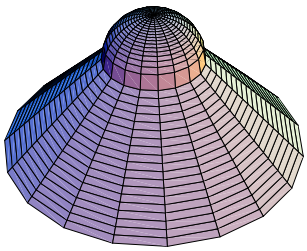
Let S be the surface formed by capping the piece of a cone $x^2 + y^2 = (4 - z)^2, 1 \leq z \leq 3$ with the upper part of the sphere $x^2 + y^2 + (z - 3)^2 = 1, z \geq 3$. The outward normals to S define a smooth orientation to S.



1) Identify the boundary C of S. Find a parameterization of C which is positive with respect to the given orientation.

$r(t) =$

2) Let F be the vector field $(0, 0, 2)$. Verify that $F = \text{curl}(A)$, where $A = (P, Q, R) = (-y, x, 0)$.

$\text{curl}(A) = \text{curl}(P, Q, R)$
$= (R_y - Q_z, P_z - R_x, Q_x - P_y) =$

3) Write first down a formula which relates:

- the flux of F through the surface S with
- the line integral for A along the boundary C of S.

$\int\int_S F \cdot dS =$

4) Find the flux of F through S by evaluating the line integral.

$\int\int_S F \cdot dS =$