(1) Evaluate the integral $\int\int_D \sqrt{x+2y}\sin(y-2x)dxdy$, where D is the region bounded by the four lines $y=2x$, $y=2x+\frac{\pi}{2}$, $x+2y=1$ and $x+2y=9$.

(2) Find the derivative matrix $D(f\circ g)(0,0,0)$ where $f(x,y,z)=(y^2,x+y+1,x+y+z)$ and $g(r,s,t)=(st,5,r)$.

(3) Let $\mathbf{X}(s,t)=(\cos(st),e^s,s+3t^2)$ be the parameterized surface with domain $D=\{(x,y):x^2+y^2\leq 3\}$. Find the equation of the tangent plane to the surface at the point $\mathbf{X}(0,1)$.

(4) Find the flux of the vector field $\mathbf{F}(x,y,z)=x\mathbf{i}+y\mathbf{j}$ through the **non-closed** surface that is the part of the cone $z=\sqrt{x^2+y^2}$ located between the planes $z=1$ and $z=3$. The surface is oriented by the normal vector pointing **downwards.**

(5) Find the mass of the surface that is the part of the paraboloid $z=x^2+y^2+5$ with $x\geq 0$ and $y\geq 0$, located between the planes $z=0$ and $z=9$. The surface density is $\delta(x,y)=\sqrt{1+4x^2+4y^2}$.

(6) Find the outward flux of the vector field $\mathbf{F}(x,y,z)=(3xz^2,y,-z^3)$ across the surface of the solid in the first octant that is bounded by the surface $x^2+4y^2=16$ and the planes $y=2z$, $x=0$, and $z=0$.

(7) Find the area of the part of the graph of the function $f(x,y)=xy$ that is outside the cylinder $x^2+y^2=1$ and inside $x^2+y^2=9$.

(8) Evaluate $\oint_C -yz\,dx+xz\,dy+z\,dz$ where C is the curve of intersection of the cylinder $x^2+y^2=1$ and the surface $z=xy$. Assume that the curve C is oriented counterclockwise as viewed from above.

(9) Find the center of mass of the region $\{(x,y):x^2+y^2\leq 1,\ x\geq 0,\ y\geq 0\}$ shaped like one fourth of a disk. Assume that the density δ of the region is constant.

(10) Find the area of the region enclosed by the curve $\mathbf{x}(t)=(t^2,\frac{t^3}{3}-t)$, $-\sqrt{3}\leq t\leq\sqrt{3}$.

(11) The force $\mathbf{F}(x,y)=(y\cos x-y^3,\sin x-3xy^2)$ acts on a particle as it moves from the point $(0,0)$ to the point $(1,1)$, first along the horizontal line segment from $(0,0)$ to $(1,0)$, and then along the vertical line segment from $(1,0)$ to $(1,1)$. Find the work done.