

ELECTRIC CIRCUITS

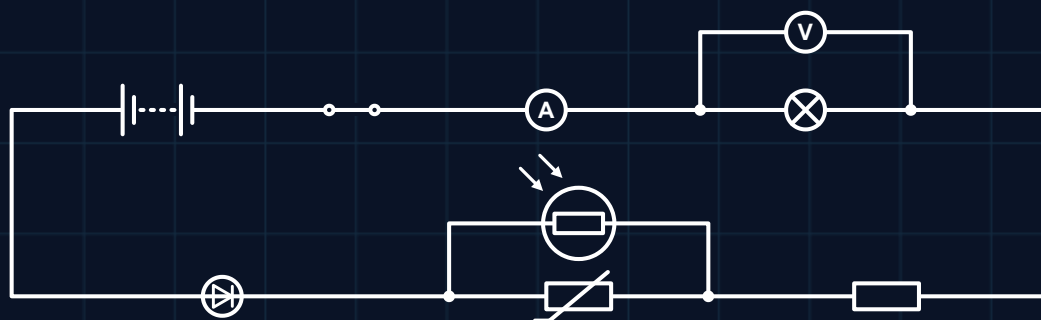
LESSON 01 COMPLETE CIRCUITS AND SYMBOLS

Your torch won't switch on. The bulb is fine and the batteries are new. What could be wrong?

IN THIS LESSON YOU WILL

- explain why a lamp only lights in a complete loop
- recognise and draw standard circuit symbols
- turn a real circuit into a neat circuit diagram
- connect an ammeter in series to measure current

ANSWER EDITION FOR TEACHERS AND SELF-MARKING



NAME

CLASS

TEACHER

TARGET GRADE

HOW THIS BOOKLET WORKS

This booklet assumes you have **never studied electricity before**. Every lesson starts from the ideas you already have and builds one step at a time. Keep it: it is your classwork book *and* your revision guide.



DO NOW

Quick questions from earlier lessons. Remembering again is what makes it stick.



LEARN IT

The explanation, diagrams and worked examples. Read this again when you revise.



TRY IT

Practice that builds up: first with support, then on your own.



LAB

Record measurements from a virtual lab or a required practical.



EXAM CORNER

An AQA-style question with a tip on how the marks are given.



REVISE IT

Summary, cover-and-answer questions and an “I can” check to colour in.



Revising at home? (1) Read the Learn it pages. (2) Cover them and answer the “Cover the page” questions in Revise it. (3) Check with the quick answers at the back.

THE ROUTE THROUGH THE UNIT (THIS LESSON IS HIGHLIGHTED)

01 Complete circuits and symbols What a circuit needs, circuit symbols and drawing rules, measuring current	02 Current and charge
03 Potential difference	04 Resistance and $V = IR$
05 Resistance of a wire RP	06 Series and parallel circuits
07 Resistors in series and parallel RP	08 I–V graphs
09 Investigating I–V characteristics RP	10 Thermistors, LDRs and sensors
11 Power and energy transfer	12 Mains, safety and the National Grid

01

COMPLETE CIRCUITS AND SYMBOLS

AQA Combined 6.2.1.1; Physics 4.2.1.1

BIG QUESTION Your torch won't switch on. The bulb is fine and the batteries are new. What could be wrong?

BY THE END YOU CAN

- explain why a lamp only lights in a complete loop
- recognise and draw standard circuit symbols
- turn a real circuit into a neat circuit diagram
- connect an ammeter in series to measure current

circuit

component

cell

battery

switch

circuit diagram

series

ammeter



RETRIEVE

WHAT DO YOU ALREADY THINK?

No wrong answers: this is your starting point.

1

Name two things that run on a battery and two that plug into the wall.

e.g. torch, phone; kettle,
TV.

2

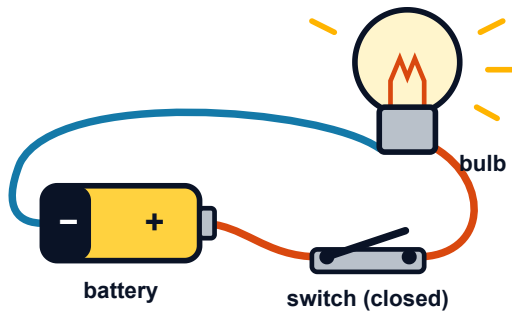
When a lamp is on, what do you think is moving in the wires?

Tiny charged particles
(electrons): you learn this
today.

3

Why does a torch need a switch?

To break or complete the
circuit, turning it off and
on.

**WHAT DOES A CIRCUIT NEED?**

A real circuit: battery, switch and bulb joined into one complete loop.

A **circuit** is a complete loop that electric charge can flow around. To light a lamp you need:

1. a **source of energy**: a cell or battery pushes the charge around;
2. a **complete loop** of wire with no gaps;
3. **components**: things that do a job, such as a lamp.

