Theorem 1 (Residue Theorem) *Let f be analytic in the region G except for the isolated singularities $a_1, a_2, \ldots, a_m$. If γ is a closed rectifiable curve in G which does not pass through any of the points a_k and if $\gamma \approx 0$ in G, then*

$$\frac{1}{2\pi i}\int_\gamma f = \sum_{k=1}^m n(\gamma; a_k)\,\mathrm{Res}(f; a_k)\,.$$

$$\begin{pmatrix} D_1 t & -a_{12}t_2 & \dots & -a_{1n}t_n \\ -a_{21}t_1 & D_2 t & \dots & -a_{2n}t_n \\ \hdotsfor{4} \\ -a_{n1}t_1 & -a_{n2}t_2 & \dots & D_n t \end{pmatrix}$$

$$\begin{multline} \left(\sum_{i\in\mathrm{n}} a_{l_i} x_i\right) \det \mathrm{K}(t=1, x_1, \ldots, x_n; l|l) \\ = \left(\prod_{i\in\mathrm{n}} \hat{x}_i\right) \sum_{I\subseteq\mathrm{n}-\{l\}} (-1)^{|I|} \mathrm{A}^{(\lambda)}(I|I) \det \mathrm{A}^{(\lambda)}(\bar{I}\cup\{l\}|\bar{I}\cup\{l\}). \quad (1) \end{multline}$$

$$v_i^k = \begin{cases} 1 & \text{if } i \in \Lambda_k, \\ 0 & \text{otherwise.} \end{cases}$$

$$\left.\frac{\partial x}{\partial y}\right|\frac{\partial y}{\partial z}$$

$$\sum_{\substack{i<B \\ i \text{ odd}}} \prod_\kappa \kappa F(r_i) \qquad \sum_{\substack{i<B \\ i \text{ odd}}} \prod_\kappa \kappa(r_i)$$

$$\overrightarrow{\psi_\delta(t) E_t h} = \underrightarrow{\psi_\delta(t) E_t h}$$

$$\overleftarrow{\psi_\delta(t) E_t h} = \underleftarrow{\psi_\delta(t) E_t h}$$

$$\overleftrightarrow{\psi_\delta(t) E_t h} = \underleftrightarrow{\psi_\delta(t) E_t h}$$

Then we have the series $A_1, A_2, \ldots$, the regional sum $A_1 + A_2 + \cdots$, the orthogonal product $A_1 A_2 \cdots$, and the infinite integral

$$\int_{A_1}\int_{A_2}\cdots$$

$$\Hat{\Hat{H}} \quad \Check{\Check{C}} \quad \Tilde{\Tilde{T}} \quad \Acute{\Acute{A}} \quad \Grave{\Grave{G}} \quad \Dot{\Dot{D}} \quad \Ddot{\Ddot{D}} \quad \Breve{\Breve{B}} \quad \Bar{\Bar{B}} \quad \Vec{\Vec{V}}$$

$$\dddot{Q} \qquad \ddddot{R}$$

$$\sqrt[\beta]{k}$$

$$\boxed{W_t - F \subseteq V(P_i) \subseteq W_t}$$

$$0 \xleftarrow[\zeta]{\alpha} F \times \triangle[n-1] \xrightarrow{\partial_0 \alpha(b)} E^{\partial_0 b}$$

$$\sideset{^*_*}{^*_*}\prod_k \qquad \sum_{0\le i\le m}{}' E_i\beta x$$

$$\mathrm{y} = \mathrm{y}' \quad \text{if and only if} \quad y'_k = \delta_k y_{\tau(k)}$$

$$\|f\|_\infty = \operatorname*{ess\,sup}_{x\in R^n} |f(x)|$$

$$\operatorname{meas}_1\{u \in R^1_+ \colon f^*(u) > \alpha\} = \operatorname{meas}_n\{x \in R^n \colon |f(x)| \geq \alpha\} \quad \forall \alpha > 0.$$

$$\varlimsup_{n\to\infty} Q(u_n, u_n - u^{\#}) \le 0 \tag{2}$$

$$\varliminf_{n\to\infty} |a_{n+1}| / |a_n| = 0 \tag{3}$$

$$\varinjlim (m_i^\lambda \cdot)^* \le 0 \tag{4}$$

$$\varprojlim_{p\in S(A)} A_p \le 0 \tag{5}$$

$$x \equiv y + 1 \pmod{m^2} \tag{6}$$

$$x \equiv y + 1 \mod m^2 \tag{7}$$

$$x \equiv y + 1 \pod{m^2} \tag{8}$$

$$\begin{aligned} \sum_{\gamma\in\Gamma_C} I_\gamma &= 2^k - \binom{k}{1}2^{k-1} + \binom{k}{2}2^{k-2} \\ &\quad + \cdots + (-1)^l\binom{k}{l}2^{k-l} + \cdots + (-1)^k \\ &= (2-1)^k = 1 \end{aligned} \tag{9}$$

