

1. Let S be the surface parametrized by

$$\mathbf{r}(u, v) = \left\langle u \cos(v), u \sin(v), \frac{v^2}{2} \right\rangle \quad \text{where } u^2 + v^2 \leq 9.$$

- (a) [4 pts] Find the surface area of S .

- (b) [3 pts] Verify that the point $P = (0, 3, \pi^2/8)$ is a point on the surface S . Find an equation for the tangent plane to S at the point P .

2. Suppose S is the part of the cylinder $x^2 + z^2 = 16$ described in cartesian coordinates by

$$S = \{(x, y, z) \mid 0 \leq y \leq 4 \text{ and } x^2 + z^2 = 16\},$$

and which is oriented via the outward pointing unit normal vector (i.e. the orientation vector is pointing away from the y -axis at every point on S).

- (a) [3 pts] Make a sketch of S . Be sure to indicate the orientation of S .

- (b) [4 pts] Find a parametrization of S . Make sure you clearly indicate the domain of the given parametrization.

- (c) [5 pts] For the vector field $\mathbf{F}(x, y, z) = \langle xe^y, e^{xyz}, ze^y \rangle$, compute the flux $\iint_S \mathbf{F} \cdot d\mathbf{S}$.