

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 4.0×10^{-6} m² 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 5.6×10^{-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?