76.2

$p(x)=0$

$y''(x)+q(x)y(x)=0$

B arbitrário

$$z=\frac{1}{\sqrt{B}}\int\sqrt{q}\,dx$$

$$A=\frac{q'+2pq}{2q^{\frac{3}{2}}}\sqrt{B}$$

$y''(z)+Ay'(z)+By=0$

$\Delta=A^2-4B$

$$y(z)=C_1\exp\left(\frac{-A+\sqrt{\Delta}}{2}z\right)+C_2\exp\left(\frac{-A-\sqrt{\Delta}}{2}z\right)$$

Prontos

43.1

$\beta : x = \ln y, y \in (0,\infty)$

$\alpha : y = e^x, x \in \Re \Rightarrow \ln y = x \therefore$ traços iguais

70.2A

$$\alpha = \begin{pmatrix} t \\ t^2 \\ t^3 \end{pmatrix} \Rightarrow \alpha' = \begin{pmatrix} 1 \\ 2t \\ 3t^2 \end{pmatrix} \Rightarrow \alpha'' = \begin{pmatrix} 0 \\ 2 \\ 6t \end{pmatrix} \Rightarrow \alpha' \times \alpha'' = w = 2\begin{vmatrix} i & j & k \\ 1 & 2t & 3t^2 \\ 0 & 1 & 3t \end{vmatrix} = 2\begin{pmatrix} 3t^2 \\ -3t \\ 1 \end{pmatrix}$$

$$k_1 = \frac{|w|}{v^3} = \frac{2\sqrt{9t^4 + 9t^2 + 1}}{(9t^4 + 4t^2 + 1)^{\frac{3}{2}}}$$

$$\alpha''' = \begin{pmatrix} 0 \\ 0 \\ 6 \end{pmatrix} \Rightarrow -\frac{w \cdot \alpha'''}{|w|^2} = \boldsymbol{\nu} = -\frac{12}{9t^4 + 9t^2 + 1}$$

função comprimento ñ deu

$$\tau = \frac{\alpha'}{v} \Rightarrow \tau' = \frac{\alpha'' v - \alpha' v'}{v^2} = \frac{2}{v}\left[\begin{pmatrix} 0 \\ 1 \\ 3t \end{pmatrix} - \frac{9t^3 + 2t}{9t^4 + 4t^2 + 1}\begin{pmatrix} 1 \\ 2t \\ 3t^2 \end{pmatrix}\right]$$

$$k_2 = \frac{|\tau'|}{v} = \frac{2}{v^2}\sqrt{\left[-\frac{9t^3 + 2t}{9t^4 + 4t^2 + 1}\right]^2 + \left[1 - \frac{9t^3 + 2t}{9t^4 + 4t^2 + 1}2t\right]^2 + \left[3t - \frac{9t^3 + 2t}{9t^4 + 4t^2 + 1}3t^2\right]^2}$$

$$k_2 = \frac{2}{v^4}\sqrt{81t^8 + 117t^6 + 54t^4 + 13t^2 + 1} = k_1 \text{ conferido!}$$

70.2B

$$\alpha = \begin{pmatrix} \cos t \\ \sin t \\ \exp t \end{pmatrix} \Rightarrow \alpha' = \begin{pmatrix} -\sin t \\ \cos t \\ \exp t \end{pmatrix} \Rightarrow \alpha'' = \begin{pmatrix} -\cos t \\ -\sin t \\ \exp t \end{pmatrix} \Rightarrow \alpha' \times \alpha'' = w = \begin{vmatrix} i & j & k \\ -\sin t & \cos t & \exp t \\ -\cos t & -\sin t & \exp t \end{vmatrix} = \begin{pmatrix} e^t \cos t + e^t \sin t \\ -e^t \cos t + e^t \sin t \\ 1 \end{pmatrix}$$

$$k = \frac{|w|}{v^3} = \frac{\sqrt{2e^{2t} + 1}}{(1 + e^{2t})^{\frac{3}{2}}}; \quad \alpha''' = \begin{pmatrix} \sin t \\ -\cos t \\ \exp t \end{pmatrix} \Rightarrow -\frac{w \cdot \alpha'''}{|w|^2} = \boldsymbol{\nu} = -\frac{2e^t}{2e^{2t} + 1}$$

