1. Evaluate the line integral $\int_C x\,dS$, where C is the arc of the parabola $y = x^2$ from (1,1) to (2,4).

2. Evaluate $\int_C 7y^2 z\,dS$, if C is given by $\mathbf{r}(t) = \langle \frac{2}{3}t^3, t, t^2 \rangle$, $0 \le t \le 1$.

3. Find the work done by the force field $\mathbf{F}(x, y, z) =< z, x, y >$ in moving a particle from the point $(3, 0, 0)$ to the point $(0, \pi/2, 3)$
   (a) along the straight line
   (b) along the helix $x = 3\cos t$, $y = t$, $z = 3\sin t$

4. Let $\mathbf{F}(x, y) =< 3 + 2xy^2, 2x^2y >$.
   (a) Show that $\mathbf{F}$ is conservative vector field.
   (b) Find its potential function.
   (c) Compute $\int_C \mathbf{F} \cdot d\mathbf{r}$ where C is any path from (-1,0) to (2,2).

5. Given the vector field $\mathbf{F} = z\mathbf{i} + 2yz\mathbf{j} + (x + y^2)\mathbf{k}$.
   (a) Find the divergence of the field.
   (b) Find the curl of the field.
   (c) Is the given field conservative? If it is, find a potential function.
   (d) Compute $\int_C z\,dx + 2yz\,dy + (x + y^2)\,dz$ where C is the positively oriented curve $y^2 + z^2 = 4, x = 5$.
   (e) Compute $\int_C z\,dx + 2yz\,dy + (x + y^2)\,dz$ where C consists of the three line segments: from $(0, 0, 0)$ to $(4, 0, 0)$, from $(4, 0, 0)$ to $(2, 3, 1)$, and from $(2, 3, 1)$ to $(1, 1, 1)$.

6. Given the line integral $I = \oint_C 4x^2y\,dx - (2 + x)\,dy$ where C consists of the line segment from $(0, 0)$ to $(2, -2)$, the line segment from $(2, -2)$ to $(2, 4)$, and the part of the parabola $y = x^2$ from $(2, 4)$ to $(0, 0)$. Use Green's theorem to **evaluate** the given integral and **sketch** the curve C indicating the *positive direction.*

7. Find a parametric representation of the following surfaces:
   (a) the portion of the plane $x + 2y + 3z = 0$ inside the cylinder $x^2 + y^2 = 9$;
   (b) $z + zx^2 - y = 0$;
   (c) the portion of the cylinder $x^2 + z^2 = 25$ that extends between the planes $y = -1$ and $y = 3$

8. Find an equation of the plane tangent to the surface $x = u, y = 2v, z = u^2 + v^2$ at the point $(1, 4, 5)$.

9. Find the area of the surface with parametric equations $x = u^2$, $y = uv$, $z = \frac{1}{2}v^2$, $0 \le u \le 1$, $0 \le v \le 2$. $x^2 + z^2 = 1$ which lies between the planes $y = 0$ and $x + y + z = 4$.

10. Find the area of the part of the paraboloid $z = x^2 + y^2$ that lies inside the cylinder $x^2 + y^2 = 4$.