1) Textbook. p.829: #59–62. p.888-889: #1–19, #25–31, #45, #46, #51, #53.

2) Compute the volume which lies above the region D in the $x-y$ plane and under the surface $z = x^2 + y^2 + 1$.

The printed review sheet has 3 hand-drawn pictures here.

In (a), D is the rectangle whose corners are $(0, 1)$, $(5, 1)$, $(0, 2)$, and $(4, 2)$.

In (b), D is the portion of the interior of the circle $x^2 + y^2 = 3$ which is to the right of the y-axis.

In (c), D is the entire region above the parabola $y = x^2$ and below the line $y = 2x+1$.

3) A hollow cylinder with a radius of 10cm and a height of 100cm is filled with gas. The density (in mg/cm^3) of the gas in the cylinder is equal to $200 - z$ where z is the vertical distance from the bottom of the cylinder. Compute the total mass of the gas.

4) A hollow sphere with a radius of 40cm is filled with gas. If the sphere is positioned in $\mathbb{R}^3$ so that its center is at the origin, then the density (in mg/cm^3) of the gas at the point (x, y, z) is equal to $\dfrac{1}{z + 40.5}$. Find the density at the bottom of the sphere, at the center of the sphere, and at the top of the sphere. Use spherical coordinates to set up an iterated integral for the total mass of the gas.

5) Show that all of the points $(1, 1)$, $(1, -1)$, $(-1, 1)$, and $(-1, -1)$ are critical points of $f(x, y) = \cos(\pi(x + y)) + x\sin^2(\pi y)$. Apply the second derivative test at each of these points.

6) Let $\vec{f} : \mathbb{R}^2 \to \mathbb{R}^2$ be given by:

$$\vec{f}(x, y) = \big\langle 2x + 5y,\ x^2 + \ln(y + 1)\big\rangle$$

a) Compute the Jacobian matrix for $\vec{f}$, and find its determinant.

b) Let D be the image of the unit square $([0, 1] \times [0, 1])$ under the transformation represented by $\vec{f}$. Sketch a rough picture of D, and compute $\iint_D x + y \, dA$.