YEAR 10 PHYSICS, AQA GCSE, LESSON 1 OF 12

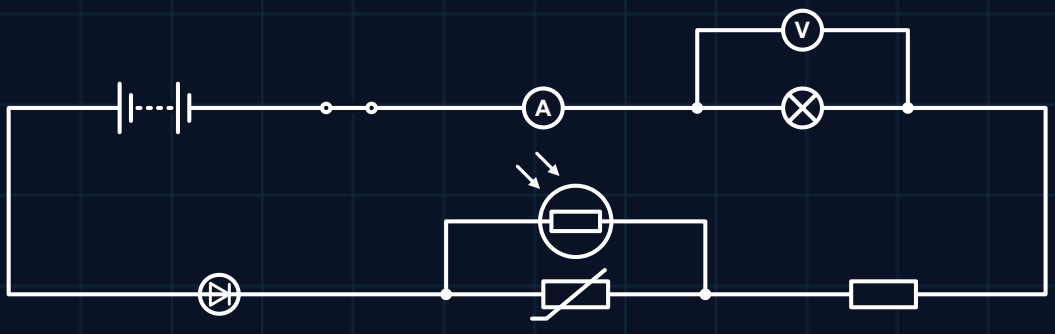
ELECTRIC CIRCUITS

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



NAME _____ CLASS _____

TEACHER _____ TARGET GRADE _____

START HERE

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 = I R

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

Lesson

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.

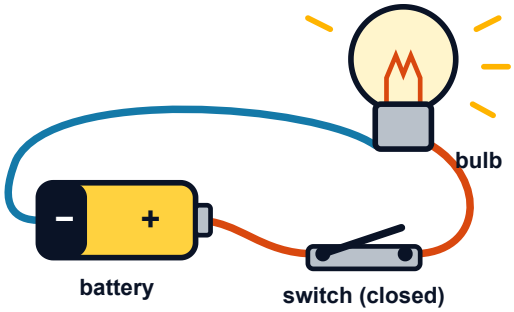
2
When a lamp is on, what do you think is moving in the wires?

3
Why does a torch need a switch?

EXPLAIN

CIRCUITS FROM SCRATCH

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.

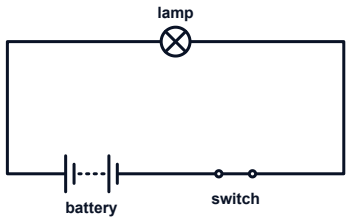
Where the model breaks: you can see a chain move quickly, but the charges in a wire drift very slowly.

! **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.

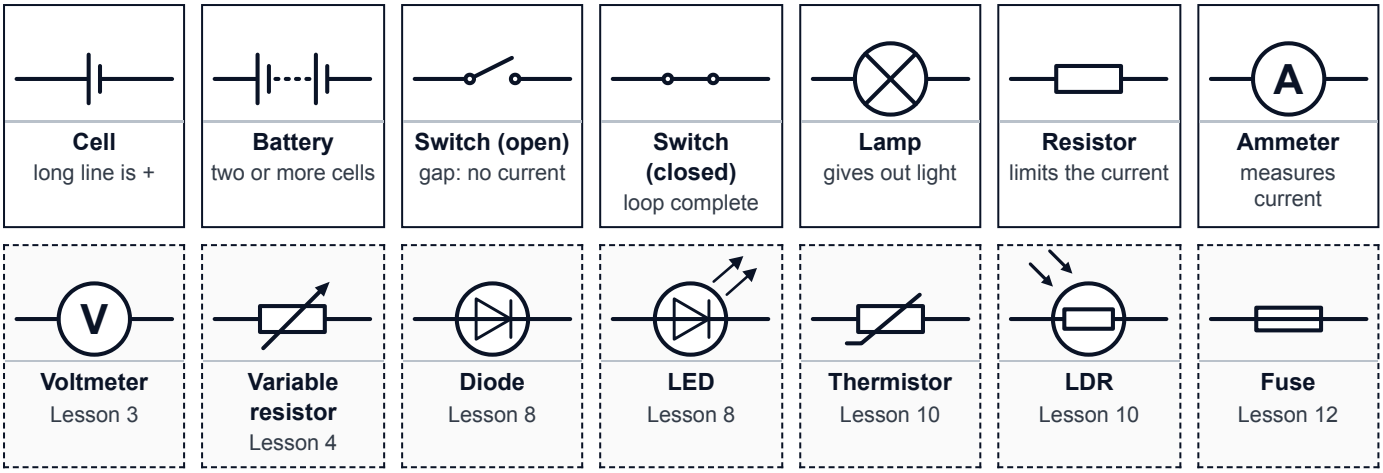
FROM A PICTURE TO A CIRCUIT DIAGRAM

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.



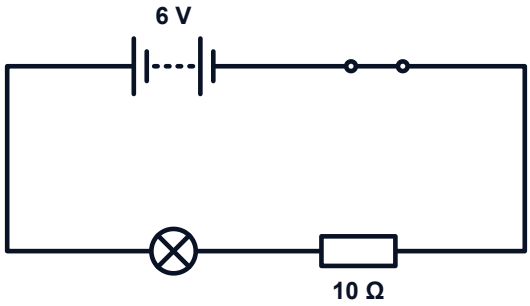
The same circuit as a circuit diagram.



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 Ω next to the symbol.

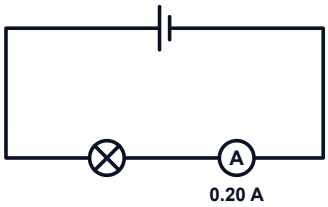


A neat diagram: ruler, right angles, no gaps.