$$\frac{\partial^2 u}{\partial t^2} = c^2 \left(\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r} + \frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2}\right)$$

$$\begin{aligned} u\,(r,\theta,0) &= 0 \\ u_t\,(r,\theta,0) &= \left\{ \begin{array}{cc} \frac{1}{\pi\epsilon^2} & \text{if } r \le \epsilon \\ 0 & \text{otherwise} \end{array} \right. \end{aligned}$$

$$\cfrac{1}{\sqrt{2} + \cfrac{1}{\sqrt{2} + \cfrac{1}{\sqrt{2} + \cfrac{1}{\sqrt{2} + \cfrac{1}{\sqrt{2} + \cdots}}}}}$$

$$P_{r-j} = \begin{cases} 0 & \text{if } r - j \text{ is odd,} \\ r!\,(-1)^{(r-j)/2} & \text{if } r - j \text{ is even.} \end{cases} \tag{10}$$

$$\begin{matrix} \vartheta & \varrho \\ \varphi & \varpi \end{matrix} \quad \begin{pmatrix} \vartheta & \varrho \\ \varphi & \varpi \end{pmatrix} \quad \begin{bmatrix} \vartheta & \varrho \\ \varphi & \varpi \end{bmatrix} \quad \begin{Bmatrix} \vartheta & \varrho \\ \varphi & \varpi \end{Bmatrix} \quad \begin{vmatrix} \vartheta & \varrho \\ \varphi & \varpi \end{vmatrix} \quad \begin{Vmatrix} \vartheta & \varrho \\ \varphi & \varpi \end{Vmatrix}$$

This is a small matrix $\left(\begin{smallmatrix} a & b \\ c & d \end{smallmatrix}\right)$

$$W(\Phi) = \begin{Vmatrix} \dfrac{\varphi}{(\varphi_1, \varepsilon_1)} & 0 & \dots & 0 & \\ \dfrac{\varphi k_{n2}}{(\varphi_2, \varepsilon_1)} & \dfrac{\varphi}{(\varphi_2, \varepsilon_2)} & \dots & 0 & \\ \hdotsfor{5} \\ \dfrac{\varphi k_{n1}}{(\varphi_n, \varepsilon_1)} & \dfrac{\varphi k_{n2}}{(\varphi_n, \varepsilon_2)} & \dots & \dfrac{\varphi k_{n\,n-1}}{(\varphi_n, \varepsilon_{n-1})} & \dfrac{\varphi}{(\varphi_n, \varepsilon_n)} \end{Vmatrix}$$

$$\sum_{\substack{0 \le i \le m \\ 0 < j < n}} P(i, j)$$

$$\left(\mathrm{E}_y \int_0^{t_\varepsilon} L_{x,y^x(s)} \varphi(x)\, ds\right)$$

$$\left(\mathrm{E}_y \int_0^{t_\varepsilon} L_{x,y^x(s)} \varphi(x)\, ds\right)$$

$$\begin{aligned} f_{h,\varepsilon}(x,y) &= \varepsilon \mathrm{E}_{x,y} \int_0^{t_\varepsilon} L_{x,y_\varepsilon(\varepsilon u)} \varphi(x)\, du \\ &= h \int L_{x,z} \varphi(x) \rho_x(dz) \\ &\quad + h\biggl[\frac{1}{t_\varepsilon}\biggl(\mathrm{E}_y \int_0^{t_\varepsilon} L_{x,y^x(s)} \varphi(x)\, ds - t_\varepsilon \int L_{x,z} \varphi(x) \rho_x(dz)\biggr) \\ &\qquad + \frac{1}{t_\varepsilon}\biggl(\mathrm{E}_y \int_0^{t_\varepsilon} L_{x,y^x(s)} \varphi(x)\, ds - \mathrm{E}_{x,y} \int_0^{t_\varepsilon} L_{x,y_\varepsilon(\varepsilon s)} \varphi(x)\, ds\biggr)\biggr] \\ &= h\widehat{L}_x \varphi(x) + h\theta_\varepsilon(x,y), \end{aligned} \tag{11}$$

