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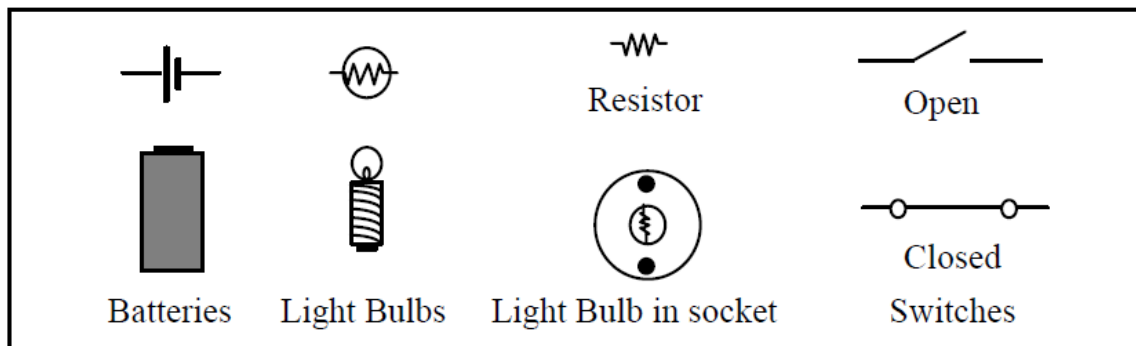
## Electric Circuit Content Tool

The purpose of this research is to find the difficulties and strategies teachers' use when teaching Electric circuits at the Grade 10 level. The assessment instrument consists of two parts; (i) Electric circuit content tool and (ii) Electric circuit Topic Specific Pedagogical Content Knowledge tool

The information will be used for research purposes only: your responses will be treated confidentially. Codes will be used to protect your identity.

### Instructions

1. Please fill in the demographic information on the TSPCK instrument
2. Answer all the question on the answer sheet provided.
3. The questions are in the form of multiple-choice items. Please indicate the option you feel is the most correct with a cross
4. Each item also has a confidence level where you indicate how sure you are of your answer.
5. All light bulbs, resistors, and batteries should be considered identical unless you are told otherwise.
6. The battery is to be assumed ideal, that is to say, the internal resistance of the battery is negligible.
7. In addition, assume the wires have negligible resistance.
8. Below is a key to the symbols used on this test.



**Answer Sheet**

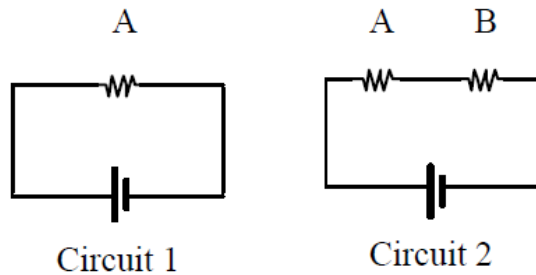
	<i>MC Item Answer</i>						<i>Confidence Level of Answer</i>			
1	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
2	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
3	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
4	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
5	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
6	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
7	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
8	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
9	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
10	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
11	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
12	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
13	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
14	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
15	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
16	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
17	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
18	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
19	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	
20	A	B	C	D	E	Blind guess	A bit unsure	Confident	Completely sure	

## Questions

- Are charges used up in a light bulb, being converted to light?
  - Yes, charges moving through the filament produce “friction” which heats up the filament and produces light.
  - Yes, charges are emitted.
  - No, charge is conserved. It is simply converted to another form such as heat and light.
  - No, charge is conserved. Charges moving through the filament produce “friction” which heats up the filament and produces light.

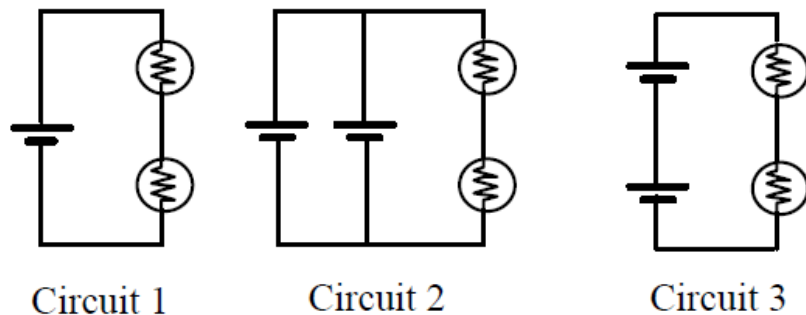
- How does the power delivered to resistor A change when resistor B is added as shown in circuits 1 and 2 respectively

