

$$\ln[126] := \text{char}[k_, \varpi_, \theta_, \alpha_] =$$

$$\begin{aligned}
& -\frac{1}{4k} \left( \frac{1}{e^{\frac{i}{2}\pi\varpi} + e^{3\frac{i}{2}\pi\varpi}} \left( -2\frac{i}{2} \left( 1 + e^{4\frac{i}{2}\pi\varpi} - 2e^{2\frac{i}{2}\pi(k+\varpi)} \right) k + e^{2\frac{i}{2}\pi\varpi} \left( -1 + e^{2\frac{i}{2}k\pi} \right) \alpha \right) \text{Csc}[k\pi] - \right. \\
& \quad \left. \text{Sec}[\pi\varpi] \left( 4k \text{Cos}[k\pi] + \alpha \text{Sin}[k\pi] \right) \left( -1 + \sqrt{1 - \frac{16k^2 \text{Cos}[\pi\varpi]^2}{(4k \text{Cos}[k\pi] + \alpha \text{Sin}[k\pi])^2}} \right) \right) \\
& \left( \left( \left( -e^{\frac{i}{2}(\pi-\theta)(k-\varpi)} k - \frac{2e^{\frac{i}{2}(k(\pi-\theta)+(-3\pi+\theta)\varpi)} \left( -1 + e^{2\frac{i}{2}\pi(k+\varpi)} \right) k}{-1 + e^{2\frac{i}{2}k\pi}} - \left( e^{-\frac{i}{2}(k(\pi+\theta)+(\pi-\theta)\varpi)} \left( e^{2\frac{i}{2}k\pi} + \right. \right. \right. \right. \\
& \quad \left. \left. \left. e^{2\frac{i}{2}k(2\pi+\theta)} - 2e^{2\frac{i}{2}(k(\pi+\theta)+\pi\varpi)} \right) k \right) / \left( -1 + e^{2\frac{i}{2}k(\pi+\theta)} \right) + \frac{i}{2} e^{\frac{i}{2}(\pi-\theta)(k-\varpi)} \alpha \right) \right. \\
& \quad \left( 2 \left( 1 + e^{2\frac{i}{2}k\theta} - 2e^{2\frac{i}{2}k(\pi+\theta)} \right) \left( -1 + e^{2\frac{i}{2}\pi(k+\varpi)} \right) k + \frac{i}{2} e^{2\frac{i}{2}\pi\varpi} \left( -1 + e^{2\frac{i}{2}k\pi} \right) \left( -1 + \right. \right. \\
& \quad \left. \left. e^{2\frac{i}{2}k(\pi+\theta)} \right) \alpha \right) - \left( e^{-\frac{i}{2}(\pi-\theta)(k+\varpi)} k - \frac{2e^{-\frac{i}{2}(k\pi-k\theta+3\pi\varpi-\theta\varpi)} \left( -1 + e^{2\frac{i}{2}\pi(k+\varpi)} \right) k}{-1 + e^{2\frac{i}{2}k\pi}} - \right. \\
& \quad \left( e^{-\frac{i}{2}(k(\pi+\theta)+(\pi-\theta)\varpi)} \left( e^{2\frac{i}{2}k\theta} + e^{2\frac{i}{2}k(\pi+2\theta)} - 2e^{2\frac{i}{2}(k(\pi+\theta)+\pi\varpi)} \right) k \right) / \\
& \quad \left. \left( -1 + e^{2\frac{i}{2}k(\pi+\theta)} \right) + \frac{i}{2} e^{-\frac{i}{2}(\pi-\theta)(k+\varpi)} \alpha \right) \left( 2 \left( -1 - e^{2\frac{i}{2}k\pi} + e^{4\frac{i}{2}k\pi} + e^{2\frac{i}{2}k(\pi+\theta)} + \right. \right. \\
& \quad \left. \left. e^{2\frac{i}{2}\pi\varpi} - e^{2\frac{i}{2}(2k\pi+k\theta+\pi\varpi)} \right) k + \frac{i}{2} e^{2\frac{i}{2}\pi\varpi} \left( -1 + e^{2\frac{i}{2}k\pi} \right) \left( -1 + e^{2\frac{i}{2}k(\pi+\theta)} \right) \alpha \right) \Bigg) \\
