Resistor Networks

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Warm-up problems

1. Which of these is a current of 3 A?
   A 2 C in 0.5 s **B** 10 C in 3 s **C** 12 C in 4.0 s **D** 8 C in 6.0 s
2. In which of these does 25 C flow?
   A 2 A for 12 s **B** 4.2 A for 6 s **C** 3 A for 8.3 s **D** 1.25 A for 20 s
3. Which gives out 30 J of energy?
   A 2 C through 12 V **B** 4 C through 8 V
   C 10 C through 3.0 V **D** 2 C through 18 V
4. If an electron beam fires 1000 electrons per second, what is the current?
   A 1000 A **B** 1.6×10^{-16} A **C** 1 A **D** 1.6×10^{-19} A

Lesson Objectives

1. To know how current flows through a network of resistors.
2. To be able to calculate the resistance of networks of resistors.
3. To learn some tricks to help do this quickly.

Textbook pp. 58–63

REMINDER: Office hours are week 1 Tuesdays 3.45–5.0 p.m. in room 19.
Next office hours: Tuesday 25 September 2012

Specification Requirement

Charge, current and potential difference
Electric current as the rate of flow of charge; potential difference as work done per unit charge.

$$I = \frac{\Delta Q}{\Delta t} \text{ and } V = \frac{W}{Q} \text{ Resistance is defined by } R = \frac{V}{I}$$

[AQA GCE AS and A Level Specification Physics A, 2009/10 onwards]

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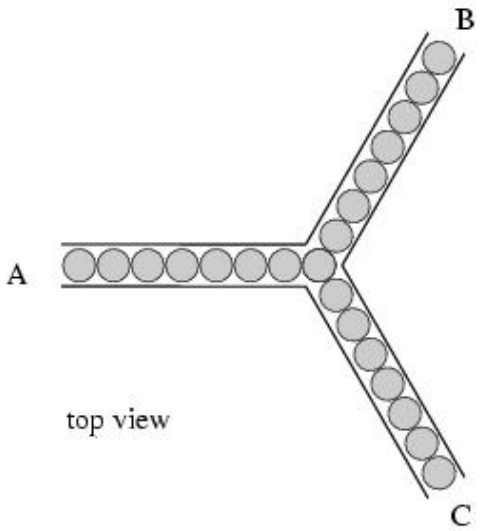
1 Consider the Y-shaped tube shown below. Suppose 2 balls per second are stuffed into the opening at A.



The number of balls per second that come out of the tube at B is

(a) always equal to 2
(b) always smaller than or equal to 2
(c) always larger than or equal to 2
(d) equal to 1
(e) depends on what happens at C

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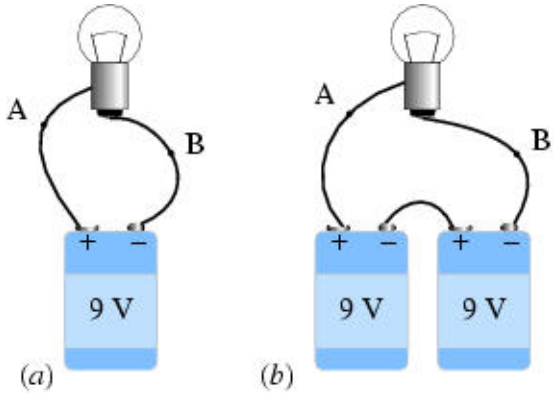
2 A light bulb is connected to a 9 V battery.



If a second battery is added in a series as shown in (b), how many of the following change?
The current I at A, the pottential difference V_{AB} between A and B, the resistance R of the lightbulb

(a) All three
(b) Two
(c) One
(d) It depends

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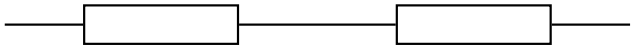
2 Consider two identical resistors wired in series.



If there is an electric current through the combination, the current in the second resistor is

(a) equal to
(b) half
(c) smaller than, but not necessarily half

the current through the first resistor.

Resistors in series and parallel

It is often necessary to find the total resistance of some complicated bunch of resistors in an electrical circuit. There are rules to help us with this, however.

Resistors in series

For resistors in series, we simply add the resistances up along the path of the current. For N resistances,

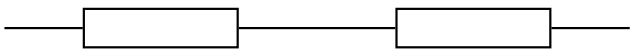
$$R = R_1 + R_2 + \ldots + R_N.$$

Resistors in parallel

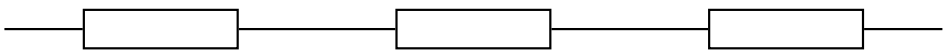
For resistors in parallel, the resistance decreases as the number of resistors increases, as the current has more ways to go.

$$\frac{1}{R} = \sum_{i=1}^{N} \frac{1}{R_i}$$

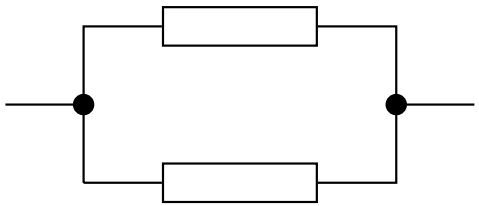
Network problem



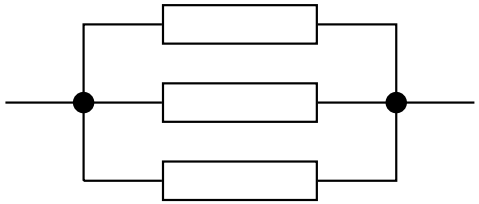
Network problem



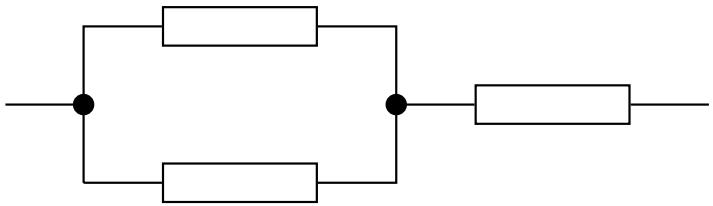
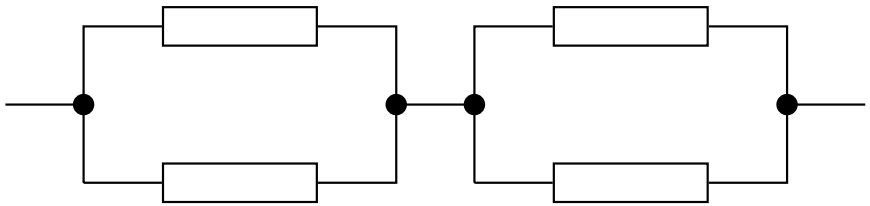
Network problem



Network problem



Network problem



Network problem