| CONTENT TOOL MEMO | | | |
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| **Question** | **Answer** | **Misconception** | **Comment – if the student answers incorrectly** |
| 1. | D | i. Attenuation model | • Charges are seen as particles that have energy. There is connection between this concept and the material covered in 'Particle Model' in the earlier grades |
| 2 | B | i. Power supply as a constant current source<br>ii. Local Reasoning<br>iii. Shared current model | • The student presumes that because the battery is the same, the same current is delivered<br>• The impact of the second resistance viewed as not having an impact because it is placed after the resistor A (using conventional current). The student doesn't view the circuit as a whole system and doesn't see that a change anywhere in the circuit impacts the entire circuit.<br>• Students will also need to know that P =VI and that increased resistance means decreased current |
| 3. | C | i. Inter-changeability of terms<br>ii. Parallel circuit misconceptions<br>iii. Power supply as a constant current source | • Students will need to know that the question is asking for voltage (J/s) and that the resistance in all the circuits is the same<br>• Students will need to see the cells connected in parallel will produce the same voltage as the single cell<br>• Students may be confused with the way the two cells in series are drawn |
| 4 | B | i. Parallel circuit misconceptions | • Student who don't understand the impact of resistors in series would most likely answer C |
| 5. | D | i. Parallel circuit misconceptions | • Most students would be able to select A but miss that C is also parallel because the current has two possible pathways |
| 6. | E | i. Local Reasoning<br>ii. Power supply as a constant current source | • Between points 1 and 2 the total V is being measured and across the light bulbs this will be less than the total V but equal to each other. Students need to understand the circuit as a |

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| | | | whole system |
| 7. | C | iv. Sequential Model<br>v. Local Reasoning<br>vi. Current as water flow | • This a common misconception, where students think current gets 'used up' as it moves through a light bulb. They don't see current as constant through a series circuit. They muddling up concepts of current flow and energy transformation<br>• If students think about current as water flow, the idea is the 'water' somehow 'dams' up behind the light bulb and that is why the current drops the light bulb |
| 8. | E | i. Short circuit | • The connecting wire between A and B provides a much lower resistance pathway so current wouldn't flow through B – effectively cutting it out of the circuit. Students will overlook the impact of the connecting wire and just focus on the bulbs |
| 9. | A | i. Battery origin<br>ii. Attenuation<br>iii. Local Reasoning | • Charges are not seen as the same particles that make up material. Some external sources is seen as the 'producer' of charges. The explanation is given that when the battery 'runs out' of charges the battery is flat.<br>• Connecting wires are seen as empty channels and not part of the whole system that makes up the circuit |
| 10. | D | i. Inter-changeability of terms<br>ii. Parallel circuit misconceptions<br>iii. Power supply as a constant current source | • Similar to Question 3. Student will need to know that the voltage delivered in Circuits 1 and 2 are the same but less than 3, so using P = VI Circuits 1 and 2 will have the lower power rating |
| 11. | B | i. Parallel circuit misconceptions | • Students struggle with the idea that adding a resistor can have the effect of dropping the overall resistor, if it is added in parallel |
| 12. | A | i. Parallel circuit misconceptions | • It is sometime difficult for students to see the two possible pathways in the realistic circuit.<br>• Students often struggle when there is a mix of parallel and series.<br>• Being able to translate the realistic from to the schematic shows an understanding of how a circuit is constructed |
| 13. | C | i. Local reasoning<br>ii. Inter-changeability of | • Students need to recognise that because there are no other cell components in the circuit the voltage |

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| | | terms | of the battery is the same as the voltage across the resistors, regardless of how the resistors are arranged.<br>• Students who answer B (decreases) are most likely interchanging concepts of voltage and current |
| 14. | C | i. Parallel circuit misconceptions | • Students will first need to see voltage delivered is the same for both circuits<br>• The addition light bulb in parallel, in Circuit 2, will have the effect of halving the total resistance and therefore doubling the total current but when the current splits at the parallel connects it halves again so the net effect on current in the parallel branches is the same as Circuit 1 |
| 15. | D. | i. Parallel circuit misconceptions<br>ii. Sequential model<br>iii. Attenuation | • Current at 5 and 6 represents the total current and they are equal – current isn't 'used up'<br>• Current in the parallel branches is equal and the same after the light bulbs |
| 16. | D | i. Local Reasoning<br>ii. Inter-changeability of terms | • The total V delivered is the same for both circuits but the available energy has to be split between two bulb equally |
| 17. | C | iv. Inter-changeability of terms.<br>v. Local reasoning | • Resistance is a property of the materials used<br>• Current changes as a result of resistance and not the other way round |
| 18. | D | i. Local reasoning<br>ii. Inter-changeability of terms | • The components and how they inter-relate is key to understanding circuits. The batter delivers and creates a fields.<br>• How energy is converted is a function of the components in the circuit. |
| 19. | D | i. Local<br>ii. reasoning | • Students sometimes battle to see that even if no current is flowing the battery still has a voltage reading. This forms the basis for understanding emf and internal resistance that is covered in the higher grades |

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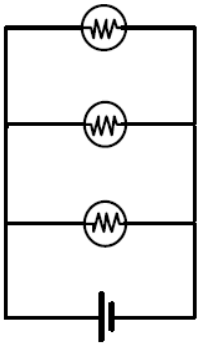
| 20. | B | i. Parallel circuit misconceptions | • The connecting wires have negligible resistance – Question 20 diagram is the same as the diagram below and then it is easy to see that the current would divide evenly three ways.<br>  |

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