& \left( \frac{1}{e^{\frac{i}{2}\pi\varpi} + e^{3\frac{i}{2}\pi\varpi}} \left( -2\frac{i}{2} \left( 1 + e^{4\frac{i}{2}\pi\varpi} - 2e^{2\frac{i}{2}\pi(k+\varpi)} \right) k + e^{2\frac{i}{2}\pi\varpi} \left( -1 + e^{2\frac{i}{2}k\pi} \right) \alpha \right) \right. \\
& \quad \left. \text{Csc}[k\pi] - \text{Sec}[\pi\varpi] \left( 4k \text{Cos}[k\pi] + \alpha \text{Sin}[k\pi] \right) \left( -1 + \sqrt{1 - \frac{16k^2 \text{Cos}[\pi\varpi]^2}{(4k \text{Cos}[k\pi] + \alpha \text{Sin}[k\pi])^2}} \right) \right) \Bigg) / \\
& \left( 16 \left( -1 + e^{2\frac{i}{2}k\pi} \right) \left( 1 + e^{-2\frac{i}{2}\pi\varpi} \right) \left( e^{2\frac{i}{2}k\pi} - e^{2\frac{i}{2}k\theta} - e^{2\frac{i}{2}\pi\varpi} + e^{2\frac{i}{2}(k(\pi+\theta)+\pi\varpi)} \right) k^3 \right) - \\
& \left( \frac{i}{2} e^{-\frac{i}{2}k\pi} \left( - \left( e^{\frac{i}{2}(\pi-\theta)(k-\varpi)} k - \frac{2e^{\frac{i}{2}(k(\pi-\theta)+(-3\pi+\theta)\varpi)} \left( -1 + e^{2\frac{i}{2}\pi(k+\varpi)} \right) k}{-1 + e^{2\frac{i}{2}k\pi}} - \right. \right. \right. \\
& \quad \left. \left( e^{-\frac{i}{2}(k(\pi+\theta)+(\pi-\theta)\varpi)} \left( e^{2\frac{i}{2}k\pi} + e^{2\frac{i}{2}k(2\pi+\theta)} - 2e^{2\frac{i}{2}(k(\pi+\theta)+\pi\varpi)} \right) k \right) / \right. \\
& \quad \left. \left( -1 + e^{2\frac{i}{2}k(\pi+\theta)} \right) + \frac{i}{2} e^{\frac{i}{2}(\pi-\theta)(k-\varpi)} \alpha \right) \left( 2e^{2\frac{i}{2}k\pi} k + 2e^{2\frac{i}{2}k\theta} k - 2e^{2\frac{i}{2}k(\pi+\theta)} k - \right. \\
& \quad \left. 2e^{2\frac{i}{2}k(2\pi+\theta)} k + e^{2\frac{i}{2}(k(2\pi+\theta)+\pi\varpi)} (2k - \frac{i}{2}\alpha) - e^{2\frac{i}{2}\pi\varpi} (2k + \frac{i}{2}\alpha) + \frac{i}{2} e^{2\frac{i}{2}\pi(k+\varpi)} \alpha + \right. \\
& \quad \left. \frac{i}{2} e^{2\frac{i}{2}(k(\pi+\theta)+\pi\varpi)} \alpha \right) - \left( e^{-\frac{i}{2}(\pi-\theta)(k+\varpi)} k - \frac{2e^{-\frac{i}{2}(k\pi-k\theta+3\pi\varpi-\theta\varpi)} \left( -1 + e^{2\frac{i}{2}\pi(k+\varpi)} \right) k}{-1 + e^{2\frac{i}{2}k\pi}} - \right. \\
& \quad \left( e^{-\frac{i}{2}(k(\pi+\theta)+(\pi-\theta)\varpi)} \left( e^{2\frac{i}{2}k\theta} + e^{2\frac{i}{2}k(\pi+2\theta)} - 2e^{2\frac{i}{2}(k(\pi+\theta)+\pi\varpi)} \right) k \right) / \\
& \quad \left. \left( -1 + e^{2\frac{i}{2}k(\pi+\theta)} \right) + \frac{i}{2} e^{-\frac{i}{2}(\pi-\theta)(k+\varpi)} \alpha \right) \\
& \left( -4e^{2\frac{i}{2}k\pi} k + 2e^{4\frac{i}{2}k\pi} k + 2e^{2\frac{i}{2}k(2\pi+\theta)} k - e^{2\frac{i}{2}\pi(k+\varpi)} (2k + \frac{i}{2}\alpha) - \right.