70.2C

$$\alpha = \begin{pmatrix} t \\ \cosh t \\ \sinh t \end{pmatrix} \Rightarrow \alpha' = \begin{pmatrix} 1 \\ \sinh t \\ \cosh t \end{pmatrix} \Rightarrow \alpha'' = \begin{pmatrix} 0 \\ \cosh t \\ \sinh t \end{pmatrix} \Rightarrow \alpha' \times \alpha'' = w = \begin{vmatrix} i & j & k \\ 1 & \sinh t & \cosh t \\ 0 & \cosh t & \sinh t \end{vmatrix} = \begin{pmatrix} 1 \\ 0 \\ \cosh t \end{pmatrix}$$

$$k = \frac{|w|}{v^3} = \frac{1}{2\sqrt{2}\sinh^2 t}; \; \alpha''' = \begin{pmatrix} 0 \\ \sinh t \\ \cosh t \end{pmatrix} \Rightarrow -\frac{w \cdot \alpha'''}{|w|^2} = \boldsymbol{\nu} = -\frac{1}{\tanh^2 t}$$

70.1A

$$\alpha=\begin{pmatrix}4\cos t\\5-5\sin t\\-3\cos t\end{pmatrix}\Rightarrow\alpha'=\begin{pmatrix}-4\sin t\\-5\cos t\\3\sin t\end{pmatrix}\Rightarrow v=5;\alpha''=\begin{pmatrix}-4\cos t\\5\sin t\\3\cos t\end{pmatrix}\Rightarrow\alpha'''=\begin{pmatrix}4\sin t\\5\cos t\\-3\sin t\end{pmatrix}$$

$$L(t)=5\int_0^t du=5t\Rightarrow L^{-1}(s)=\frac{s}{5}\Rightarrow\beta(s)=\alpha\left(\frac{s}{5}\right)=\left(4\cos\frac{s}{5};5-5\sin\frac{s}{5};-3\cos\frac{s}{5}\right)$$

$$\boldsymbol{\tau}=\frac{\alpha'}{5}\Rightarrow\tau'=\frac{1}{5}\alpha''\Rightarrow\mathbf{n}=\frac{\tau'}{|\tau'|}=\frac{\alpha''}{|\alpha''|}=\frac{\alpha''}{5}$$

$$\vec{w}=\alpha'\times\alpha''=\begin{vmatrix}i&j&k\\-4\sin t&-5\cos t&3\sin t\\-4\cos t&5\sin t&3\cos t\end{vmatrix}=\begin{pmatrix}-15\\0\\-20\end{pmatrix};\mathbf{b}=\frac{w}{|w|}=-\frac{1}{5}\begin{pmatrix}3\\0\\4\end{pmatrix};k=\frac{|w|}{v^3}=\frac{25}{5^3}=\frac{1}{5};\boldsymbol{\mathcal{V}}=-\frac{w\cdot\alpha'''}{|w|^2}=0$$

70.1B

$$\alpha=\begin{pmatrix}1-\cos t\\\sin t\\t\end{pmatrix}\Rightarrow\alpha'=\begin{pmatrix}\sin t\\\cos t\\1\end{pmatrix}\Rightarrow v=\sqrt{2};\alpha''=\begin{pmatrix}\cos t\\-\sin t\\0\end{pmatrix}\Rightarrow\alpha'''=\begin{pmatrix}-\sin t\\-\cos t\\0\end{pmatrix}$$

$$L(t)=\sqrt{2}\int_0^t du=t\sqrt{2}\Rightarrow L^{-1}(s)=\frac{s}{\sqrt{2}}\Rightarrow\beta(s)=\alpha\left(\frac{s}{\sqrt{2}}\right)=\left(1-\cos\frac{s}{\sqrt{2}};\sin\frac{s}{\sqrt{2}};\frac{s}{\sqrt{2}}\right)$$

$$\boldsymbol{\tau}=\frac{\alpha'}{\sqrt{2}}\Rightarrow\tau'=\frac{\alpha''}{\sqrt{2}}\Rightarrow\mathbf{n}=\frac{\tau'}{|\tau'|}=\frac{\alpha''}{|\alpha''|}=\alpha''$$

$$\vec{w}=\alpha'\times\alpha''=\begin{vmatrix}i&j&k\\\sin t&\cos t&1\\\cos t&-\sin t&0\end{vmatrix}=\begin{pmatrix}\sin t\\\cos t\\-1\end{pmatrix};\mathbf{b}=\frac{w}{|w|}=\frac{w}{\sqrt{2}};k=\frac{|w|}{v^3}=\frac{1}{2};\boldsymbol{\mathcal{V}}=-\frac{w\cdot\alpha'''}{|w|^2}=\frac{1}{2}$$

