(7) $\iint_S F \cdot dS \quad F = \langle x^2, y^2, z^2 \rangle \qquad 0 \le z \le \sqrt{1-y^2} \quad 0 \le x \le 2$

$S = S_1 + S_2 + S_3 + S_4$

$S_1)$ $dS = n\,dS \quad dS = -i\,dS \quad \iint_{S_1} F \cdot dS = \iint_{S_1} \langle x^2, y^2, z^2 \rangle(-i)\,dS = \iint_{S_1} -x^2 dS = 0 \iint_{S_1} dS = 0$

$S_2)$ $dS = i\,dS = \iint_{S_2} F \cdot i\,dS = \iint_{S_2} \langle x^2, y^2, z^2 \rangle dS = \iint_{S_2} x^2 dS = 4 \iint_{S_2} dS = 4\left(\frac{\pi(1)^2}{2}\right) = 2\pi$

area of surface

$S3)$ $d = n\,dS \quad n = -k \quad \iint_{S_3} F \cdot dS = \iint_{S_3} \langle x^2, y^2, z^2 \rangle \cdot -k\,dS = -\iint_{S_3} z^2 dS = 0 = 0$

$S_4 = \quad y^2 + z^2 = 1 \quad x = 0 \quad x = 2 \quad z = 1$

$z = \cos u \quad y = \sin u \quad x = v \qquad u \in [-\frac{\pi}{2}, \frac{\pi}{2}] \quad v \in [0, 2]$

$r = \langle v, \sin u, \cos u \rangle$

$r_u = \langle 0, \cos u, -\sin u \rangle \quad r_v = \langle 1, 0, 0 \rangle$

$r_u \times r_v = \langle \begin{vmatrix} \cos u & -\sin u \\ 0 & 0 \end{vmatrix}, -\begin{vmatrix} 0 & -\sin u \\ 1 & 0 \end{vmatrix}, \begin{vmatrix} 0 & \cos u \\ 1 & 0 \end{vmatrix} \rangle = \langle 0, -\sin u, -\cos u \rangle \quad dS = \langle 0, \sin u, \cos u \rangle dA$

$\iint_{S_4} F \cdot dS = \iint_D \langle v^2, \sin^2 u, \cos^2 u \rangle \cdot \langle 0, \sin u, \cos u \rangle dA = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \int_0^2 \sin^3 u + \cos^3 u \, dv\,du$

$= 2 \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^3 u + \cos^3 u \, du = \frac{1}{2} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} 4\sin^3 u + 4\cos^3 u \, du = \frac{1}{2} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} 3\sin u - \sin 3u + 3\cos u + \cos 3u \, du$

$= \frac{1}{2}\left[-3\cos u + \frac{\cos 3u}{3} + 3\sin u + \frac{\sin 3u}{3}\right]_{-\frac{\pi}{2}}^{\frac{\pi}{2}} = \frac{1}{2}(2)\left(3 - \frac{1}{3}\right) = \frac{8}{3}$

$S = S_1 + S_2 + S_3 + S_4$
$= 0 + 2\pi + 0 + \frac{8}{3}$
$= \boxed{2\pi + \frac{8}{3}}$

(8) $(3, 5, -1) \qquad x = 4 - t \qquad y = 2t - 1 \qquad z = 3t$

$\frac{dx}{dt} = -1 \quad \frac{dy}{dt} = 2 \quad \frac{dz}{dt} = -3 \qquad \langle -1, 2, -3 \rangle \qquad t = 0 \quad \langle 4, -1, 0 \rangle$

$\langle 3, 5, -1 \rangle - \langle 4, -1, 0 \rangle = \langle 1, -6, 1 \rangle \qquad \langle -1, 2, -3 \rangle \times \langle 1, -6, 1 \rangle =$

$\langle \begin{vmatrix} 2 & -3 \\ -6 & 1 \end{vmatrix}, \begin{vmatrix} -1 & -3 \\ 1 & 1 \end{vmatrix}, \begin{vmatrix} -1 & 2 \\ 1 & -6 \end{vmatrix} \rangle = \langle -16, -2, 4 \rangle$

$-16(x-3) - 2(y-5) + 4(z+1) = 0$

$-16x - 2y + 4z + 62 = 0$

$\boxed{8x + y - 2z - 31 = 0}$