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平面翼

$$u = 2\int_{-1}^{1}(X U^{(1)} + Y V^{(1)})dx$$

$$v = 2\int_{-1}^{1}(X U^{(2)} + Y V^{(2)})dx$$

$$\zeta = 2\int_{-1}^{1}(X Z^{(1)} + Y Z^{(2)})dx$$

$$2\pi U^{(1)} = \frac{\partial}{\partial x}(\lg R + \Phi) + 2k\Phi \qquad V_2 = -\frac{\partial}{\partial x}(\lg R + \Phi)$$

$$2\pi V^{(1)} = 2\pi U^{(2)} = \frac{\partial}{\partial y}(\lg R + \Phi)$$

$$\Phi = K_0 e^{-k(x'-x)} = \sqrt{\frac{\pi}{2k(x'-x)}} e^{-\frac{k}{2}\frac{y'^2}{(x'-x)}}$$

$$Z^{(1)} = -\frac{k}{\pi}\frac{\partial}{\partial y}\Phi, \quad Z^{(2)} = \frac{k}{\pi}\frac{\partial}{\partial x}\Phi.$$

B. C.) $u = -1, \quad v = \alpha \qquad$ for $|x| < 1$.

$[u = u_1 + u_2, \quad v = v_1 + v_2]$

$$\left[\begin{array}{ll} u_1 = -1, & u_2 = 0 \\ \underset{\text{平板}}{v_1 = 0}, & v_2 = \alpha \end{array}\right]$$

$$u_1 = -1 = 2\int_{-1}^{1} X U^{(1)} dx \approx \frac{2k}{\pi}\sqrt{\frac{\pi}{2k}}\int_{-1}^{1}\frac{X(x)e}{\sqrt{(x-x')}}dx'$$

$$v_1 = 0 = 2\int_{-1}^{1} X U^{(2)} dx =$$

$$u_2 = 0 = 2\int Y V^{(1)} dx = 2\int Y\left(\frac{\partial}{\partial y}\lg R + \Phi\right)dx$$

$$v_2 = \alpha = 2\int Y V^{(2)} dx \doteq \frac{1}{\pi}\int Y \frac{\partial}{\partial x}\lg R\, dx$$

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平板翼

$u=0\ ,\ v=1$

$$v_p = \frac{1}{\pi}\int_0^1 \Upsilon \frac{x-x'}{R^2}\,dx \quad = \frac{1}{\pi}\int_0^1 \frac{\Upsilon\,dx}{x-x'}$$

(x',y')

$$u_p = +\frac{1}{\pi}\int_0^1 \Upsilon \frac{y'}{R^2}\,dx \quad = \frac{1}{\pi}\int_0^1 \frac{\Upsilon\, y'\,dx}{(x-x')^2} = \Upsilon\,\mathrm{sgn}(y')$$

$$u_F = \frac{1}{\pi}\int_0^1 \Upsilon \frac{\partial \Phi}{\partial y}\,dx \qquad \Upsilon = -\sqrt{\frac{1-x}{x}} - \frac{1}{\sqrt{x(1-x)}}$$

$$= -\frac{2-x}{\sqrt{x(1-x)}} \doteqdot \frac{2}{\sqrt{x}}$$

$$v_F = \frac{-1}{\pi}\int_0^1 \Upsilon \frac{\partial \Phi}{\partial x}\,dx \qquad 1-x = \frac{1}{2}(1-\cos\theta)$$

$$x = \frac{1}{2}(1+\cos\theta)\ , \qquad \Upsilon = -\frac{1-\cos\theta}{\sin\theta} = \sqrt{\frac{1-\cos}{1+\cos}} = \sqrt{\frac{1-x}{x}}$$

$$v_p = \frac{1}{\pi}\int_0^\pi \frac{\Upsilon \sin\theta\,d\theta}{\cos\theta - \cos\theta'} = \frac{+1}{\pi}\int_0^\pi \frac{\cos\theta\,d\theta}{\cos\theta - \cos\theta'} = +1$$