\end{aligned}$$

$$\begin{aligned}
& \left. \left( e^{2i(k(\pi+\theta)+\pi\varpi)} (2k + i\alpha) + e^{2i\pi\varpi} (4k + i\alpha) + i e^{2i(k(2\pi+\theta)+\pi\varpi)} \alpha \right) \right. \\
& \left. \text{Sec}[\pi\varpi] (\alpha + 4k \text{Csc}[k\pi] \text{Sin}[\pi\varpi] \text{Sin}[\pi(k+\varpi)]) \right) / \\
& \left( 16 (-1 + e^{2ik\pi}) (1 + e^{-2i\pi\varpi}) (e^{2ik\pi} - e^{2ik\theta} - e^{2i\pi\varpi} + e^{2i(k(\pi+\theta)+\pi\varpi)}) k^3 \right) - \\
& \frac{1}{4k} i e^{-ik\pi} \text{Sec}[\pi\varpi] (\alpha + 4k \text{Csc}[k\pi] \text{Sin}[\pi\varpi] \text{Sin}[\pi(k+\varpi)]) \\
& \left( \left( (-2 (1 + e^{2ik\theta} - 2 e^{2ik(\pi+\theta)}) (-1 + e^{2i\pi(k+\varpi)}) k - \right. \right. \\
& i e^{2i\pi\varpi} (-1 + e^{2ik\pi}) (-1 + e^{2ik(\pi+\theta)}) \alpha \left( e^{i(\pi-\theta)(k-\varpi)} - \frac{1}{2(1 + e^{-2i\pi\varpi}) k} \right. \\
& \left( e^{i(\pi-\theta)(k-\varpi)} k + \frac{2 e^{i(k(\pi-\theta)+(-3\pi+\theta)\varpi)} (-1 + e^{2i\pi(k+\varpi)}) k}{-1 + e^{2ik\pi}} + \right. \\
& \left. (e^{-i(k(\pi+\theta)+(\pi-\theta)\varpi)} (e^{2ik\pi} + e^{2ik(2\pi+\theta)} - 2 e^{2i(k(\pi+\theta)+\pi\varpi)}) k) / \right. \\
& \left. (-1 + e^{2ik(\pi+\theta)}) - i e^{i(\pi-\theta)(k-\varpi)} \alpha \right) \left. \right) + \\
& (2 (-1 - e^{2ik\pi} + e^{4ik\pi} + e^{2ik(\pi+\theta)} + e^{2i\pi\varpi} - e^{2i(2k\pi+k\theta+\pi\varpi)}) k + \\
& i e^{2i\pi\varpi} (-1 + e^{2ik\pi}) (-1 + e^{2ik(\pi+\theta)}) \alpha \left( e^{-i(\pi-\theta)(k+\varpi)} - \frac{1}{2(1 + e^{-2i\pi\varpi}) k} \right. \\
& \left( -e^{-i(\pi-\theta)(k+\varpi)} k + \frac{2 e^{-i(k\pi-k\theta+3\pi\varpi-\theta\varpi)} (-1 + e^{2i\pi(k+\varpi)}) k}{-1 + e^{2ik\pi}} + \right. \\
& \left. (e^{-i(k(\pi+\theta)+(\pi-\theta)\varpi)} (e^{2ik\theta} + e^{2ik(\pi+2\theta)} - 2 e^{2i(k(\pi+\theta)+\pi\varpi)}) k) / \right. \\
& \left. (-1 + e^{2ik(\pi+\theta)}) - i e^{-i(\pi-\theta)(k+\varpi)} \alpha \right) \left. \right) \left. \right) \\
& \left( \frac{1}{e^{i\pi\varpi} + e^{3i\pi\varpi}} (-2i (1 + e^{4i\pi\varpi} - 2 e^{2i\pi(k+\varpi)}) k + e^{2i\pi\varpi} (-1 + e^{2ik\pi}) \alpha) \right. \\
& \text{Csc}[k\pi] - \text{Sec}[\pi\varpi] (4k \text{Cos}[k\pi] + \alpha \text{Sin}[k\pi]) \\
