1. Let $\vec{\boldsymbol{F}} = -2(x^2 + y^2)(\hat{\boldsymbol{x}} + \hat{\boldsymbol{y}})$.
   - Construct $d\vec{\boldsymbol{S}}$ for the paraboloid $z = 3 - x^2 - y^2$ over the region defined by $x^2 + y^2 \leq 1$.
   - Make a rough sketch of the surface. Is this a closed surface?
   - Evaluate $\vec{\boldsymbol{F}} \cdot d\vec{\boldsymbol{S}}$. How many variables do you (should you?) have?
   - Reckon the value of $\int_S \vec{\boldsymbol{F}} \cdot d\vec{\boldsymbol{S}}$ where S is the surface defined above.
   - Referring to your sketch, should it be positive or negative or zero?
2. Let $\vec{\boldsymbol{G}} = 5\hat{\boldsymbol{z}}$.
   - If S is the portion of the plane $2x - y - z = 3$ where $0 \leq x \leq 1.5$ and $2x - 3 \leq y \leq 0$, construct $d\vec{\boldsymbol{S}}$.
   - Ascertain the value of $\int_S \vec{\boldsymbol{G}} \cdot d\vec{\boldsymbol{S}}$ in this case.
3. Let Ω be the lower hemisphere of the sphere of radius 5 and let $\vec{\boldsymbol{H}} = x\,\hat{\boldsymbol{x}} + y\,\hat{\boldsymbol{y}} + z\,\hat{\boldsymbol{z}}$.
   - Sketch Ω and $\vec{\boldsymbol{H}}$ and decide if $\iint_\Omega \vec{\boldsymbol{H}} \cdot d\vec{\boldsymbol{S}}$ is positive, negative or zero.
   - Construct $d\vec{\boldsymbol{S}}$ for Ω. Try using spherical coordinates.
   - Compute the value of $\iint_\Omega \vec{\boldsymbol{H}} \cdot d\vec{\boldsymbol{S}}$ explicitly.
   - Does it agree with your decision?