Section 15.1

Exercise 1. Calculate the iterated integral $\int_0^1 \int_0^2 ye^{y-x} dx\ dy$.

Exercise 2. Calculate the double integral $\iint_R \frac{x}{1+xy} dA, R = [0,1] \times [0,1]$.

Exercise 3. Find the average value of the function $f(x, y) = e^y\sqrt{x + e^y}$ over the rectangle $R = [0, 3] \times [0, 1]$.

Section 15.2

Exercise 4. Set up the iterated integrals for both orders of integration for the integral $\iint_D y^2 e^{xy} dA$, where D is the region bounded by $y = x, y = 3$ and $x = 0$. Then evaluate the double integral using the easier order and explain why it is easier.

Exercise 5. Find the volume of the solid in the first octant under the plane $z = x + y$, above the surface $z = xy$, and enclosed by the surfaces $x = 0, y = 0$ and $x^2 + y^2 = 4$ by subtracting two volumes.

Exercise 6. Sketch the region of integration and change the order of integration for the iterated integral $\int_{-3}^{3} \int_{0}^{\sqrt{9-y^2}} f(x, y)\, dx\, dy$.

Section 15.3

Exercise 7. Evaluate the integral $\iint_D \cos\sqrt{x^2+y^2}dA$, where D is the disk with center at the origin and radius 3, by changing to polar coordinates.

Exercise 8. Use a double integral to find the area of the region enclosed by both of the cardioids $r = 1+\cos\theta$ and $r = 1-\cos\theta$.

Exercise 9. Use polar coordinates to find the volume of the solid inside the sphere $x^2+y^2+z^2 = 16$ and outside the cylinder $x^2 + y^2 = 4$.

Section 15.4

Exercise 10. Find the mass and center of mass of the lamina that occupies the region D bounded by $y = x + 2$ and $y = x^2$ with density function $\rho(x, y) = kx^2$.

Exercise 11. A lamina occupies the region inside the circle $x^2 + y^2 = 2y$ but outside the circle $x^2 + y^2 = 1$. Find the center of mass if the density at any point is inversely proportional to its distance from the origin.

Exercise 12. A lamina with constant density $\rho(x, y) = \rho$ occupies the region under the curve $y = \sin x$ from $x = 0$ to $x = \pi$. Find the moments of inertia I_x and I_y and the radii of gyration $\overline{\overline{x}}, \overline{\overline{y}}$.

Section 15.5

Exercise 13. Find the area of the surface of the part of the cylinder $x^2 + z^2 = 4$ that lies above the square with vertices $(0,0),(2,0),(0,2),(2,2)$.

Exercise 14. Find the area of the surface $z = \frac{2}{3}(x^{\frac{3}{2}} + y^{\frac{3}{2}})$ over the region $D = \{(x,y)|0 \leq x \leq 1, 0 \leq x \leq 2\}$.

Exercise 15. Use midpoint rule for double integrals with $m = n = 2$ to estimate the area of the surface $z = xy + x^2 + y^2$, $0 \leq x \leq 4, 0 \leq y \leq 4$.