& \left. \left( -1 + \sqrt{1 - \frac{16k^2 \text{Cos}[\pi\varpi]^2}{(4k \text{Cos}[k\pi] + \alpha \text{Sin}[k\pi])^2}} \right) \right) / \\
& (8 (-1 + e^{2ik\pi}) (e^{2ik\pi} - e^{2ik\theta} - e^{2i\pi\varpi} + e^{2i(k(\pi+\theta)+\pi\varpi)}) k^2) - \\
& i e^{-ik\pi} \left( (2 e^{2ik\pi} k + 2 e^{2ik\theta} k - 2 e^{2ik(\pi+\theta)} k - 2 e^{2ik(2\pi+\theta)} k + e^{2i(k(2\pi+\theta)+\pi\varpi)} (2k - \right. \\
& i \alpha) - e^{2i\pi\varpi} (2k + i\alpha) + i e^{2i\pi(k+\varpi)} \alpha + i e^{2i(k(\pi+\theta)+\pi\varpi)} \alpha) \left( e^{i(\pi-\theta)(k-\varpi)} - \right.
\end{aligned}$$

$$\begin{aligned}
& \frac{1}{2 \left(1 + e^{-2 i \pi \Xi}\right) k} \left( e^{i (\pi - \theta) (k - \Xi)} k + \frac{2 e^{i (k (\pi - \theta) + (-3 \pi + \theta) \Xi)} \left(-1 + e^{2 i \pi (k + \Xi)}\right) k}{-1 + e^{2 i k \pi}} + \right. \\
& \left. \left( e^{-i (k (\pi + \theta) + (\pi - \theta) \Xi)} \left( e^{2 i k \pi} + e^{2 i k (2 \pi + \theta)} - 2 e^{2 i (k (\pi + \theta) + \pi \Xi)} \right) k \right) / \right. \\
& \left. \left( -1 + e^{2 i k (\pi + \theta)} \right) - i e^{i (\pi - \theta) (k - \Xi)} \alpha \right) \Bigg) + \\
& \left( -4 e^{2 i k \pi} k + 2 e^{4 i k \pi} k + 2 e^{2 i k (2 \pi + \theta)} k - e^{2 i \pi (k + \Xi)} (2 k + i \alpha) - e^{2 i (k (\pi + \theta) + \pi \Xi)} \right. \\
& \left. (2 k + i \alpha) + e^{2 i \pi \Xi} (4 k + i \alpha) + i e^{2 i (k (2 \pi + \theta) + \pi \Xi)} \alpha \right) \left( e^{-i (\pi - \theta) (k + \Xi)} - \right. \\
& \frac{1}{2 \left(1 + e^{-2 i \pi \Xi}\right) k} \left( -e^{-i (\pi - \theta) (k + \Xi)} k + \frac{2 e^{-i (k \pi - k \theta + 3 \pi \Xi - \theta \Xi)} \left(-1 + e^{2 i \pi (k + \Xi)}\right) k}{-1 + e^{2 i k \pi}} + \right. \\
& \left. \left( e^{-i (k (\pi + \theta) + (\pi - \theta) \Xi)} \left( e^{2 i k \theta} + e^{2 i k (\pi + 2 \theta)} - 2 e^{2 i (k (\pi + \theta) + \pi \Xi)} \right) k \right) / \right. \\
& \left. \left( -1 + e^{2 i k (\pi + \theta)} \right) - i e^{-i (\pi - \theta) (k + \Xi)} \alpha \right) \Bigg) \Bigg) \\
& \left. \text{Sec}[\pi \Xi] (\alpha + 4 k \text{Csc}[k \pi] \text{Sin}[\pi \Xi] \text{Sin}[\pi (k + \Xi)]) \right) \Bigg) / \\
