B	C
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>
1	2	3
Greatest		Least
OR		
<input style="width: 20px; height: 20px;" type="checkbox"/>	<input style="width: 20px; height: 20px;" type="checkbox"/>	<input style="width: 20px; height: 20px;" type="checkbox"/>
All	All	Cannot
the same	zero	determine

Explain your reasoning.

(b)

A	B	C
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>
1	2	3
Greatest		Least
OR		
<input style="width: 20px; height: 20px;" type="checkbox"/>	<input style="width: 20px; height: 20px;" type="checkbox"/>	<input style="width: 20px; height: 20px;" type="checkbox"/>
All	All	Cannot
the same	zero	determine

Explain your reasoning.

(c)

A	B	C
<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>	<input style="width: 50px; height: 20px;" type="text"/>
1	2	3
Greatest		Least
OR		
<input style="width: 20px; height: 20px;" type="checkbox"/>	<input style="width: 20px; height: 20px;" type="checkbox"/>	<input style="width: 20px; height: 20px;" type="checkbox"/>
All	All	Cannot
the same	zero	determine

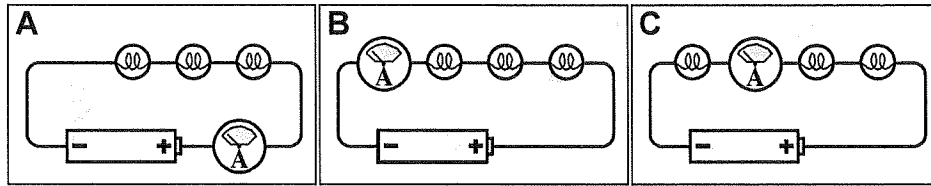
Explain your reasoning.

D2-RT07: SIMPLE LIGHT BULB CIRCUITS I—AMMETER READING

All of the bulbs in the circuits below are identical, as are all of the batteries.

For the two items below rank the current measured by the ammeter.

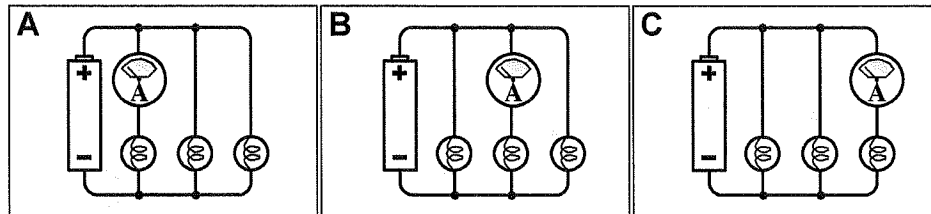
(a)



			OR			
1	2	3		All the same	All zero	Cannot determine
Greatest		Least				

Explain your reasoning.

(b)



			OR			
1	2	3		All the same	All zero	Cannot determine
Greatest		Least				

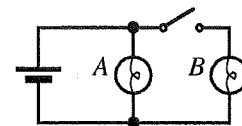
Explain your reasoning.

D2-CT08: CIRCUIT WITH TWO LIGHT BULBS—CURRENT IN BULB

A battery is connected to a circuit with two bulbs and a switch as shown.

When the switch is closed, does the current in bulb A (a) *increase*, (b) *decrease*, or (c) *remain the same*? _____

Explain your reasoning.



TIPERS

D2-RT09: SIMPLE LIGHT BULB CIRCUITS II—AMMETER READING

All of the bulbs in the circuits below are identical, as are all of the batteries.

For the two items below rank the current measured by the ammeter.

(a)

A

B

C

			OR			
1	2	3		All	All	Cannot
Greatest		Least		the same	zero	determine

Explain your reasoning.

(b)

A

B

C

			OR			
1	2	3		All	All	Cannot
Greatest		Least		the same	zero	determine

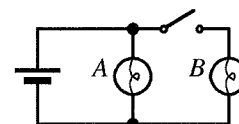
Explain your reasoning.

D2-CT10: CIRCUIT WITH TWO LIGHT BULBS—CURRENT IN BATTERY

A battery is connected to a circuit with two bulbs and a switch as shown.

When the switch is closed, does the current in the battery (i) *increase*, (ii) *decrease*, or (iii) *remain the same*? _____

Explain your reasoning.

