Formula Sheet

AMS 261, Spring 2019

$$\text{proj}_{\mathbf{v}}\mathbf{u} = \left(\frac{\mathbf{u}\cdot\mathbf{v}}{\|\mathbf{v}\|^2}\right)\mathbf{v}$$

$$\mathbf{u}\times\mathbf{v} = (u_2v_3 - u_3v_2)\mathbf{i} + (u_3v_1 - u_1v_3)\mathbf{j} + (u_1v_2 - u_2v_1)\mathbf{k}$$

$$\begin{aligned} x &= r\cos(\theta) \\ y &= r\sin(\theta) \\ z &= z \\ \mathrm{d}V &= r\mathrm{d}r\mathrm{d}\theta\mathrm{d}z \end{aligned} \qquad \begin{aligned} x &= \rho\sin(\phi)\cos(\theta) \\ y &= \rho\sin(\phi)\sin(\theta) \\ z &= \rho\cos(\phi) \\ \mathrm{d}V &= \rho^2\sin(\phi)\mathrm{d}\rho\mathrm{d}\theta\mathrm{d}\phi \end{aligned}$$

$$\mathbf{T}(t) = \frac{\mathbf{r}'(t)}{\|\mathbf{r}'(t)\|} \qquad \mathbf{N}(t) = \frac{\mathbf{T}'(t)}{\|\mathbf{T}'(t)\|}$$

$$d = (f_{xx})(f_{yy}) - (f_{xy})^2: \quad (d>0, f_{xx}>0)\to\min, \quad (d>0, f_{xx}<0)\to\max, \quad d<0\to\text{saddle}$$

$$\begin{aligned} K &= \left\|\vec{T}\,'(s)\right\| \\ K &= \frac{|y''|}{\left[1+(y')^2\right]^{3/2}} \end{aligned} \qquad \begin{aligned} K &= \frac{\|\vec{r}\,'(t)\times\vec{r}\,''(t)\|}{\|\vec{r}\,'(t)\|^3} \\ s &= \int\|\vec{r}\,'(t)\|\,\mathrm{d}t \end{aligned}$$

$$\vec{\nabla}\cdot\vec{F} = \frac{\partial M}{\partial x} + \frac{\partial N}{\partial y} + \frac{\partial P}{\partial z}$$

$$\vec{\nabla}\times\vec{F} = \left(\frac{\partial P}{\partial y} - \frac{\partial N}{\partial z}\right)\mathbf{i} + \left(\frac{\partial M}{\partial z} - \frac{\partial P}{\partial x}\right)\mathbf{j} + \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)\mathbf{k}$$

$$\oint_C (M\mathrm{d}x + N\mathrm{d}y) = \iint_R \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)\mathrm{d}A$$

$$S = \iint_D \|\vec{r}_u\times\vec{r}_v\|\,\mathrm{d}A$$

$$\oiint_S \vec{F}\cdot\vec{N}\mathrm{d}S = \iiint_Q \mathbf{div}\ \vec{F}\,\mathrm{d}V$$

$$\oint_C \vec{F}\cdot\mathrm{d}\vec{r} = \iint_S \left(\mathbf{curl}\ \vec{F}\right)\cdot\vec{N}\,\mathrm{d}S$$