& \left( 8 \left( -1 + e^{2 i k \pi} \right) \left( e^{2 i k \pi} - e^{2 i k \theta} - e^{2 i \pi \Xi} + e^{2 i (k (\pi + \theta) + \pi \Xi)} \right) k^2 \right) \Bigg) \\
\text{Out}[126] = & -\frac{1}{4 k} \left( \left( 5.55112 \times 10^{-17} - 0.707107 i \right) \left( \left( 3.06162 \times 10^{-17} + 0.5 i \right) \left( -1 + e^{2 i k \pi} \right) - \right. \right. \\
& 2 i \left( \left( 0. + 1.22465 \times 10^{-16} i \right) - 2 e^{2 i (0.25 + k) \pi} \right) k \Bigg) \text{Csc}[k \pi] - \\
& 1.41421 \left( -1 + \sqrt{1 - \frac{8. k^2}{(4 k \text{Cos}[k \pi] + 0.5 \text{Sin}[k \pi])^2}} \right) (4 k \text{Cos}[k \pi] + 0.5 \text{Sin}[k \pi]) \Bigg) \\
& \left( \left( 0.03125 + 0.03125 i \right) \left( \left( (-0.5 + 3.06162 \times 10^{-17} i) \left( -1 + e^{2 i k \pi} \right) \left( -1 + e^{\frac{7 i k \pi}{3}} \right) + \right. \right. \right. \\
& 2 \left( 1 + e^{\frac{i k \pi}{3}} - 2 e^{\frac{7 i k \pi}{3}} \right) \left( -1 + e^{2 i (0.25 + k) \pi} \right) k \Bigg) \left( (0. + 0.5 i) e^{\frac{5}{6} i (-0.25 + k) \pi} - \right. \\
& e^{\frac{5}{6} i (-0.25 + k) \pi} k - \frac{2 e^{i \left( -2.22529 + \frac{5 k \pi}{6} \right)} \left( -1 + e^{2 i (0.25 + k) \pi} \right) k}{-1 + e^{2 i k \pi}} - \frac{1}{-1 + e^{\frac{7 i k \pi}{3}}} \\
& e^{-i \left( 0.654498 + \frac{7 k \pi}{6} \right)} \left( e^{2 i k \pi} + e^{\frac{13 i k \pi}{3}} - 2 e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \right) k \Bigg) - \left( (0. + 0.5 i) \right. \\
& e^{-\frac{5}{6} i (0.25 + k) \pi} + e^{-\frac{5}{6} i (0.25 + k) \pi} k - \frac{2 e^{-i \left( 2.22529 + \frac{5 k \pi}{6} \right)} \left( -1 + e^{2 i (0.25 + k) \pi} \right) k}{-1 + e^{2 i k \pi}} -
\end{aligned}$$

$$\begin{aligned}
& \frac{1}{-1 + e^{\frac{7ik\pi}{3}}} e^{-i\left(0.654498 + \frac{7k\pi}{6}\right)} \left( e^{\frac{ik\pi}{3}} + e^{\frac{8ik\pi}{3}} - 2e^{2i\left(0.785398 + \frac{7k\pi}{6}\right)} \right) k \Bigg) \\
& \left( (-0.5 + 3.06162 \times 10^{-17} i) (-1 + e^{2ik\pi}) \left( -1 + e^{\frac{7ik\pi}{3}} \right) + \right. \\
& \left. 2 \left( (-1. + 1. i) - e^{2ik\pi} + e^{\frac{7ik\pi}{3}} + e^{4ik\pi} - e^{2i\left(0.785398 + \frac{13k\pi}{6}\right)} \right) k \right) \Bigg) \\
