(1) Find the center of mass of the shape located inside of the cylinder $x^2 + y^2 = 1$ that is bounded from below by the plane $z = -1$ and from above by the plane $z = 2$. The density is $\rho(x, y, z) = x^2 + y^2$.

(2) Let $x(t) = (3 \cos t, 3 \sin t, 3)$, $0 \leq t \leq \pi$, be a path in $\mathbb{R}^3$. Let $f(x, y) = 2x^2 + 2y^2$ be a function and let $\mathbf{F}(x, y, z) = 2xi + 2yj + 2zk$ be a vector field on $\mathbb{R}^3$.
   a: Find $\int_x f ds$.
   b: Find $\int_x \mathbf{F} \cdot ds$.

(3) Find the work done by the force field $\mathbf{F}(x, y, z) = xzi + e^{\cos z}j - 3zk$ on the particle that moved along the path $c(t) = (t^2, 117, t^3)$ for $0 \leq t \leq 1$.

(4) Is the following vector field $\mathbf{F}(x, y, z) = 3x^2 \cos yi + (z^2 - x^3 \sin y)j + 2yzk$ a conservative vector field? If yes, then use the line integral to find the potential function.

(5) Let $D$ be the part of the disk $x^2 + y^2 \leq 1$ located above the $x$-axis with a positively oriented boundary $\partial D$. Calculate $\int_{\partial D} (y^2 + 3x^3)dy + (-3y^3 + \sin x)dx$. Hint: Be careful, look at the integral twice.

(6) Let $\mathbf{F}(x, y) = (7x + \sin y)i + (e^x - 6y)j$ be a vector field, and let $\mathbf{n}$ be the outward unit normal to the positively oriented circle $C = \{(x, y)|x^2 + y^2 = 9\}$. Calculate the flux integral $\int_C \mathbf{F} \cdot \mathbf{n}ds$.

(7) Consider the double integral $\int_0^1 \int_0^{\sqrt{1-x}} e^{3x-x^3} \, dx \, dy$.
   (a) Sketch the region of integration.
   (b) Evaluate the integral.

(8) Let $B$ be the portion of the solid ball $x^2 + y^2 + z^2 \leq a^2$ in the first octant as shown.
   (a) Set up, but do not evaluate, three triple integrals for $\iiint_B z \, dV$. Use cartesian coordinates in one integral, cylindrical coordinates in another, and spherical coordinates in the third.
   (b) Evaluate one of the three integrals in part (a).

(9) Let $D$ be the region in the $xy$-plane bounded by the lines $y = -2x + 4$, $y = -2x + 7$, $y = x - 2$ and $y = x + 1$. Evaluate $\iiint_D (x - y)\sqrt{2x + y} \, dx \, dy$ by changing variables.

(10) (no work required) Set up, but do not evaluate, the integrals for the volume of the solid bounded by $z = 1$, $y = 0$, and $z = x^2 + y$ using the two orders of integration indicated below.

$$\int \int \int dx \, dy \, dz \quad \int \int \int dz \, dy \, dx$$

(11) Find the centroid of the quarter of disk of radius $a$ located in the first quadrant (i.e. above the $x$-axis and to the right from the $y$-axis).