

Show all your work if you want to receive credit.

1. A three-dimensional force acts radially toward the origin with magnitude equal to the square root of the distance from the origin. Write the force as a vector field.
2. Evaluate the line integral  $\oint_C x^2 dy$  where  $C$  is the ellipse  $4x^2 + y^2 = 4$ , oriented counterclockwise.
3. Compute the mass  $m$  of a rod with density  $\rho(x, y) = x$  in the shape of  $y = x^2, 0 \leq x \leq 3$ .
4. Find the value of  $\oint_C \mathbf{F} \cdot d\mathbf{r}$  if  $\mathbf{F} = \langle 2y, 3x - 5y^2 \rangle$  and  $C$  is the closed path formed by the square, traveled clockwise, with vertices  $(0, 0)$ ,  $(0, 3)$ ,  $(3, 3)$ , and  $(3, 0)$ .
5. Explain why the formula  $\frac{1}{2} \oint_C xdy - ydx$  can be used to find the area inside a closed simple path  $C$ .
6. Sketch the parametric surface  $x = u \cos v, y = u \sin v, z = u$ .
7. Set up the integral  $\iint z^2 dS$  where  $S$  is the portion of the cone  $z = \sqrt{x^2 + y^2}$  between  $z = 1$  and  $z = 4$ .
8. Find  $\iiint_{\partial Q} \mathbf{F} \cdot \mathbf{n} dS$  where  $Q$  is the cube  $-1 \leq x \leq 1, -1 \leq y \leq 1, -1 \leq z \leq 1$ , and  $\mathbf{F} = \langle 4y^2, 3z - \cos x, z^3 - x \rangle$ .
9. Suppose a line integral  $\oint_C \mathbf{F} \cdot d\mathbf{r}$  is performed over path  $C$  that meets all the requirements for Green's Theorem. If the vector field  $\mathbf{F}$  is conservative, what is the result of the line integral? Explain.
10. What is the primary condition about the region of integration that must be satisfied in order to use the Divergence Theorem?