$$\Upsilon = -\sqrt{\frac{1-x}{x}} = -\sqrt{\frac{1-\cos}{1+\cos}} = -\frac{\sin\frac{\theta}{2}}{\cos\frac{\theta}{2}} = -\frac{1-\cos\theta}{\sin\theta}$$

$$u_F = \frac{-1}{\pi}\sqrt{\frac{\pi}{2k}}\,\frac{\partial}{\partial y}\int_0^{x'} \sqrt{\frac{1-x}{x}}\,\frac{e^{-\frac{k(y-y')^2}{2(x'-x)}}}{\sqrt{x'-x}}\,dx \qquad -\frac{+y'}{(x'-x)}$$

$$= +\frac{1}{\sqrt{2\pi k}}\frac{\partial}{\partial y'}\int_0^{x'} e^{-\frac{y'^2}{2(x'-x)}}\frac{\sqrt{1-x}\,dx}{\sqrt{x(x'-x)}}$$

$$= +\frac{k y'}{\sqrt{2\pi k}}\int_0^{x'} e^{-\frac{k y'^2}{2(x'-x)}}\frac{\sqrt{1-x}\,dx}{\sqrt{x}\,(x'-x)^{\frac{3}{2}}}$$

$$\frac{k y'^2}{2(x'-x)} = \eta^2\ , \quad \eta = \sqrt{\frac{k}{2}}\frac{y'}{\sqrt{x'-x}}\ , \quad d\eta = \frac{1}{2}\sqrt{\frac{k}{2}}\frac{y'\,dx}{(x'-x)^{\frac{3}{2}}}$$

$$\therefore\ u_F = +\frac{2}{\sqrt{\pi}}\int_{\eta_0}^{\infty} e^{-\eta^2}\sqrt{\frac{1-x}{x}}\,d\eta\ , \qquad \eta_0 = \frac{k y'^2}{2x'}\ , \quad x'-x = \frac{k y'^2}{2\eta^2}$$

$$x = x' - \frac{k y'^2}{2\eta^2}$$

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$$\eta^2 = \eta_0^2 + u^2, \quad \eta\, d\eta = u\, du, \quad d\eta = \frac{u\, du}{\sqrt{\eta_0^2 + u^2}}$$

$$\sqrt{\frac{1-\cancel{X}}{\cancel{X}}} = \sqrt{\frac{1-X' + \frac{\;}{\;}}{X' - \frac{ky'^2}{2(\eta_0^2+u^2)}}} = \sqrt{\frac{1-X'}{X'}} \sqrt{\frac{\eta_0^2 + u^2 + \eta_0'^2}{\eta_0^2 + u^2 - \eta_0^2}}$$

$$\sqrt{\frac{1-X}{X}}\, d\eta = \sqrt{\frac{1-X'}{X'}}\, du \frac{\sqrt{\eta_0^2 + \eta_0'^2 + u^2}}{\sqrt{\eta_0^2 + u^2}} \xrightarrow[u \to 0]{} \frac{du}{\sqrt{X'}}$$

$$u_F \doteqdot + \frac{2}{\sqrt{\pi}} \frac{e^{-\eta_0^2}}{\sqrt{X'}} \int_0^\infty e^{-u^2} du = + \frac{e^{-\eta_0^2}}{\sqrt{X}} \xrightarrow[y \to 0]{} + \frac{1}{\sqrt{X}}$$

$$\frac{d\eta}{\sqrt{X(1-X)}} = \frac{1}{\sqrt{X'(1-X')}} \frac{u\, du}{\sqrt{\eta_0^2 + u^2}} \frac{\eta_0^2 + u^2}{u\sqrt{\eta_0^2 + \eta_0'^2 + u^2}} \xrightarrow{u \to 0} \frac{du}{\sqrt{X'(1-X')}} \frac{1}{\sqrt{1 + \frac{X'}{1-X'}}}$$

$$= \frac{du}{\sqrt{X'}}$$

$$v_F = \frac{1}{\sqrt{2\pi k}} \frac{\partial}{\partial X'} \int_0^{X'} e^{-\frac{ky'^2}{2(X'-X)}} \frac{\sqrt{1-X}\, dX}{\sqrt{X(X'-X)}}$$