- Increases
- Decreases
- Stays the same



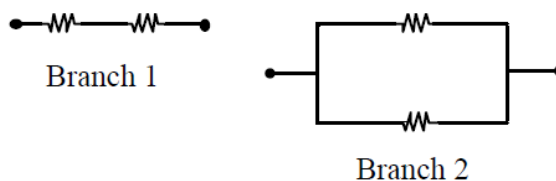
- Consider the circuits shown below. Which circuit or circuits have the greatest energy delivered to it per second?

- Circuit 1
- Circuit 2
- Circuit 3
- Circuit 1 = Circuit 2
- Circuit 2 = Circuit 3

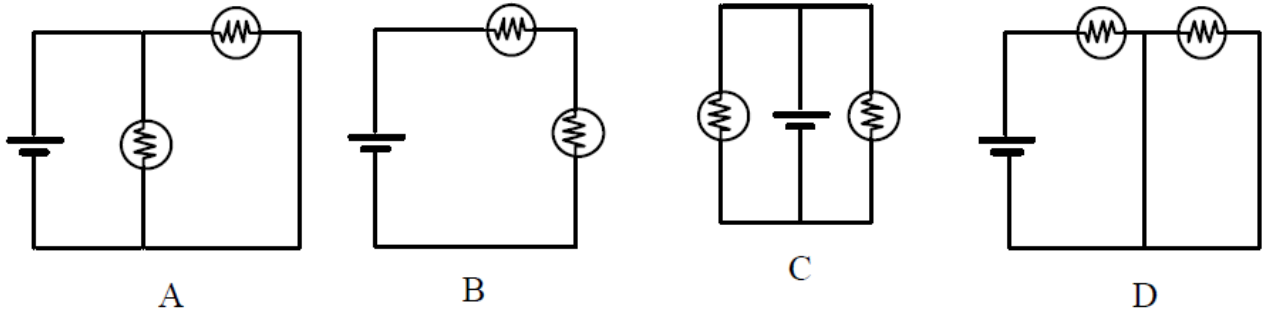


- Compare the resistance of branch 1 with that of branch 2. A branch is a section of a circuit. Which has the least resistance?

- Branch 1
- Branch 2
- Neither, they are the same



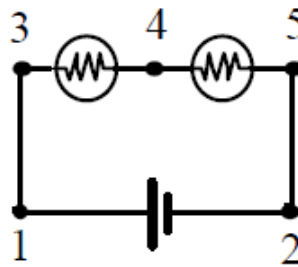
5. Consider the following circuits



Which circuit/s above represent(s) a circuit consisting of two light bulbs in parallel with a battery?

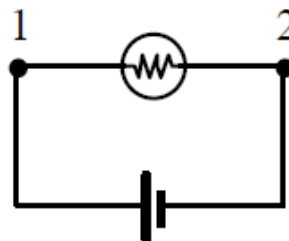
- A. A
  - B. B
  - C. C
  - D. A and C
  - E. A, C and D
6. Rank the potential difference between points 1 and 2, points 3 and 4 and points 4 and 5 in the circuit shown below from highest to lowest

- A. 1 and 2; 3 and 4; 4 and 5
- B. 1 and 2; 4 and 5; 1 and 2
- C. 3 and 4; 4 and 5; 1 and 2
- D. 3 and 4 = 4 and 5; 1 and 2
- E. 1 and 2; 3 and 4 = 4 and 5



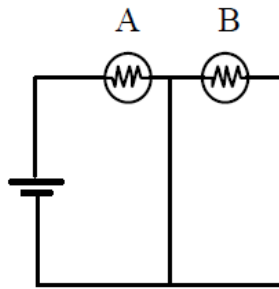
7. Compare the current at point 1 with the current at point 2. Which point has the larger current?

