Math2E - Practice Midterm2

1. Label each expression as a scalar quantity, a vector quantity or undefined, if f is a scalar function and $\mathbf{F}$ is a vector field.
   a. $\nabla \cdot (\nabla f)$ b. $\nabla \times (\nabla \cdot \mathbf{F})$
   c. $\nabla(\nabla \times \mathbf{F})$ d. $\nabla(\nabla \cdot \mathbf{F})$
   e. $\nabla \times (\nabla f)$

2. Evaluate $\int_C (\tan x - y^3)dx + (x^3 - \sin y)dy$, where C is the circle $x^2 + y^2 = 2$, and C is positively oriented.

3. Evaluate $\int\int_S (x - z)dS$, where S is the portion of the cylinder $x^2 + z^2 = 1$ above the xy-plane between $y = 1$ and $y = 2$.

4. Evaluate the flux integral $\int\int_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F} =< y, -x, z >$, S is the portion of $z = \sqrt{x^2 + y^2}$ below $z = 4$. ($\mathbf{n}$ downward).

5. Evaluate $\int\int_S \mathbf{F} \cdot \mathbf{n} dS$, where $\mathbf{F}(x, y, z) = 4x\mathbf{i} + (x^2 - 2y)\mathbf{j} + (3z + x^2)\mathbf{k}$ and S is the boundary of $z = x^2 + y^2$ and $z = 2 - x^2 - y^2$ with outward orientation.