$$= \frac{1}{\sqrt{2\pi k}} \frac{ky'^2}{2} \int_0^1 e^{-\eta^2} \sqrt{\frac{1-X}{X}} \frac{dX}{(X'-X)^{\frac{3}{2}}} = \frac{2}{\sqrt{\pi}\, ky'} \int_{\eta_0}^\infty \sqrt{\frac{1-X}{X}}\, e^{-\eta^2} d\eta$$

$$\frac{ky'^2}{2(X'-X)} \frac{dX}{(X'-X)^{\frac{3}{2}}} = \frac{2\sqrt{2}\,\eta^2\, d\eta}{\sqrt{k}\, y'}$$

$$v_F \doteqdot \frac{2}{\sqrt{\pi}\, ky'} \frac{e^{-\eta_0^2}\eta_0^2}{\sqrt{X'}} \int_0^\infty e^{-u^2} du = \frac{e^{-\eta_0^2}}{ky'} \frac{\eta_0^2}{\sqrt{X'}} = \frac{y'}{2X'^{\frac{3}{2}}} e^{-\eta_0^2}$$

$$\zeta = 2k v_F = \frac{ky'}{X'^{\frac{3}{2}}} e^{-\eta_0^2} \doteqdot -\frac{\partial u_F}{\partial y}$$

$$= \frac{\sqrt{2k}}{X'}\, \eta_0\, e^{-\eta_0^2}$$

$u = -1, \quad v = 0$

$$u_P = \frac{-1}{\pi}\int_0^{X'} X \frac{dX}{X - X'}$$

$$v_P = \frac{1}{\pi}\int_0^1 X \frac{+y'}{(X-X')^2} dX \longrightarrow \quad X = \frac{1}{\sqrt{2\pi k X'}} = X\, \mathrm{sgn}(y') \qquad \frac{1}{\sqrt{X'}}$$

$$u_F = \frac{-1}{\pi}\int_0^1 X\left(2k\overline{\Phi} - \frac{\partial \overline{\Phi}}{\partial x}\right) dx,$$

$$v_F = +\frac{1}{\pi}\int_0^1 X \frac{\partial \overline{\Phi}}{\partial y} dx,$$

$$u_F = -\sqrt{\frac{2k}{\pi}}\int_0^1 X\left(1 - \frac{y'^2}{\cancel{4}(X'-X)^2}\right)\frac{e^{-\eta^2}dX}{\sqrt{X'-X}}$$

$$= \frac{-1}{\pi}\int_0^{X'}\frac{e^{-\eta^2}dX}{\sqrt{X}(X'-X)} = -\frac{\sqrt{2k}}{\pi}\frac{y'}{\sqrt{X'}}\int_{\eta_0}^{\infty} e^{-\eta^2}\frac{d\eta}{\eta\sqrt{\eta^2-\eta_0^2}} = -\frac{2}{\pi}\eta_0 e^{-\eta_0^2}\int_0^{\infty}\frac{e^{-u^2}du}{\eta_0^2+u^2}$$

$$\frac{k}{2}\frac{y'^2}{(X'-X)} = \eta^2, \quad \frac{dX}{\sqrt{X'-X}} = \frac{2\sqrt{2}}{\sqrt{k}}\frac{X'-X}{y'}d\eta = \sqrt{2k}\frac{y'}{\eta^2}d\eta$$

$$\frac{1}{\sqrt{X}} = \frac{1}{\sqrt{X' - \frac{ky'^2}{2\eta^2}}} = \frac{\eta}{\sqrt{X'}\sqrt{\eta^2-\eta_0^2}} \qquad ; \eta_0 = \frac{\sqrt{k}}{\sqrt{2X'}}y'$$

$$\eta^2 - \eta_0^2 = u^2, \quad 2\eta\, d\eta = 2u\, du \qquad d\eta = \frac{u\,du}{\sqrt{\eta_0^2+u^2}}$$

$$\frac{d\eta}{\eta\sqrt{\eta^2-\eta_0^2}} = \frac{u\,du}{(\eta_0^2+u^2)u} = \frac{du}{\eta_0^2+u^2}$$

