№ п/п	Название формул	Системы: произвольная	ортогональная криволинейная
1	Закон перехода от прямоугольной к криволинейной системе координат	$x^i = x^i(\alpha^1, \alpha^2, \alpha^3)$	$x^1 = x^1(\alpha^1, \alpha^2, \alpha^3)$ $x^2 = x^2(\alpha^1, \alpha^2, \alpha^3)$ $x^3 = x^3(\alpha^1, \alpha^2, \alpha^3)$
2	Координаты локального базиса	$\vec{e}_i \left\{ \frac{\partial x^1}{\partial \alpha^i}, \frac{\partial x^2}{\partial \alpha^i}, \frac{\partial x^3}{\partial \alpha^i} \right\}$	$\vec{e}_1 \left\{ \frac{\partial x^1}{\partial \alpha^1}, \frac{\partial x^2}{\partial \alpha^1}, \frac{\partial x^3}{\partial \alpha^1} \right\}$ $\vec{e}_2 \left\{ \frac{\partial x^1}{\partial \alpha^2}, \frac{\partial x^2}{\partial \alpha^2}, \frac{\partial x^3}{\partial \alpha^2} \right\}$ $\vec{e}_3 \left\{ \frac{\partial x^1}{\partial \alpha^3}, \frac{\partial x^2}{\partial \alpha^3}, \frac{\partial x^3}{\partial \alpha^3} \right\}$
3	Элемент длины	$ds^2 = g_{ij}\, d\alpha^i\, d\alpha^j$	$ds^2 = (H_1\, d\alpha^1)^2 +$ $+ (H_2\, d\alpha^2)^2 + (H_3\, d\alpha^3)^2$
4	Компоненты фундаментальной матрицы g_{ij} *	$g_{ij} = \vec{e}_i \cdot \vec{e}_j$	$g_{11} = H_1^2,\ g_{22} = H_2^2,$ $g_{33} = H_3^2$
5	Определитель фундаментальной матрицы g	$g = \det \lvert g_{ij} \rvert$	$g = (H_1 H_2 H_3)^2$
6	Компоненты матрицы g^{ij} *	$g^{ij} = \frac{1}{g} \frac{\partial g}{\partial g_{ij}}$	$g^{11} = \frac{1}{H_1^2},\ g^{22} = \frac{1}{H_2^2},$ $g^{33} = \frac{1}{H_3^2}$

* Остальные компоненты равны нулю.

системах координат

координат

прямоугольная	цилиндрическая	сферическая
$x^1 = \alpha^1$ $x^2 = \alpha^2$ $x^3 = \alpha^3$	$x^1 = \alpha^1 \cos\alpha^2$ $x^2 = \alpha^1 \sin\alpha^2$ $x^3 = \alpha^3$	$x^1 = \alpha^1 \sin\alpha^2 \cos\alpha^3$ $x^2 = \alpha^1 \sin\alpha^2 \sin\alpha^3$ $x^3 = \alpha^1 \cos\alpha^2$
$\vec{e}_1 (1, 0, 0)$ $\vec{e}_2 (0, 1, 0)$ $\vec{e}_3 (0, 0, 1)$	$\vec{e}_1 \{\cos\alpha^2, \sin\alpha^2, 0\}$ $\vec{e}_2 \{-\alpha^1\sin\alpha^2, \alpha^1\cos\alpha^2, 0\}$ $\vec{e}_3 \{0, 0, 1\}$	$\vec{e}_1 \{\sin\alpha^2\cos\alpha^3, \sin\alpha^2 \times$ $\times \sin\alpha^3, \cos\alpha^2\}$ $\vec{e}_2 \{\alpha^1\cos\alpha^2\cos\alpha^3,$ $\alpha^1\cos\alpha^2\sin\alpha^3, -\alpha^1\sin\alpha^2\}$ $\vec{e}_3 \{-\alpha^1\sin\alpha^2\sin\alpha^3,$ $\alpha^1\sin\alpha^2\cos\alpha^2, 0\}$
$ds^2 = (d\alpha^1)^2 +$ $+ (d\alpha^2)^2 +$ $+ (d\alpha^3)^2$	$ds^2 = (d\alpha^1)^2 +$ $+ (\alpha^1 d\alpha^2)^2 +$ $+ (d\alpha^3)^2$	$ds^2 = (d\alpha^1)^2 + (\alpha^1 d\alpha^2)^2 +$ $+ (\alpha^1 \sin\alpha^2 d\alpha^3)^2$
$g_{11} = g_{22} =$ $= g_{33} = 1$	$g_{11} = 1, \ g_{22} = (\alpha^1)^2,$ $g_{33} = 1$	$g_{11} = 1, \ g_{22} = (\alpha^1)^2,$ $g_{33} = (\alpha^1 \sin\alpha^2)^2$
$g = 1$	$g = (\alpha^1)^2$	$g = (\alpha^1)^4 \sin^2\alpha^2$
$g^{11} = g^{22} =$ $= g^{33} = 1$	$g^{11} = 1, \ g^{22} = \frac{1}{(\alpha^1)^2},$ $g^{33} = 1$	$g^{11} = 1, \ g^{22} = \frac{1}{(\alpha^1)^2},$ $g^{33} = \frac{1}{(\alpha^1 \sin\alpha^2)^2}$