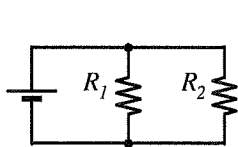


TIPERs

D2-QRT19: TWO RESISTOR CIRCUITS—CURRENT, RESISTANCE, AND VOLTAGE DROP CHART

For items (a) and (b) below complete the table, showing the value of the currents in and voltages across all elements.

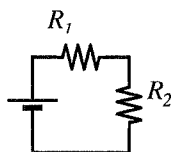
(a) The resistance values for this circuit are given in the table, as is the battery voltage.



	ΔV	I	R
Battery	15.0 V		
R_1			5.0 Ω
R_2			3.0 Ω

Explain your reasoning.

(b) The resistance values for this circuit are given in the table, as is the current in the battery.



	ΔV	I	R
Battery		4.0 A	
R_1			2.0 Ω
R_2			1.0 Ω

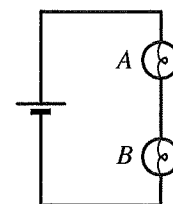
Explain your reasoning.

D2-CT20: TWO LIGHT BULBS IN A CIRCUIT—BULB BRIGHTNESS

Two identical light bulbs are connected to a battery as shown.

Is bulb A (i) *brighter than*, (ii) *dimmer than*, or (iii) *the same brightness as* bulb B? _____

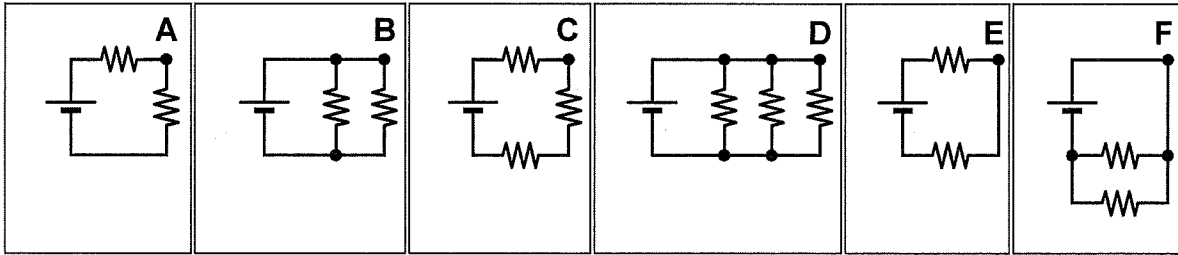
Explain your reasoning.



TIPERS

D2-RT23: SIMPLE RESISTOR CIRCUITS I—CURRENT

All of the resistors in the circuits shown are identical, as are all of the batteries.



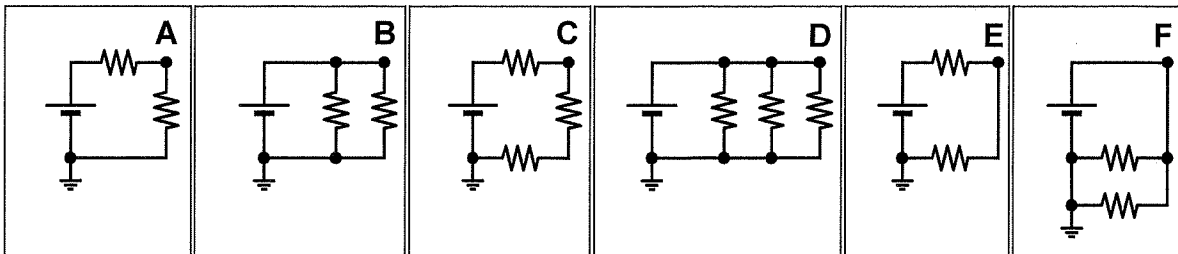
Rank the current at the upper right-hand corner of each circuit.

1	2	3	4	5	6	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Greatest					Least		All the same	All zero	Cannot determine

Explain your reasoning.

D2-RT24: SIMPLE RESISTOR CIRCUITS WITH A GROUND—VOLTAGE

All of the resistors in the circuits below are identical, as are all of the batteries.



