Vector Fields: 2-D:
$$f(x,y) = P(x,y)i + Q(x,y)j = \langle P(x,y), Q(x,y) \rangle$$

Cyl Coord $x = r \cos(\theta), y = r \sin(\theta), z = z$ $r^2 = x^2 + y^2, \text{ Jacobian} = r$
Sph Coord $x = a \sin(\theta) \cos(\theta), y = a \sin(\theta) \sin(\theta), z = a \cos(\theta), \text{ Jacobian}$

Sph Coord
$$x = \rho \sin(\varphi) \cos(\theta)$$
 $y = \rho \sin(\varphi) \sin(\theta)$ $z = \rho \cos(\varphi)$ Jacobian $= \rho^2 \sin(\varphi)$ $0 \le \theta \le 2\pi$ $0 \le \varphi \le \pi$ **Center of Mass:** $m = \iint_D \rho(x, y) dA$, $M_y = \iint_D x \rho(x, y) dA$, $M_x = \iint_D y \rho(x, y) dA$, $(\bar{x}, \bar{y}) = \left(\frac{M_y}{m}, \frac{M_x}{m}\right)$

 $\int \sin^2(x) dx = \frac{1}{2}x - \frac{1}{2}\sin(2x) + C, \int \cos^2(x) dx = \frac{1}{2}x + \frac{1}{2}\sin(2x) + C$

Change of variables: $J(u, v) = \left(\frac{\partial x}{\partial u}\frac{\partial y}{\partial v}\right) - \left(\frac{\partial y}{\partial u}\frac{\partial x}{\partial v}\right)$ Green theorem $\oint P dx + Q dy = \iint_{P} \left(\frac{\partial Q}{\partial u} - \frac{\partial P}{\partial v}\right) dA$ **<u>Line Integral</u>** $\int Pdx + Qdy = \int P(x,y)dx + \int Q(x,y)dy$, $\int f(x,y)dx = \int f(x(t),y(t))x'(t)dt + \int f(x(t),y(t))y'(t)dt$

of variables:
$$f(u, v) = \left(\frac{1}{\partial u}\frac{1}{\partial v}\right) - \left(\frac{1}{\partial v}\frac{1}{\partial u}\right)$$
 Green theorem $\oint P dx + Q dy = \iint_D \left(\frac{1}{\partial x} - \frac{1}{\partial y}\right) dA$
egral $\int P dx + Q dy = \int P(x, y) dx + \int Q(x, y) dy$, $\int f(x, y) dx = \int f(x(t), y(t))x'(t) dt + \int f(x(t), y(t)) dx$ (is paramete $\int P(x, y) dx = \int P(x,$

ntegral
$$\int Pdx + Qdy = \int P(x,y)dx + \int Q(x,y)dy$$
, $\int f(x,y)dx = \int f(x(t),y(t))x'(t)dt + \int f(x(t),y(t))y'(t)dt$
c Calc: If $F(x,y) = \langle P(x,y), Q(x,y) \rangle$ is conservative, $f(x,y)$ satisfies $\nabla f(x,y) = F(x,y)$, and C is parameterized by $\vec{r}(t)$
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FTVec Calc: If
$$F(x,y) = \langle P(x,y), Q(x,y) \rangle$$
 is conservative, $f(x,y)$ satisfies $\nabla f(x,y) = F(x,y)$, and C is parameterized by $\vec{r}(t) = \langle x(t), y(t) \rangle$ $a \le t \le b$, then $\int_c p \, dx - Q \, dy = f(\vec{r}(b)) - f(\vec{r}(a))$ $\sin^{-1}(x) = \frac{1}{\sqrt{1-x^2}}, \cos^{-1}(x) = \frac{-1}{\sqrt{1-x^2}}, \tan^{-1}(x) = \frac{1}{1+x^2}, \cot^{-1}(x) = \frac{1}{1+x^2}, \sec^{-1}(x) = \frac{1}{x\sqrt{x^2-1}}, \csc^{-1}(x) = \frac{-1}{x\sqrt{x^2-1}}$