№ п/п	Название формул	Системы	
		произвольная	ортогональная криволинейная
7	Координаты взаимного базиса $\vec{e}^i$	$\vec{e}^i = g^{ij}\vec{e}_j$	$\vec{e}^1 = \frac{\vec{e}_1}{H_1^2}$ $\vec{e}^2 = \frac{\vec{e}_2}{H_2^2}$ $\vec{e}^3 = \frac{\vec{e}_3}{H_3^2}$
8	Координаты ортонормированного базиса $\vec{k}_i$	—	$\vec{k}_1 = \frac{\vec{e}_1}{H_1}$ $\vec{k}_2 = \frac{\vec{e}_2}{H_2}$ $\vec{k}_2 = \frac{\vec{e}_3}{H_3}$
9	Физические компоненты вектора $\vec{a}$	$a^i_{(\text{ф})} \equiv A^i \equiv A_i = \vec{a}\cdot\vec{k}_i$	$A^\beta = \vec{a}\cdot\vec{k}_\beta = \frac{a_\beta}{H_\beta} = a^\beta H_\beta$ $\langle \beta = 1,\ 2,\ 3 \rangle$
10	Символы Кристоффеля 1-го рода *	$\Gamma_{ij,k} = \frac{1}{2}\left(\frac{\partial g_{ik}}{\partial \alpha^j} + \frac{\partial g_{jk}}{\partial \alpha^i} - \frac{\partial g_{ij}}{\partial \alpha^k}\right)$	$\Gamma_{\beta\beta,\beta} = H_\beta \frac{\partial H_\beta}{\partial \alpha^\beta}$, $\Gamma_{\beta\gamma,\beta} = -\Gamma_{\beta\beta,\gamma} = H_\beta \frac{\partial H_\beta}{\partial \alpha^\gamma}$ $\langle \beta \neq \gamma;\ \beta = \gamma = 1,\ 2,\ 3 \rangle$

* Остальные компоненты равны нулю.

