

# On current electricity

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## Warm-up problems

1. What are the units of charge, current, voltage and resistance? Express each of these units in SI base units.
2. What are the other two alternative names for *voltage*? Give the equation linking voltage, energy and charge.
3. Give the equations linking
  - (a) current to charge and time,
  - (b) resistance to current and voltage.

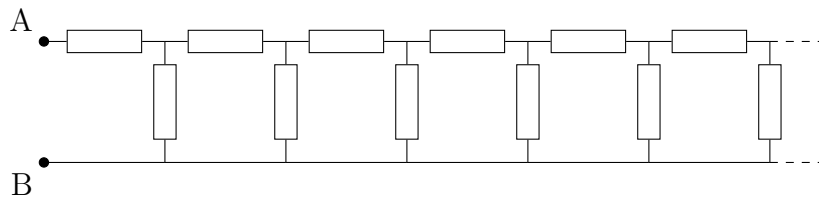
## Regular problems

4. Why are *electrons*, rather than *protons*, the principal charge carriers in a metal wire?
5.
  - (a) What is the current in a circuit if the charge passing each point is (i) 10 C in 2 s, (ii) 20 C in 40 s, (iii) 240 C in 2 minute?
  - (b) If the current through a lamp is 5 A, what charge passes in (i) 1 s, (ii) 10 s, (iii) 1 minute?
6. The voltage across a lamp is 12 V. How much electrical energy is changed into heat and light when
  - (a) a charge of 1 C passes through it,
  - (b) a charge of 5 C passes through it,
  - (c) a current of 2 A passes through it for 10 s?
7.
  - (a) What is the voltage across a  $220\ \Omega$  resistor when a current of 3 mA flows through it?
  - (b) The voltage across a  $2.7\ \text{k}\Omega$  resistor is 5.4 V. What current flows?
  - (c) Calculate the resistance of a resistor if a voltage of 9 V causes a current of 1.5 mA to flow through it.
  - (d) A current of 0.4 mA flows through a  $10\ \text{k}\Omega$  resistor. What is the voltage across its ends?
8.
  - (a) If the voltage across a circuit is held constant while the resistance doubles, what change occurs in the current?

- (b) If the resistance across a circuit halves while the voltage increases by a factor of three, what change occurs in the current?
9. (a) What is the combined resistance of the following resistors connected in parallel:  $220\ \Omega$ ,  $100\ \Omega$ ,  $470\ \Omega$ ?
- (b) Calculate the the combined value of the following resistors connected in series:  $33\ \text{k}\Omega$ ,  $18\ \text{k}\Omega$ ,  $4.7\ \text{k}\Omega$ . If a battery supplies a current of  $215\ \mu\text{A}$  through the resistors when they are connected to it, what is the battery voltage?

## Extension problems

10. A  $10\ \text{k}\Omega$  and a  $6\ \text{k}\Omega$  resistor are connected in series. If both resistors have a manufacturing tolerance of  $\pm 10\%$ , what, approximately, are the maximum and minimum values of resistance we should expect to measure across the combination?
11. In the following infinite network of  $1\ \Omega$  resistors, what is the resistance (as measured by an ohmmeter) between A and B?



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