

1 Sebastian's math test

The default math mode font is *Math Italic*. This should not be confused with ordinary *Text Italic* – notice the different spacing! `\mathbf` produces bold roman letters: **abcABC**. If you wish to embolden complete formulas, use the `\boldmath` command *before* going into math mode. This changes the default math fonts to bold.

normal $x = 2\pi \Rightarrow x \simeq 6.28$
`mathbf` $\mathbf{x} = 2\pi \Rightarrow \mathbf{x} \simeq 6.28$
`boldmath` $\mathbf{x} = 2\pi \Rightarrow \mathbf{x} \simeq 6.28$

Greek is available in upper and lower case: $\alpha, \beta \dots \Omega$, and there are special symbols such as \hbar (compare to h). Digits in formulas 1, 2, 3... may differ from those in text: 4, 5, 6...

There is Sans Serif alphabet abcdeABCD selected by `\mathsf` and Typewriter math abcdeABCD selected by `\mathtt`.

There is a calligraphic alphabet `\mathcal` for upper case letters $\mathcal{A}\mathcal{B}\mathcal{C}\mathcal{D}\mathcal{E} \dots$, and there are letters for number sets: $\mathbb{A} \dots \mathbb{Z}$, which are produced using `\mathbb`. There are Fraktur letters $\mathfrak{a}\mathfrak{b}\mathfrak{c}\mathfrak{d}\mathfrak{e}\mathfrak{A}\mathfrak{B}\mathfrak{C}\mathfrak{D}\mathfrak{E}$ produced using `\mathfrak`.

$$\sigma(t) = \frac{1}{\sqrt{2\pi}} \int_0^t e^{-x^2/2} dx \quad (1)$$

$$\prod_{j \geq 0} \left(\sum_{k \geq 0} a_{jk} z^k \right) = \sum_{k \geq 0} z^n \left(\sum_{\substack{k_0, k_1, \dots \geq 0 \\ k_0 + k_1 + \dots = n}} a_0 k_0 a_1 k_1 \dots \right) \quad (2)$$

$$\pi(n) = \sum_{m=2}^n \left[\left(\sum_{k=1}^{m-1} \lfloor (m/k) / \lceil m/k \rceil \rfloor \right)^{-1} \right] \quad (3)$$

$$\overbrace{\{a, \dots, a, b, \dots, b\}}^{k \text{ a's} \quad l \text{ b's}} \quad (4)$$

$k+l$ elements

$$\begin{aligned} & \nearrow \mu^+ + \nu_\mu \\ \mathbb{W}^+ & \rightarrow \pi^+ + \pi^0 \\ & \rightarrow \kappa^+ + \pi^0 \\ & \searrow e^+ + \nu_e \end{aligned}$$

$$\pm \frac{\begin{vmatrix} x_1 - x_2 & y_1 - y_2 & z_1 - z_2 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix}}{\sqrt{\begin{vmatrix} l_1 & m_1 \\ l_2 & m_2 \end{vmatrix}^2 + \begin{vmatrix} m_1 & n_1 \\ n_1 & l_1 \end{vmatrix}^2 + \begin{vmatrix} m_2 & n_2 \\ n_2 & l_2 \end{vmatrix}^2}}$$

2 Math Tests

Math test are taken from[?].

2.1 Math Alphabets

Math Italic (`\mathnormal`)

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z,
a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, ι, j,
A, B, Γ, Δ, E, Z, H, Θ, I, K, Λ, M, N, Ξ, O, Π, P, Σ, T, Υ, Φ, X, Ψ, Ω,
α, β, γ, δ, ε, ζ, η, θ, ι, κ, λ, μ, ν, ξ, ο, π, ρ, σ, τ, υ, φ, χ, ψ, ω, ε, ϑ, Ϙ, ϙ, ς, φ, ℓ, ϕ,

Math Roman (`\mathrm`)

0, 1, 2, 3, 4, 5, 6, 7, 8, 9,
A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z,
a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, ι, j,
A, B, Γ, Δ, E, Z, H, Θ, I, K, Λ, M, N, Ξ, O, Π, P, Σ, T, Υ, Φ, X, Ψ, Ω,
α, β, γ, δ, ε, ζ, η, θ, ι, κ, λ, μ, ν, ξ, ο, π, ρ, σ, τ, υ, φ, χ, ψ, ω, ε, ϑ, Ϙ, ϙ, ς, φ, ℓ, ϕ,

Math Bold (`\mathbf`)

0, 1, 2, 3, 4, 5, 6, 7, 8, 9,
A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z,
a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, ι, j,

Math Sans Serif (`\mathsf`)

0, 1, 2, 3, 4, 5, 6, 7, 8, 9,
A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z,
a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, ι, j,

Caligraphic (`\mathcal`)

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z,

Fraktur (`\mathfrak`)

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z,
a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, ι, j,

Blackboard Bold (`\mathbb`)

