Answer on Question #46035, Physics, Electromagnetism

A current flows in a wire of circular cross-section with the free electrons travelling with a mean drift velocity v. If an equal current flows in a wire of the same material but of twice theradius, what is the new mean drift velocity?

Solution

Mean drift velocity can be evaluated as

$$v = \frac{eE}{m}\tau$$

where e is charge of electron, E is accelerating electric field, m is mass of electron and τ is mean time between collisions. E is proportional to U, the voltage. When doubling the radius we get 4 time bigger area of cross section of the wire. Hence, its resistance per unit length will decrease in 4 times. With the same current, it means, the voltage also decrease in 4 times. Hence, the mean drift velocity will be 4 times smaller, $v/4$.