& \left( (5.55112 \times 10^{-17} - 0.707107 i) \left( (3.06162 \times 10^{-17} + 0.5 i) (-1 + e^{2ik\pi}) - \right. \right. \\
& \left. \left. 2i \left( (0. + 1.22465 \times 10^{-16} i) - 2e^{2i(0.25+k)\pi} \right) k \right) \operatorname{Csc}[k\pi] - 1.41421 \right. \\
& \left. \left( -1 + \sqrt{1 - \frac{8 \cdot k^2}{(4k \operatorname{Cos}[k\pi] + 0.5 \operatorname{Sin}[k\pi])^2}} \right) (4k \operatorname{Cos}[k\pi] + 0.5 \operatorname{Sin}[k\pi]) \right) \Bigg) / \\
& \left( (-1 + e^{2ik\pi}) \left( (-6.12323 \times 10^{-17} - 1. i) - e^{\frac{ik\pi}{3}} + e^{2ik\pi} + e^{2i\left(0.785398 + \frac{7k\pi}{6}\right)} \right) k^3 \right) + \\
& \left( (0.0441942 - 0.0441942 i) e^{-ik\pi} \left( \left( (0. - 0.5 i) e^{\frac{5}{6}i(-0.25+k)\pi} + \right. \right. \right. \\
& \left. \left. \left. e^{\frac{5}{6}i(-0.25+k)\pi} k + \frac{2e^{i\left(-2.22529 + \frac{5k\pi}{6}\right)} (-1 + e^{2i(0.25+k)\pi}) k}{-1 + e^{2ik\pi}} + \right. \right. \right. \\
& \left. \left. \frac{1}{-1 + e^{\frac{7ik\pi}{3}}} e^{-i\left(0.654498 + \frac{7k\pi}{6}\right)} \left( e^{2ik\pi} + e^{\frac{13ik\pi}{3}} - 2e^{2i\left(0.785398 + \frac{7k\pi}{6}\right)} \right) k \right) \right. \\
& \left( (0. + 0.5 i) e^{2i(0.25+k)\pi} + (0. + 0.5 i) e^{2i\left(0.785398 + \frac{7k\pi}{6}\right)} + 2e^{\frac{ik\pi}{3}} k + \right. \\
& \left. 2e^{2ik\pi} k - 2e^{\frac{7ik\pi}{3}} k - 2e^{\frac{13ik\pi}{3}} k + e^{2i\left(0.785398 + \frac{13k\pi}{6}\right)} ((0. - 0.5 i) + 2k) - \right. \\
& \left. (6.12323 \times 10^{-17} + 1. i) ((0. + 0.5 i) + 2k) \right) - \left( (0. + 0.5 i) e^{-\frac{5}{6}i(0.25+k)\pi} + \right. \\
& \left. e^{-\frac{5}{6}i(0.25+k)\pi} k - \frac{2e^{-i\left(2.22529 + \frac{5k\pi}{6}\right)} (-1 + e^{2i(0.25+k)\pi}) k}{-1 + e^{2ik\pi}} - \right. \\
& \left. \frac{1}{-1 + e^{\frac{7ik\pi}{3}}} e^{-i\left(0.654498 + \frac{7k\pi}{6}\right)} \left( e^{\frac{ik\pi}{3}} + e^{\frac{8ik\pi}{3}} - 2e^{2i\left(0.785398 + \frac{7k\pi}{6}\right)} \right) k \right) \\
& \left( (0. + 0.5 i) e^{2i\left(0.785398 + \frac{13k\pi}{6}\right)} - 4e^{2ik\pi} k + 2e^{4ik\pi} k + 2e^{\frac{13ik\pi}{3}} k - \right. \\
& \left. e^{2i(0.25+k)\pi} ((0. + 0.5 i) + 2k) - e^{2i\left(0.785398 + \frac{7k\pi}{6}\right)} ((0. + 0.5 i) + 2k) + \right. \\