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z,

2.2 Character Sidebearings

|A| + |B| + |C| + |D| + |E| + |F| + |G| + |H| + |I| + |J| + |K| + |L| + |M| +
|N| + |O| + |P| + |Q| + |R| + |S| + |T| + |U| + |V| + |W| + |X| + |Y| + |Z| +
|a| + |b| + |c| + |d| + |e| + |f| + |g| + |h| + |i| + |j| + |k| + |l| + |m| +
|n| + |o| + |p| + |q| + |r| + |s| + |t| + |u| + |v| + |w| + |x| + |y| + |z| + |t| + |j| +
|A| + |B| + |Γ| + |Δ| + |E| + |Z| + |H| + |Θ| + |I| + |K| + |Λ| + |M| +
|N| + |Ξ| + |O| + |Π| + |P| + |Σ| + |T| + |Υ| + |Φ| + |X| + |Ψ| + |Ω| +
|α| + |β| + |γ| + |δ| + |ε| + |ζ| + |η| + |θ| + |ι| + |κ| + |λ| + |μ| +
|ν| + |ξ| + |ο| + |π| + |ρ| + |σ| + |τ| + |υ| + |φ| + |χ| + |ψ| + |ω| +
|ε| + |ϑ| + |Ϙ| + |ϙ| + |ς| + |φ| + |ℓ| + |ϕ| +

|A| + |B| + |C| + |D| + |E| + |F| + |G| + |H| + |I| + |J| + |K| + |L| + |M| +
|N| + |O| + |P| + |Q| + |R| + |S| + |T| + |U| + |V| + |W| + |X| + |Y| + |Z| +
|a| + |b| + |c| + |d| + |e| + |f| + |g| + |h| + |i| + |j| + |k| + |l| + |m| +
|n| + |o| + |p| + |q| + |r| + |s| + |t| + |u| + |v| + |w| + |x| + |y| + |z| + |t| + |j| +
|A| + |B| + |Γ| + |Δ| + |E| + |Z| + |H| + |Θ| + |I| + |K| + |Λ| + |M| +
|N| + |Ξ| + |O| + |Π| + |P| + |Σ| + |T| + |Υ| + |Φ| + |X| + |Ψ| + |Ω| +

|A| + |B| + |C| + |D| + |E| + |F| + |G| + |H| + |I| + |J| + |K| + |L| + |M| +
|N| + |O| + |P| + |Q| + |R| + |S| + |T| + |U| + |V| + |W| + |X| + |Y| + |Z| +

2.3 Superscript positioning

$$\begin{aligned} &A^2 + B^2 + C^2 + D^2 + E^2 + F^2 + G^2 + H^2 + I^2 + J^2 + K^2 + L^2 + M^2 + \\ &N^2 + O^2 + P^2 + Q^2 + R^2 + S^2 + T^2 + U^2 + V^2 + W^2 + X^2 + Y^2 + Z^2 + \\ &a^2 + b^2 + c^2 + d^2 + e^2 + f^2 + g^2 + h^2 + i^2 + j^2 + k^2 + l^2 + m^2 + \\ &n^2 + o^2 + p^2 + q^2 + r^2 + s^2 + t^2 + u^2 + v^2 + w^2 + x^2 + y^2 + z^2 + i^2 + j^2 + \\ &A^2 + B^2 + \Gamma^2 + \Delta^2 + E^2 + Z^2 + H^2 + \Theta^2 + I^2 + K^2 + \Lambda^2 + M^2 + \\ &N^2 + \Xi^2 + O^2 + \Pi^2 + P^2 + \Sigma^2 + T^2 + \Upsilon^2 + \Phi^2 + X^2 + \Psi^2 + \Omega^2 + \\ &\alpha^2 + \beta^2 + \gamma^2 + \delta^2 + \epsilon^2 + \zeta^2 + \eta^2 + \theta^2 + i^2 + \kappa^2 + \lambda^2 + \mu^2 + \\ &\nu^2 + \xi^2 + o^2 + \pi^2 + \rho^2 + \sigma^2 + \tau^2 + v^2 + \phi^2 + \chi^2 + \psi^2 + \omega^2 + \\ &\varepsilon^2 + \vartheta^2 + \varpi^2 + \varrho^2 + \varsigma^2 + \phi^2 + \ell^2 + \wp^2 + \end{aligned}$$

$$\begin{aligned} &A^2 + B^2 + C^2 + D^2 + E^2 + F^2 + G^2 + H^2 + I^2 + J^2 + K^2 + L^2 + M^2 + \\ &N^2 + O^2 + P^2 + Q^2 + R^2 + S^2 + T^2 + U^2 + V^2 + W^2 + X^2 + Y^2 + Z^2 + \\ &a^2 + b^2 + c^2 + d^2 + e^2 + f^2 + g^2 + h^2 + i^2 + j^2 + k^2 + l^2 + m^2 + \\ &n^2 + o^2 + p^2 + q^2 + r^2 + s^2 + t^2 + u^2 + v^2 + w^2 + x^2 + y^2 + z^2 + i^2 + j^2 + \\ &A^2 + B^2 + \Gamma^2 + \Delta^2 + E^2 + Z^2 + H^2 + \Theta^2 + I^2 + K^2 + \Lambda^2 + M^2 + \\ &N^2 + \Xi^2 + O^2 + \Pi^2 + P^2 + \Sigma^2 + T^2 + \Upsilon^2 + \Phi^2 + X^2 + \Psi^2 + \Omega^2 + \end{aligned}$$