координат		
прямоугольная	цилиндрическая	сферическая
$\vec{e}^1\{1, 0, 0\}$ $\vec{e}^2\{0, 1, 0\}$ $\vec{e}^3\{0, 0, 1\}$	$\vec{e}^1\{\cos\alpha^2, \sin\alpha^2, 0\}$ $\vec{e}^2\left\{-\frac{\sin\alpha^2}{\alpha^1}, \frac{\cos\alpha^2}{\alpha^1}, 0\right\}$ $\vec{e}^3\{0, 0, 1\}$	$\vec{e}^1\{\sin\alpha^2\cos\alpha^3, \sin\alpha^2 \times$ $\times \sin\alpha^3, \cos\alpha^2\}$ $\vec{e}^2\left\{\frac{\cos\alpha^2\cos\alpha^3}{\alpha^1},\right.$ $\left.\frac{\cos\alpha^2\sin\alpha^3}{\alpha^1}, -\frac{\sin\alpha^2}{\alpha^1}\right\},$ $\vec{e}^3\left\{-\frac{\sin\alpha^3}{\alpha^1\sin\alpha^2},\right.$ $\left.\frac{\cos\alpha^3}{\alpha^1\sin\alpha^2}, 0\right\}$
$\vec{k}_1\{1, 0, 0\}$ $\vec{k}_2\{0, 1, 0\}$ $\vec{k}_3\{0, 0, 1\}$	$\vec{k}_1\{\cos\alpha^2, \sin\alpha^2, 0\}$ $\vec{k}_2\{-\sin\alpha^2, \cos\alpha^2, 0\}$ $\vec{k}_3\{0, 0, 1\}$	$\vec{k}_1\{\sin\alpha^2\cos\alpha^3, \sin\alpha^2 \times$ $\times \sin\alpha^3, \cos\alpha^2\}$ $\vec{k}_2\{\cos\alpha^2, \cos\alpha^3, \cos\alpha^2 \times$ $\times \sin\alpha^3, -\sin\alpha^2\}$ $\vec{k}_3\{-\sin\alpha^3, \cos\alpha^3, 0\}$
$A^1 = a^1$ $A^2 = a^2$ $A^3 = a^3$	$A^1 = \vec{a}\cdot\vec{k}_1 = a^1$ $A^2 = \vec{a}\cdot\vec{k}_2 = a^2\alpha^1$ $A^3 = \vec{a}\cdot\vec{k}_3 = a^3$	$A^1 = \vec{a}\cdot\vec{k}_1 = a^1$ $A^2 = \vec{a}\cdot\vec{k}^2 = a^2\alpha^1$ $A^3 = \vec{a}\cdot\vec{k}_3 = a^3\alpha^1\sin\alpha^2$
	$\Gamma_{12,2} = -\Gamma_{22,1} = \alpha^1$	$\Gamma_{21,2} = -\Gamma_{22,1} = \alpha^1$ $\Gamma_{31,3} = -\Gamma_{33,1} =$ $= \alpha^1\sin^2\alpha^2$ $\Gamma_{33,3} = -\Gamma_{33,2} =$ $= (\alpha^1)^2\sin\alpha^2\cos\alpha^3$

№ п/п	Название формул	Системы	
		Произвольная	ортогональная криволинейная
11	Символы Кристоффеля 2-го рода*	$\Gamma_{ij}^{k} = g^{kl}\Gamma_{ij,l}$	$\Gamma_{\beta\beta}^{\beta} = \frac{1}{H_\beta} = \frac{\partial H_\beta}{\partial \alpha^\beta}$ $\Gamma_{\beta\gamma}^{\nu} = -\frac{H_\beta}{H_\gamma^2}\frac{\partial H_\beta}{\partial \alpha^\gamma}$ $\Gamma_{\beta\gamma}^{\beta} = \frac{1}{H_\beta}\frac{\partial H_\beta}{\partial \alpha^\gamma}$ $\langle \beta = \gamma;\ \gamma = 1, 2, 3 \rangle$
12	Элемент объема	$dV = \sqrt{g}\, d\alpha^1 d\alpha^2 d\alpha^3$	$dV = H_1 H_2 H_3 d\alpha^1 d\alpha^2 d\alpha^3$
13	Градиент скаляра φ	$\operatorname{grad}\varphi = \nabla_i \varphi \vec{e}^{\,i}$	$\frac{\partial\varphi}{\partial\alpha^1}\frac{\vec{k}_1}{H_1} + \frac{\partial\varphi}{\partial\alpha^2}\frac{\vec{k}_2}{H_2} + \frac{\partial\varphi}{\partial\alpha^3}\frac{\vec{k}_3}{H_3}$
14	Дивергенции вектора $\vec{a}$	$\operatorname{div}\vec{a} = \nabla_i a^i$	$\left\{\frac{\partial}{\partial\alpha^1}(H_2H_3A^1) + \frac{\partial}{\partial\alpha^2}(H_1H_3A^2) + \frac{\partial}{\partial\alpha^3}(H_1H_2A^3)\right\}/H_1H_2H_3$

