

Problem 4.1 A cube 2 m on a side is located in the first octant in a Cartesian coordinate system, with one of its corners at the origin. Find the total charge contained in the cube if the charge density is given by $\rho_v = xy^2e^{-2z}$ (mC/m³).

Solution: For the cube shown in Fig. P4.1, application of Eq. (4.5) gives

$$\begin{aligned} Q &= \int_V \rho_v dV = \int_{x=0}^2 \int_{y=0}^2 \int_{z=0}^2 xy^2e^{-2z} dx dy dz \\ &= \left(\frac{-1}{12} x^2 y^3 e^{-2z} \right) \bigg|_{x=0}^2 \bigg|_{y=0}^2 \bigg|_{z=0}^2 = \frac{8}{3} (1 - e^{-4}) = 2.62 \text{ mC}. \end{aligned}$$

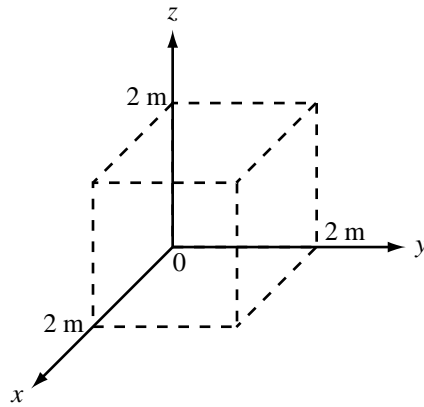


Figure P4.1: Cube of Problem 4.1.