$$\begin{aligned} &\mathcal{A}^2 + \mathcal{B}^2 + \mathcal{C}^2 + \mathcal{D}^2 + \mathcal{E}^2 + \mathcal{F}^2 + \mathcal{G}^2 + \mathcal{H}^2 + \mathcal{I}^2 + \mathcal{J}^2 + \mathcal{K}^2 + \mathcal{L}^2 + \mathcal{M}^2 + \\ &\mathcal{N}^2 + \mathcal{O}^2 + \mathcal{P}^2 + \mathcal{Q}^2 + \mathcal{R}^2 + \mathcal{S}^2 + \mathcal{T}^2 + \mathcal{U}^2 + \mathcal{V}^2 + \mathcal{W}^2 + \mathcal{X}^2 + \mathcal{Y}^2 + \mathcal{Z}^2 + \end{aligned}$$

2.4 Subscript positioning

$A_i + B_i + C_i + D_i + E_i + F_i + G_i + H_i + I_i + J_i + K_i + L_i + M_i +$
 $N_i + O_i + P_i + Q_i + R_i + S_i + T_i + U_i + V_i + W_i + X_i + Y_i + Z_i +$
 $a_i + b_i + c_i + d_i + e_i + f_i + g_i + h_i + i_i + j_i + k_i + l_i + m_i +$
 $n_i + o_i + p_i + q_i + r_i + s_i + t_i + u_i + v_i + w_i + x_i + y_i + z_i + \iota_i + J_i +$
 $A_i + B_i + \Gamma_i + \Delta_i + E_i + Z_i + H_i + \Theta_i + I_i + K_i + \Lambda_i + M_i +$
 $N_i + \Xi_i + O_i + \Pi_i + P_i + \Sigma_i + T_i + \Upsilon_i + \Phi_i + X_i + \Psi_i + \Omega_i +$
 $\alpha_i + \beta_i + \gamma_i + \delta_i + \epsilon_i + \zeta_i + \eta_i + \theta_i + \iota_i + \kappa_i + \lambda_i + \mu_i +$
 $\nu_i + \xi_i + o_i + \pi_i + \rho_i + \sigma_i + \tau_i + v_i + \phi_i + \chi_i + \psi_i + \omega_i +$
 $\varepsilon_i + \vartheta_i + \varpi_i + \varrho_i + \varsigma_i + \varphi_i + \ell_i + \wp_i +$

$A_i + B_i + C_i + D_i + E_i + F_i + G_i + H_i + I_i + J_i + K_i + L_i + M_i +$
 $N_i + O_i + P_i + Q_i + R_i + S_i + T_i + U_i + V_i + W_i + X_i + Y_i + Z_i +$
 $a_i + b_i + c_i + d_i + e_i + f_i + g_i + h_i + i_i + j_i + k_i + l_i + m_i +$
 $n_i + o_i + p_i + q_i + r_i + s_i + t_i + u_i + v_i + w_i + x_i + y_i + z_i + \iota_i + J_i +$
 $A_i + B_i + \Gamma_i + \Delta_i + E_i + Z_i + H_i + \Theta_i + I_i + K_i + \Lambda_i + M_i +$
 $N_i + \Xi_i + O_i + \Pi_i + P_i + \Sigma_i + T_i + \Upsilon_i + \Phi_i + X_i + \Psi_i + \Omega_i +$

$\mathcal{A}_i + \mathcal{B}_i + \mathcal{C}_i + \mathcal{D}_i + \mathcal{E}_i + \mathcal{F}_i + \mathcal{G}_i + \mathcal{H}_i + \mathcal{I}_i + \mathcal{J}_i + \mathcal{K}_i + \mathcal{L}_i + \mathcal{M}_i +$
 $\mathcal{N}_i + \mathcal{O}_i + \mathcal{P}_i + \mathcal{Q}_i + \mathcal{R}_i + \mathcal{S}_i + \mathcal{T}_i + \mathcal{U}_i + \mathcal{V}_i + \mathcal{W}_i + \mathcal{X}_i + \mathcal{Y}_i + \mathcal{Z}_i +$

