CIRCUITS DAY 1: ELECTRIC CURRENT & CHARGE FLOW

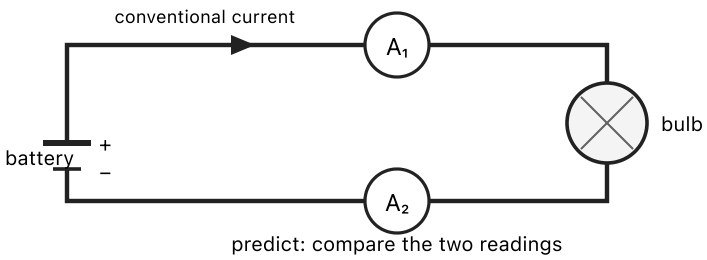
CED 11.1 · Skill 3.B · FRQ: QQT

PREDICT BEFORE OBSERVING

Ammeter A_1 is just before a bulb and A_2 is just after it in the same loop. Circle one: **A_2 is smaller / A_2 is equal / A_2 is larger / A_2 is zero**. Be ready to defend your choice.

Observation source: battery–bulb loop with a movable ammeter; projected PhET *Circuit Construction Kit: DC* as an exact substitute for this observation; or the printed circuit below.

PRINTED FALLBACK — PREDICT THE TWO READINGS



predict: compare the two readings

CURRENT IS A RATE

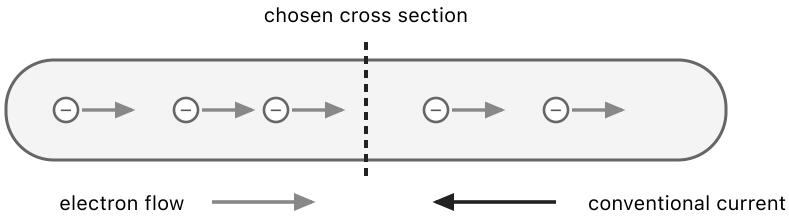
Electric current is the rate at which charge crosses a chosen cross section.

$$I = \frac{\Delta Q}{\Delta t} \qquad 1\ \text{A} = 1\ \text{C/s}$$

QUICK A total charge of $18\ \text{C}$ crosses a point in $12\ \text{s}$. Find the average current and carry the units through the division.

CURRENT DIRECTION AND ELECTRON FLOW

DIRECTION OF CURRENT VS. DIRECTION OF ELECTRON FLOW



The arrows on the electrons show electron flow to the right. Conventional current is defined in the opposite direction, to the left.

- Current is not a vector, but a circuit current has a direction around the path.
- Conventional current is defined as the direction positive charge would move.
- In metal wires, electrons flow opposite the conventional-current direction.
- With zero current, electrons still have microscopic thermal motion; their net electron flow is zero.

WE DO A wire carries $0.80\ \text{A}$. Find the magnitude of charge crossing a point in $25\ \text{s}$.

YOU DO For that same current, how many electrons cross per second? Use $e = 1.60 \times 10^{-19}\ \text{C}$.

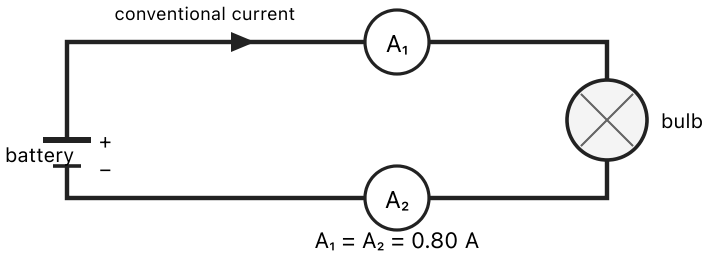
CHARGE IS CONSERVED AROUND ONE LOOP

In a steady series circuit, charge does not accumulate in any element. Therefore the current is the same at every point in the loop.

$$I_{\text{before}} = I_{\text{through}} = I_{\text{after}}$$

The bulb receives electrical energy and transfers it to light and thermal energy. The moving charges continue through the circuit.

USE ONE CURRENT LABEL AROUND THE LOOP



REASON A student claims that a $0.80\ \text{A}$ current before the bulb becomes $0.50\ \text{A}$ afterward. Calculate the charge that would accumulate in the bulb in $20\ \text{s}$ if that claim were true.

Signal and drift: charge carriers are already present throughout the wire. Closing the switch establishes an electric field through the connected circuit; it does not require one electron to race from the battery to the bulb.

PRACTICE

1. A current of $0.65\ \text{A}$ flows for $40\ \text{s}$. Find the charge that crosses one point.

2. A pulse transfers $7.2\ \text{C}$ in $4.0\ \text{s}$. Find the average current.

3. A $0.60\ \text{A}$ current is carried by electrons. Find the number of electrons crossing a section each second.

4. An ammeter before a bulb reads $1.25\ \text{A}$. What should an ammeter after the bulb read in the same steady series loop? Explain.

5. Draw arrows for conventional current and electron flow on a battery–wire–bulb loop. State why the arrows point in opposite directions.