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**.

> **!** A circuit with just one loop is a **series circuit**. Everything in that loop is ‘in series’.

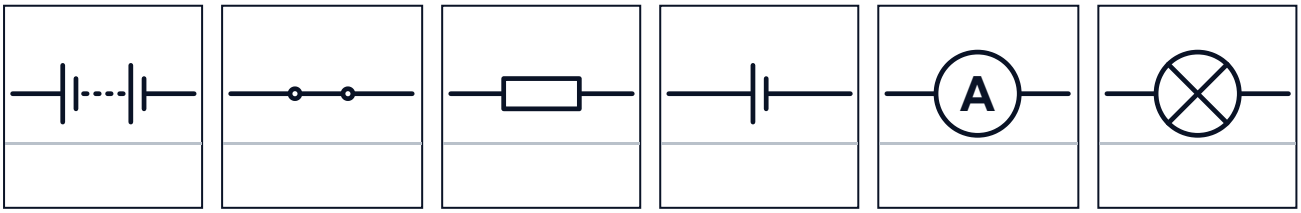


The ammeter is in series with the lamp.

PRACTISE

TRY IT

1 Name each symbol.

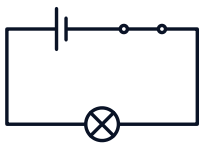


2 Draw the symbol for each component. Use a ruler for the straight lines.

Open switch	Lamp	Cell	Ammeter	Resistor	Battery

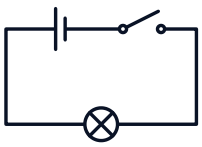
3 Will the lamp light? Circle **Yes** or **No** for each circuit.

A



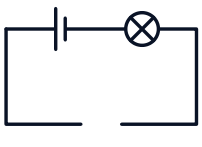
Yes **No**

B



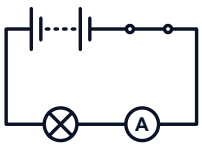
Yes **No**

C



Yes **No**

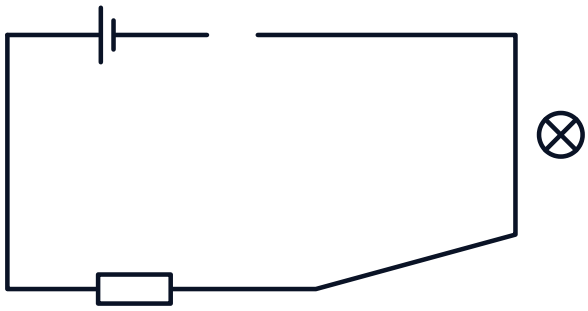
D



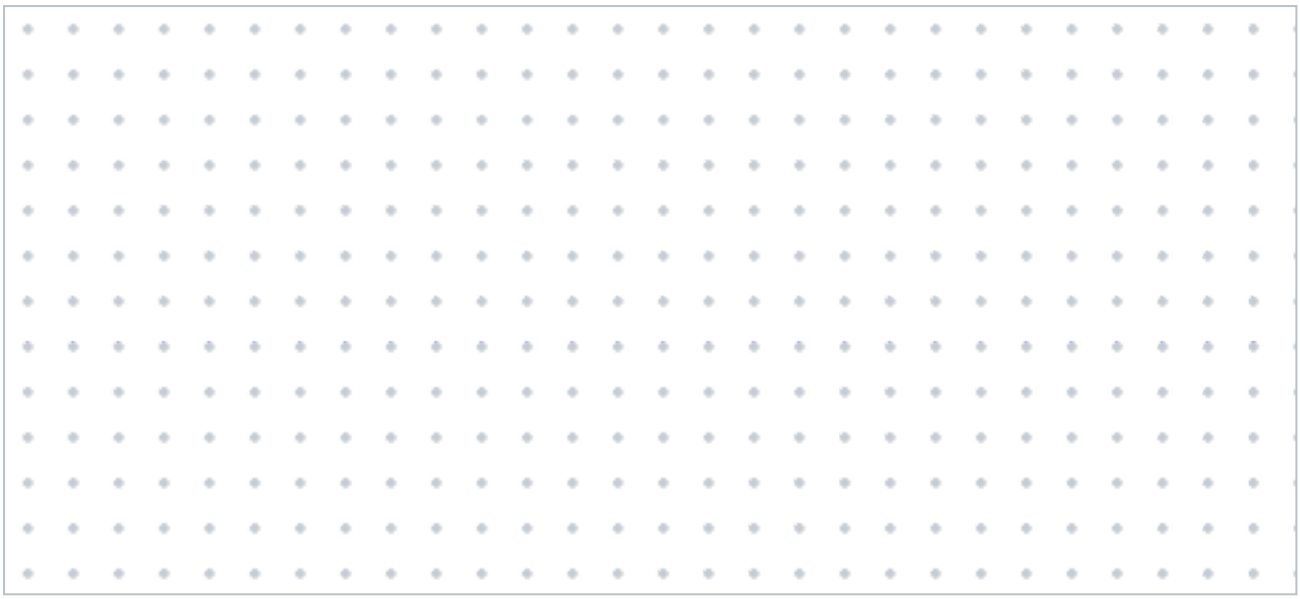
Yes **No**

Explain your answer for circuit C.

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



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.

AQA-STYLE

EXAM CORNER

Write in full sentences. Show every step of a calculation.

> **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]**

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

REVIEW LATER

REVISE IT

Use this box after the lesson and before tests.

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

REFERENCE

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).