2.5 Accent positioning

$\hat{A} + \hat{B} + \hat{C} + \hat{D} + \hat{E} + \hat{F} + \hat{G} + \hat{H} + \hat{I} + \hat{J} + \hat{K} + \hat{L} + \hat{M} +$
 $\hat{N} + \hat{O} + \hat{P} + \hat{Q} + \hat{R} + \hat{S} + \hat{T} + \hat{U} + \hat{V} + \hat{W} + \hat{X} + \hat{Y} + \hat{Z} +$
 $\hat{a} + \hat{b} + \hat{c} + \hat{d} + \hat{e} + \hat{f} + \hat{g} + \hat{h} + \hat{i} + \hat{j} + \hat{k} + \hat{l} + \hat{m} +$
 $\hat{n} + \hat{o} + \hat{p} + \hat{q} + \hat{r} + \hat{s} + \hat{t} + \hat{u} + \hat{v} + \hat{w} + \hat{x} + \hat{y} + \hat{z} + \hat{i} + \hat{j} +$
 $\hat{A} + \hat{B} + \hat{\Gamma} + \hat{\Delta} + \hat{E} + \hat{Z} + \hat{H} + \hat{\Theta} + \hat{I} + \hat{K} + \hat{\Lambda} + \hat{M} +$
 $\hat{N} + \hat{\Xi} + \hat{O} + \hat{\Pi} + \hat{P} + \hat{\Sigma} + \hat{T} + \hat{\Upsilon} + \hat{\Phi} + \hat{X} + \hat{\Psi} + \hat{\Omega} +$
 $\hat{a} + \hat{\beta} + \hat{\gamma} + \hat{\delta} + \hat{\epsilon} + \hat{\zeta} + \hat{\eta} + \hat{\theta} + \hat{i} + \hat{k} + \hat{\lambda} + \hat{\mu} +$
 $\hat{v} + \hat{\xi} + \hat{o} + \hat{\pi} + \hat{\rho} + \hat{\sigma} + \hat{\tau} + \hat{v} + \hat{\phi} + \hat{\chi} + \hat{\psi} + \hat{\omega} +$
 $\hat{\epsilon} + \hat{\vartheta} + \hat{\omega} + \hat{\varrho} + \hat{\varsigma} + \hat{\phi} + \hat{\ell} + \hat{\wp} +$

$\hat{A} + \hat{B} + \hat{C} + \hat{D} + \hat{E} + \hat{F} + \hat{G} + \hat{H} + \hat{I} + \hat{J} + \hat{K} + \hat{L} + \hat{M} +$
 $\hat{N} + \hat{O} + \hat{P} + \hat{Q} + \hat{R} + \hat{S} + \hat{T} + \hat{U} + \hat{V} + \hat{W} + \hat{X} + \hat{Y} + \hat{Z} +$
 $\hat{a} + \hat{b} + \hat{c} + \hat{d} + \hat{e} + \hat{f} + \hat{g} + \hat{h} + \hat{i} + \hat{j} + \hat{k} + \hat{l} + \hat{m} +$
 $\hat{n} + \hat{o} + \hat{p} + \hat{q} + \hat{r} + \hat{s} + \hat{t} + \hat{u} + \hat{v} + \hat{w} + \hat{x} + \hat{y} + \hat{z} + \hat{i} + \hat{j} +$

$\hat{A} + \hat{B} + \hat{C} + \hat{D} + \hat{E} + \hat{F} + \hat{G} + \hat{H} + \hat{I} + \hat{J} + \hat{K} + \hat{L} + \hat{M} +$
 $\hat{N} + \hat{O} + \hat{P} + \hat{Q} + \hat{R} + \hat{S} + \hat{T} + \hat{U} + \hat{V} + \hat{W} + \hat{X} + \hat{Y} + \hat{Z} +$

2.6 Differentials

$$\begin{aligned}
& dA + dB + dC + dD + dE + dF + dG + dH + dI + dJ + dK + dL + dM + \\
& dN + dO + dP + dQ + dR + dS + dT + dU + dV + dW + dX + dY + dZ + \\
& da + db + dc + dd + de + df + dg + dh + di + dj + dk + dl + dm + \\
& dn + do + dp + dq + dr + ds + dt + du + dv + dw + dx + dy + dz + di + dj + \\
& dA + dB + d\Gamma + d\Delta + dE + dZ + dH + d\Theta + dI + dK + d\Lambda + dM + \\
& dN + d\Xi + dO + d\Pi + dP + d\Sigma + dT + d\Upsilon + d\Phi + dX + d\Psi + d\Omega + \\
& d\alpha + d\beta + d\gamma + d\delta + d\epsilon + d\zeta + d\eta + d\theta + d\iota + d\kappa + d\lambda + d\mu + \\
& dv + d\zeta + do + d\pi + d\rho + d\sigma + d\tau + dv + d\phi + d\chi + d\psi + d\omega + \\
& d\varepsilon + d\vartheta + d\varpi + d\rho + d\varsigma + d\phi + d\ell + d\wp + \\
& dA + dB + d\Gamma + d\Delta + dE + dZ + dH + d\Theta + dI + dK + d\Lambda + dM + \\
& dN + d\Xi + dO + d\Pi + dP + d\Sigma + dT + d\Upsilon + d\Phi + dX + d\Psi + d\Omega +
\end{aligned}$$

$$\begin{aligned}
& dA + dB + dC + dD + dE + dF + dG + dH + dI + dJ + dK + dL + dM + \\
& dN + dO + dP + dQ + dR + dS + dT + dU + dV + dW + dX + dY + dZ + \\
& da + db + dc + dd + de + df + dg + dh + di + dj + dk + dl + dm + \\
& dn + do + dp + dq + dr + ds + dt + du + dv + dw + dx + dy + dz + di + dj + \\
& dA + dB + d\Gamma + d\Delta + dE + dZ + dH + d\Theta + dI + dK + d\Lambda + dM + \\
& dN + d\Xi + dO + d\Pi + dP + d\Sigma + dT + d\Upsilon + d\Phi + dX + d\Psi + d\Omega + \\
& d\alpha + d\beta + d\gamma + d\delta + d\epsilon + d\zeta + d\eta + d\theta + d\iota + d\kappa + d\lambda + d\mu + \\
& dv + d\zeta + do + d\pi + d\rho + d\sigma + d\tau + dv + d\phi + d\chi + d\psi + d\omega + \\
& d\varepsilon + d\vartheta + d\varpi + d\rho + d\varsigma + d\phi + d\ell + d\wp + \\
& dA + dB + d\Gamma + d\Delta + dE + dZ + dH + d\Theta + dI + dK + d\Lambda + dM + \\
& dN + d\Xi + dO + d\Pi + dP + d\Sigma + dT + d\Upsilon + d\Phi + dX + d\Psi + d\Omega +
\end{aligned}$$