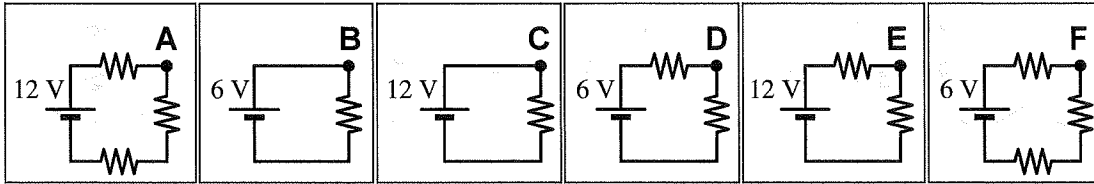
Rank the voltage at the upper right-hand corner of the circuits relative to ground.

1	2	3	4	5	6	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Greatest					Least		All the same	All zero	Cannot determine

Explain your reasoning.

D2-RT25: SIMPLE RESISTOR CIRCUITS II—CURRENT

All of the resistors in the circuits below are identical. Three of the circuits contain 6-volt batteries and three contain 12-volt batteries.



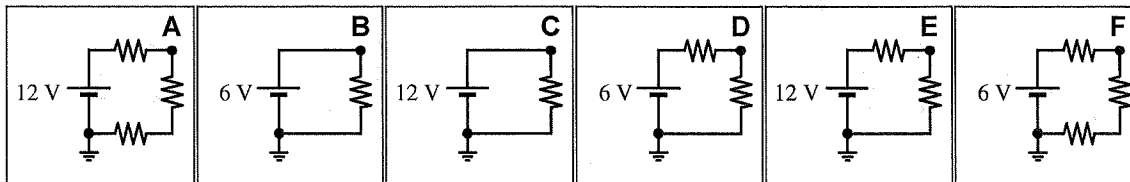
Rank the current at the upper right-hand corner of each circuit.

1	2	3	4	5	6	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Greatest					Least		All the same	All zero	Cannot determine

Explain your reasoning.

D2-RT26: SIMPLE RESISTOR CIRCUITS WITH A GROUND—VOLTAGE DROP

The following circuits contain either a 6-volt or a 12-volt battery and one or more identical resistors.



Rank the reading on a voltmeter connected between the upper right-hand corner and ground.

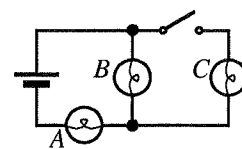
1	2	3	4	5	6	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Greatest					Least		All the same	All zero	Cannot determine

Explain your reasoning.

TIPERs

D2-SCT36: LIGHT BULB CIRCUIT WITH SWITCH—BULB BRIGHTNESS

Three light bulbs and a switch are connected to a battery as shown. Four students are discussing what would happen to the brightness of bulb A when the switch closes:



Althea: *“The current in bulb A has to be the same as the current in the battery, since they are in the same branch. The battery is going to put out the same current whether the switch is open or closed, so the current in bulb A is going to remain the same, and its brightness won’t change when the switch closes.”*

Bertha: *“I agree. All that is going to happen when the switch closes is that bulb C is going to turn on, and it’s going to get half of the current. Bulb B only gets half the current as well, so it gets dimmer. But bulb A still gets all the current, and its brightness doesn’t change.”*

Cassidy: *“I think bulb A gets brighter. The current in the circuit goes up, because when the switch closes the resistance of the circuit goes down. Since bulb A gets all the current in the circuit, it gets brighter.”*

Dupree: *“When the switch closes, the resistance of the circuit goes up, because you’ve added one bulb, which has resistance. The current in the circuit goes down, and bulb A gets dimmer.”*

With which, if any, of these students do you agree?

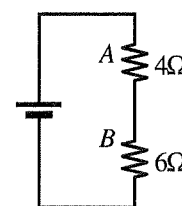
Althea _____ Bertha _____ Cassidy _____ Dupree _____ None of them _____

Explain your reasoning.

D2-WWT37: CIRCUIT WITH TWO RESISTORS—CURRENT

A battery is connected to a circuit containing two resistors as shown. A student states:

“Using Ohm’s law, the current is the voltage divided by the resistance, so when you have a bigger resistor, you have a smaller current. In this case, resistor B is a larger resistance than A, so it will have a smaller current.”



What, if anything, is wrong with this statement? If something is wrong, identify it and explain how to correct it. If this statement is correct, explain why.

