

(1) A copper wire 1 km long is connected across a 6-volt battery. How long does it take a conduction electron to drift around the circuit? (Room temperature.)

With one conduction electron per atom, copper contains approximately 8×10^{22} conduction electrons per cm^3 . (Atomic weight 63.5; density 9 g cm^{-3} .) The resistivity of copper at room temperature is $2 \times 10^{-6} \text{ ohm cm}$. Applying 6 V to 10^5 cm of wire causes a current density of 30 A cm^{-2} . The drift speed of the conduction electrons in cm s^{-1} must then be $30 / (8 \times 10^{22} \times 1.6 \times 10^{-19}) = 2.3 \times 10^{-3} \text{ cm s}^{-1}$. At that rate an electron will drift once around the circuit in a little more than one year.