$$\begin{aligned}
& \partial A + \partial B + \partial C + \partial D + \partial E + \partial F + \partial G + \partial H + \partial I + \partial J + \partial K + \partial L + \partial M + \\
& \partial N + \partial O + \partial P + \partial Q + \partial R + \partial S + \partial T + \partial U + \partial V + \partial W + \partial X + \partial Y + \partial Z + \\
& \partial a + \partial b + \partial c + \partial d + \partial e + \partial f + \partial g + \partial h + \partial i + \partial j + \partial k + \partial l + \partial m + \\
& \partial n + \partial o + \partial p + \partial q + \partial r + \partial s + \partial t + \partial u + \partial v + \partial w + \partial x + \partial y + \partial z + \partial i + \partial j + \\
& \partial A + \partial B + \partial \Gamma + \partial \Delta + \partial E + \partial Z + \partial H + \partial \Theta + \partial I + \partial K + \partial \Lambda + \partial M + \\
& \partial N + \partial \Xi + \partial O + \partial \Pi + \partial P + \partial \Sigma + \partial T + \partial \Upsilon + \partial \Phi + \partial X + \partial \Psi + \partial \Omega + \\
& \partial \alpha + \partial \beta + \partial \gamma + \partial \delta + \partial \epsilon + \partial \zeta + \partial \eta + \partial \theta + \partial \iota + \partial \kappa + \partial \lambda + \partial \mu + \\
& \partial v + \partial \zeta + \partial o + \partial \pi + \partial \rho + \partial \sigma + \partial \tau + \partial v + \partial \phi + \partial \chi + \partial \psi + \partial \omega + \\
& \partial \varepsilon + \partial \vartheta + \partial \varpi + \partial \rho + \partial \varsigma + \partial \phi + \partial \ell + \partial \wp + \\
& \partial A + \partial B + \partial \Gamma + \partial \Delta + \partial E + \partial Z + \partial H + \partial \Theta + \partial I + \partial K + \partial \Lambda + \partial M + \\
& \partial N + \partial \Xi + \partial O + \partial \Pi + \partial P + \partial \Sigma + \partial T + \partial \Upsilon + \partial \Phi + \partial X + \partial \Psi + \partial \Omega +
\end{aligned}$$

2.7 Slash kerning

1/A+1/B+1/C+1/D+1/E+1/F+1/G+1/H+1/I+1/J+1/K+1/L+1/M+
1/N+1/O+1/P+1/Q+1/R+1/S+1/T+1/U+1/V+1/W+1/X+1/Y+1/Z+
1/a+1/b+1/c+1/d+1/e+1/f+1/g+1/h+1/i+1/j+1/k+1/l+1/m+
1/n+1/o+1/p+1/q+1/r+1/s+1/t+1/u+1/v+1/w+1/x+1/y+1/z+1/ι+1/ϰ+
1/Α+1/Β+1/Γ+1/Δ+1/Ε+1/Ζ+1/Η+1/Θ+1/Ι+1/Κ+1/Λ+1/Μ+
1/Ν+1/Ξ+1/Ο+1/Π+1/Ρ+1/Σ+1/Τ+1/Υ+1/Φ+1/Χ+1/Ψ+1/Ω+
1/α+1/β+1/γ+1/δ+1/ε+1/ζ+1/η+1/θ+1/ι+1/κ+1/λ+1/μ+
1/ν+1/ξ+1/ο+1/π+1/ρ+1/σ+1/τ+1/υ+1/φ+1/χ+1/ψ+1/ω+
1/ε+1/ϑ+1/Ϙ+1/ϙ+1/ς+1/φ+1/ℓ+1/Ϙ+

A/2+B/2+C/2+D/2+E/2+F/2+G/2+H/2+I/2+J/2+K/2+L/2+M/2+
N/2+O/2+P/2+Q/2+R/2+S/2+T/2+U/2+V/2+W/2+X/2+Y/2+Z/2+
a/2+b/2+c/2+d/2+e/2+f/2+g/2+h/2+i/2+j/2+k/2+l/2+m/2+
n/2+o/2+p/2+q/2+r/2+s/2+t/2+u/2+v/2+w/2+x/2+y/2+z/2+ι/2+ϰ/2+
Α/2+Β/2+Γ/2+Δ/2+Ε/2+Ζ/2+Η/2+Θ/2+Ι/2+Κ/2+Λ/2+Μ/2+
Ν/2+Ξ/2+Ο/2+Π/2+Ρ/2+Σ/2+Τ/2+Υ/2+Φ/2+Χ/2+Ψ/2+Ω/2+
α/2+β/2+γ/2+δ/2+ε/2+ζ/2+η/2+θ/2+ι/2+κ/2+λ/2+μ/2+
ν/2+ξ/2+ο/2+π/2+ρ/2+σ/2+τ/2+υ/2+φ/2+χ/2+ψ/2+ω/2+
ε/2+ϑ/2+Ϙ/2+ϙ/2+ς/2+φ/2+ℓ/2+Ϙ/2+