* Остальные компоненты равны нулю

координат		
прямоугольная	цилиндрическая	сферическая
	$\Gamma^1_{22}=-\alpha^1$ $\Gamma^2_{21}=\dfrac{1}{\alpha^1}$	$\Gamma^1_{22}=-\alpha^1$ $\Gamma^1_{33}=-\alpha^1\sin^2\alpha^2$ $\Gamma^2_{33}=-\sin\alpha^2\cos\alpha^2$ $\Gamma^2_{21}=\dfrac{1}{\alpha^1}$ $\Gamma^3_{31}=\dfrac{1}{\alpha^1}$ $\Gamma^3_{32}=\operatorname{ctg}\alpha^2$
$dV=dx^1dx^2dx^3$	$dV=\alpha^1 d\alpha^1 d\alpha^2 d\alpha^3$	$dV=(\alpha^1)^2\sin^2 d\alpha^1 d\alpha^2 d\alpha^3$
$\dfrac{\partial\varphi}{\partial x^1}\vec{k}_1+\dfrac{\partial\varphi}{\partial x^2}\vec{k}_2+\dfrac{\partial\varphi}{\partial x^3}\vec{k}_3$	$\dfrac{\partial\varphi}{\partial\alpha^1}\vec{k}_1+\dfrac{1}{\alpha^1}\dfrac{\partial\varphi}{\partial\alpha^2}\vec{k}_2+\dfrac{\partial\varphi}{\partial\alpha^3}\vec{k}_3$	$\dfrac{\partial\varphi}{\partial\alpha^1}\vec{k}_1+\dfrac{1}{\alpha^1}\dfrac{\partial\varphi}{\partial\alpha^3}\vec{k}_2-\dfrac{1}{\alpha^1\sin\alpha^2}\dfrac{\partial\varphi}{\partial\alpha^3}\vec{k}_3$
$\dfrac{\partial A^1}{\partial x^1}+\dfrac{\partial A^2}{\partial x^2}+\dfrac{\partial A^3}{\partial x^3}$	$\dfrac{1}{\alpha^1}\left\{\dfrac{\partial}{\partial\alpha^1}(\alpha^1A^1)+\dfrac{\partial A^2}{\partial\alpha^2}+\dfrac{\partial}{\partial\alpha^3}\left(\alpha^1\dfrac{\partial A^3}{\partial\alpha^3}\right)\right\}$	$\dfrac{1}{(\alpha^1)^2\sin\alpha^2}\left\{\dfrac{\partial}{\partial\alpha^1}[(\alpha^1)^2\times\sin\alpha^2A^1]+\dfrac{\partial}{\partial\alpha^2}(\alpha^1\sin\alpha^2A^2)+\dfrac{\partial}{\partial\alpha^3}(\alpha^1A^3)\right\}$

№ п/п	Название формул	Системы	
		произвольная	ортогональная криволинейная
15	Ротор вектора $\vec{a}$	$\operatorname{rot}\vec{a}= \frac{1}{\sqrt{g}}\,\varepsilon^{ijk}\nabla_i a_j \vec{e}_k$	$\frac{1}{H_1H_2H_3}\begin{vmatrix} H_1\vec{k}_1 & H_2\vec{k}_2 & H_3\vec{k}_3 \\ \frac{\partial}{\partial\alpha^1} & \frac{\partial}{\partial\alpha^2} & \frac{\partial}{\partial\alpha^3} \\ H_1A^1 & H_2A^2 & H_3A^3 \end{vmatrix}$
16	Лапласиан скаляра φ	$\Delta\varphi = g^{ij}\Delta_i\Delta_j\varphi$	$\frac{1}{H_1H_2H_3}\times \left\{\frac{\partial}{\partial\alpha^1}\left(\frac{H_2H_3}{H_1}\frac{\partial\varphi}{\partial\alpha^1}\right)+\frac{\partial}{\partial\alpha^2}\left(\frac{H_1H_3}{H_2}\frac{\partial\varphi}{\partial\alpha^2}\right)+\frac{\partial}{\partial\alpha^3}\left(\frac{H_1H_2}{H_3}\frac{\partial\varphi}{\partial\alpha^3}\right)\right\}$
17	Лапласиан вектора $\vec{a}$	[1] $\Delta^*\vec{a} = g^{ij}\nabla_i\nabla_j a_k \vec{e}^k$	