- A. Point 1
- B. Point 2
- C. Neither, they are the same

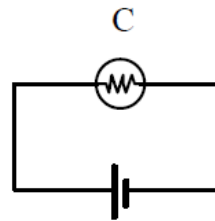


8. Compare the brightness of bulbs A and B in circuit 1 with the brightness of bulb C in circuit 2. Which bulb or bulbs are the brightest?

- A. A
- B. B
- C. C
- D. A = B
- E. A = C



Circuit 1



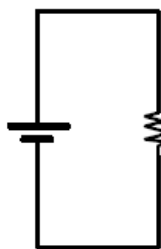
Circuit 2

9. Why do the lights in your home come on almost instantaneously?

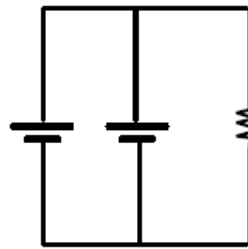
- A. Charges are already in the wire. When the circuit is completed, there is a rapid rearrangement of surface charges in the circuit.
- B. Charges store energy. When the circuit is completed, the energy is released.
- C. Charges in the wire travel very fast.
- D. The circuits in a home are wired in parallel. Thus, a current is already flowing.

10. Consider the power delivered to each of the resistors shown in the circuits below. Which circuit or circuits have the least power delivered to it/them?

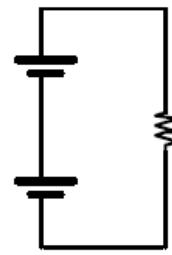
- A. Circuit 1
- B. Circuit 2
- C. Circuit 3
- D. Circuit 1 = Circuit 2
- E. Circuit 1 = Circuit 3



Circuit 1



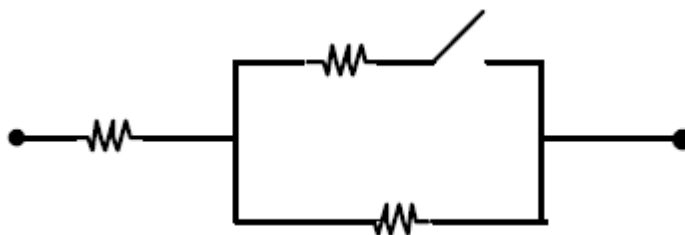
Circuit 2



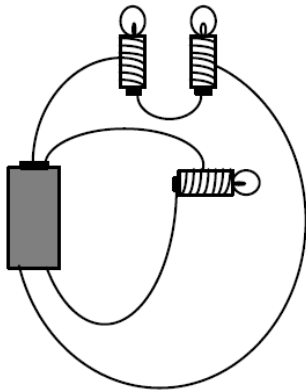
Circuit 3

11. How does the resistance between the endpoints change when the switch is closed?

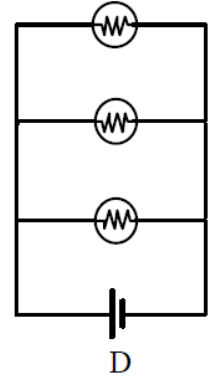
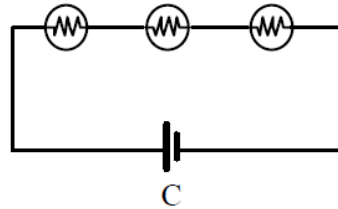
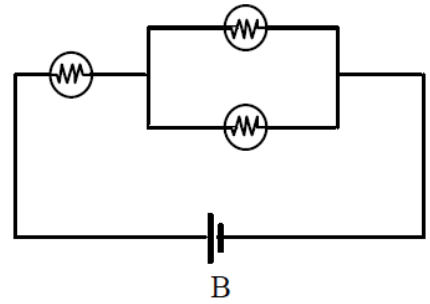
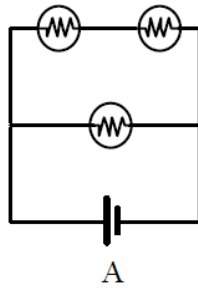
- A. Increases
- B. Decreases
- C. Stays the same