70.1C

$$\alpha=\begin{pmatrix}e^t\\e^{-t}\\t\sqrt{2}\end{pmatrix}\Rightarrow\alpha'=\begin{pmatrix}e^t\\-e^{-t}\\\sqrt{2}\end{pmatrix}\Rightarrow v=\sqrt{e^{2t}+e^{-2t}+2}=e^t+e^{-t};\alpha''=\begin{pmatrix}e^t\\e^{-t}\\0\end{pmatrix}\Rightarrow\alpha'''=\begin{pmatrix}e^t\\-e^{-t}\\0\end{pmatrix}$$

$$L(t)=2\int_0^t\cosh u\,du=2\sinh t\Rightarrow L^{-1}(s)=\operatorname{arg\,sinh}\frac{s}{2}=\ln\left(s+\sqrt{4+s^2}\right)-\ln 2$$

$$\beta(s)=\alpha\left(\operatorname{arg\,sinh}\frac{s}{2}\right)=\left(\frac{s+\sqrt{4+s^2}}{2};\frac{2}{s+\sqrt{4+s^2}};\sqrt{2}\operatorname{arg\,sinh}\frac{s}{2}\right)$$

$$\vec{w}=\alpha'\times\alpha''=\begin{vmatrix}i&j&k\\e^t&-e^{-t}&\sqrt{2}\\e^t&e^{-t}&0\end{vmatrix}=\begin{pmatrix}-e^{-t}\sqrt{2}\\e^t\sqrt{2}\\2\end{pmatrix}=\sqrt{2}\begin{pmatrix}-e^{-t}\\e^t\\\sqrt{2}\end{pmatrix}\Rightarrow|w|=v\sqrt{2};\mathbf{b}=\frac{w}{|w|}=\frac{w}{\sqrt{2}\left(e^t+e^{-t}\right)}$$

$$k=\frac{|w|}{v^3}=\frac{\sqrt{2}}{e^{2t}+e^{-2t}+2};\boldsymbol{\mathcal{V}}=-\frac{w\cdot\alpha'''}{|w|^2}=\frac{2\sqrt{2}}{2v^2}=\frac{\sqrt{2}}{e^{2t}+e^{-2t}+2};\boldsymbol{\tau}=\frac{\alpha'}{v}=\frac{\alpha'}{e^t+e^{-t}};\mathbf{n}=\mathbf{b}\times\boldsymbol{\tau}=\frac{w}{v\sqrt{2}}\times\frac{\alpha'}{v}$$

$$\mathbf{n}=\frac{1}{v^2\sqrt{2}}w\times\alpha'=\frac{1}{e^{2t}+e^{-2t}+2}\begin{vmatrix}i&j&k\\-e^{-t}&e^t&\sqrt{2}\\e^t&-e^{-t}&\sqrt{2}\end{vmatrix}=\frac{1}{e^{2t}+e^{-2t}+2}\begin{pmatrix}\sqrt{2}\left(e^t+e^{-t}\right)\\\sqrt{2}\left(e^t+e^{-t}\right)\\e^{-2t}-e^{2t}\end{pmatrix}=\frac{1}{1+e^{2t}}\begin{pmatrix}\sqrt{2}e^t\\\sqrt{2}e^t\\\frac{1-e^{2t}}{1+e^{2t}}\end{pmatrix}$$

36.7 – Ciclóide – 43.3

Centro $O = (x_c, y_c) = (vt, R)$

$$\alpha(t) = O(t) + R\hat{u}(t), \begin{cases} \hat{u}(0) = (0,-1) \\ \hat{u}(90^\circ) = (-1,0) \\ \hat{u}(180^\circ) = (0,1) \\ \hat{u}(270^\circ) = (1,0) \end{cases} \Rightarrow \alpha(t) = \begin{pmatrix} vt - R\sin t \\ R - R\cos t \end{pmatrix}$$

$\alpha(2\pi) = (2\pi v, 0)$

Sem deslize $\Rightarrow$ Comprimento $= 2\pi R = 2\pi v \Rightarrow v = R$

$$\therefore \alpha(t) = R\begin{pmatrix} t - \sin t \\ 1 - \cos t \end{pmatrix}$$