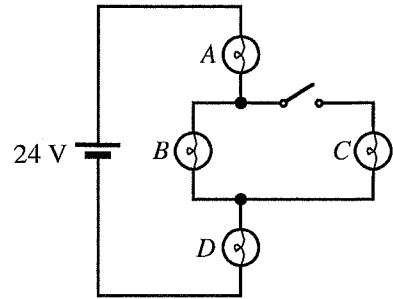
TIPERS

D2-CT40: FOUR LIGHT BULBS CIRCUIT WITH SWITCH—EFFECT OF CLOSING SWITCH

A battery is connected to four identical bulbs and a switch as shown.

(a) When the switch is closed, does the brightness of bulb C (i) *increase*, (ii) *decrease*, or (iii) *remain the same*? _____

Explain your reasoning.



(b) When the switch is closed, does the current in the battery (i) *increase*, (ii) *decrease*, or (iii) *remain the same*? _____

Explain your reasoning.

(c) When the switch is closed, does the brightness of bulb A (i) *increase*, (ii) *decrease*, or (iii) *remain the same*? _____

Explain your reasoning.

(d) When the switch is closed, is bulb D (i) *brighter* than bulb A, (ii) *dimmer* than bulb A, or (iii) *the same* brightness as bulb A? _____

Explain your reasoning.

(e) When the switch is closed, does the brightness of bulb D (i) *increase*, (ii) *decrease*, or (iii) *remain the same*? _____

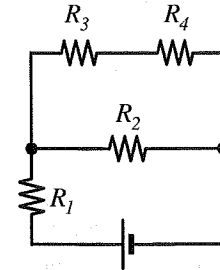
Explain your reasoning.

(f) When the switch is closed, does the brightness of bulb B (i) *increase*, (ii) *decrease*, or (iii) *remain the same*? _____

Explain your reasoning.

D2-SCT41: FOUR RESISTOR CIRCUIT I—CURRENT

In the circuit shown, the sizes of the resistors vary as $R_3 > R_1 > R_2 > R_4$. Four students discussing the currents in this circuit make the following statements:



- Ajay: "I think the current in R_1 will be the largest because all of the current from the battery goes through it."
- Belen: "Right, and after R_1 the current splits into two parts at the junction. The current through R_2 , R_3 , and R_4 will all be the same because there are two branches in the circuit and each branch will get half of the current."
- Ciara: "From Ohm's law, current is biggest where resistance is smallest. I think the current through R_2 will be largest because that branch has the lowest resistance in the circuit."
- Damaris: "Also using Ohm's law, I think the current in R_3 will be the smallest because R_3 has the largest resistance. The current in R_4 will be largest, because that resistor has the smallest resistance."
- Efren: "The current in R_3 will be the same as the current in R_4 because they are in the same branch."

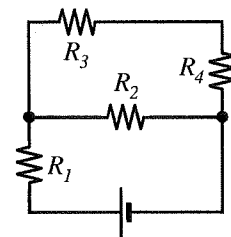
With which, if any, of these students do you agree?

Ajay _____ Belen _____ Ciara _____ Damaris _____ Efren _____ None of them _____

Explain your reasoning.

D2-SCT42: FOUR RESISTOR CIRCUIT II—CURRENT

In the circuit shown, the sizes of the resistors vary as $R_3 > R_2 > R_4 > R_1$. Four students discussing the currents in this circuit make the following statements:



- Ali: "I think the current in R_1 will be the largest because all of the current from the battery goes through it."
- Ben: "I think the current through R_2 , R_3 , and R_4 will all be the same because there are two branches in the circuit and each branch will get half of the current."
- Clyde: "Well I disagree with Ben. I think the current in R_2 will be larger than the current in R_3 and R_4 . The currents in the branches depend on the resistances of the branches."
- Dar: "The only thing I am sure about is that the current in R_3 will be the same as that in R_4 because they are in the same branch."

With which, if any, of these students do you agree?

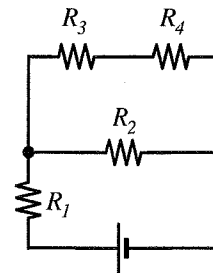
Ali _____ Ben _____ Clyde _____ Dar _____ None of them _____

Explain your reasoning.

TIPERS

D2-SCT43: FOUR RESISTOR CIRCUIT III—POTENTIAL DIFFERENCE

In the circuit shown, the sizes of the resistors vary as $R_3 > R_1 > R_2 > R_4$. Four students discussing the potential differences in this circuit make the following statements:



Anselma: "I think the potential difference across R_1 will be the largest because all of the current from the battery goes through it, and it is not the smallest resistance in the circuit."