$$u_F = -\mathrm{erfc}(\eta_0) \quad \text{公式より}$$

$$u_P = -\frac{1}{\pi\sqrt{2\pi k}}\int_0^{X'}\frac{dX}{\sqrt{X}(X'-X)} = O\left(\frac{1}{\sqrt{k}}\right)$$

$$v_F \doteqdot \sqrt{\frac{1}{2\pi X k}}\left(1 - e^{-\eta_0^2}\right) \qquad \nu = \frac{1}{k}$$

$$\zeta = \sqrt{\frac{2k}{\pi X}}\left(\quad \right)$$

$$\iint \frac{\phi_y}{v_{2p}} \tilde{u}_{2p}\, dx\, dy = \int \phi\, \tilde{u}\, dx - \iint \phi\, \tilde{u}_y\, dx\, dy$$

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$$\varsigma_1 (v_1 \tilde{u}_1 - u_1 \tilde{v}_1) = \sqrt{\frac{2k}{\pi x'}} \left[\frac{1}{\sqrt{2\pi k x'}} (1 - e^{-\eta^2})\, \mathrm{erfc}(\eta') + \mathrm{erfc}(\eta) \frac{(1 - e^{-\eta'^2})}{\sqrt{2\pi k (1+x')}} \right]$$

$$= \frac{1}{\pi} \left[\frac{1}{x'} (1 - e^{-\eta^2})\, \mathrm{erfc}\, \eta' + \frac{(1 - e^{-\eta'^2})}{\sqrt{x'(1+x')}} \mathrm{erfc}\, \eta \right]$$

$$\varsigma_2 (v_2 \tilde{u}_1 - u_2 \tilde{v}_1) = \alpha \frac{\sqrt{2k}}{x'} \eta e^{-\eta^2} \left[\left(1 + \frac{\eta e^{-\eta'^2}}{\sqrt{2k}\, x'}\right) \mathrm{erfc}\, \eta' - \left(-\sqrt{\frac{1+x'}{x'}} + \frac{e^{-\eta^2}}{\sqrt{x'}}\right) \frac{(1 - e^{-\eta'^2})}{\sqrt{2\pi k (1+x')}} \right]$$

$$e^{-\eta^2}$$

$$\varsigma_1 (v_2 \tilde{u}_2 - u_2 \tilde{v}_2) = \alpha \sqrt{\frac{2k}{\pi x'}} \left[\left(1 + \frac{y'}{x'^{\frac{3}{2}}} e^{-\eta^2}\right) \left(\sqrt{\frac{x'}{1+x'}} - \frac{e^{-\eta'^2}}{\sqrt{1+x'}}\right) - \left(\sqrt{\frac{1+x'}{x'}} - \frac{e^{-\eta'^2}}{\sqrt{x'}}\right) \left(1 + \frac{y'}{(1+x')^{\frac{3}{2}}} e^{-\eta'^2}\right) \right]$$

$$\varsigma_2 (v_1 \tilde{u}_2 - u_1 \tilde{v}_2) = \alpha \frac{\sqrt{2k}}{x'} \eta e^{-\eta^2} \left[\frac{1}{\sqrt{2\pi k x'}} (1 - e^{-\eta^2}) \left(\sqrt{\frac{x'}{1+x'}} - \frac{e^{-\eta'^2}}{\sqrt{1+x'}}\right) - \mathrm{erfc}\, \eta \left(1 + \frac{y'}{(1+x')^{\frac{3}{2}}} e^{-\eta'^2}\right) \right]$$

$$\longrightarrow -\alpha \sqrt{2k} \int \frac{dx}{x'} \int_0^\infty \eta e^{-\eta^2} \mathrm{erfc}\, \eta \, dy'$$

$$\eta = \frac{\sqrt{k}}{\sqrt{2x'}} y', \quad \frac{dy'}{\sqrt{x'}} = \sqrt{\frac{2}{k}}\, d\eta$$

$$= -2\alpha \int^1 \frac{dx'}{\sqrt{x'}} \int_0^\infty \eta e^{-\eta^2} \mathrm{erfc}\, \eta \, d\eta$$

$$= -2\alpha \left(1 - \frac{1}{\sqrt{2}}\right)$$

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$u = u_1 + u_2$, $v = v_1 + v_2$