12. Which schematic diagram best represents the realistic circuit shown below?

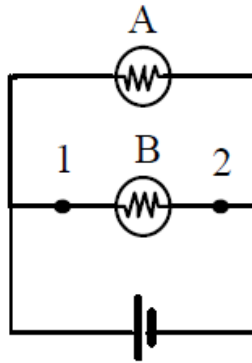


- A. A
- B. B
- C. C
- D. D
- E. None of the above



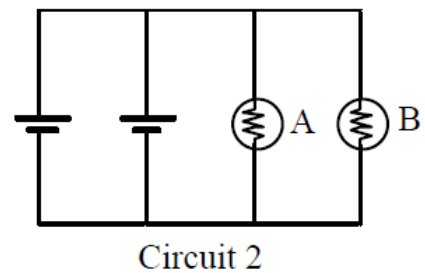
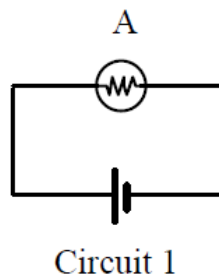
13. What happens to the potential difference between points 1 and 2 if bulb A is removed?

- A. Increases
- B. Decreases
- C. Stays the same



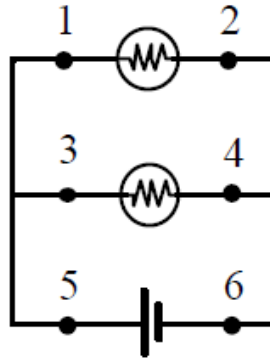
14. Compare the brightness of bulb A in circuit 1 with bulb A in circuit 2. Which bulb is dimmer?

- A. Bulb A in circuit 1
- B. Bulb A in circuit 2
- C. Neither, they are the same



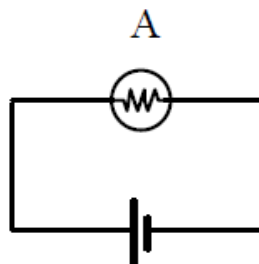
15. Rank the currents at points 1, 2, 3, 4, 5, and 6 from highest to lowest.

- A. 5, 1, 3, 2, 4, 6
- B. 5, 3, 1, 4, 2, 6
- C. 5 = 6, 3 = 4, 1 = 2
- D. 5 = 6, 1 = 2 = 3 = 4
- E. 1 = 2 = 3 = 4 = 5 = 6

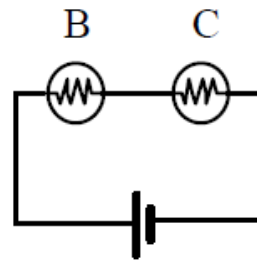


16. Compare the energy delivered per second to the light bulb in circuit 1 with the energy delivered per second to the light bulbs in circuit 2. Which bulb or bulbs have the least energy delivered to it/them per second?

- A. A
- B. B
- C. C
- D. B = C
- E. A = B = C



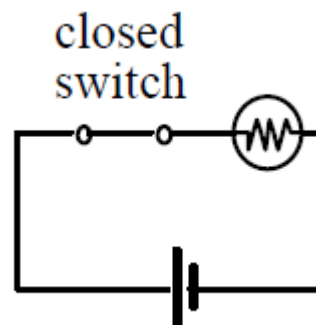
Circuit 1



Circuit 2

17. Immediately after the switch is opened, what happens to the resistance of the bulb?

- A. The resistance increases.
- B. The resistance decreases.
- C. The resistance stays the same.
- D. The resistance goes to zero.

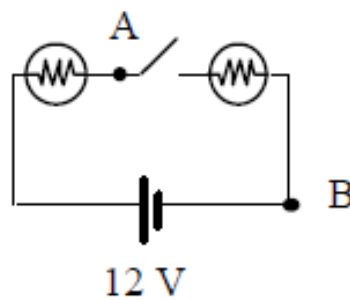


18. If you double the current through a battery, is the potential difference across a battery doubled?

- A. Yes, because Ohm's law says  $V = IR$ .
- B. Yes, because as you increase the resistance, you increase the potential difference.
- C. No, because as you double the current, you reduce the potential difference by half.
- D. No, because the potential difference is a property of the battery.
- E. No, because the potential difference is a property of everything in the circuit.

19. What is the potential difference between points A and B?

- A. 0 V
- B. 3 V
- C. 6 V
- D. 12 V



20. The current in the main branch is 1.2 A. What are the magnitudes of currents  $i_1$ ,  $i_2$ , and  $i_3$ ?

- A. 0.6/0.3/0.3
- B. 0.4/0.4/0.4