Singularidades : $\alpha' = R\begin{pmatrix} 1 - \cos t \\ \sin t \end{pmatrix} = 0 \Rightarrow \begin{cases} \cos t = 1 \\ \sin t = 0 \end{cases} \Rightarrow t = 2k\pi$

$0 < t < 2\pi$

$v = R\sqrt{(1-\cos t)^2 + \sin^2 t} = R\sqrt{2 - 2\cos t}$

$L(t) = R\sqrt{2}\int_0^t \sqrt{1-\cos u}\ du$

$u = 2x \Rightarrow du = 2dx$

$L(t) = 2R\sqrt{2}\int_0^{\frac{t}{2}} \sqrt{1-\cos^2 x + \sin^2 x}\ dx = 2R\sqrt{2}\sqrt{2}\int_0^{\frac{t}{2}} |\sin x|\ dx$

$t < 2\pi \Rightarrow \dfrac{t}{2} < \pi \Rightarrow \sin t > 0$

$L(t) = 4R\int_0^{\frac{t}{2}} \sin x\ dx = 4R\left(1 - \cos\dfrac{t}{2}\right) \Rightarrow L^{-1}(s) = 2\arccos\left(1 - \dfrac{s}{4R}\right) = 2\theta(s) = h(s)$

$$\beta(s) = \alpha \circ h(s) = R\begin{pmatrix} 2\theta - \sin(2\theta) \\ 1 - \cos(2\theta) \end{pmatrix} = 2R\begin{pmatrix} \theta - \sin\theta\cos\theta \\ \sin^2\theta \end{pmatrix}$$

$$\cos\theta = \frac{4R - s}{4R} \Rightarrow \sin^2\theta + \frac{16R^2 - 16Rs + s^2}{16R^2} = 1 \Rightarrow \sin^2\theta = \frac{16Rs - s^2}{16R^2} \Rightarrow \sin\theta = \frac{\sqrt{16Rs - s^2}}{4R}$$

$$\beta(s) = 32R^3\begin{pmatrix} 16R^2\theta + (s - 4R)\sqrt{16Rs - s^2} \\ 16Rs - s^2 \end{pmatrix}$$

71.9

$$\beta(t) = \alpha(-t) \Rightarrow \begin{cases} k_\alpha = k_\beta \\ \boldsymbol{V}_\alpha = -\boldsymbol{V}_\beta \end{cases}$$

$$w_1 = \alpha' \times \alpha''; v_1 = \sqrt{(x')^2 + (y')^2 + (z')^2}; k_\alpha = \frac{|w_1|}{v_1^3}; \boldsymbol{V}_\alpha = \frac{w \cdot \alpha'''}{|w|^2}$$

$$\beta' = -\alpha'; \beta'' = -\alpha'' \Rightarrow w_2 = \beta' \times \beta'' = \alpha' \times \alpha'' = w_1 \therefore \boldsymbol{V}_\beta = \frac{w_1 \cdot (-\alpha''')}{|w_1|^2} = -\boldsymbol{V}_\alpha$$

$$v_2 = \sqrt{(-x')^2 + (-y')^2 + (-z')^2} = v_1 \therefore k_\beta = k_\alpha$$

76.3

$$\alpha=\begin{pmatrix} r\cos t \\ r\sin t \\ f \end{pmatrix}\Rightarrow \alpha'=\begin{pmatrix} -r\sin t \\ r\cos t \\ f' \end{pmatrix}\Rightarrow \alpha''=\begin{pmatrix} -r\cos t \\ -r\sin t \\ f'' \end{pmatrix}$$

$$v=\sqrt{r^2+(f')^2}\Rightarrow v'=\frac{f'f''}{v}$$

$$\tau=\frac{\alpha'}{v}\Rightarrow \tau'=\frac{\alpha''v-\alpha'\frac{f'f''}{v}}{v^2}=\frac{\vec{u}}{v^3};\vec{u}=\begin{pmatrix} -rv^2\cos t+f'f''r\sin t \\ -rv^2\sin t-f'f''r\cos t \\ f''v^2-(f')^2 f'' \end{pmatrix}$$

$$\mathbf{n}=\frac{\tau'}{|\tau'|}=\frac{\vec{u}}{|u|}\perp\mathbf{k}\Rightarrow f''v^2-(f')^2f''=0$$