$\cancel{\hat{u}_1} = u_1 = -1$, $v_1 = 0 = \hat{v}_1$ $\tilde{u}_1 = 1$

$\hat{u}_2 = u_2 = 0$, $v_2 = \alpha$, $\tilde{v}_2 = -\alpha$

$\tilde{X}_1$, $\tilde{Y}_1 = \theta_0$, $\tilde{X}_2 = 0$

$$\int_C (X + \tilde{X}_1) ds = -\rho \iint_D \zeta (v\tilde{u}_1 - u\tilde{v}_1) ds$$

$\tilde{Y}_1 = 0$

$$\int_C \left[\alpha Y - (\tilde{X}_2 + \alpha \tilde{Y}_2)\right] ds = -\rho \iint_D \zeta (v\tilde{u}_2 - u\tilde{v}_2) ds$$

$\underline{\tilde{X}_2 = 0}$

$$\int_C (X + \tilde{X}_1) ds = -\iint_D \zeta (v\tilde{u}_1 - u\tilde{v}_1) ds = -2\iint_{D}$$

$$-\alpha \int_C (Y + \cancel{\tilde{Y}_2}) ds = -\iint_D \zeta (v\tilde{u}_2 - \cancel{u\tilde{v}_2}) ds$$

$\tilde{u}_2 X + \tilde{v}_2 Y$ $u = u_1 + u_2$, $v = v_1 + v_2$, $\zeta = \zeta_1 + \zeta_2$

$u\tilde{X}_2 + v\tilde{Y}$

$$\zeta v = \zeta_1 v_1 + \underbrace{\zeta_1 v_2}_{} + \underbrace{\zeta_2 v_1}_{} + \underbrace{\zeta_2 v_2}_{}$$

$$\zeta u = \underbrace{\zeta_1 u_1}_{0} + \underbrace{\zeta_1 u_2}_{c} + \underbrace{\zeta_2 u_1}_{c} + \underbrace{\zeta_2 u_2}_{0}$$

ζ_1 : odd	ζ_2 : even
u_1 : even	u_2 : odd
v_1 : odd	v_2 : even
$\zeta_1 v_1$: even	$\zeta_2 v_2$: even
$\zeta_1 u_1$: odd	$\zeta_2 u_2$: odd
$\zeta_1 v_2$: odd	$\zeta_2 v_1$: odd
$\zeta_1 u_2$: even	$\zeta_2 u_1$: even

$\overset{odd}{(\zeta_1 v_2 + \zeta_2 v_1)}\, \tilde{u}_1$; odd

$\underbrace{(\zeta_1 v_2 + \zeta_2 v_1)}_{even}\, \tilde{u}_2$; even

$(\zeta_1 u_2 + \zeta_2 u_1)\, \tilde{v}_1$; odd

$(\zeta_1 u_2 + \zeta_2 u_1)\, \tilde{v}_2$, even

$(\zeta_1 v_1 + \zeta_2 v_2)\, \tilde{u}_1$; even

$(\quad '' \quad)\, \tilde{u}_2$; odd

$\overset{odd}{(\zeta_1 u_1 + \zeta_2 u_2)}\, \tilde{v}_1$; even

$(\quad)\, \tilde{v}_2$; odd

$\tilde{u}_{2p}, \tilde{v}_{2p}$
$\tilde{u}_1, \tilde{v}_1$

$$\int_c (X + \tilde{X}_1)\, ds = -2 \iint_{\frac{D}{2}} \left[(\zeta_1 v_1 + \zeta_2 v_2)\tilde{u}_1 - (\zeta_1 u_1 + \zeta_2 u_2)\tilde{v}_1 \right] dx\,dy$$

