**Answer on question**

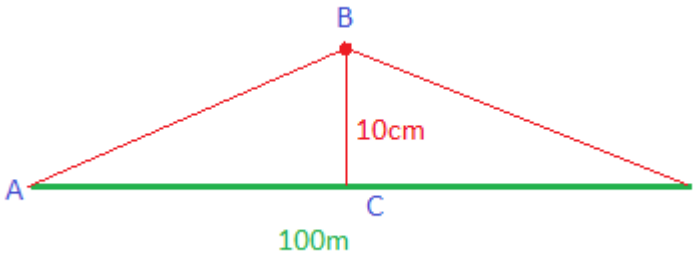
A 100 m long thread carries charges uniformly distributed along its length. An electron, 10 cm away from the centre of the thread along a line perpendicular to the thread experiences an attractive force of 2.7 × 10−12N. Calculate the total charge on the thread.

**Solution**

Look at the picture. First of all we find the force of a half (AC) of the thread.

The electron is placed in point B. Let point A is a small piece of thread with charge $dq = \mu dx, \mu = \frac{Q}{L}$,

$\mu$ is a linear density of charge in the thread, Q is a full charge of the tread, L is its length (100m). The length of AB is $\sqrt{BC^2 + (AC - x)^2} = \sqrt{0.01 + (50 - x)^2}$, where x is position of point A, 0<x<50. The direction of resultant force is parallel to BC.




The formula for force between the electron and small piece of the thread is

$$dF = \frac{kedq}{\sqrt{0.01 + (50 - x)^2}} \cos \widehat{ABC} = \frac{ke\mu(50 - x)dx}{0.01 + (50 - x)^2}$$

The resultant force is

$$F = 2e\mu k \int_0^{50} \frac{(50 - x)dx}{0.01 + (50 - x)^2} = \frac{eQk}{L} \ln \frac{0.01}{2500.01} = -12.43 \frac{eQk}{L} = 2.7 * 10^{-12} N \rightarrow$$

The full charge in the thread

$$Q = \frac{2.7 * 10^{-12}}{-12.43 * ek} L = \frac{2.7 * 10^{-12} * 100}{12.43 * 1.6 * 10^{-19} * 9 * 10^9} = 0.015C$$

**Answer** $Q = 0.015\ C$