

Please show all work and justify all answers on the blank pages provided.

1. Find $\int \mathbf{F} \cdot d\mathbf{R}$ where $\mathbf{F} = (y + 2)\mathbf{i} + x\mathbf{j}$, along the $C: x = \sin t, y = -\cos t, 0 \leq t \leq \frac{\pi}{2}$.
2. Give an example (or a sketch) of a region in the plane that is *not* a domain.
3. Give an example (or a sketch) of a domain in the plane that is connected, but is *not* simply connected.
4. One of the following vector fields is conservative and one is not. Determine which one is conservative and find an associated potential function.

$$\mathbf{F} = e^{x+y}\mathbf{i} + e^{xy}\mathbf{j}$$

$$\mathbf{G} = (2x + y)\mathbf{i} + (z \cos yz + x)\mathbf{j} + (y \cos yz)\mathbf{k}$$

5. Determine the element of surface area dS for the surface parameterized by

$$x = (5 + 2 \cos v) \cos u$$

$$y = (5 + 2 \cos v) \sin u$$

$$z = 2 \sin v$$

6. Let S be the closed cylinder of radius 3 with axis along the z -axis, top at $z = 15$, and bottom at $z = 0$. Calculate $\iint_S z dS$.
7. Verify the Divergence Theorem for the vector field $\mathbf{F} = (y - x)\mathbf{i} + (y - z)\mathbf{j} + (x - y)\mathbf{k}$ over the unit cube $D = [0, 1] \times [0, 1] \times [0, 1]$.