

2015 SCORING GUIDELINES

Question 2

12 points total

Distribution
of points

- (a)
- i) 3 points
- For indicating that R_{eq} of the entire circuit or the combination of bulbs 2 and 3 decreases 1 point
- For indicating a change in I_{tot} or the potential difference across bulb 1 consistent with Ohm's law and the change in R_{eq} stated in the response 1 point
- For indicating a change in brightness consistent with the current or potential difference change stated in the response 1 point
- ii) 3 points
- For indicating that $P_1 = \frac{1}{4}(\mathcal{E}^2/R)$ 1 point
- For indicating that the new equivalent resistance of the circuit is $R_{\text{eq,new}} = (3/2)R$ 1 point
- Note: Credit is earned if calculation is done in part (i) and used here.
- For manipulating equations to show that the power expended by bulb 1 is $P_{\text{new}} = \frac{16}{9}P_1$ 1 point
- iii) 1 point
- For using or referring to the expression from part (a)(ii) to support the claim made in (a)(i) regarding the brightness of bulb 1: e.g., $16/9 > 1$, and indicating an understanding that brightness is related to power consumption 1 point
- (b)
- i) 1 point
- For explaining that the brightness of bulb 2 decreases after the switch is closed because it expends less power (or the current through bulb 2 decreases, or the potential difference across bulb 2 decreases) 1 point
- ii) 1 point
- For a calculation that supports the reasoning in part i 1 point

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Question 2 (continued)

Distribution
of points

- (c) 3 points
- For indicating in either part (c)i or part (c)ii that brightness is dependent on potential difference across the bulb OR on current through the bulb 1 point
- i)
- For a reasonable explanation for why bulb 1 is brighter than bulb 2 1 point
- Example: Immediately after the switch is closed, the potential difference across the capacitor will be zero (like a short in the circuit), so the current through bulb 2 would be zero, which is less than the current through bulb 1.
- Note: No points will be awarded for indicating that bulb 1 is brighter than bulb 2 with no justification.
- ii)
- For a reasonable explanation for why bulb 1 is the same brightness as bulb 2 1 point
- Example: The current through bulb 2 increases as the potential difference across the capacitor increases (becomes like an open circuit), so a long time after the switch is closed, the current through bulb 2 will be equal to the full current through bulb 1.
- Note: No points will be awarded for indicating that bulb 1 is the same brightness as bulb 2 without a justification.