1. $x = v^2, y = u + v, z = u^2$

$r(u,v) = \cancel{v^2 j}\ v^2 i + (u+v)j + u^2 k$

$r_u = 0i + j + 2uk$

$r_v = 2vi + j + 0k$

$r_u \times r_v = \begin{vmatrix} i & j & k \\ 0 & 1 & 2u \\ 2v & 1 & 0 \end{vmatrix} = (0-2u)i - (0-4uv)j + (0-2v)k$

$= -2ui + 4uvj - 2vk$

$r(u,v) = v^2 i + (u+v)j + u^2 k = (1, 2, 1)$

$u = 1, \quad v = 1$

$r_u \times r_v = -2i + 4j - 2k$

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

$-2x + 2 + 4y - 8 - 2z + 2 = 0$

$-2x + 4y - 2z = 4$

2. $\frac{x}{2} + \frac{y}{2} + \frac{z}{2} = 1$

$x + y + z = 2$

$\iint_S z\,dS = \iint_D f(x,y,g(x,y)) \sqrt{\left(\frac{dg}{dx}\right)^2 + \left(\frac{dg}{dy}\right)^2 + 1}\, dA$

$z = 2 - x - y$

$\iint_S z\,dS = \iint_D z\sqrt{1^2 + 1^2 + 1}\, dA = \sqrt{3}\iint_D z\,dA$

$\frac{x}{2} + \frac{y}{2} = 1$

$y = 2 - x \qquad D: (0 \le x \le 2,\ 2-x \le y \le 2)$

$\sqrt{3}\int_0^2\int_{2-x}^2 z\,dy\,dx = -\sqrt{3}\int_0^2 \frac{(x-4)x}{2}\,dx = -\sqrt{3}\cdot\left(-\frac{8}{3}\right) = \frac{8\sqrt{3}}{3}$

1. $g = 1 - x^2 - y^2$

$P = xy,\ Q = yz,\ R = zx$

$$\iint_S F \cdot ds = \iint_D -xy(-2x) - yz(-2y) + xz)\, dA$$

$$= \iint_D (2x^2y + (2y^2 + x)z)\, dA$$

$$= \iint_D (2x^2y + (2y^2 + x)(1 - x^2 - y^2))\, dA$$

$$= -\int_0^1 \frac{15x^3 - 5x^2 - 10x - 4}{15}\, dx$$

$$= \frac{83}{180}$$