#2.

\[ \text{Volume} = \int_{0}^{\pi} \int_{0}^{1} r^2 \sin \theta \, dr \, d\theta \]

\[ = \left[ \frac{r^3}{3} \right]_{0}^{1} \int_{0}^{\pi} \sin \theta \, d\theta \]

\[ = \left[ -\cos \theta \right]_{0}^{\pi} \]

\[ = \left( -1 - (-1) \right) \]

\[ = 0 \]

\[ \text{Volume} = 0 \]
#3.

\[ \iiint z \, dv \]

\[ \iiint (\cos \phi) e^x \sin \phi \, d\rho \, d\phi \, dz \]

\[ = \int_0^{\pi/2} \int_0^{\pi/2} \int_0^3 (\cos \phi) e^x \sin \phi \, d\rho \, d\phi \, dz \]

\[ = \frac{1}{2} \sin \phi \left[ \left. (\frac{e^3}{4}) \right|_0^1 \right] \]

\[ = \frac{1}{4} e^3 \]

\[ 0 \leq \phi \leq \frac{\pi}{2} \]

\[ 0 \leq \theta \leq \frac{\pi}{2} \]

\[ 1 \leq \rho \leq 3 \]
4. \( u = x + y \quad v = x - y \) \( n=1 \) \( u + v = 2x \Rightarrow x = \frac{u+v}{2} \)
\( u - v = 2y \Rightarrow y = \frac{v}{2} (u - v) \)
\[
\begin{align*}
\frac{\partial(x,y)}{\partial(u,v)} &= \left| \begin{array}{cc}
\frac{1}{2} & \frac{v}{2} \\
\frac{v}{2} & -\frac{1}{2}
\end{array} \right| = \left| -\frac{v}{2} - \frac{v}{2} \right| = \left| -\frac{v}{2} \right| = \frac{v}{2}
\end{align*}
\]
\[
\int_{-1}^{1} \int_{0}^{1} \ln (\frac{v}{2}) \, du \, dv
\]

5. \( \bar{r}(t) = (1-t) \bar{r}_0 + t \bar{r}_1 \) \Rightarrow \( \bar{r}(t) = (1-t) \langle 0,0,0 \rangle + t \langle 2,2,2 \rangle \)
\( \bar{r}(t) = \langle 2t, 2t, 2t \rangle \), \( 0 \leq t \leq 1 \)
\Rightarrow \( x(t) = 2t, \quad y(t) = 2t, \quad z(t) = 2t \)
\[
= \int_{0}^{t} \int_{0}^{t} e^{-r(t)} \cdot r(t) \cdot dt \quad |r(t)| = \sqrt{2^2 + 2^2 + 2^2} = 2\sqrt{3}
\]
\[
\int_{0}^{1} \int_{0}^{1} \frac{(2t) \dot{r}(t)}{(2\sqrt{3})} \text{dt}
\]
\[
\int_{c}^{e} e^{t} \, dt = \int_{0}^{1} (\lambda t) e^{\left(\frac{2\lambda t}{\sqrt{b}}\right)} \left(\frac{2}{\sqrt{b}}\right) \, dt
\]

\[
= 4\sqrt{b} \int_{0}^{1} t e^{y_1^2} \, dt = 4\sqrt{b} \cdot \frac{2}{2} e^{\frac{y_1}{2}} \left. \right|_{\frac{u_0}{\sqrt{b}}}^{u_0} = \frac{1}{2} \left( e^{y_1} - 1 \right)
\]