(2)

Cut the surface S' into two pieces, S_1 and S_2. The boundary of S_1 is the curve C and positive orientation for C points as shown. The boundary of S_2 is also the curve C but positive orientation for C runs the opposite way. Thus

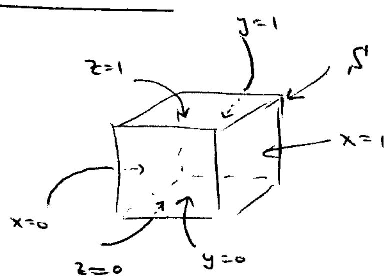
$$\iint_S (\text{curl } \underset{\sim}{F}) \cdot d\underset{\sim}{S} = \iint_{S_1} (\text{curl } \underset{\sim}{F}) \cdot d\underset{\sim}{S} + \iint_{S_2} (\text{curl } \underset{\sim}{F}) \cdot d\underset{\sim}{S}$$

$$= \int_C \underset{\sim}{F} \cdot d\underset{\sim}{r} - \int_C \underset{\sim}{F} \cdot d\underset{\sim}{r} \quad \text{by Stokes' Theorem}$$

$$= 0.$$

SECTION THREE

(1)



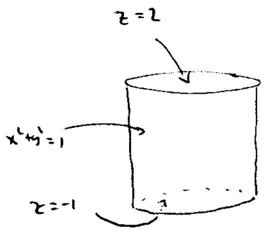
Let E be the solid cube, and S' be its boundary.

Then the Divergence Theorem gives

$$\iint_S \underset{\sim}{F} \cdot d\underset{\sim}{S} = \iiint_E (\text{div } \underset{\sim}{F})\, dV$$

$$= \int_{x=0}^{x=1} \int_{y=0}^{y=1} \int_{z=0}^{z=1} 3+3x \; dz\,dy\,dx = \underline{\underline{9/2}}$$

(2)



Let E be the solid shown and S be its boundary. By the Divergence Theorem:

$$\iint_S \underset{\sim}{F} \cdot d\underset{\sim}{S} = \iiint_E (\text{div } \underset{\sim}{F})\, dV = \iiint_E (3x^2 + 3y^2)\, dV$$

$$= \int_{\theta=0}^{\theta=2\pi} \int_{r=0}^{r=1} \int_{z=-1}^{z=2} 3r^2 \cdot r \, dz\, dr\, d\theta = \underline{\underline{\frac{9\pi}{2}}}$$

SECTION FOUR

See page 975 of the textbook.