A cube of edge length a in free space is charged with a volume charge density

$$\rho_u = \rho_0 \sin(\pi x/a)\,, \quad 0 \le x \le a\,,$$

where ρ_0 is a constant. Find the total charge in the cube.

Solution:

$$\begin{aligned} Q &= \int_0^a \int_0^a \int_0^a \rho_u \, dxdydz \\ &= \rho_0 a^2 \int_0^a \sin(\pi x/a) dx \\ &= \frac{2\rho_0 a^3}{\pi} \end{aligned}$$

Answer:

$$Q = \frac{2\rho_0 a^3}{\pi}$$