$$\begin{aligned} |I_1| &= \left|\int_\Omega gRu\, d\Omega\right| \\ &\le C_3 \left[\int_\Omega \left(\int_a^x g(\xi,t)\, d\xi\right)^2 d\Omega\right]^{1/2} \\ &\quad \times \left[\int_\Omega \left\{u_x^2 + \frac{1}{k}\left(\int_a^x cu_t\, d\xi\right)^2\right\} c\Omega\right]^{1/2} \\ &\le C_4 \left\| f \left| \widetilde{S}_{a,-}^{-1,0} W_2(\Omega, \Gamma_l) \right| \right\| \left| |u| \overset{\circ}{\to} W_2^{\widetilde{A}}(\Omega; \Gamma_r, T) \right\|. \end{aligned} \tag{12}$$

$$\begin{aligned} |I_2| &= \left|\int_0^T \psi(t) \left\{u(a,t) - \int_{\gamma(t)}^a \frac{d\theta}{k(\theta,t)} \int_a^\theta c(\xi) u_t(\xi,t)\, d\xi\right\} dt\right| \\ &\le C_6 \left\| f \int_\Omega \left| \widetilde{S}_{a,-}^{-1,0} W_2(\Omega, \Gamma_l) \right| \right\| \left| |u| \overset{\circ}{\to} W_2^{\widetilde{A}}(\Omega; \Gamma_r, T) \right\|. \end{aligned} \tag{13}$$

$$\int_a^b \left\{ \int_a^b [f(x)^2 g(y)^2 + f(y)^2 g(x)^2] - 2f(x)g(x)f(y)g(y)\,dx \right\} dy$$
$$= \int_a^b \left\{ g(y)^2 \int_a^b f^2 + f(y)^2 \int_a^b g^2 - 2f(y)g(y) \int_a^b fg \right\} dy \quad (14)$$

$$D(a,r) \equiv \{z \in \mathbb{C} \colon |z-a| < r\}, \quad (15)$$
$$seg(a,r) \equiv \{z \in \mathbb{C} \colon \Im z = \Im a,\ |z-a| < r\},$$
$$c(e,\theta,r) \equiv \{(x,y) \in \mathbb{C} \colon |x-e| < y \tan\theta,\ 0 < y < r\}, \quad (16)$$
$$C(E,\theta,r) \equiv \bigcup_{e \in E} c(e,\theta,r). \quad (17)$$

$$\gamma_x(t) = (\cos tu + \sin tx, v), \quad (18)$$
$$\gamma_y(t) = (u, \cos tv + \sin ty), \quad (19)$$
$$\gamma_z(t) = \left(\cos tu + \frac{\alpha}{\beta} \sin tv, -\frac{\beta}{\alpha} \sin tu + \cos tv \right). \quad (20)$$

$$\gamma_x(t) = (\cos tu + \sin tx, v),$$
$$\gamma_y(t) = (u, \cos tv + \sin ty),$$
$$\gamma_z(t) = \left(\cos tu + \frac{\alpha}{\beta} \sin tv, -\frac{\beta}{\alpha} \sin tu + \cos tv \right).$$

$$x = y \qquad \text{by eq:C} \quad (21)$$
$$x' = y' \qquad \text{by eq:D} \quad (22)$$
$$x + x' = y + y' \qquad \text{by Axiom 1.} \quad (23)$$

$$\begin{aligned} \varphi(x,z) &= z - \gamma_{10} x - \gamma_{mn} x^m z^n \\ &= z - M r^{-1} x - M r^{-(m+n)} x^m z^n \end{aligned} \quad (24)$$

$$\zeta^0 = (\xi^0)^2,$$
$$\zeta^1 = \xi^0 \xi^1,$$
$$\zeta^2 = (\xi^1)^2,$$

$$\varphi(x,z) = z - \gamma_{10} x - \gamma_{mn} x^m z^n$$
$$= z - M r^{-1} x - M r^{-(m+n)} x^m z^n$$

$$\zeta^0 = (\xi^0)^2, \quad (25)$$
$$\zeta^1 = \xi^0 \xi^1, \quad (26)$$
$$\zeta^2 = (\xi^1)^2, \quad (27)$$

$$V_i = v_i - q_i v_j, \qquad X_i = x_i - q_i x_j, \qquad U_i = u_i, \qquad \text{for } i \neq j; \tag{28}$$

