

Honors Physics Electric Circuits HW, part 1 (Homework)

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1.

If a current of 78.0 mA exists in a metal wire, how many electrons flow past a given cross section of the wire in 10.0 min?

2.

A total charge of 4.0 mC passes through a cross-sectional area of a wire in 8.0 s. What is the current in the wire?

3.

In a particular television picture tube, the measured beam current is 55.0 μ A. How many electrons strike the screen every second?

4.

An aluminum wire with a cross-sectional area of $4.0 \times 10^{-6} \text{ m}^2$ carries a current of 2.0 A. Find the drift speed of the electrons in the wire. The density of aluminum is 2.7 g/cm^3 . (Assume that one electron is supplied by each atom.)

5.

When operating at 104 V, a resistor carries a current of 0.51 A. What current is carried if

(a) the operating voltage is lowered to 94 V?

(b) the voltage is raised to 114 V?

6.

Calculate the diameter of a 2.5 cm length of tungsten filament in a small lightbulb if its resistance is 0.047 Ω . (The electrical resistivity of tungsten is $5.6 \times 10^{-8} \Omega \cdot \text{m}$)

7.

A wire, 50.0 m long and 2.00 mm in diameter, is connected to a source with a potential difference of 9.11 V, and the current is found to be 33.7 A. Assume a temperature of 20°C and using Table 17.1, identify the metal of the wire.

Resistivities and Temperature Coefficients of Resistivity for Various Materials ^a		
Material	Resistivity ($\Omega \cdot \text{m}$)	Temperature Coefficient of Resistivity [$(^\circ\text{C})^{-1}$]
Silver	1.59×10^{-8}	3.8×10^{-3}
Copper	1.7×10^{-8}	3.9×10^{-3}
Gold	2.44×10^{-8}	3.4×10^{-3}

Aluminum	2.82×10^{-8}	3.9×10^{-3}
Tungsten	5.6×10^{-8}	4.5×10^{-3}
Iron	10.0×10^{-8}	5.0×10^{-3}
Platinum	11×10^{-8}	3.92×10^{-3}
Lead	22×10^{-8}	3.9×10^{-3}
Nichrome ^b	150×10^{-8}	0.4×10^{-3}
Carbon	3.5×10^5	-0.5×10^{-3}
Germanium	0.46	-48×10^{-3}
Silicon	640	-75×10^{-3}
Glass	$10^{10} - 10^{14}$	-
Hard rubber	$\approx 10^{13}$	-
Sulfur	10^{15}	-
Quartz (fused)	75×10^{16}	-
^a All values are at 20°C.		
^b A nickel-chromium alloy commonly used in heating elements.		

Table 17.1

8.

A rectangular block of copper (resistivity = 1.7×10^{-8}) has sides of length 8 cm, 23 cm, and 34 cm. If the block is connected to a 8.0 V source across opposite faces of the rectangular block, what are

- (a) the maximum current and
 (b) minimum current that can be carried?

9.

How many 106 W lightbulbs can you use in a 126 V circuit without tripping a 15 A circuit breaker? (The bulbs are connected in parallel.)

10.

The power supplied to a typical black-and-white television set is 84 W when the set is connected to 120 V.

- (a) How much electric energy does this set consume in 1 hour?
 (b) A color television set draws about 2.1 A when connected to 120 V. How much time is required for it to consume the same energy as the black-and-white model consumes in 1 hour?

11.

The tungsten heating element in a 1460 W heater is 3.30 m long, and the resistor is to be connected to a 140 V source. What is the cross-sectional area of the wire? (Assume a temperature of 20°C.)

12.

A copper cable is designed to carry a current of 340 A with a power loss of 1.60 W/m. What is the required radius of this cable?

13.

A small motor draws a current of 1.75 A from a 135 V line. The output power of the motor is 0.20 hp.

- (a) At a rate of \$0.060/kWh, what is the cost of operating the motor for 2.0 h?
- (b) What is the efficiency of the motor?

14.

A 110 V motor produces 2.40 hp of mechanical power. If this motor is 95.0% efficient in converting electrical power to mechanical power, find

- (a) the current drawn by the motor and
- (b) the total electrical energy (in both kWh and joules) used by this motor in running for one hour.
- (c) If electrical energy costs \$0.069/kWh, what does it cost to run the motor for this hour?