
 General Physics: Electromagnetism, Problem Set 7

Exercise 1 :

Consider the circuit below. The internal resistance of the battery is $r = 1 \Omega$, the resistance of the resistor is $R = 10 \Omega$. What is the *EMF* of the battery, if the heat power delivered on the resistor is $P = 40 \text{ W}$? How much of heat energy W_B will be delivered in the battery during 1 hour?

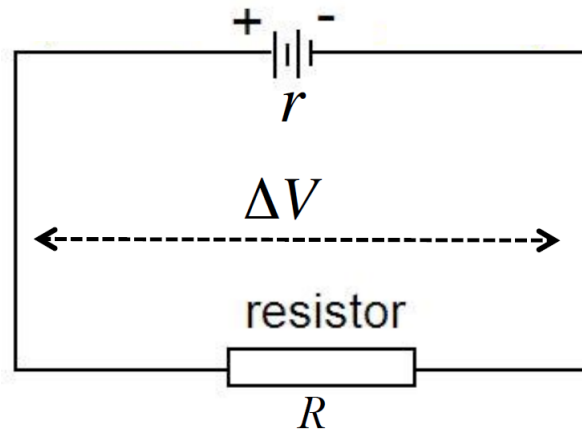


Figure 1: Simple circuit with a battery and a resistor.

Exercise 2 :

Two 100Ω light bulbs are connected (a) in series and (b) in parallel to a 24 V battery. What is the current through each bulb in both cases? For which circuit will the bulbs be brighter?

Hint: The more power consumed, the brighter the bulb.

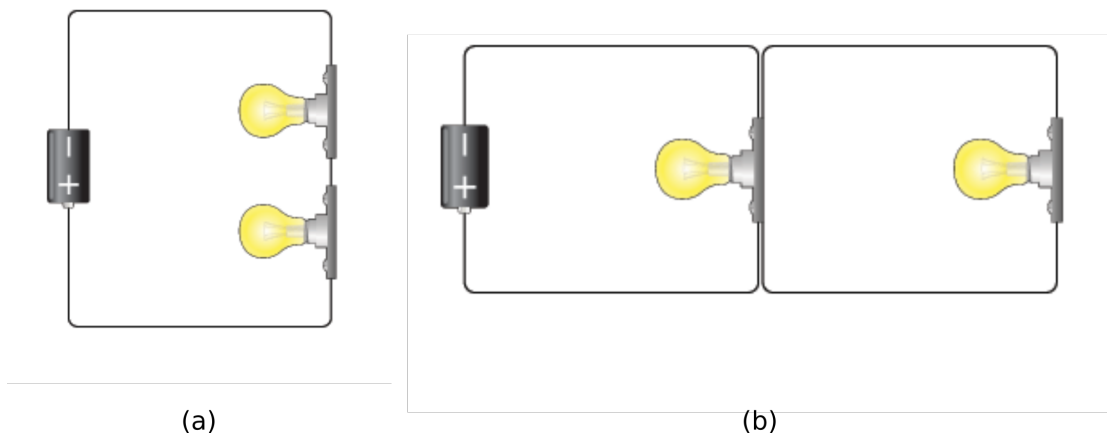


Figure 2: Series (a) and parallel (b) circuit of two light bulbs powered by a battery.

Exercise 3 :

Determine the equivalent resistance of the "ladder" of equal resistors R shown in the figure below. In other words, what resistance would an *ohmmeter* read if connected between points A and B?