Brooke: "I think the potential difference through R_2 will be largest because that branch will have the larger current of the two branches in the circuit."

Chandra: "I am not sure about the potential difference across R_1 , but I think the potential differences across the two horizontal branches will be the same."

Deangelo: "I'm pretty sure the potential difference across R_3 will be larger than the potential difference across R_4 , because R_3 has a larger resistance than R_4 ."

Eloy: "I think the two horizontal branches have the same potential difference as the battery since they are in parallel with the battery."

With which, if any, of these students do you agree?

Anselma _____ Brooke _____ Chandra _____ Deangelo _____ Eloy _____ None of them _____

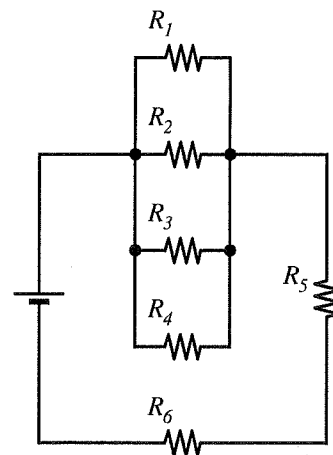
Explain your reasoning.

D2-SCT44: SIX RESISTOR CIRCUIT—CURRENT

In the circuit pictured below the sizes of the resistors vary as

$$R_3 > R_5 > R_1 > R_2 > R_4 > R_6$$

Four students discussing the currents in this circuit make the following statements:



Anne: "I think the current in R_6 and R_5 will be the largest because all of the current from the battery goes through both of those resistors."

Benicio: "I think the current through R_6 will be the smallest because that resistor is the last one in the circuit to get the current, and it is the smallest resistor."

Celestine: "I am not sure about the largest current, but I think the current in R_3 will be the lowest because R_3 has the largest resistance."

Dulce: "The only thing I am sure about is that the current across R_6 will be the largest because it is the smallest resistor in the circuit."

With which, if any, of these students do you agree?

Anne _____ Benicio _____ Celestine _____ Dulce _____ None of them _____

Explain your reasoning.

TIPERS**D2-WBT47: THREE RESISTORS CIRCUIT CHART I—CIRCUIT**

A circuit contains three resistors and a battery. The chart gives the currents in each element, the potential difference across each element, and the resistance values of the resistors.

	ΔV	I	R
Battery	36.0 V	3.0 A	
R_1	9.0 V	3.0 A	3.0 Ω
R_2	15.0 V	3.0 A	5.0 Ω
R_3	12.0 V	3.0 A	4.0 Ω

Draw an electric circuit that is consistent with the values of this chart. Label the resistors.

D2-WBT48: THREE RESISTORS CIRCUIT CHART II—CIRCUIT

A circuit contains three resistors and a battery. The chart gives the currents in each element, the potential difference across each element, and the resistance values of the resistors.

	ΔV	I	R
Battery	24.0 V	16.0 A	
R_1	24.0 V	8.0 A	3.0 Ω
R_2	24.0 V	6.0 A	4.0 Ω
R_3	24.0 V	2.0 A	12.0 Ω

Draw an electric circuit that is consistent with the values of this chart. Label the resistors.

D2-WBT49: THREE RESISTORS CIRCUIT CHART III—CIRCUIT

A circuit contains three resistors and a battery. The chart gives the currents in each element, the potential difference across each element, and the resistance values of the resistors.

	ΔV	I	R
Battery	18.0 V	6.0 A	
R_1	6.0 V	6.0 A	1.0 Ω
R_2	12.0 V	2.0 A	6.0 Ω
R_3	12.0 V	4.0 A	3.0 Ω

Draw an electric circuit that is consistent with the values of this chart. Label the resistors.

D2-WBT50: THREE RESISTORS CIRCUIT CHART IV—CIRCUIT

A circuit contains three resistors and a battery. The chart gives the currents in each element, the potential difference across each element, and the resistance values of the resistors.

	ΔV	I	R
Battery	12.0 V	4.0 A	
R_1	3.0 V	3.0 A	1.0 Ω
R_2	9.0 V	3.0 A	3.0 Ω
R_3	12.0 V	1.0 A	12.0 Ω

Draw an electric circuit that is consistent with the values of this chart. Label the resistors.