α^2 を negl すれば $\quad = -2 \iint_{\frac{D}{2}} \left(\zeta_1 (v_1 \tilde{u}_1 - u_1 \tilde{v}_1)\right) dx\,dy$ ——→ 平均をとれば

$$-\alpha \int_c (Y + \cancel{\tilde{Y}})\, ds = -2 \iint_{\frac{D}{2}} \left[(\zeta_1 v_2 + \zeta_2 v_1)\tilde{u}_2 - (\zeta_1 u_2 + \zeta_2 u_1)\tilde{v}_2 \right] dx\,dy.$$

$\tilde{u}_2 = \tilde{u}_{2p}$, $\tilde{v}_2 = \tilde{v}_{2p}$ でもよい。

$$\eta_0 = \frac{k y'^2}{2 \cancel{X'}}$$

$$u_1 = u_F = -\operatorname{erfc}(\eta_0)$$

$$v_1 = v_{1F} = \sqrt{\frac{1}{2\pi k X'}}\left(1 - e^{-\eta^2}\right)$$

$$\zeta_1 = \sqrt{\frac{2k}{\pi X}}\left(\cancel{1}\, e^{-\eta^2}\right)\eta$$

$$u_2 = u_{2p} + u_{2F}, \quad u_{2p} = -\sqrt{\frac{1 - X'}{X'}}\,\alpha$$

$$u_{2F} = \frac{e^{-\eta^2}}{\sqrt{X'}}\,\alpha$$

$$v_2 = v_{2p} + v_{2F} = \alpha \cancel{\mp} \frac{\alpha |y'|}{X'^{\frac{3}{2}}} e^{-\eta^2}$$

$$\zeta_2 = 2k v_{2F} = \alpha \cancel{\mp} \frac{\cancel{2k}}{X'} \eta\, e^{-\eta^2}$$

aft wake では
$u_{2p} = 0$ for $y' < 0$
$v_{2p} = \frac{1}{\sqrt{kX'}}$

$y' > 0$

$$\tilde{u}_1 = \operatorname{erfc}(\eta') \qquad \eta' = \frac{k y'^2}{2(1 + X')}$$

$$\tilde{v}_1 = \sqrt{\frac{1}{2\pi k (1 + X')}}\left(1 - e^{-\eta'^2}\right)$$

$$\tilde{u}_2 = \sqrt{\frac{X'}{1 + X'}} - \frac{e^{-\eta'^2}}{\sqrt{1 + X'}}$$

$$\tilde{v}_2 = -\cancel{\alpha} - \frac{\cancel{\alpha}\, y'}{(1 + X')^{\frac{3}{2}}} e^{-\eta'^2}$$

$$\tilde{\zeta}_2 = 2k \tilde{v}_{2F} = -\alpha \frac{\sqrt{2k}}{1 + X'} \eta' e^{\eta'^2}$$

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$$\int_0^\infty \eta e^{-\eta^2} \operatorname{erfc}\eta \, d\eta = -\frac{1}{2} e^{-\eta^2} \operatorname{erfc}\eta \Big|_0^\infty - \frac{1}{\sqrt{\pi}} \int_0^\infty e^{-2\eta^2} d\eta$$

$\sqrt{2}$

$$= \frac{1}{2}\left(1 - \frac{1}{\sqrt{2}}\right)$$

$$\int_0^1 \frac{dx'}{\sqrt{x'}} = 2\sqrt{x'}\Big|_0^1 = 2$$

$$\frac{1}{x'} = t \qquad dx' = -\frac{dt}{t^2}$$

$$\int_1^\infty \frac{dx'}{\sqrt{x'}\sqrt{1+x'}} = \int_0^1 \frac{\sqrt{t}\, dt}{t^2 \sqrt{1+\frac{1}{t}}} = \int_0^1 \frac{dt}{t\sqrt{1+t}}$$

$$\int_1^\infty \frac{dx'}{x'\sqrt{1+x'}} = \int_0^1 \frac{dt}{\sqrt{t}\sqrt{1+t}} = 2\int_0^1 \frac{du}{\sqrt{1+u^2}}$$

$t = u^2$

η

$$\int_0^\infty e^{-\eta^2} \eta \, d\eta = \frac{1}{2} e^{-\eta^2} \Big| = \frac{1}{2}$$