$$V_j = v_j, \qquad X_j = x_j, \qquad U_j u_j + \sum_{i \neq j} q_i u_i. \tag{29}$$

$$u_{\theta\theta} + \frac{v^2}{1 - \frac{v^2}{c^2}} u_{vv} + v u_v = 0$$

$$u(\theta, v) = \frac{e^{\frac{-4\sqrt{-c_1}\,\theta\, c^2 + v^2}{4c^2}} \left(\text{WhittakerW}\left(-\frac{-c_1}{2} + \frac{1}{2}, \frac{i\sqrt{-c_1}}{2}, \frac{v^2}{2c^2}\right) c_4 + \text{WhittakerM}\left(-\frac{-c_1}{2} + \frac{1}{2}, \frac{i\sqrt{-c_1}}{2}, \frac{v^2}{2c^2}\right) c_3\right) \left(c_1 e^{2\sqrt{-c_1}\,\theta}\right.}{v}$$

$$u(x, t) = \sum_{n=1}^{\infty} \left(D_n \cos\left(c\frac{n\pi}{L} t\right) + E_n \sin\left(c\frac{n\pi}{L} t\right)\right) \Phi_n(x) \tag{1}$$

$$\begin{aligned} \int_0^L f(x)\, \Phi_n(x)\, dx &= D_n \int_0^L \Phi_n^2(x)\, dx \\ &= \frac{L}{2} D_n \end{aligned}$$

$$\begin{aligned} \int_0^L g(x)\, \Phi_n(x)\, dx &= E_n c \frac{n\pi}{L} \int_0^L \Phi_n^2(x)\, dx \\ &= \frac{L}{2} E_n c \frac{n\pi}{L} \\ &= \frac{1}{2} E_n c n \pi \end{aligned}$$

$$\Delta F_0 = \sqrt{\sum_{i=1}^{n} \left(\frac{\delta F_0}{\delta x_i} \Delta x_i\right)^2} \tag{30}$$

$$\Delta F_0 = \sqrt{6.044 \cdot 10^{-6} \mathrm{m}^2} \tag{31}$$

$$\begin{aligned} a &= b + c \\ d &= e + f + g + r + c + e + f + g + r + c + e + f + g + r \\ h + i &= j \end{aligned} \tag{1}$$

$$\frac{du}{dt} = \frac{\partial u}{\partial x} \frac{dx}{dt} + \frac{\partial u}{\partial t} \tag{2}$$

Integrating the above w.r.t t gives

$$\begin{aligned} \int \left(x' x'' + 6 x' x^5\right) dt &= 0 \\ \frac{x'^2}{2} + x^6 &= c_1 \end{aligned}$$

$$\int (1-x)^{20} x^4 \, dx = -\frac{1}{21}(1-x)^{21} + \frac{2}{11}(1-x)^{22} - \frac{6}{23}(1-x)^{23} + \frac{1}{6}(1-x)^{24} - \frac{1}{25}(1-x)^{25}$$

And

$$\int \frac{\left(-15+x^2\right)\log\left(x^2\right) + \left(180+24x-12x^2\right)\log\left(\log\left(x^2\right)\right) + \left(-45-3x^2\right)\text{lo}}{\left(225-240x+94x^2-16x^3+x^4\right)\log\left(x^2\right) + \left(1350-540x-96x^2+60x^3-6x^4\right)\log\left(x^2\right)\log^2\left(\log\left(x^2\right)\right) + (20}$$

$$\frac{d}{dx}\phi(x,y) = 0$$

Hence

$$\frac{\partial \phi}{\partial x} + \frac{\partial \phi}{\partial y}\frac{dy}{dx} = 0 \tag{B}$$

Integrating (1) w.r.t. x gives

$$\begin{aligned} \int \frac{\partial \phi}{\partial x} \, \mathrm{d}x &= \int M \, \mathrm{d}x \\ \int \frac{\partial \phi}{\partial x} \, \mathrm{d}x &= \int -2x - 1 \, \mathrm{d}x \\ \phi &= -x^2 - x + f(y) \end{aligned} \tag{3}$$

Where $f(y)$ is used for the constant of integration since ϕ is a function of both x and y. Taking derivative of equation (3) w.r.t y gives

$$\frac{\partial \phi}{\partial y} = 0 + f'(y) \tag{4}$$

But since ϕ itself is a constant function, then let $\phi = c_2$ where c_2 is new constant and combining c_1 and c_2 constants into the constant c_1 gives the solution as

$$c_1 = -x^2 - x + y$$