

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

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1. Evaluate  $\int_C \mathbf{F} \cdot d\mathbf{s}$  where  $C$  is the line from  $(0, 0, 0)$  to  $(1, 2, 4)$  and  $\mathbf{F}(x, y, z) = (x^2, y, xz - y)$ .
2. Consider the force  $\mathbf{F}(x, y, z) = (2x, 3y, z)$ . Compute the work done in moving a particle along the parabola  $y = x^2, z = 0$  from  $x = -2$  to  $x = 1$ .
3. Find an equation for the plane tangent at  $(6, 11, 4)$  to the surface parameterized by  $x = 3u, y = u + v^2, z = u^2$ , with  $v \geq 0$ .
4. Let  $S$  be the hemisphere  $x^2 + y^2 + z^2 = 4, z \geq 0$ .
  - a. Find a parameterization  $\Phi(u, v)$  for  $S$ .
  - b. Use vector calculus methods to find the area of the surface  $S$ .
5. Evaluate  $\iint_S f dS$ , where  $S$  is the part of the plane for which  $x \geq 0, y \geq 0$ , and  $z \geq 0$  and  $f(x, y, z) = x$ .

**Be sure to pick up a sheet with the take-home problems.**