(31) $F(x,y,z) = \langle x^2, y^2, z^2 \rangle \quad z \in [0, \sqrt{1-y^2}] \quad x \in [0,2]$

$S = S_1 + S_2 + S_3 + S_4$

$S_1)$ $dS = n\,dS = dS = -i\,dS$: $\iint_{S_1} F \cdot dS = \iint_{S_1} (x^2 i + y^2 j + z^2 k) \cdot -i)\,dS$

$= \iint_{S_1} -x^2\,dS = \iint_{S_1} 0^2\,dS = 0 = S_1$

$S_2)$ $dS = i\,dS \quad \iint_{S_2} F \cdot dS = \iint_{S_2} (x^2 i + y^2 j + z^2 k) \cdot i\,dS = \iint_{S_2} x^2\,dS$

$= 4 \iint_{S_2} dS = 4 \left(\frac{\pi (1)^2}{2} \right) = 2\pi$

area of surface

$S_3)$ $dS = n\,dS \quad n = -k \quad \iint_{S_3} F \cdot dS = \iint_{S_3} \langle x^2, y^2, z^2 \rangle \cdot -k\,dS$

$= -\iint_{S_3} z^2\,dS = -0 = 0$

$S_4)$ $y^2 + z^2 = 1 \quad x = 0 \quad x = 2 \quad z = 0 \qquad u \in [-\frac{\pi}{2}, \frac{\pi}{2}] \quad v \in [0,2]$

$z = \cos u \quad y = \sin u \quad x = v \quad r = \langle v, \sin u, \cos u \rangle$

$r_u = \langle 0, \cos u, -\sin u \rangle$

$r_v = \langle 1, 0, 0 \rangle$

$r_u \times r_v = \left\langle \begin{vmatrix} \cos u & -\sin u \\ 0 & 0 \end{vmatrix}, + \begin{vmatrix} 0 & -\sin u \\ 1 & 0 \end{vmatrix}, \begin{vmatrix} 0 & \cos u \\ 1 & 0 \end{vmatrix} \right\rangle = \langle 0, -\sin u, -\cos u \rangle$

$dS = -(r_u \times r_v)\,dA = \langle 0, \sin u, \cos u \rangle\,dA$