(28) 1. Let $S$ be the portion of the cone $z = 2\sqrt{x^2 + y^2}$ between the planes $z = 2$ and $z = 4$ and vector field $\mathbf{F} = (0, -x, z)$.
(a) Determine whether or not the vector field $\mathbf{F}$ is conservative.

(b) Find a parametrization of $S$ and express $\mathbf{r}$ (position vector) and $\mathbf{F}$ in terms of it.

(c) Set up (do not solve) an iterated integral for $\int \int_S \mathbf{F} \cdot \mathbf{n} \, d\sigma$, where $\mathbf{n}$ is the upward pointing normal.
2. Find a potential function for the vector field \( \mathbf{F}(x, y) = (x - 5, 3y^2 + 7) \).

3. Use Green’s Theorem to evaluate \( \oint_C \left( e^{x^2} - 2y \right) dx + \left( e^{y^2} + 4x \right) dy \), where \( C \) is the circle \( x^2 + y^2 = 4 \), oriented counterclockwise.
(18) 4. Use Stokes’ Theorem to express the flux integral \( \iint_S \nabla \times (yi) \cdot n \, d\sigma \) as a definite integral (do not solve it), where \( S \) is the portion of the paraboloid \( z = 1 - x^2 - y^2 \) above the \( xy \)-plane with outward pointing normal \( n \).

(18) 5. Use the Divergence Theorem to evaluate \( \iint_S \mathbf{F} \cdot n \, d\sigma \), where \( \mathbf{F} = (y^3 - 2x, e^{xz}, 4z) \) and \( S \) is the boundary of the rectangular box \( 0 \leq x \leq 2, 1 \leq y \leq 2, -1 \leq z \leq 2 \), with exterior unit normal.