1. Compute the divergence and curl of

$$\mathbf{F}(x, y, z) = \langle 3x + 2z^2, \frac{x^3 y^2}{z}, -(z - 7x) \rangle$$

2. Is the following vector field conservative?

$$\mathbf{F} = \langle 4y^2 + \frac{3x^2 y}{z^2}, 8xy + \frac{x^3}{z^2}, 11 - \frac{2x^3 y}{z^3} \rangle$$

For problems 3-5, write down a vector equation which describes the surface (or set of parametric equations).

3. The plane $7x + 3y + 4z = 15$.

4. The cylinder $x^2 + y^2 = 5$ for $-1 \le z \le 6$.

5. The portion of the sphere of radius 6 with $x \ge 0$.

6. Determine the surface area of the plane $2x + 3y + 6z = 9$ that is inside the cylinder $x^2 + y^2 = 7$.

7. Evaluate $\int \int_S z + 3y - x^2 \, dS$ where S is the part of the $z = 2 - 3y + x^2$ that lies over the triangle in the xy-plane with vertices $(0, 0)$, $(2, 0)$ and $(2, -4)$.

8. Calculate the line integral

$$\int_C x^2 y \, dx + (y - 3) \, dy$$

where C is a rectangle with vertices $(1, 1), (4, 1), (4, 5)$ and $(1, 5)$ oriented counterclockwise.

9. Calculate the line integral $\int_C \mathbf{F} \cdot d\mathbf{r}$, where

$$\mathbf{F} = \langle xy, x^2 + y^2 + z^2, yz \rangle$$

and C is the boundary of the parallelogram with vertices $(0, 0, 1), (0, 1, 0), (2, 0, -1)$ and $(2, 1, -2)$.

10. Calculate the surface integral $\int \int_S \mathbf{F} \cdot d\mathbf{S}$, where S is the cylinder $x^2 + y^2 = 1$, with $0 \le z \le 2$, including the circular top and bottom, and $\mathbf{F} = \langle \frac{x^3}{3} + yz, \frac{y^3}{3} - \sin(xz), z - x - y \rangle$.