[1] Символ Δ^* обозначает оператор Лапласа вектора и тензора,

координат		
прямоугольная	**цилиндрическая**	**сферическая**
$\begin{vmatrix} \vec{k}_1 & \vec{k}_2 & \vec{k}_3 \\ \frac{\partial}{\partial x^1} & \frac{\partial}{\partial x^2} & \frac{\partial}{\partial x^3} \\ A^1 & A^2 & A^3 \end{vmatrix}$	$\frac{1}{\alpha^1}\begin{vmatrix} \vec{k}_1 & \alpha^1\vec{k}_2 & \vec{k}_3 \\ \frac{\partial}{\partial\alpha^1} & \frac{\partial}{\partial\alpha^2} & \frac{\partial}{\partial\alpha^3} \\ A^1 & \alpha^1 A^2 & A^3 \end{vmatrix}$	$\frac{1}{(\alpha^1)^2\sin\alpha^2}\times$ $\times\begin{vmatrix} \vec{k}_1 & \alpha^1\vec{k}_2 & \alpha^1\sin\alpha^2\,\vec{k}_3 \\ \frac{\partial}{\partial\alpha^1} & \frac{\partial}{\partial\alpha^2} & \frac{\partial}{\partial\alpha^3} \\ A^1 & \alpha^1 A^2 & \alpha^1\sin\alpha^2\, A^3 \end{vmatrix}$
$\frac{\partial^2\varphi}{\partial(x^1)^2}+\frac{\partial^2\varphi}{\partial(x^2)^2}+\frac{\partial^2\varphi}{\partial(x^3)^2}$	$\frac{1}{\alpha^1}\left\{\frac{1}{\partial\alpha^1}\left(\alpha^1\frac{\partial\varphi}{\partial\alpha^1}\right)+\frac{\partial}{\partial\alpha^2}\left(\frac{1}{\alpha^1}\frac{\partial\varphi}{\partial\alpha^2}\right)+\frac{\partial}{\partial\alpha^3}\left(\alpha^1\frac{\partial\varphi}{\partial\alpha^2}\right)\right\}$	$\frac{1}{(\alpha^1)^2\sin\alpha^2}\times\left\{\frac{\partial}{\partial\alpha^1}\left[(\alpha^1)^2\times\sin\alpha^2\frac{\partial\varphi}{\partial\alpha^1}\right]+\frac{\partial}{\partial\alpha^2}\left(\sin\alpha^2\frac{\partial\varphi}{\partial\alpha^2}\right)+\frac{\partial}{\partial\alpha^3}\left(\frac{1}{\sin\alpha^2}\frac{\partial\varphi}{\partial\alpha^2}\right)\right\}$
$\Delta^*\vec{a}=\Delta\vec{a}$	$\Delta a_1-\frac{2}{(\alpha^1)^3}\frac{\partial a_2}{\partial\alpha^2}+\frac{a_2}{(\alpha^1)^4}-\frac{a_1}{(\alpha^1)^2}$ $\Delta a_2-\frac{2}{\alpha^1}\frac{\partial a_2}{\partial\alpha^1}+\frac{2}{\alpha^1}\frac{\partial a_1}{\partial\alpha^2}+a_1$ Δa_3	$\Delta a_1-\frac{2}{(\alpha^1)^3\sin^2\alpha^2}\frac{\partial a_2}{\partial\alpha^2}-\frac{2}{(\alpha^1)^3}\frac{\partial a_2}{\partial\alpha^2}-\frac{2a_1}{(\alpha^1)^2}-\frac{2a_2}{(\alpha^1)^2}\operatorname{ctg}\alpha^2$ $\Delta a_2+\frac{2}{(\alpha^1)^2\sin^3\alpha^2}\frac{\partial a_2}{\partial\alpha^2}-\frac{a_2}{(\alpha^1)^3\sin^2\alpha^2}\Delta a_3+\frac{2}{\alpha^1}\times\left(\frac{\partial a_1}{\partial\alpha^2}-\frac{\partial a_2}{\partial\alpha^1}\right)+\frac{2}{(\alpha^1)^2}\times\operatorname{ctg}\alpha^2\left(\frac{\partial a_2}{\partial\alpha^2}-\frac{\partial a_2}{\partial\alpha^2}\right)$

а символ Δ — оператор Лапласа скаляра.

