

## Answer on Question #45991 – Physics – Electromagnetism

### Question.

The current  $I$  in a conductor as a function of time  $t$  is given as  $I(t)=5t^2-3t+10$ , where current is in amperes A and  $t$  is in seconds s. What quantity of charge moves across a section through the conductor during the interval  $t=2s$  to  $t=5s$ ?

Given:

$$I(t) = 5t^2 - 3t + 10$$

$$t \in [2,5]$$

Find:

$$Q = ?$$

### Solution.

Electric current is the rate of charge flow past a given point in an electric circuit. By definition the electric current is:

$$I = \frac{\Delta Q}{\Delta t} = \frac{dQ}{dt}$$

So,  $dQ = Idt$ . Let integrate this expression:

$$\begin{aligned} Q &= \int dQ = \int Idt = \int_2^5 (5t^2 - 3t + 10)dt = \left. \frac{5}{3}t^3 - \frac{3}{2}t^2 + 10t \right|_2^5 = \\ &= \frac{5}{3} \cdot 125 - \frac{3}{2} \cdot 25 + 10 \cdot 5 - \left( \frac{5}{3} \cdot 8 + \frac{3}{2} \cdot 4 - 10 \cdot 2 \right) = \frac{5}{3} \cdot 117 - \frac{3}{2} \cdot 21 + 10 \cdot 3 = \\ &= 195 - 31.5 + 30 = 193.5 \text{ C} \end{aligned}$$

### Answer.

$$Q = \int Idt = 193.5 \text{ C}$$