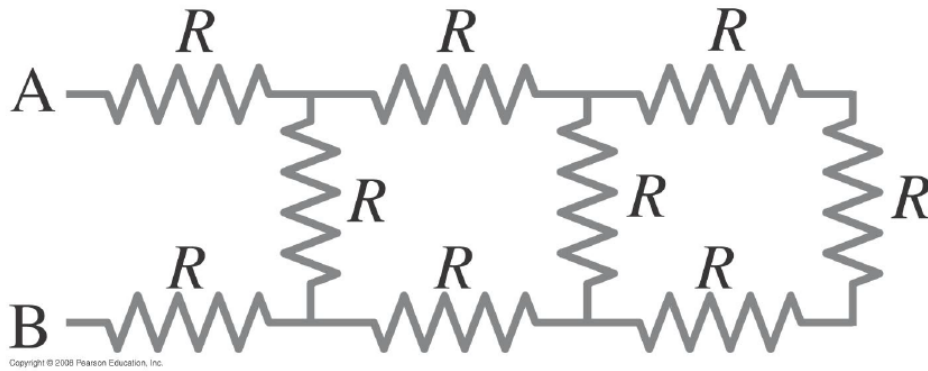
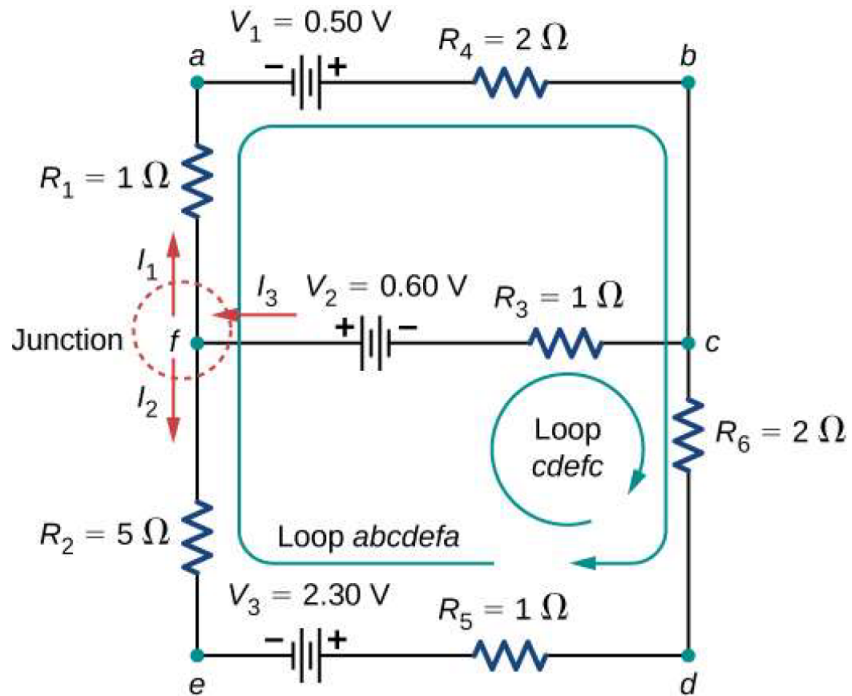


Figure 3: "Ladder" of resistors.

Exercise 4 :

Calculate the current in each resistor inside the circuit shown below.



Exercise 5 :

Calculate the current in each resistor inside the circuit shown below.

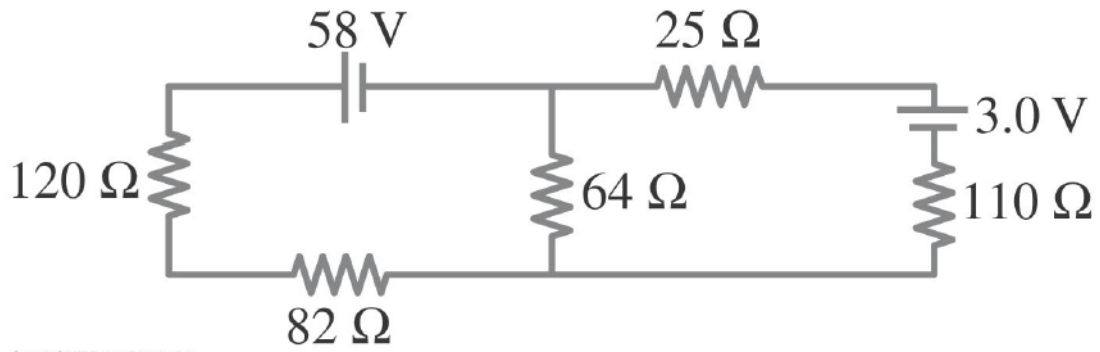


Figure 4: Circuit with two batteries and resistors.

