1. $E = x^2 + y^2 = 16 \wedge z = -5 \wedge z = 4$

   $x^2 + y^2 = 16 \equiv T(r, \theta) = (r\cos(\theta), r\sin(\theta)), 0 \leq \theta \leq 2\pi$

   $\wedge - 5rleqz \leq 4$

   $E' = \begin{cases} x = r\cos(\theta) \\ y = r\sin(\theta) \\ z = z \end{cases} \wedge$

   $\begin{cases} 0 \leq \theta \leq 2\pi \\ -4 \leq r \leq 4 \\ -5 \leq z \leq 4 \end{cases}$

   $\int\int\int_E \sqrt{x^2 + y^2} dV(x, y) = \int\int\int_{E'} r^2 dr$

   $\int_{-4}^{4}(\int_0^{2\pi}(\int_{-5}^{4} r^2 dz)d\theta)dr$

   - $\int_{-5}^{4} r^2 dz =$

     $\frac{r^3}{3}\Big|_{-5}^{4} =$

     $\frac{4^3}{3} + \frac{5^3}{3} = 63$

2. $E = z = x^2 + y^2 \wedge z = 4$

   $E' = \begin{cases} x = r\cos(\theta) \\ y = r\sin(\theta) \\ z = z \end{cases} \wedge$

   $\begin{cases} 0 \leq \theta \leq 2\pi \\ 0 \leq r \leq 2 \\ r^2 \leq z \leq 4 \end{cases}$

   $\int_0^2(\int_0^{2\pi}(\int_{r^2}^{4} zr dz)d\theta)dr$

   - $\int_{r^2}^{4} zr dz =$

     $r \ \frac{z^2}{2}\Big|_{r^2}^{4} =$

     $r(8 - \frac{r^4}{2}) =$

     $8r - \frac{r^5}{2}$

   - $\int_0^{2\pi} 8r - \frac{r^5}{2} d\theta =$

     $16r\pi - 8r^5\pi = 8\pi(2r - r^5)$

   - $8\pi \cdot \int_0^2 2r - r^5 dr =$

     $8\pi(r^2 - \frac{r^6}{6}\Big|_0^2) =$

     $8\pi(4 - \frac{32}{3})$

3. $E = x^2 + y^2 = 1 \wedge z = 0 \wedge z^2 = 4x^2 + 4y^2$

   $E' = \begin{cases} x = r\cos(\theta) \\ y = r\sin(\theta) \\ z = z \end{cases} \wedge$

   $\begin{cases} 0 \leq \theta \leq 2\pi \\ \frac{z}{2} \leq r \leq 1 \\ 0 \leq z \leq 2 \end{cases}$

   $\int_0^2(\int_0^{2\pi}(\int_{\frac{z}{2}}^{1} r^3\cos^2(\theta)dr)d\theta)dz$

   - $\int_{\frac{z}{2}}^{1} r^3\cos^2(\theta)dr =$

     $\cos^2(\theta) \ \frac{r^4}{4}\Big|_{\frac{z}{2}}^{1} =$

     $\cos^2(\theta)(\frac{1}{4} - \frac{z^4}{64}) =$

- $(-\frac{z^4}{64}+\frac{1}{4})\int_0^{2\pi}\cos^2(\theta)d\theta =$
  $(-\frac{z^4}{64}+\frac{1}{4})\ -2\cos(\theta)\sin(\theta)|_0^{2\pi} =$
  $-\frac{z^4}{64}+\frac{1}{4}$
- $\int_0^2 -\frac{z^4}{64}+\frac{1}{4}dz =$
  $-\frac{z^5}{320}+\frac{z}{4}\Big|_0^2 =$
  $-\frac{1}{10}+\frac{1}{2}=\frac{2}{5}$