$-\eta \ldots$

$$\int_0^\infty e^{-2\eta^2} \eta \, d\eta = \frac{1}{4}$$

$$\sqrt{\frac{1-x}{x}}\, dx$$

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$$\sqrt{\frac{2k}{\pi X'}}\sqrt{\frac{X'}{1-X'}}\int_0^\infty e^{-\eta^2}dy' = \frac{2}{\sqrt{\pi}}\sqrt{\frac{X'}{1-X'}}\int_0^\infty e^{-\eta^2}d\eta = \sqrt{\frac{X'}{1-X'}}$$

$$\int_0^1\sqrt{\frac{X'}{1-X'}}dX' = 2\int_0^1\sqrt{1-t^2}\,dt = 2\int_0^{\frac{\pi}{2}}\cos^2\theta\,d\theta = \int_0^{\frac{\pi}{2}}(1+\cos 2\theta)d\theta$$

$$\sqrt{1-X'} = t \qquad -\frac{dX'}{2\sqrt{1-X'}} = dt. \qquad = \frac{\pi}{2} + \frac{\sin 2\theta}{2}$$

$$= \frac{\pi}{2} \quad //$$

$$X' = 1-t^2$$

$$\frac{k}{2X'}y'^2 = \eta^2$$

$$\frac{k}{X'}y'dy' = 2\eta\,d\eta$$

$$\sqrt{\frac{2k}{\pi X'}}\sqrt{\frac{X'}{1-X'}}\frac{y'}{X'^{\frac{3}{2}}}e^{-2\eta^2}dy' = \sqrt{\frac{2}{\pi k}}\frac{2}{\sqrt{1-X'}\sqrt{X'}}\int_0^\infty e^{-2\eta^2}\eta\,d\eta$$

$$= \frac{1}{\sqrt{2\pi k}}\frac{1}{\sqrt{X'(1-X')}}$$

$$\frac{1}{4}\int_0^\infty e^{-2\eta^2}4\eta\,d\eta \qquad \frac{1}{4}e^{-2\eta} \qquad \frac{1}{4}$$

$$X' = \sin^2\theta$$

$$\int_0^1\frac{dX'}{\sqrt{X'(1-X')}} = 2\int_0^{\frac{\pi}{2}}\frac{\sin\theta\cos\theta\,d\theta}{\sin\theta\cos\theta} = \pi //$$

$$\frac{\sqrt{2\pi}}{\sqrt{k}} = \frac{\sqrt{2}\,\pi}{\sqrt{\pi k}}$$

$$\frac{1}{\sqrt{2\pi k}}\int\frac{dX'}{\sqrt{X'(1-X')}} = \frac{\sqrt{\pi}}{\sqrt{2k}} \quad //$$

$$D = \frac{2\sqrt{2}}{\sqrt{\pi k}} \qquad = \frac{\pi D}{2}$$

$$\iint\frac{\sqrt{2k}}{X'}\eta\sqrt{\frac{1}{2\pi\,dX'}}e^{-\eta^2}(1-e^{-\eta^2})\,dy' = \frac{1}{\sqrt{\pi}}\sqrt{\frac{2}{k}}\int_0^1\frac{dX'}{\sqrt{X'(1-X')}}\int_0^\infty\eta e^{-\eta^2}(1-e^{-\eta^2})\,d\eta$$

$$\sqrt{\frac{X'}{1-X'}}$$

$$\left(\frac{1}{2}-\frac{1}{4}\right) = \frac{1}{4}$$

$$= \frac{1}{2\sqrt{2\pi k}}\int_0^1\frac{dX'}{\sqrt{X'(1-X')}} = \frac{\sqrt{\pi}}{2\sqrt{2k}} \quad //$$

$$\frac{1}{4}\times\frac{180}{\pi}$$

$$\frac{3C_L}{2\pi} = \pi\frac{3\pi}{2}D$$

$$\alpha(\ ) = L(3D \quad \frac{d\alpha}{dC} = \frac{1}{\pi(\ \ 3\pi)}$$