2.8 Big operators

$$\sum_{i=1}^n x^n \quad \prod_{i=1}^n x^n \quad \coprod_{i=1}^n x^n \quad \int_{i=1}^n x^n \quad \oint_{i=1}^n x^n$$

$$\bigotimes_{i=1}^n x^n \quad \bigoplus_{i=1}^n x^n \quad \bigodot_{i=1}^n x^n \quad \bigwedge_{i=1}^n x^n \quad \bigvee_{i=1}^n x^n \quad \biguplus_{i=1}^n x^n \quad \bigcup_{i=1}^n x^n \quad \bigcap_{i=1}^n x^n \quad \bigsqcup_{i=1}^n x^n$$

2.9 Radicals

$$\sqrt{x+y} \quad \sqrt{x^2+y^2} \quad \sqrt{x_i^2+y_j^2} \quad \sqrt{\left(\frac{\cos x}{2}\right)} \quad \sqrt{\left(\frac{\sin x}{2}\right)}$$

$$\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{x+y}}}}}}}$$

2.10 Over- and underbraces

$$\overbrace{x} \quad \overbrace{x+y} \quad \overbrace{x^2+y^2} \quad \overbrace{x_i^2+y_j^2} \quad \underbrace{x} \quad \underbrace{x+y} \quad \underbrace{x_i+y_j} \quad \underbrace{x_i^2+y_j^2}$$

2.11 Normal and wide accents

$$\acute{x} \quad \ddot{x} \quad \vec{x} \quad \bar{x} \quad \bar{x} \quad \overline{\overline{x}} \quad \tilde{x} \quad \tilde{x} \quad \tilde{x} \quad \widehat{\widehat{x}} \quad \hat{x} \quad \hat{x} \quad \hat{x} \quad \widehat{\widehat{\widehat{x}}}$$

2.12 Long arrows

$$\longleftrightarrow \leftrightarrow \longleftarrow \longrightarrow \longleftrightarrow \Leftrightarrow \Leftrightarrow \Leftrightarrow \Leftrightarrow \Leftrightarrow$$

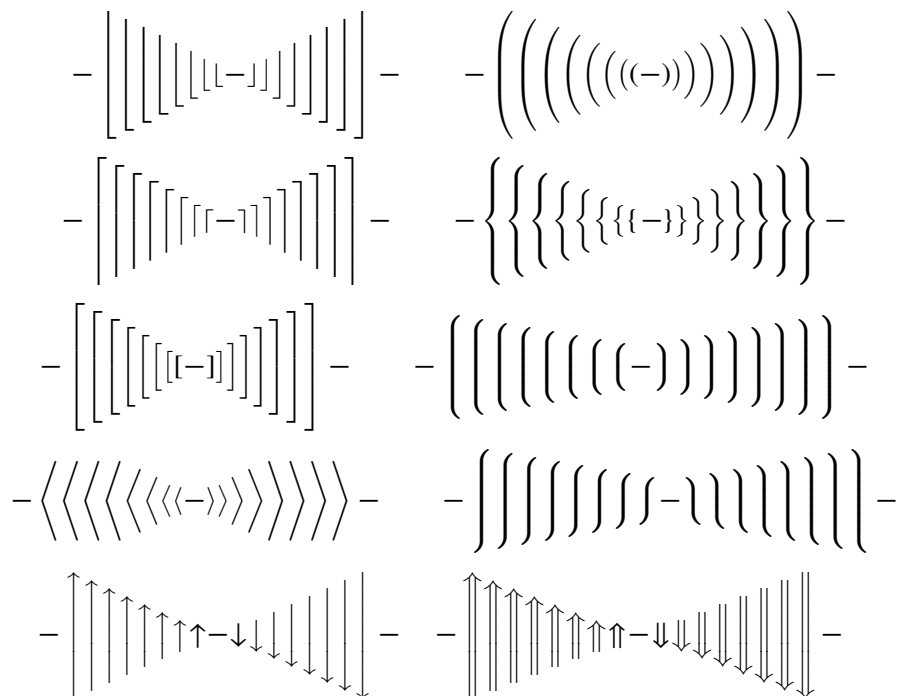
2.13 Left and right delimiters

$$-(f) \quad -[f] \quad -[f] \quad -[f] \quad -\langle f \rangle \quad -\{f\}$$

$$-(f) \quad -[f] \quad -[f] \quad -[f] \quad -\langle f \rangle \quad -\{f\}$$

$$-)f(\quad -)f[\quad -)f/ \quad -\frown \quad -\frown \quad -\frown$$

2.14 Big-g-g delimiters



2.15 Symbols

This is from [?]

