Instructions: Show all work. Use exact answers unless otherwise asked to round.

1. Evaluate the integral $\int_0^1 \int_x^1 e^{x/y} dy dx$ by reversing the order of integration.

2. Set up and evaluate $\iiint_Q x dV$ where Q is bounded by the cylinder $y^2 + z^2 = 9$ and the planes $x = 0, y = 3x, z = 0$ in the first octant. Use an appropriate coordinate system.

3. Set up and evaluate $\iiint_Q xe^{x^2+y^2+z^2} dV$ where Q is the portion of the unit ball $x^2 + y^2 + z^2 \leq 1$ that lies in the first octant. Use an appropriate coordinate system.

4. Consider the space curve $\vec{r}(t) = t\hat{\imath} + e^t\hat{\jmath} + e^{-t}\hat{k}$.
   a. Find $\vec{r}'(t)$

   b. Find $\|\vec{r}'(t)\|$.

   c. Are there any points at which $\|\vec{r}'(t)\|$ reaches an extremum? (minimum or maximum?)

   d. Find the unit tangent vector $\vec{T}(t)$.

5. Find the unit normal vector of $\vec{r}(t) = \cos 4t\,\hat{\imath} + t\hat{\jmath} - \sin 4t\,\hat{k}$.

6. Find the directional derivative for the function $f(x,y) = x^2y - e^{x-y}$ at the point $(1,1)$ in the direction of $\langle 2, -5\rangle$.