# Multiple choice questions

1. Three conductors join as shown in the diagram. The direction of the current in each conductor is shown by the arrow.

**X**

**Y**

**Z**

The current in the conductor Z is 10 A. The current in the conductor Y is 6 A. What will be the current in conductor X?

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A.** | 4 A |  | **B.** | 6 A |  | **C.** | 10 A |  | **D.** | 16 A |

1. Six dry cells, each with a voltage of 1.5 V, are placed in series. However two of the cells have been connected wrongly, as shown in the diagram.

+ -

+ -

+ -

+ -

- +

- +

What is the overall voltage of this arrangement of six dry cells?

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A.** | 0 V |  | **B.** | 3 V |  | **C.** | 6 V |  | **D.** | 9 V |

1. Which of these is the correct way that the voltmeter and the ammeter should be connected in order to calculate the resistance across a component?

|  |  |  |
| --- | --- | --- |
|  | ***Voltmeter*** | ***Ammeter*** |
| **A** | Connected in series to the component | Connected in parallel to the component |
| **B** | Connected in series to the component | Connected in series to the component |
| **C** | Connected in parallel to the component | Connected in parallel to the component |
| **D** | Connected in parallel to the component | Connected in series to the component |

1. The diagram shows a circuit set up to investigate the resistance of metal wire AB.

**A**

**B**

metal wire

steel paper clip with circuit wire attached

Which of these statements is true?

|  |  |
| --- | --- |
| **A.** | The brightness of the bulb does not change as long as the steel paper clip touches the metal wire. |
| **B.** | The bulb was brighter when the paper clip moved towards A. |
| **C.** | The bulb was brighter when the bulb moved towards B. |
| **D.** | The bulb did not light up as steel is a poor conductor electricity. |

1. Which of these terms best describes the flow of electricity?

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A.** | Current |  | **B.** | Potential difference  |  | **C.** | Resistance  |  | **D.** | Voltage  |

1. All bulbs in the circuit are identical. The top ammeter reads 6 A and the bottom ammeter reads 4 A.

L

4A

M

6A

What are the correct readings on ammeters L and M?

|  |  |  |
| --- | --- | --- |
|  | ***Ammeter L*** | ***Ammeter M*** |
| **A** | 2 A | 4 A |
| **B** | 6 A | 2 A |
| **C** | 2 A | 6 A |
| **D** | 6 A | 6 A |

1. In the circuit diagram there are three switches: S1, S2 and S3

Lamp L

**S1**

**S2**

**S3**

To make lamp L as bright as possible which switch or switches must be closed?

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A.** | S1 only |  | **B.** | S1 and S2  |  | **C.** | S2 only  |  | **D.** | S1, S2 and S3  |

1. Consider the circuit below:

6 V

4 Ω

6 Ω

2 Ω

What is the potential difference in volts across the 4 Ω resistor?

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A.** | 1 V |  | **B.** | 2 V  |  | **C.** | 4 V  |  | **D.** | 6 V |

# Structured questions

1. The lighting circuit was taken from a car handbook. It comprises of six bulbs A to F and includes:
* 2 front sidelights rated at 12 V, 6 W each (1 watt (W) = 1 amp x 1 volt)
* 2 rear lights rated at 12 V, 6 W each
* 2 headlights rated at 12 V, 60 W each

fuse

**A**

**B**

**C**

**D**

**E**

**F**

12 V

The front sidelights and rear sidelights are switched on and off together by a certain switch. The headlights can only be switched on when the sidelights are on but have their own switch.

1. i. Which of the lamps A, B, C, D, E, or F are headlights? **[2 marks]**

ii. Why are all the lamps arranged in parallel? **[1 mark]**

1. How much current passes through **[2 marks]**

i. each sidelight and rear light?

ii. each headlight?

1. What is the resistance of the filament in **[2 marks]**

i. each sidelight rear light?

ii. each headlight?

1. All of the lights in this circuit are protected by one fuse. Suggest a suitable fuse rating, and explain your choice. **[2 marks]**

1. The table compares the electrical resistance of two common different types of wire (nichrome and copper) at room temperature.

|  |  |  |  |
| --- | --- | --- | --- |
| ***Type of wire*** | ***Length of wire*** | ***Thickness of wire*** | ***Electrical resistance*** |
| Nichrome wire | 0.25 m | Thin | 3.5 Ω |
| Nichrome wire | 5.00 m | Thin | 70.0 Ω |
| Nichrome wire | 0.50 m | Thick | 0.5 Ω |
| Copper wire | 0.50 m | Thin | 0.01 Ω |

Using the table identify three factors that affect electrical resistance in wires (excluding temperature). State how the electrical resistance varies with each of these factors.

 **[3 marks]**

**[Total = 20 marks]**

# Answers

1. A - since no charge accumulates at a circuit junction, the net current flowing into the junction = the net current flowing out. Therefore 10 A = 4 A + 6 A
2. B - (4 x 1.5 V) - (2 x 1.5 V) = 3.0 V
3. D - The voltmeter must be connected in parallel across the component to read its voltage. The ammeter must be connected in series to the component to read the current passing through.
4. B - the metal wire (AB) has electrical resistance. Therefore the closer the steel paper clip is to side A, the less its resistance and the brighter the bulb will glow.
5. A - flow of electricity is called current. The electrical energy required to move this current is called potential difference which is measured as voltage.
6. C - the current of 6 A is split between the circuit with two bulbs and the circuit with one bulb. If the one bulb circuit has 4 A then the two bulb circuit must have only 2 A (identical bulbs). Therefore the reading on ammeter L is 2 A. The two bulb circuit is half as bright as the one bulb circuit. Ammeter M would read 6 A as the current from the two circuits has recombined.
7. C - lamp L will be brightest if no current flows through the other two bulbs. This occurs when only switch S2 is closed.
8. B - the total resistance of all three resistors is 4 Ω + 6 Ω + 2 Ω = 12 Ω (as they are in series). Using the relationship:

current (A) = voltage (V) ÷ resistance (Ω)
current (A) = 6 V ÷ 12 Ω = 0.5 A

This is the current that passes through all three resistors. So across the 4 Ω resistor

voltage (V) = current (A) x resistance (Ω)
voltage (V) = 0.5 A x 4 Ω = 2 V

1. (a) (i) E and F

(ii) The lamps are arranged in parallel so if one of them blows, the other lights will still work.

(b) (i) Side lights and rear lights are rated at 12 V and 6 W.
 Using the relationship: power (W) = voltage (V) x current (A)

 6 W = 12 V x current

 current = 6 ÷12 = 0.5 A

 (ii) Headlights are rated at 12 V and 60 W.

 Using the relationship: power (W) = voltage (V) x current (A)

 60 W = 12 V x current

 current = 60 ÷ 12 = 5 A

 (c) (i) Using the relationship: voltage (V) = current (A) x resistance (Ω)
 12 V = 0.5 A x resistance (Ω)
 resistance = 12 ÷ 0.5 = 24 Ω

 (ii) Using the relationship: voltage (V) = current (A) x resistance (Ω)

 12 V = 5 A x resistance (Ω)

 resistance = 12 ÷ 5 = 2.4 Ω

(d) The fuse is determined by the total current of the circuit.
Total current = current in two front sidelights + current in two rear lights + current in two headlamps
 = (2 x 0.5) + (2 x 0.5) + (2 x 5) = 12 A As total current is 12 A we need a 13 A fuse.

1. Resistance increases as the length of the wire increases.
Resistance increases as the cross-sectional area of the wire decreases (gets thinner).
Resistance depends upon the type of material the wire is made from.