11. (cont)

$$\|\vec{r}_u \times \vec{r}_v\| = 81 \sin u$$

$$SA = \int_{v=0}^{v=2\pi} \int_{u=0}^{u=\pi} (81 \sin u)\, du\, dv$$

$$= 81 \int_{v=0}^{v=2\pi} \left[-\cos u\right]_{u=0}^{u=\pi} dv$$

$$= -81 \int_{v=0}^{v=2\pi} \left[\cos \pi - \cos 0\right] dv$$

$$= -81 \int_{v=0}^{v=2\pi} \left[-1 - 1\right] dv$$

$$= -81(-2) \int_{v=0}^{v=2\pi} dv$$

$$= 162 \left[v\right]_{v=0}^{v=2\pi}$$

$$= 162 \left[2\pi - 0\right]$$

$$= 324\pi$$