A straight rod of length extends from x=0 to x=L. The linear mass density of rod varies with x coordinate is $\lambda = a_0 + b_0 x^2$. The gravitational force experienced by a point mass m at x=-a, is

Solution
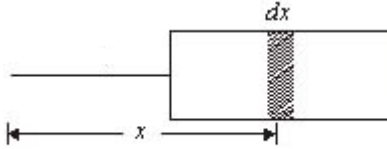
$$dF = \frac{Gm\lambda dx}{x^2}$$

The gravitational force experienced by a point mass m at x=-a, is

$$F = \int\limits_{a}^{a+L} \frac{Gm[a_0 + b_0 x^2]dx}{x^2} = a_0 \int\limits_{a}^{a+L} \frac{Gmdx}{x^2} + b_0 \int\limits_{a}^{a+L} Gmdx = Gm\left[a_0\left(\frac{1}{a} - \frac{1}{a+L}\right) + b_0 L\right].$$

Answer: $Gm\left[a_0\left(\frac{1}{a} - \frac{1}{a+L}\right) + b_0 L\right].$