Section 7.1

7.1.1. Evaluate $\int_{\sigma} f \, ds$ where $f(x, y, z) = x + y + z$ and $\sigma : t \mapsto (\sin(t), \cos(t), t)$, $t \in [0, 2\pi]$.

7.1.2. Evaluate the path integral $\int_{C} f \, ds$ where $f(x, y, z) = yz$ and $C$ is the curve parameterized by $\sigma : t \mapsto (t, 3t, 2t)$, $t \in [1, 3]$.

Section 7.2

7.2.1. Let $\mathbf{F}(x, y, z) = x\mathbf{i} + y\mathbf{j} + zk$. Evaluate the line integral of $\mathbf{F}$ along the path $\sigma(t) = (t, t, t)$, $0 \leq t \leq 1$.

7.2.2. Consider the force $\mathbf{F}(x, y, z) = x\mathbf{i} + y\mathbf{j} + zk$. Compute the work done in moving along the parabola $y = x^2$, $z = 0$, from $x = -1$ to $x = 2$.

Section 7.3

7.3.1. Find the equation of the tangent plane to the parameterized surface $\Phi(u, v) = (2u, u^2 + v^2)$ at the point $(0, 1, 1)$.

7.3.2. Find an expression for the unit vector normal to the parameterized surface

$\Phi(u, v) = (\cos(v)\sin(u), \sin(v)\sin(u), \cos(u))$, $(u, v) \in [0, \pi] \times [0, 2\pi]$.

Identify this surface.

Section 7.4

7.4.1. Find the surface area of the unit sphere $S$ represented parametrically by

$\Phi(\theta, \phi) = (\cos(\theta)\sin(\phi), \sin(\theta)\sin(\phi), \cos(\phi))$, $(\theta, \phi) \in [0, 2\pi] \times [0, \pi]$.

7.4.2. Let $\Phi(u, v) = (u - v, u + v, uv)$ and let $D$ be the unit disk in the $uv$ plane. Find the area of $\Phi(D)$.

Section 7.5

7.5.1. Evaluate $\int_{S} z \, dS$ where $S$ is the upper hemisphere of radius $a$, that is, the set

$\left\{ (x, y, z) \in \mathbb{R}^3 \mid z = \sqrt{a^2 + x^2 + y^2} \right\}$.

Section 7.6

7.6.1. Let the temperature of a point in $\mathbb{R}^3$ be given by $3x^2 + 3z^2$. Compute the heat flux across the surface $x^2 + z^2 = 2$, $0 \leq y \leq 2$ if $k = 1$. 