1. Evaluate the integral \( \int \int_D y \cos(xy) \, dA \) where \( D = [1, 2] \times [0, \pi] \)

2. Consider
\[
\int_0^0 \int_{\sqrt{4-x^2}}^{\sqrt{4-x^2}} e^{\sqrt{x^2+y^2}} \sqrt{x^2+y^2} \, dy \, dx + \int_0^2 \int_0^{\sqrt{4-x^2}} e^{\sqrt{x^2+y^2}} \sqrt{x^2+y^2} \, dy \, dx.
\]
(a) Sketch the region of integration.

(b) Find the value using polar coordinates.
3. Reverse the order of integration on \( \int_0^1 \int_0^{2y} f(x, y) \, dx \, dy + \int_1^2 \int_{4-2y}^{2y} f(x, y) \, dx \, dy \).

4. Find the \( x \)-coordinate of the centre of mass of the triangular lamina with vertices (1,0), (3,0), (3,2) and density \( \rho(x, y) = x \)
5. SET UP, BUT DO NOT EVALUATE, the double integral for the surface area of 
\[ z = x + x^2 - 2y^2 \] that lies above the region in the xy-plane bounded by \( y = 2x \) and \( y = x^2 \).

6. SET UP, BUT DO NOT EVALUATE, the simplified triple integral for the volume of the region in the first octant bounded by \( x^2 + y^2 + z^2 = 3 \), \( x^2 + y^2 + z^2 = 7 \) and \( z = \sqrt{x^2 + y^2} \), using spherical polar coordinates.

7. SET UP, BUT DO NOT EVALUATE, the simplified triple integral for the moment about the yz-plane of the region in the first octant bounded by \( z = 4 - x^2 - y^2 \), \( y = \sqrt{3}x \), \( y = 0 \) and \( x^2 + y^2 = 1 \) using cylindrical polar coordinates and \( \rho(x, y, z) = 1 \).
8. Consider the region in the first quadrant bounded by $xy^2 = 8$, $xy^2 = 9$, $y = x$ and $y = 3x$

(a) Sketch this region.

(b) Find a transformation $x = f(u, v)$, $y = g(u, v)$ that transforms this region to a rectangle in the $uv$-plane.

(c) SET UP, BUT DO NOT EVALUATE, a simplified double integral to find the area of this region, using $u$ and $v$. 

Page 4 Total (20 pts)