Circuits Puzzles: Scoring Rubric

SK Partners

(Rubric last updated August 24, 2016)

Miscellaneous Notes

99 vs. 0:

- Blank ballots are scored 99. Blank ballots include:
  - Ballots with nothing written on them.
  - Ballots with only student names or ID numbers.
- If a ballot has anything written/drawn on it that is related to the puzzles or circuits, continue to score that entire puzzle using the rubrics below, i.e., give 0s where applicable.

Batteries in circuits:

- In the rubrics below, it is assumed that drawings of batteries in circuits should show wires connecting to *opposite* ends of the battery (not, for example, wires connected to only one end of the battery).

Puzzle 1: Light the Bulb

Part 1 of 1: "Draw a picture of your circuit!"

- Possible score points: 1 or 0
- **1 point** requires a drawing that shows:
  - All circuit components--battery, light bulb, and connecting wires; AND
  - The circuit is closed.
  - Note: Circuits may have multiple bulbs and/or batteries.
- **0 points** if:
  - No circuit is drawn;
  - Circuit is open; OR
  - Circuit is missing the battery, bulb, or connecting wires.

Maximum Total Points Possible: 1

Puzzle 2: Pink "?" Box

Part 1 of 2 (box contents): "What's inside the pink box?"

- Possible score points: 1 or 0
- **1 point** requires response of "wire" [the answer is circled or otherwise clearly indicated]
    - **NOTE:** Box contents may be shown in the ballot's top section (circle your answer) and/*or in the ballot's bottom section (in circuit drawing).*
- **0 points** if no response, battery is circled, or something other than wire is clearly indicated in some way

Part 2 of 2 (circuit drawing): "Draw a picture of the circuit that told you what's inside the pink box."

- Possible score points: 1 or 0
- **1 point** requires a drawing that shows:
    - Closed circuit, with just the pink box and a bulb; OR
    - Closed circuit, with the pink box, a bulb, and a battery.
- **0 points** if:
    - No circuit is drawn;
    - Circuit is open;
    - Drawing is only of the box's contents; OR
    - Circuit is closed and includes only the pink box and a battery (but no bulb).

RULES FOR CALCULATING TOTAL SCORES:

- ***Option A: Sum of scores.*** *Sum (a) score for box contents and (b) score for circuit drawing.*
    - *Maximum possible points = 2*
- ***Option B: 1/0 scoring.***
    - *If contents score = 1 AND drawing score = 1, then total score = 1.*
    - *If contents score = 0 OR drawing score = 0, then total score = 0.*
    - *Maximum possible points = 1.*

Puzzle 3: Electric Mystery Mania (3 boxes)

Part 1 of 2 (Box Contents): "What's inside the box?" Possible score points: 1 or 0 **NOTE:** Box contents may be provided in the ballot's top section (circle your answer) and/*or in the ballot's bottom section (circuit drawing).*	**Part 2 of 2 (Circuit Drawing):** "Draw a picture of the circuit that told you what's inside the box." Possible score points: 1 or 0
RED BOX	

1 point requires response of "WIRE" [the answer is circled or clearly indicated in some other way]
 	
0 points if no response, something else is circled, or something else is clearly indicated in some way
	1 point requires a drawing that shows:
	• Closed circuit with
	  ○ The box,
	  ○ A bulb, and
	  ○ A battery.
	0 points if:
	• No circuit is drawn;
	• Circuit is open;
	• Drawing is only of the box's contents; OR
	• Circuit is closed but with incorrect components.

BLUE BOX	

1 point requires response of "BULB" [the answer is circled or clearly indicated in some other way]
 	
0 points if no response, something else is circled, or something else is clearly indicated in some way
	1 point requires a drawing that shows:
	• Closed circuit with
	  ○ The box,
	  ○ A bulb, and
	  ○ A battery.
	0 points if:
	• No circuit is drawn;
	• Circuit is open;
	• Drawing is only of the box's contents; OR
	• Circuit is closed but with incorrect components.

YELLOW BOX	

1 point requires response of "2 BATTERIES" or "BATTERY" [the answer is circled or clearly indicated in some other way]
 	
0 points if no response, something else is circled, or something else is clearly indicated in some way
	1 point requires a drawing that shows:
	• Closed circuit with
	  ○ The box, and
	  ○ A bulb.
	0 points if:
	• No circuit is drawn;
	• Circuit is open;
	• Drawing is only of the box's contents; OR
	• Circuit is closed but with incorrect components.

RULES FOR CALCULATING TOTAL SCORES (FOR <u>EACH</u> BOX):

- ***Option A: Sum of scores.*** *Sum (a) score for box contents and (b) score for circuit drawing.*
  - *Maximum possible points = 2*
- ***Option B: 1/0 scoring.***
  - *If contents score = 1 AND drawing score = 1, then total score = 1.*
  - *If contents score = 0 OR drawing score = 0, then total score = 0.*
  - *Maximum possible points = 1.*

Puzzle 4: Motor

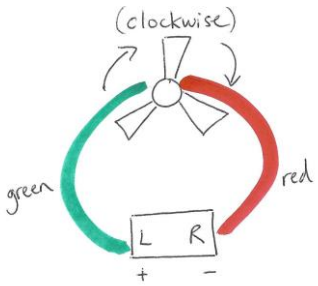
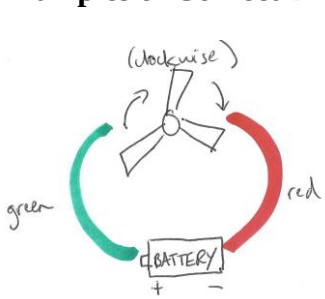
Part 1 of 2 (battery direction): "Which way is the battery facing?"

