Use the indicated method to solve each problem. Show all work (on separate paper) and use proper notation.

For problems 1 through 5, use the information below:

\[ \vec{G} = x\hat{i} + y\hat{j} + (2 - 2z)\hat{k} \quad \vec{F} = 2yz\hat{i} + 2x\hat{j} + (xy + z)\hat{k} . \]

- \( S_1 \) is the portion of \( z = 10 - \sqrt{x^2 + y^2} \) above the plane \( z = 4 \), oriented upward.
- \( S_2 \) is the disk of radius 6 centered at (0,0,4), parallel to the \( xy \) plane, oriented downward.
- \( S_3 \) is the closed surface composed of \( S_1 \) and \( S_2 \), oriented outward.
- \( C \) is the circle of radius 6 centered at (0,0,4), parallel to the \( xy \) plane, oriented counterclockwise.

1. Find the flux of \( G \) through \( S_1 \) using Case 4.
2. Find the flux of \( G \) through \( S_2 \) using Case 2.
3. Find the flux of \( G \) through \( S_3 \) using the Divergence Theorem.
4. Find \( \text{curl}\vec{F} \).
5. Find the flux of \( G \) through \( S_1 \) using Stoke’s Theorem.

For problems 6 through 8, use the information below:

\[ \vec{H} = \alpha \left( \frac{-z\hat{j} + y\hat{k}}{y^2 + z^2} \right) \]

- \( C \) is the circle of radius 8 centered at (3,0,0), parallel to the \( yz \) plane, oriented counterclockwise.

6. Find \( \text{curl}\vec{H} \). Include any restrictions.
7. Can you use Stoke’s Theorem to find the value of the line integral around \( C \)? Why or why not?
8. Find \( \int_C \vec{H} \cdot d\vec{r} \).