THINK OF IT LIKE A BIKE CHAIN

The chain is already full of links, just as wires are already full of charge. When you push the pedals (the cell), the *whole* chain moves at once, and the back wheel (the lamp) turns immediately. Break the chain anywhere and everything stops.

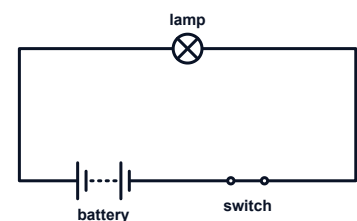
Where the model breaks: you can see a chain move quickly, but the charges in a wire drift very slowly.

! No complete loop, no current. A gap anywhere (an open switch, a loose wire, a broken bulb) stops the flow of charge *everywhere* in the loop.

FROM A PICTURE TO A CIRCUIT DIAGRAM

Drawing real objects takes a long time, and everyone draws them differently. Scientists and electricians everywhere use the same **circuit symbols**, so anyone can read a **circuit diagram**. This diagram shows exactly the same circuit as the picture above.

Learn the first row of symbols now. The dashed ones come later in the unit: you do not need them yet.



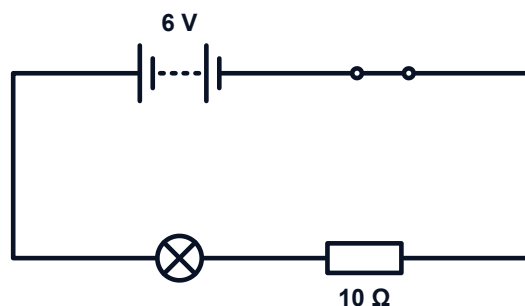
The same circuit as a circuit diagram.

Cell long line is +	Battery two or more cells	Switch (open) gap: no current	Switch (closed) loop complete	Lamp gives out light	Resistor limits the current	Ammeter measures current
Voltmeter Lesson 3	Variable resistor Lesson 4	Diode Lesson 8	LED Lesson 8	Thermistor Lesson 10	LDR Lesson 10	Fuse Lesson 12

Solid boxes: learn today. Dashed boxes: the lesson where you meet them is shown.

RULES FOR DRAWING CIRCUIT DIAGRAMS

- 1 Use a **pencil and a ruler**.
- 2 Draw wires as **straight lines** with **right-angle corners**.
- 3 Leave **no gaps**: every wire joins something at both ends.
- 4 Put each symbol **in** the wire, so the wire goes into it on both sides.
- 5 Write values such as 6 V or $10\ \Omega$ next to the symbol.



A neat diagram: ruler, right angles, no gaps.

MEASURING THE CURRENT

The flow of charge is called the **current**. We measure it in **amperes (A)**, or 'amps', with an **ammeter**. The ammeter goes *in* the loop so that the charge flows through it. This is called connecting it **in series**.



The ammeter is in series with the lamp.

- ! A circuit with just one loop is a **series circuit**. Everything in that loop is 'in series'.



PRACTISE
TRY IT

- 1 Name each symbol.

battery	closed switch	resistor	cell	ammeter	lamp

2 Draw the symbol for each component. Use a ruler for the straight lines.

Open switch	Lamp	Cell	Ammeter	Resistor	Battery

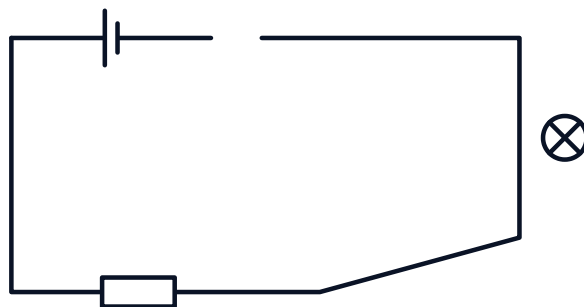
3 Will the lamp light? Circle **Yes** or **No** for each circuit.

<p>A</p> <p>☒ Yes No</p>	<p>B</p> <p>Yes ☒ No</p>	<p>C</p> <p>Yes ☒ No</p>	<p>D</p> <p>☒ Yes No</p>
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Explain your answer for circuit C.

