1.(a) Ask us if you're not sure what the pictures look like.

(b) $\int_0^2 \int_0^{3-3z/2} \int_0^{2-2y/3-z} f(x,y,z)\,dx\,dy\,dz$

(c) $\int_0^2 \int_3^{3-3z/2} 2 - \frac{2}{3}y - z\,dy\,dz$; other answers possible.

2. (a) Again, ask us about the picture. For (b),

$$V(S) = \iiint_S 1\,dV = \int_0^{2\pi} \int_{\pi/4}^{\pi/3} \int_0^4 \rho^2 \sin\phi\,d\rho\,d\phi\,d\theta = 2\pi \frac{64}{3} \int_{\pi/4}^{\pi/3} \sin\phi\,d\phi = \cdots = \frac{64\pi}{3}\left(\sqrt{2} - 1\right)$$

3. (i) This is the half cone $z = \sqrt{x^2 + y^2}$ for $0 \le z \le 1$.

(ii) $\vec{n} = \vec{r}_u \times \vec{r}_v = \langle -u\cos v, -u\sin v, u\rangle$, and $\vec{n}(1/2, \pi/2) = \langle 0, -1/2, 1/2\rangle$.

(iii) $A(S) = \int_0^1 \int_0^{2\pi} |\vec{r}_u \times \vec{r}_v|\,dv\,du = \cdots = 2\pi\sqrt{2}\int_0^1 u\,du = \pi\sqrt{2}$.

4. (a) One possibility is a clockwise half circle.

(b) One possibility is a straight line segment, up the y-axis.

(c) The line integral over the segment on the y-axis is zero; the other part is positive; hence the entire thing is positive.

(d) One possibility is a counter-clockwise circle around the origin.

5. (a) Ask us about the picture.

(b) $\int_C \vec{F} \cdot d\vec{r} = \int_{3\pi/4}^{7\pi/4} \langle -\sin^2 t, \cos^2 t\rangle \cdot \langle \sin t, -\cos t\rangle\,dt = \cdots = -\int_{3\pi/4}^{7\pi/4} \sin^3 t + \cos^3 t\,dt$. This eventually boils down to $-5\sqrt{2}/3$.

6. (a) Ask us about the picture

(b) Let $x = u^3$, $y = v^3$, and $z = w^3$. Then the area expansion factor is simply $27u^2v^2w^2$. In uvw-space, the domain is the tetrahedron in the first octant, cut off by the plane $u + v + w = 8$. The integral is

$$V(S) = \iiint_S dV = \int_0^8 \int_0^{8-u} \int_0^{8-u-v} 27u^2v^2w^2\,dw\,dv\,du$$