$$f''=0\vee r^2+(f')^2=(f')^2\Rightarrow r=0,\forall f(t)$$

$$f''=0\Rightarrow f'=A\Rightarrow f(t)=At+B;A,B\in\Re$$

70.5

$$\forall t\in I,\alpha'\times\alpha'=\mathbf{0}\Rightarrow\alpha=\vec{P}+t\vec{u}$$

$$\begin{vmatrix} i & j & k \\ x' & y' & z' \\ x'' & y'' & z'' \end{vmatrix}=0\Rightarrow\begin{vmatrix} y' & z' \\ y'' & z'' \end{vmatrix}=\begin{vmatrix} x' & z' \\ x'' & z'' \end{vmatrix}=\begin{vmatrix} x' & y' \\ x'' & y'' \end{vmatrix}=0\Rightarrow\text{"Alguém" é zero ou}$$

$$\begin{cases} y''=x''\dfrac{y'}{x'} \\ z''=y''\dfrac{z'}{y'}=x''\dfrac{z'}{x'}\Rightarrow x''\dfrac{y'}{x'}\dfrac{z'}{y'}=x''\dfrac{z'}{x'} \quad (identidade) \end{cases}\Rightarrow\begin{cases} f(t)=x''/x' \\ y''=f(t)y' \\ z''=f(t)z' \end{cases}\Rightarrow\begin{cases} y''=z'' \\ \dfrac{y''}{z''}=\dfrac{y'}{z'}=1 \\ y'=z' \end{cases}$$

$$x'=g,y'=h\Rightarrow\frac{dh}{dt}=fh\Rightarrow\int\frac{dh}{h}=\int f\,dt\Rightarrow\ln h=\int\frac{dg}{dt}\frac{dt}{dx}dt=\int\frac{dg}{dx}dt=\int\frac{d}{dx}\left(\frac{dx}{dt}\right)dt=\int\frac{d}{dt}\left(\frac{dx}{dx}\right)dt=0+c$$

$$h=e^c\Rightarrow\begin{pmatrix} y \\ z \end{pmatrix}=\begin{pmatrix} A \\ C \end{pmatrix}t+\begin{pmatrix} B \\ D \end{pmatrix},A,B>0\Rightarrow x''=0\Rightarrow x=Et+F,\underline{\underline{cqd}}$$

$$\alpha:I\to\Re^3$$

$$\forall t\in I,\exists r_t:X_\lambda=\alpha(t)+\lambda\alpha'(t)$$

$$C=\bigcap_{t\in I}r_t\neq\varnothing\Rightarrow\alpha(t)=\vec{P}+t\vec{u}$$

Consideremos, sem perda de generalidade, $\vec{P}=\mathbf{0}\in C$. Vamos mostrar que $\alpha(t)=t\vec{u}$

Sejam $t_0=a,t_1=b$

$$\mathbf{0}=\alpha_a+\lambda\alpha'_a=\alpha_b+\mu\alpha'_b$$

$$\lambda=-\frac{x_a}{x'_a}=-\frac{y_a}{y'_a}=-\frac{z_a}{z'_a};\mu=-\frac{x_b}{x'_b}=-\frac{y_b}{y'_b}=-\frac{z_b}{z'_b}$$

$$x'=-\frac{1}{\lambda}x\Rightarrow\frac{dx}{dt}=f(t)\cdot x\Rightarrow\int\frac{dx}{x}=\int f(t)\,dt\Rightarrow\ln x=F(t)+C\Rightarrow x(t)=e^c g(t)$$

Analogamente, $y(t)=e^k g(t);z(t)=e^q g(t)$

$$\therefore\begin{pmatrix} x \\ y \\ z \end{pmatrix}=\begin{pmatrix} A \\ B \\ C \end{pmatrix}t',\begin{cases} A,B,C>0 \\ t'=g(t) \end{cases}$$

p. 36, 6

F: $\mathbb{R}^2 \to \mathbb{R}$, $(x_0,y_0) \in \mathbb{R}^2$

$(x, y) : F(x, y) = 0$ forma curva C no plano xy

$F(x_0, y_0) = 0$

$F_x(x_0, y_0) \neq 0$

$F_y(x_0, y_0) \neq 0$

Na vizinhança de (x_0, y_0), podemos aproximar C como $\alpha = (x, f(x))$ ou $\beta = (f(y), y)$

$$\alpha' = \begin{pmatrix} x' \\ \frac{df}{dx} x' \end{pmatrix}; \beta' = y' \begin{pmatrix} \frac{df}{dy} \\ 1 \end{pmatrix}$$

$\alpha' = \mathbf{0} \Rightarrow x' = 0 \Rightarrow x(t) = k$, mas nesse caso $\beta' \neq \mathbf{0}$

???