Symbol	Control Sequence	mathcode	Family	Hex Position
∂	partial	"0140	1	40
\flat	flat	"015B	1	5B
\natural	natural	"015C	1	5C
\sharp	sharp	"015D	1	5D
ℓ	ell	"0160	1	60
\imath	imath	"017B	1	7B
\jmath	jmath	"017C	1	7C
\wp	wp	"017D	1	7D
\prime	prime	"0230	2	30
∞	infty	"0231	2	31
\triangle	triangle	"0234	2	34
\forall	forall	"0238	2	38
\exists	exists	"0239	2	39
\neg	neg	"023A	2	3A
\emptyset	emptyset	"023B	2	3B
\Re	Re	"023C	2	3C
\Im	Im	"023D	2	3D

\top	top	"023E	2	3E
\perp	bot	"023F	2	3F
\aleph	aleph	"0240	2	40
∇	nabla	"0272	2	72
\clubsuit	clubsuit	"027C	2	7C
\diamond	diamondsuit	"027D	2	7D
\heartsuit	heartsuit	"027E	2	7E
\spadesuit	spadesuit	"027F	2	7F
\int	smallint	"1273	2	73
\sqcup	bigscup	"1346	3	46
\oint	ointop	"1348	3	48
\odot	bigodot	"134A	3	4A
\oplus	bigoplus	"134C	3	4C
\otimes	bigotimes	"134E	3	4E
Σ	sum	"1350	3	50
\prod	prod	"1351	3	51
\int	intop	"1352	3	52
\cup	bigcup	"1353	3	53
\cap	bigcap	"1354	3	54
\oplus	biguplus	"1355	3	55
\wedge	bigwedge	"1356	3	56
\vee	bigvee	"1357	3	57
\coprod	coprod	"1360	3	60
\triangleright	triangleright	"212E	1	2E
\triangleleft	triangleleft	"212F	1	2F
$*$	star	"213F	1	3F
\cdot	cdot	"2201	2	01
\times	times	"2202	2	02
$*$	ast	"2203	2	03
\div	div	"2204	2	04
\diamond	diamond	"2205	2	05
\pm	pm	"2206	2	06
\mp	mp	"2207	2	07
\oplus	oplus	"2208	2	08
\ominus	ominus	"2209	2	09
\otimes	otimes	"220A	2	0A
\oslash	oslash	"220B	2	0B
\odot	odot	"220C	2	0C
\bigcirc	bigcirc	"220D	2	0D
\circ	circ	"220E	2	0E

•	bullet	"220F	2	0F
△	bigtriangleup	"2234	2	34
▽	bigtriangledown	"2235	2	35
∪	cup	"225B	2	5B
∩	cap	"225C	2	5C
⊕	uplus	"225D	2	5D
∧	wedge	"225E	2	5E
∨	vee	"225F	2	5F
∖	setminus	"226E	2	6E
∩	wr	"226F	2	6F
∩	amalg	"2271	2	71
∩	sqcup	"2274	2	74
∩	sqcap	"2275	2	75
†	dagger	"2279	2	79
‡	ddagger	"227A	2	7A
↵	leftharpoonup	"3128	1	28
↶	leftharpoondown	"3129	1	29
↷	rightharpoonup	"312A	1	2A
↸	rightharpoondown	"312B	1	2B
(smile	"315E	1	5E
)	frown	"315F	1	5F
∞	asympt	"3210	2	10
≡	equiv	"3211	2	11
⊂	subseteq	"3212	2	12
⊃	supseteq	"3213	2	13
≤	leq	"3214	2	14
≥	geq	"3215	2	15
≲	preceq	"3216	2	16
≳	succeq	"3217	2	17
≈	sim	"3218	2	18
≈	approx	"3219	2	19
⊂	subset	"321A	2	1A
⊃	supset	"321B	2	1B
⊂	ll	"321C	2	1C
⊃	gg	"321D	2	1D
⊂	prec	"321E	2	1E
⊃	succ	"321F	2	1F
←	leftarrow	"3220	2	20
→	rightarrow	"3221	2	21
↔	leftrightarrow	"3224	2	24
↗	nearrow	"3225	2	25
↘	searrow	"3226	2	26
↔	simeq	"3227	2	27
⇐	Leftarrow	"3228	2	28
⇒	Rightarrow	"3229	2	29
⇔	Leftrightarrow	"322C	2	2C

\nwarrow	nwarrow	"322D	2	2D
\swarrow	swarrow	"322E	2	2E
\propto	propto	"322F	2	2F
\in	in	"3232	2	32
\ni	ni	"3233	2	33
$/$	not	"3236	2	36
\dagger	mapstochar	"3237	2	37
\perp	perp	"323F	2	3F
\vdash	vdash	"3260	2	60
\dashv	dashv	"3261	2	61
$ $	mid	"326A	2	6A
\parallel	parallel	"326B	2	6B
\sqsubseteq	sqsubseteq	"3276	2	76
\sqsupseteq	sqsupseteq	"3277	2	77

2.16 Miscellaneous formulae

Taken from [?]

$$\hbar v = E, \quad \hbar \neq \pi, \quad \partial j, \quad x^j, \quad x^l$$

Some other other equations: $\sum^J a^l, r^a$ and D^k .

