Answers

A switch is a gap in the loop that can be opened and closed. Breaking the loop anywhere stops the current everywhere in it, so the switch works equally well before or after the lamp.

1. - C) The lamp goes out, because opening the switch breaks the loop wherever it is placed.

A junction dot is drawn wherever wires are joined. Wires that cross without a dot are not connected, like a road crossing a railway on a bridge.

2. - B) The wires are not connected; one simply passes over the other.

The shape of a diagram means nothing. Corners are square only to keep diagrams tidy, so to compare diagrams you trace the connections.

3. - D) They are the same circuit, because only the connections matter and not the shape.

The current needs a complete loop. A break in either place stops the current throughout the loop, so it makes no difference which clip is loosened.

4. - C) The lamp goes out again, because a break anywhere in the loop stops the current everywhere.

In a series circuit there is one path for the current, so the current is the same everywhere. The lamps do not use up the current, even though this guess seems reasonable.

5. - A) The prediction is wrong, because there is only one path, so every part of the circuit carries the same current.

In a series circuit the current is equal at every point. Each extra lamp makes it harder for the battery to drive current round the loop, so the current falls everywhere (from 0.20 A to 0.14 A in the example) and the lamps grow dimmer.

6. - D) The current is the same everywhere in the loop but smaller than before, and the lamps are dimmer.

Lamps transfer energy, which is why they become hot and give out light. Current is the movement of charge round a continuous loop. The charge cannot leak out or pile up in a lamp, so the current is the same all the way round.

7. - B) The lamps take energy from the circuit, but the current is not used up because the charge has nowhere else to go.

At the junction the current from the battery splits between the branches. Nothing is lost or created at a junction, so the two 0.30 A branch currents add up to 0.60 A in the single part of the circuit.

8. - C) 0.60 A, because the branch currents add up to the current through the battery.

The branch currents add up to the current through the battery. Adding 0.30 A and 0.18 A gives 0.48 A in the single part of the circuit.

9. - C) 0.48 A

In a parallel circuit the order of the branches does not matter. Each lamp remains on its own branch between the same two junctions, so swapping them does not change the circuit.

10. - B) It is the same circuit, because each lamp is still on its own path between the same two junctions.

In the parallel circuit each lamp carries 0.30 A instead of 0.20 A, so each lamp is brighter. The battery supplies 0.60 A, three times the 0.20 A it supplied in series, so it runs down faster.

11. - C) Each lamp carries 0.30 A and is brighter, but the battery supplies more current and runs down faster.

Current must pass through an ammeter for it to be measured, so the ammeter goes in series in the loop. This means the circuit has to be broken open to fit it in.

12. - A) In series with the lamp, after opening the circuit to insert it into the loop.

An ammeter is built to let current through very easily. Across a lamp it gives the current a far easier path than the lamp, so almost all the current passes through the meter. The lamp goes out and the meter may be damaged by an excessive current.

13. - D) The lamp goes out and the meter may be damaged, because the ammeter offers an easy route and almost all the current goes through it.

A voltmeter is built to let almost no current pass. Placed in the loop, it nearly stops the current, so the lamp barely lights. A voltmeter should be connected in parallel across the component.

14. - A) The lamp barely lights, because the voltmeter lets almost no current through.

In series the supply's potential difference is shared between the components, though not necessarily equally. The shares add up to the battery's 3.0 V, so 3.0 V minus 2.0 V leaves 1.0 V.

15. - A) 1.0 V, because the supply's potential difference is shared between the components and the shares add up to 3.0 V.

In a series circuit there is only one loop, so a gap at any lamp stops the current everywhere. Every lamp looks equally dark, so the faulty one cannot be identified by sight and the lamps must be tested or replaced one at a time.

16. - C) Every lamp is equally dark, because the single broken loop stops the current through all of them.

A broken filament breaks only its own branch. The other branch still runs from one junction to the other and keeps the full potential difference of the battery, so its lamp is unchanged.

17. - B) It stays lit at the same brightness, because its own branch is unbroken and still has the full battery potential difference across it.

In series the supply is shared equally between identical lamps, so 6.0 V ÷ 3 = 2.0 V each. In parallel each branch gets the whole potential difference of the supply, so each lamp has 6.0 V.

18. - D) 2.0 V in series and 6.0 V in parallel

The battery gives each unit of charge a fixed amount of energy. In parallel, charge goes through one lamp only, so nothing is divided up and that lamp gets all of it. In series, charge passes through both lamps and its energy is split between them.

19. - A) Each unit of charge passes through only one lamp before returning to the battery, so it spends all of its energy there.

A component in series with a circuit can stop the current in the whole loop when it breaks or is opened. This behaviour is a nuisance in a string of lamps but is exactly what a safety device needs.

20. - C) Anything in series can break the whole loop, which is what a safety device needs to do.