$v = 1; k \neq 0;$

$r_t : X_\lambda = \alpha_t + \lambda \mathbf{n}_t$

$\mathbf{0} = P \in \bigcap_{t \in I} r_t$

$0 = \alpha_a + \lambda n_a = \alpha_b + \lambda n_b$

$$\lambda = -\frac{x_a}{n_{x,a}} = -\frac{y_a}{n_{y,a}} = -\frac{z_a}{n_{z,a}}; \mu = -\frac{x_b}{n_{x,b}} = -\frac{y_b}{n_{y,b}} = -\frac{z_b}{n_{z,b}}$$

$qmq\ \alpha(t) \subset S : x^2 + y^2 + z^2 = R^2$

$qmq\, \boldsymbol{V} = 0$, ou seja, $\alpha(t) \in \gamma : ax + by + cz + d = 0$

$$w = \alpha' \times \alpha'' = \begin{vmatrix} i & j & k \\ x' & y' & z' \\ x'' & y'' & z'' \end{vmatrix} = i\begin{vmatrix} y' & z' \\ y'' & z'' \end{vmatrix} - j\begin{vmatrix} x' & z' \\ x'' & z'' \end{vmatrix} + k\begin{vmatrix} x' & y' \\ x'' & y'' \end{vmatrix}$$

$$|w| = \sqrt{\begin{vmatrix} y' & z' \\ y'' & z'' \end{vmatrix}^2 + \begin{vmatrix} x' & z' \\ x'' & z'' \end{vmatrix}^2 + \begin{vmatrix} x' & y' \\ x'' & y'' \end{vmatrix}^2}$$

$$|w|' = \frac{\begin{vmatrix} y' & z' \\ y'' & z'' \end{vmatrix}\begin{vmatrix} y' & z' \\ y'' & z'' \end{vmatrix}' + \begin{vmatrix} x' & z' \\ x'' & z'' \end{vmatrix}\begin{vmatrix} x' & z' \\ x'' & z'' \end{vmatrix}' + \begin{vmatrix} x' & y' \\ x'' & y'' \end{vmatrix}\begin{vmatrix} x' & y' \\ x'' & y'' \end{vmatrix}'}{|w|} = \frac{u}{|w|} = \frac{w' \cdot w}{|w|}$$

$$w' = \alpha' \times \alpha'''; b = \frac{w}{|w|}$$

$$qmq\ w' = w\frac{u}{|w|^2} = \frac{w' \cdot w}{|w|^3} w$$

$$w' = i\begin{vmatrix} y' & z' \\ y'' & z'' \end{vmatrix}' - j\begin{vmatrix} x' & z' \\ x'' & z'' \end{vmatrix}' + k\begin{vmatrix} x' & y' \\ x'' & y'' \end{vmatrix}'$$

$\tau = \alpha'$

$$n = \frac{\tau'}{|\tau'|} = \frac{\alpha''}{|\alpha''|} = \frac{\alpha''}{k} = \frac{1}{\sqrt{(x'')^2 + (y'')^2 + (z'')^2}}\begin{pmatrix} x'' \\ y'' \\ z'' \end{pmatrix} \qquad n = b \times \tau = \frac{1}{|w|}(\alpha' \times \alpha'' \times \alpha')$$

$$k = \frac{|w|}{v^3} \neq 0 \Rightarrow \alpha'' \neq C\alpha'$$

$k = |\alpha''| \neq 0 \Rightarrow x'', y'' \neq 0$

$$\boldsymbol{V} = \frac{w \cdot \alpha'''}{|w|^2}$$

$$\frac{1}{v} b' = vn$$

$$qmq \begin{vmatrix} x' & y' & z' \\ x'' & y'' & z'' \\ x''' & y''' & z''' \end{vmatrix} = 0$$

$x' y^2 z^3 + x^3 y' z^2 + x^2 y^3 z' = x' y^3 z^2 + x^2 y' z^3 + x^3 y^2 z'$

$\lambda n_y = -y$

$$\lambda \frac{y''}{|\alpha''|} = -y$$

$\lambda y'' = -y\sqrt{(x'')^2 + (y'')^2 + (z'')^2}$