Let $\mathbf{A} = (a_{ij})$ be the adjacency matrix of graph G . The corresponding Kirchhoff matrix $\mathbf{K} = (k_{ij})$ is obtained from \mathbf{A} by replacing in $-\mathbf{A}$ each diagonal entry by the degree of its corresponding vertex; i.e., the i th diagonal entry is identified with the degree of the i th vertex. It is well known that

$$\det \mathbf{K}(i|i) = \text{the number of spanning trees of } G, \quad i = 1, \dots, n \quad (5)$$

where $\mathbf{K}(i|i)$ is the i th principal submatrix of \mathbf{K} .

Let $C_{i(j)}$ be the set of graphs obtained from G by attaching edge $(v_i v_j)$ to each spanning tree of G . Denote by $C_i = \bigcup_j C_{i(j)}$. It is obvious that the collection of Hamiltonian cycles is a subset of C_i . Note that the cardinality of C_i is $k_{ii} \det \mathbf{K}(i|i)$. Let $\hat{X} = \{\hat{x}_1, \dots, \hat{x}_n\}$. Define multiplication for the elements of \hat{X} by

$$\hat{x}_i \hat{x}_j = \hat{x}_j \hat{x}_i, \quad \hat{x}_i^2 = 0, \quad i, j = 1, \dots, n. \quad (6)$$

Let $\hat{k}_{ij} = k_{ij} \hat{x}_j$ and $\hat{k}_{ij} = -\sum_{j \neq i} \hat{k}_{ij}$. Then the number of Hamiltonian cycles H_c is given by the relation

$$\left(\prod_{j=1}^n \hat{x}_j \right) H_c = \frac{1}{2} \hat{k}_{ij} \det \hat{\mathbf{K}}(i|i), \quad i = 1, \dots, n. \quad (7)$$

The task here is to express (??) in a form free of any $\hat{x}_i, i = 1, \dots, n$. The result also leads to the resolution of enumeration of Hamiltonian paths in a graph.

It is well known that the enumeration of Hamiltonian cycles and paths in a complete graph K_n and in a complete bipartite graph $K_{n_1 n_2}$ can only be found from

first combinatorial principles. One wonders if there exists a formula which can be used very efficiently to produce K_n and $K_{n_1 n_2}$. Recently, using Lagrangian methods, Goulden and Jackson have shown that H_c can be expressed in terms of the determinant and permanent of the adjacency matrix. However, the formula of Goulden and Jackson determines neither K_n nor $K_{n_1 n_2}$ effectively. In this paper, using an algebraic method, we parametrize the adjacency matrix. The resulting formula also involves the determinant and permanent, but it can easily be applied to K_n and $K_{n_1 n_2}$. In addition, we eliminate the permanent from H_c and show that H_c can be represented by a determinantal function of multivariables, each variable with domain $\{0, 1\}$. Furthermore, we show that H_c can be written by number of spanning trees of subgraphs. Finally, we apply the formulas to a complete multigraph $K_{n_1 \dots n_p}$.

The conditions $a_{ij} = a_{ji}$, $i, j = 1, \dots, n$, are not required in this paper. All formulas can be extended to a digraph simply by multiplying H_c by 2. The boundedness, property of Φ_0 , then yields

$$\int_{\mathcal{D}} |\bar{\partial}u|^2 e^{\alpha|z|^2} \geq c_6 \alpha \int_{\mathcal{D}} |u|^2 e^{\alpha|z|^2} + c_7 \delta^{-2} \int_A |u|^2 e^{\alpha|z|^2}.$$

Let $B(X)$ be the set of blocks of Λ_X and let $b(X) = |B(X)|$. If $\phi \in Q_X$ then ϕ is constant on the blocks of Λ_X .

$$P_X = \{\phi \in M \mid \Lambda_\phi = \Lambda_X\}, \quad Q_X = \{\phi \in M \mid \Lambda_\phi \geq \Lambda_X\}. \quad (8)$$

If $\Lambda_\phi \geq \Lambda_X$ then $\Lambda_\phi = \Lambda_Y$ for some $Y \geq X$ so that

$$Q_X = \bigcup_{Y \geq X} P_Y.$$

Thus by Möbius inversion

$$|P_Y| = \sum_{X \geq Y} \mu(Y, X) |Q_X|.$$

Thus there is a bijection from Q_X to $W^{B(X)}$. In particular $|Q_X| = w^{b(X)}$.

$$W(\Phi) = \left\| \begin{array}{cccc} \frac{\varphi}{(\varphi_1, \varepsilon_1)} & 0 & \dots & 0 \\ \frac{\varphi k_{n2}}{(\varphi_2, \varepsilon_1)} & \frac{\varphi}{(\varphi_2, \varepsilon_2)} & \dots & 0 \\ \dots & \dots & \dots & \dots \\ \frac{\varphi k_{n1}}{(\varphi_n, \varepsilon_1)} & \frac{\varphi k_{n2}}{(\varphi_n, \varepsilon_2)} & \dots & \frac{\varphi k_{nn-1}}{(\varphi_n, \varepsilon_{n-1})} \quad \frac{\varphi}{(\varphi_n, \varepsilon_n)} \end{array} \right\|$$