Problem 1: Calculate the integral of the function $f(x, y) = 1/x$ over the region bounded by the parabolas $y = x^2$ and $y = 2x - x^2$.

Problem 2: Evaluate the iterated integral
\[ \int_{-1}^{1} \int_0^{1-|y|} \frac{y^2 e^x}{(1-x)^3} \, dx \, dy. \]
Hint: Sketch the domain of integration.

Problem 3: Find the volume of the solid defined by the inequalities
\[ 0 \leq x \leq 1 \quad 0 \leq y \leq 1 \quad 0 \leq z \leq x(y-x). \]

Problem 4: Use cylindrical coordinates to find the center of mass (assuming uniform density) of the solid bounded by the paraboloids
\[ z = x^2 + y^2 \quad \text{and} \quad z = 3 - 2x^2 - 2y^2. \]

Problem 5: Find the volume of the part of the ball $x^2 + y^2 + z^2 \leq 4$ which lies in the first octant and satisfies the inequality $z^2 \leq x^2 + y^2$.

Problem 6: Let $D$ denote the cone bounded by the plane $z = -1$ and the conic surface $z^2 = x^2 + y^2$. Set up, but DO NOT evaluate, iterated integrals which evaluate $\iiint_D f \, dV$
\begin{enumerate}
  \item[a)] in Cartesian coordinates in the orders $dx \, dy \, dz$ and $dz \, dy \, dx$;
  \item[b)] in cylindrical coordinates in the orders $d\theta \, dr \, dz$ and $dz \, dr \, d\theta$;
  \item[c)] in spherical coordinates in the orders $d\rho \, d\varphi \, d\theta$ and $d\theta \, d\varphi \, d\rho$;
  \item[d)] Evaluate ONLY ONE of the iterated integrals above when $f$ is the function $f(x, y, z) = (x^2 + y^2)^{-\frac{1}{2}}$.
\end{enumerate}
Hint: In part d) pick the integral which seems to be the easiest to compute. If you have done everything correctly you will not need any trigonometric substitutions nor integration by parts.

Problem 7: Evaluate the integral $\iint_D xy \, dA$, where $D$ is the domain bounded by the curves
\[ xy = 1 \quad y = x^2 \quad xy = 27 \quad y = 8x^2. \]
Hint: Find a change of variables which will simplify the domain $D$. 