1.(i) D can be described by $-y_0 \le y \le y_0$, $y^2 \le x \le \sqrt{1-y^2}$.

1.(ii) Start with $x = y^2 = \sqrt{1-y^2}$, or $y^4 = 1 - y^2$. Letting $u = y^2$, this is the quadratic equation $u^2 + u - 1$, which has solutions at $u = \frac{-1\pm\sqrt{5}}{2}$. Solving for y we have $y = \pm\sqrt{\frac{-1\pm\sqrt{5}}{2}}$. We want the positive real solution, which is $\sqrt{\frac{-1+\sqrt{5}}{2}}$.

1.(iii)

$$\int\!\!\int_D xy^4\, dA = \int_{-y_0}^{y_0}\int_{y^2}^{\sqrt{1-y^2}} xy^4 dA = \int_{-y_0}^{y_0}\left[\frac{x^2y^4}{2}\right]_{y^2}^{x=\sqrt{1-y^2}} dA = \int_{-y_0}^{y_0}\frac{1}{2}\left(y^4 - y^6 - y^8\right) dA = \frac{y_0^5}{5} - \frac{y_0^7}{7} - \frac{y_0^9}{9}$$

2.(i) Set $u = xy$ and $v = x/y$, so $2 \le u \le 4$ and $\frac{1}{2} \le v \le 3$. Note that $uv = x^2$; hence $x = \sqrt{uv}$. Similarly, $y = \sqrt{u/v}$. Hence our transformation is

$$\begin{aligned} x &= \sqrt{uv} \qquad & 2 \le u \le 4 \\ y &= \sqrt{u/v} \qquad & \frac{1}{2} \le v \le 3 \end{aligned}$$

2.(ii) The correct absolute value of the Jacobian for this change of variables is $\frac{1}{2v}$. Thus our integral becomes

$$\int\!\!\int_D x^2y^2\, dA = \int_2^4\int_{1/2}^3 (uv)\frac{u}{v}\frac{1}{2v} dv du = \int_2^4\int_{1/2}^3 \frac{u^2}{2v}\, dv\, du = \cdots = \frac{26\ln 6}{3}$$

3. By symmetry, $\int\!\int_D f\, dA = 2\int\!\int_{D_1} f\, dA$. Switching to polar coordinates,

$$2\int\!\!\int_{D_1}[2(x^2+y^2)+1]\, dx\, dy = 2\int_{\pi/6}^{\pi/2}\int_0^4 2r^3 + r\, dr\, d\theta = \cdots = \frac{272\pi}{3}$$

4. This problem is impossible unless you change the order of integration!

$$\int_0^2\int_{y^2}^4 y\, e^{x^2}\, dx\, dy = \int_0^4\int_0^{\sqrt{x}} y\, e^{x^2}\, dy\, dx = \int_0^4 \frac{1}{2}x\, e^{x^2}\, dx = \cdots = \frac{e^{16}-1}{4}$$

5. $\int_{-\pi}^{\pi}\sin(y+c)\, dy = 0$ for any constant c. Thus if you set this integral up as $dy\, dx$, the inner integral evaluates to 0 and the entire answer is zero.

6.(i) The first grid curve is a circle of radius $R/2$ centered at $(1/2, 1/2, M/2)$ in the plane $z = M/2$. The second curve is similar; replace $1/2$ with 1.
6.(ii) S is the slanted cone on the left; ask us for reasons!