Exercise 6 :

A good battery of a car is used to start a second car with a low battery. The good battery has an EMF of 12.5 V and an internal resistance of $0.020\ \Omega$. Let's suppose that the low battery has an EMF of 10.1 V and an internal resistance of $0.10\ \Omega$. The cables have a resistance $R_j = 0.0026\ \Omega$ each and can be connected as shown in the figure below. Let's suppose that all the rest of the car can be represented as a $R_c = 0.15\ \Omega$.

1. Find the current I_3 flowing into the starter motor if only the low battery is connected;
2. Find the current flowing into the starter motor if now also the good battery is connected.

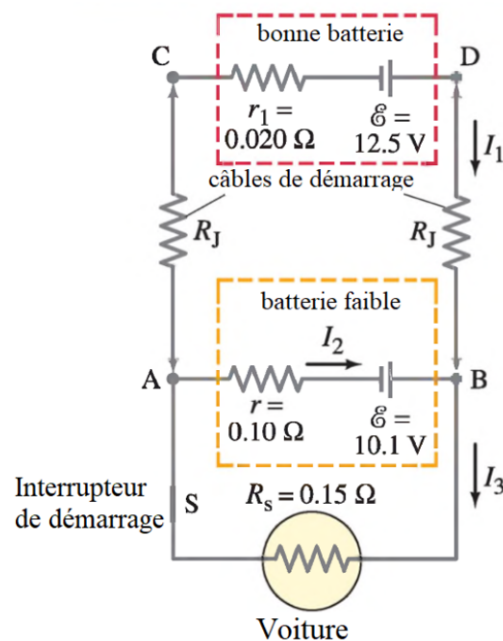


Figure 5: Schematic of the equivalent circuit.

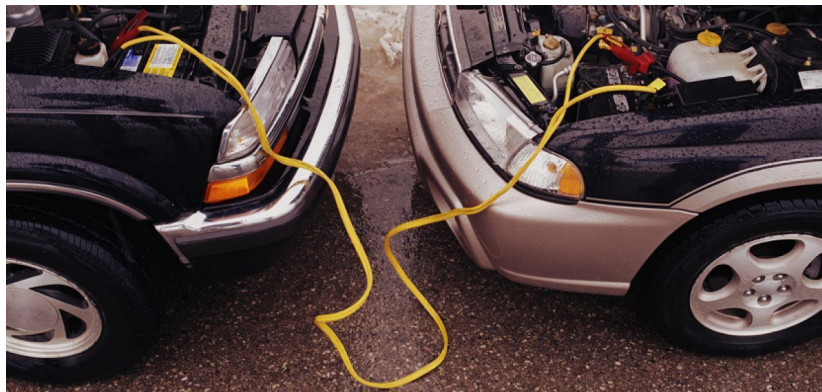


Figure 6: Two batteries, a good one and a low one, connected as shown in the circuit on top.

Exercise 7 :

Consider a hollow cylinder of length L and inner radius a and outer radius b , as shown in the figure below. The material has resistivity ρ .

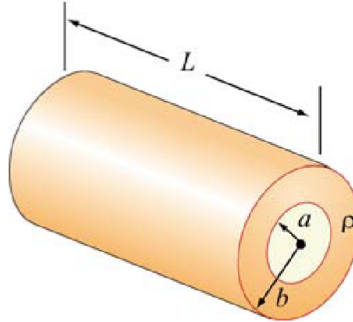


Figure 7: A hollow cylinder

1. Suppose a potential difference is applied between the ends of the cylinder and produces a current flowing parallel to the axis. What is the resistance measured?
2. If instead the potential difference is applied between the inner and outer surfaces so that current flows radially outward, what is the resistance measured?