№ п/п	Название формул	Системы	
		произвольная	цилиндрическая
18	Лапласиан тензора $\underset{\sim}{a}$ (симметричного)	$\Delta^* a = g^{il} \nabla_i \nabla_j a_{kl} \vec{e}^k \otimes \vec{e}^l$ **прямоугольная** $\Delta^* \underset{\sim}{a} = \Delta \underset{\sim}{a}$	$\Delta a_{11} - \frac{4}{(\alpha^1)^3} \frac{\partial a_{12}}{\partial \alpha^2} - \frac{2}{(\alpha^1)^2} a_{11} + \frac{2}{(\alpha^1)^4} a_{22}$ $\Delta a_{22} - \frac{4}{\alpha^1} \frac{\partial a_{22}}{\partial \alpha^1} + \frac{4}{\alpha^1} \frac{\partial a_{12}}{\partial \alpha^2} + \frac{2}{(\alpha^1)^2} a_{22} + 2a_{11}$ Δa_{33} $\Delta a_{12} - \frac{2}{\alpha^1} \frac{\partial a_{12}}{\partial \alpha^1} - \frac{2}{(\alpha^1)^3} \frac{\partial a_{22}}{\partial \alpha^2} + \frac{2}{\alpha^1} \frac{\partial a_{11}}{\partial a^2} - \frac{5}{(\alpha^1)^2} a_{12}$ $\Delta a_{13} - \frac{2}{(\alpha^1)^3} \frac{\partial a_{23}}{\partial \alpha^2} - \frac{1}{(\alpha^1)^2} a_{13}$ $\Delta a_{23} - \frac{2}{a^1} \frac{\partial a_{23}}{\partial \alpha^1} + \frac{2}{\alpha^1} \frac{\partial a_{13}}{\partial \alpha^2}$

Продолжение

координат

	Сферическая	

$$\Delta a_{11} - \frac{4}{(\alpha^1)^2}\frac{\partial a_{11}}{\partial \alpha^2} -$$
$$- \frac{4}{(\alpha^1)^2 \sin^2 \alpha^2}\frac{\partial a_{13}}{\partial \alpha^3} -$$
$$- \frac{4}{(\alpha^1)^2} a_{11} - \frac{4}{(\alpha^1)^3} \times$$
$$\times \operatorname{ctg} \alpha^2 a_{12} + \frac{2}{(\alpha^1)^4} a_{22} +$$
$$+ \frac{2}{(\alpha^1)^4 \sin^2 \alpha^2} a_{33}$$

$$\Delta a_{22} - \frac{4}{\alpha^1}\frac{\partial a_{22}}{\partial \alpha^1} +$$
$$+ \frac{4}{\alpha^1}\frac{\partial a_{12}}{\partial \alpha^2} -$$
$$- \frac{4 \operatorname{ctg} \alpha^2}{(\alpha^1)^2 \sin^2 \alpha^2}\frac{\partial a_{23}}{\partial \alpha^2} -$$
$$- \operatorname{ctg}^2 \alpha^2 a_{22} +$$
$$+ \frac{2 \operatorname{ctg}^2 \alpha^2}{(\alpha^1)^2 \sin^2 \alpha^2} a_{33} + 2a_{11}$$

$$\Delta a_{33} - \frac{4}{\alpha^1}\frac{\partial a_{33}}{\partial \alpha^1} -$$
$$- \frac{4}{(\alpha^1)^2} \operatorname{ctg} \alpha^2 \frac{\partial a_{33}}{\partial \alpha^2} +$$
$$+ \frac{4}{(\alpha^1)^2}\frac{\partial a_{12}}{\partial q^2} +$$
$$+ \frac{4 \operatorname{ctg} \alpha^2}{(\alpha^1)^2}\frac{\partial a_{22}}{\partial \alpha^2} +$$
$$+ \frac{2}{(\alpha^1)^2 \sin^2 \alpha^2} a_{33} +$$
$$+ 2 \sin^2 \alpha^2 a_{11} +$$
$$+ \frac{2 \cos^2 \alpha^2}{(\alpha^1)^2} a_{22} +$$
$$+ \frac{4}{\alpha^1} \sin \alpha^2 \cos \alpha^2 a_{12}$$

