1. [25] Let $C$ be the line segment from $(1, 2, 3)$ to $(4, 0, 2)$.
   a) Find $\int_C x \, dy$.

   b) Find $\int_C x \, ds$.

   HONOR PLEDGE: I pledge on my honor that I have not given or received any unauthorized assistance on this examination.

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   Signature ____________________________________________
2. [25] Let \( \mathbf{F}(x, y, z) = (3y + yze^{xz})\mathbf{i} + (3x + e^{xz})\mathbf{j} + yxe^{xz}\mathbf{k} \).

a) Show that \( \mathbf{F} \) is conservative.

b) Calculate \( \int_{C} \mathbf{F} \cdot d\mathbf{r} \) where \( C \) is the curve parameterized by
\[ \mathbf{r}(t) = (t^2 - \sqrt{3 + t^2})\mathbf{i} - t\cos(\pi t)\mathbf{j} + (t^6 - 1)\mathbf{k} \] for \(-1 \leq t \leq 1\).

c) Calculate \( \int_{C} \mathbf{F} \cdot d\mathbf{r} \) where \( C \) is the circle in the plane \( z = 3 \) with center \((1, 2, 3)\) and radius 4, oriented clockwise when viewed from above.
3. [25] Let $R$ be the region bounded by the paraboloids $y = 2x^2 + 2z^2$ and $y = 12 - x^2 - z^2$.
Let $\mathbf{F}(x, y, z) = \sin(yz)\mathbf{i} + (z - y)\mathbf{j} + e^{xy}\mathbf{k}$. Let $\Sigma$ be the boundary of $R$, oriented outwards.
Calculate $\iint_{\Sigma} \mathbf{F} \cdot \mathbf{n} \, dS$. 

4. [25] Let $\Sigma$ be the portion of the paraboloid $z = x^2 + y^2$ below the plane $z = x$. Let $\mathbf{F}(x, y, z) = xy^2 \mathbf{i} - z^2 \mathbf{j} + e^z \mathbf{k}$.
   
a) Without using Stokes' Theorem, set up (but do not evaluate) $\int \int_\Sigma \text{curl} \mathbf{F} \cdot \mathbf{n} \, dS$.

b) Evaluate $\int \int_\Sigma \text{curl} \mathbf{F} \cdot \mathbf{n} \, dS$ by any (correct) method you wish.