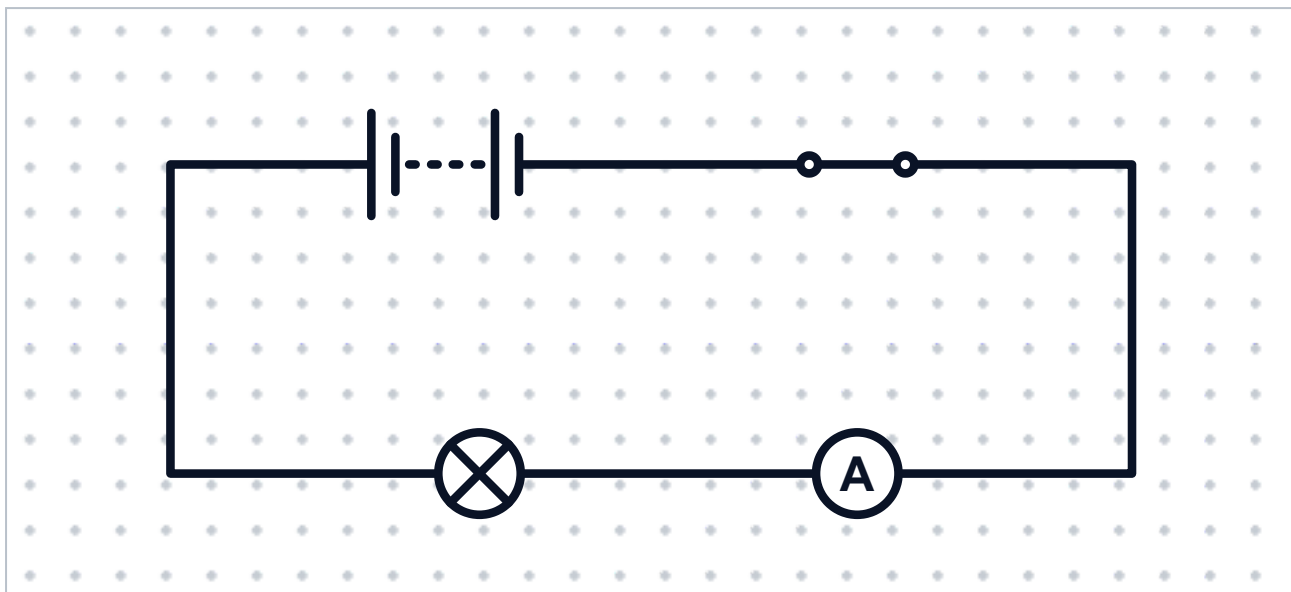
C has a gap in the bottom wire, so the loop is not complete and no charge can flow.

4 Jo drew this circuit diagram. Find **three** mistakes.



1. There is a gap in the top wire. 2. One wire is slanted: wires should be straight with right-angle corners. 3. The lamp is not connected into the wire (the wire does not go into it).

- 5 Draw a circuit diagram for a **battery**, a **closed switch**, a **lamp** and an **ammeter**, all in one loop.



- 6 **Torch detective.** Look back at the big question. Suggest **two** faults that could stop the torch working, and how you could test for each one.

e.g. a loose or broken wire/connection, leaving a gap: check or replace each connection.

The switch does not close properly: replace it with a working switch. The batteries are in the wrong way round: turn them round.



Get the marks: Examiners look for correct symbols, a complete loop with no gaps, and the ammeter in series.

- 7 Draw a circuit diagram to show a battery, a resistor and a lamp connected in series, with an ammeter to measure the current. **[3 marks]**

Correct symbols for battery, resistor and lamp (1); all in one complete loop with no gaps (1); ammeter in series in the same loop (1).



- 8 State what is meant by a *series* circuit. **[1 mark]**

The components are connected one after another in a single loop.

**SUMMARY**

- A circuit needs a source (cell or battery) and a **complete loop**.
- A gap anywhere stops the current everywhere.
- Circuit diagrams use standard symbols, drawn with a ruler: straight wires, right-angle corners, no gaps.
- An ammeter measures current and goes **in series**.

COVER THE PAGE AND ANSWER

- | | |
|---|---|
| 1 What two things does a circuit need for a current to flow?
..... | 2 What is the difference between a cell and a battery?
..... |
| 3 What does an open switch do?
..... | 4 How is an ammeter connected?
..... |

I CAN...

explain why a circuit must be a complete loop



recognise and draw the symbols for a cell, battery, switch, lamp, resistor and ammeter



draw a neat circuit diagram using the rules



connect an ammeter in series



KEY WORDS FROM THIS LESSON

Learn the meaning and spelling. In exams, precise words earn marks: say “p.d. across” and “current through”.

Ammeter: Measures current. Connected in series.

Battery: Two or more cells joined together.

Current (I): The rate of flow of charge.

Series: Components connected one after another in a single loop.

CHECK YOURSELF

QUICK ANSWERS

Answers to the “Do now” and “Cover the page” questions, so you can check yourself when revising. Answers to the longer questions are in your teacher's answer edition.

DO NOW

1. e.g. torch, phone; kettle, TV.
2. Tiny charged particles (electrons): you learn this today.
3. To break or complete the circuit, turning it off and on.

COVER THE PAGE

1. A source (cell or battery) and a complete loop.
2. A battery is two or more cells joined together.
3. Makes a gap, so no current flows.
4. In series (in the loop).