

Ch 9. Prob 24

$$I = I_0 e^{-t/\tau}$$

$$I_0 = 3.00 \text{ A} \quad @ \quad t = 0.00$$

$$\tau = 0.50 \text{ s}$$

Find The charge flowing Through the conductor
between $t = 0.00 \text{ s}$ and $t = 3\tau$

Since $I = \frac{dQ}{dt} \rightarrow \int_0^Q dQ = \int_{t=0}^{t=3\tau} I dt$

$$Q = \int_{t=0}^{3\tau} I_0 e^{-t/\tau} dt$$

$$= I_0 \int_0^{3\tau} e^{-t/\tau} dt = I_0 \left. \frac{e^{-t/\tau}}{(-1/\tau)} \right|_0^{3\tau}$$

$$= -\tau I_0 [e^{-3\tau/\tau} - e^0]$$

$$= \tau I_0 [1 - e^{-3}]$$

$$= (0.50 \text{ s})(3.00 \text{ A}) [1 - 0.0498]$$

$$Q = 1.43 \text{ C}$$