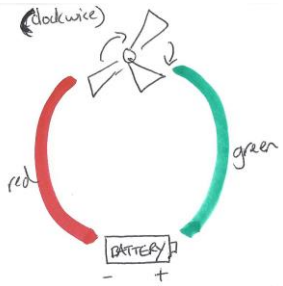
- Possible score points: 1 or 0
- **1 point** requires correct battery orientation
    - LEFT side of box: +
    - RIGHT side of box: -
    - NOTE: Battery direction may be shown in the ballot's top section (using the answer spaces provided) and/*or in the ballot's bottom section (in circuit drawing).*
- **0 points** if:
    - No answer is provided; OR
    - + or - are marked on the wrong sides of the mystery box; OR
    - "L" and/or "R" are written in the answer spaces provided.

Part 2 of 2 (circuit drawing): "Draw pictures of the circuits that told you which way the battery is facing."

- Possible score points: 0-2 (partial credit possible)
- There are two possible solution strategies, each of which is scored differently and elaborated below: (i) compare two circuits, or (ii) reverse polarity of batteries in series.

i. "Compare two circuits" solution strategy

<table>
<tr><th>Circuit 1: BOX and Motor (with fan)</th><th>Circuit 2: BATTERY and Motor (with fan)</th></tr>
<tr><td>1 point requires a drawing that shows:
Closed circuit with
The box, and
The motor/fan.
Complete and correct labels:
Correct direction of the fan, and
Colors of the wires (red and green).
0.5 points requires a drawing that shows:
Closed circuit with
The box, and
The motor/fan.
Labels on drawing are missing, incorrect, or incomplete.
0 points if:
This circuit is not drawn; OR
Circuit is open.</td><td>1 point requires a drawing that shows:
Closed circuit with
The battery, and
The motor/fan.
Complete and correct labels:
+ and - sides of the battery,
Correct direction of the fan, and
Colors of the wires (red and green).
0.5 points requires a drawing that shows:
Closed circuit with
The battery, and
The motor/fan.
Labels on drawing are missing, incorrect, or incomplete.
0 points if:
This circuit is not drawn; OR
Circuit is open.</td></tr>
<tr><td>Examples of Correct Drawings:
 
</td><td>Examples of Correct Drawings:
 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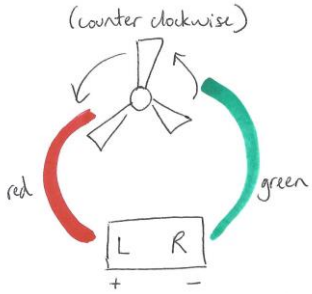
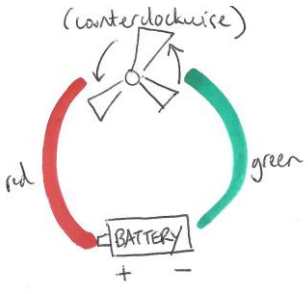
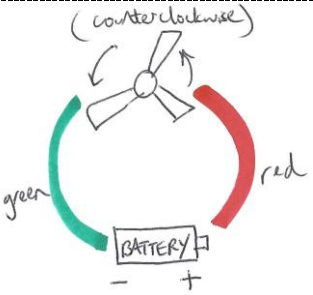
<tr><td> 
</td><td> 


</td></tr>
<tr><td colspan="2">TOTAL POINTS for Circuit DRAWING: Add up ALL points from above.</td></tr>
</table>

RULES FOR CALCULATING TOTAL SCORES:

- ***Option A: Sum of scores.*** *Sum (a) score for motor direction and (b) score for motor circuit drawing(s).*
    - *Maximum possible points = 3*
    - *Possible score points: 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0.*
- ***Option B: 1/0 scoring.***
    - *If direction score = 0 OR drawing score = 0, then total score = 0.*
    - *If direction score =1 AND drawing score > 0, then total score = sum of scores.*
    - *Maximum possible points = 3*
    - *Possible score points: 0, 1.0, 1.5, 2.0, 2.5, 3.0.*

ii. "Reverse polarity of batteries in series" solution strategy

2 points requires a drawing that shows:

- Closed circuit with
  - The box,
  - The battery, and
  - The motor/fan.
- Both of the following required labels:
  - Direction of the battery (+ and - sides clearly marked), AND
  - Correct indication of whether the fan turns in the circuit drawn:
    - Fan *turns* if both batteries are correctly in series (+ connected to -)
    - Fan *does not turn* with reverse polarity (+ connected to +, or - connected to -)

1.25 points requires a drawing that shows:

- Closed circuit with
  - The box,
  - The battery, and
  - The motor/fan.
- One but not both of the following required labels:
  - Direction of the battery (+ and - sides clearly marked), OR
  - Correct indication of whether the fan turns in the circuit drawn:
    - Fan *turns* if both batteries are correctly in series (+ connected to -)
    - Fan *does not turn* with reverse polarity (+ connected to +, or - connected to -)

0.5 points requires a drawing that shows:

- Closed circuit with
  - The box,
  - The battery, and
  - The motor/fan.
- Both labels on drawing (battery direction, whether fan turns) are missing or incorrect.

0 points if:

- No circuit drawn; OR
- Circuit is open.

RULES FOR CALCULATING TOTAL SCORES:

- ***Option A: Sum of scores.*** *Sum (a) score for motor direction and (b) score for motor circuit drawing(s).*
  - *Maximum possible points = 3*
  - *Possible score points: 0,* 0.5, 1.25, 1.5, 2.0, 2.25, 3.0.
- ***Option B: 1/0 scoring.***
  - *If direction score = 0 OR drawing score = 0, then total score = 0.*
  - *If direction score =1 AND drawing score > 0, then total score = sum of scores.*
  - *Maximum possible points = 3.*
  - *Possible score points: 0, 1.0, 1.5, 2.25, 3.0.*