$$\Delta a_{12} - \frac{2}{\alpha^1}\frac{\partial a_{12}}{\partial \alpha^1} -$$
$$- \frac{2}{(\alpha^1)^3}\frac{\partial a_{22}}{\partial \alpha^2} -$$
$$- \frac{2}{(\alpha^1)^2 \sin^2 \alpha^2}\frac{\partial a_{23}}{\partial \alpha^3} +$$
$$+ \frac{2}{\alpha_2}\frac{\partial a_{11}}{\partial \alpha^2} -$$
$$- \frac{2 \operatorname{ctg} \alpha^2}{(\alpha^1)^2 \sin^2 \alpha^2}\frac{\partial a_{13}}{\partial \alpha^3} -$$
$$- \frac{5}{(\alpha^1)^2} a_{12} -$$
$$- \frac{2}{(\alpha^1)^2} \operatorname{ctg} \alpha^2 a_{22} +$$
$$+ \frac{2 \operatorname{ctg} \alpha^2}{(\alpha^1)^3 \sin^2 \alpha^2} a_{33} -$$
$$- \frac{\operatorname{ctg}^2 \alpha^2}{(\alpha^1)^2} a_{12}$$

$$\Delta a_{12} - \frac{2}{\alpha^1}\frac{\partial a_{12}}{\partial a_1} -$$
$$- \frac{2 \operatorname{ctg} \alpha^2}{(\alpha^1)^2}\frac{\partial a_{13}}{\partial \alpha^2} -$$
$$- \frac{2}{(\alpha^1)^3}\frac{\partial a_{22}}{\partial \alpha^2} -$$
$$- \frac{2}{(\alpha^1)^3 \sin^2 \alpha^2}\frac{\partial a_{32}}{\partial \alpha^2} +$$
$$+ \frac{2 \operatorname{ctg} \alpha^2}{(\alpha^1)^2}\frac{\partial a_{12}}{\partial \alpha^2} -$$
$$- \frac{5}{(\alpha^1)^2} a_{13} +$$
$$+ \frac{2}{\alpha^1}\frac{\partial a_{11}}{\partial \alpha^2} +$$
$$+ \frac{1}{(\alpha^1)^2 \sin^2 \alpha^2} a_{13} -$$

$$- \frac{2 \operatorname{ctg} \alpha^2}{(\alpha^1)^3} a_{23} -$$
$$- \frac{\operatorname{ctg}^2 \alpha^2}{(\alpha^1)^2} a_{13}$$

$$\Delta a_{23} - \frac{4}{\alpha^1}\frac{\partial a_{23}}{\partial \alpha^1} -$$
$$- \frac{2 \operatorname{ctg} \alpha^2}{(\alpha^1)^2}\frac{\partial a_{23}}{\partial \alpha^2} +$$
$$+ \frac{2}{\alpha^1}\frac{\partial a_{13}}{\partial \alpha^2} +$$
$$+ \frac{2}{\alpha^1}\frac{\partial a_{12}}{\partial \alpha^3} -$$
$$- \frac{2 \operatorname{ctg} \alpha^2}{(\alpha^1)^2 \sin^2 \alpha^2}\frac{\partial a_{33}}{\partial \alpha^3} +$$
$$+ \frac{2 \operatorname{ctg} \alpha^2}{(\alpha^1)^2}\frac{\partial a_{22}}{\partial \alpha^2} +$$
$$+ \frac{1}{(\alpha^1)^2 \sin^2 \alpha^2} a_{23} -$$
$$- \frac{3 \operatorname{ctg} \alpha^2}{\alpha^1} a_{13} -$$
$$- \frac{3 \operatorname{ctg}^2 \alpha^2}{(\alpha^1)^2} a_{33}$$