& \left. (6.12323 \times 10^{-17} + 1. i) ((0. + 0.5 i) + 4k) \right) \Bigg)
\end{aligned}$$

$$\begin{aligned}
& \left. \left( 0.5 + 2.82843 k \operatorname{Csc}[k \pi] \operatorname{Sin}[(0.25 + k) \pi] \right) \right) / \\
& \left( (-1 + e^{2 i k \pi}) \left( (-6.12323 \times 10^{-17} - 1. i) - e^{\frac{i k \pi}{3}} + e^{2 i k \pi} + e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \right) k^3 \right) - \\
& \frac{1}{k} (0. + 0.353553 i) \\
& e^{-i k \pi} \\
& (0.5 + \\
& \quad 2.82843 \\
& \quad k \\
& \quad \operatorname{Csc}[k \pi] \\
& \quad \operatorname{Sin}[(0.25 + k) \pi]) \\
& \left( \left( \left( (-0.5 + 3.06162 \times 10^{-17} i) (-1 + e^{2 i k \pi}) (-1 + e^{\frac{7 i k \pi}{3}}) + \right. \right. \right. \\
& \quad \left. \left. 2 \left( (-1. + 1. i) - e^{2 i k \pi} + e^{\frac{7 i k \pi}{3}} + e^{4 i k \pi} - e^{2 i \left( 0.785398 + \frac{13 k \pi}{6} \right)} \right) k \right) \right. \\
& \quad \left. \left( e^{-\frac{5}{6} i (0.25 + k) \pi} - 1 / k (0.25 + 0.25 i) \left( (0. - 0.5 i) e^{-\frac{5}{6} i (0.25 + k) \pi} - \right. \right. \right. \\
& \quad \left. \left. e^{-\frac{5}{6} i (0.25 + k) \pi} k + \frac{2 e^{-i \left( 2.22529 + \frac{5 k \pi}{6} \right)} (-1 + e^{2 i (0.25 + k) \pi}) k}{-1 + e^{2 i k \pi}} + \right. \right. \\
& \quad \left. \left. \frac{1}{-1 + e^{\frac{7 i k \pi}{3}}} e^{-i \left( 0.654498 + \frac{7 k \pi}{6} \right)} \left( e^{\frac{i k \pi}{3}} + e^{\frac{8 i k \pi}{3}} - 2 e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \right) k \right) \right) + \\
& \quad \left( (0.5 - 3.06162 \times 10^{-17} i) (-1 + e^{2 i k \pi}) (-1 + e^{\frac{7 i k \pi}{3}}) - 2 \left( 1 + e^{\frac{i k \pi}{3}} - 2 e^{\frac{7 i k \pi}{3}} \right) \right. \\
& \quad \left. (-1 + e^{2 i (0.25 + k) \pi}) k \right) \left( e^{\frac{5}{6} i (-0.25 + k) \pi} - 1 / k (0.25 + 0.25 i) \left( (0. - 0.5 i) \right. \right. \\
& \quad \left. \left. e^{\frac{5}{6} i (-0.25 + k) \pi} + e^{\frac{5}{6} i (-0.25 + k) \pi} k + \frac{2 e^{i \left( -2.22529 + \frac{5 k \pi}{6} \right)} (-1 + e^{2 i (0.25 + k) \pi}) k}{-1 + e^{2 i k \pi}} + \right. \right. \\
& \quad \left. \left. \frac{1}{-1 + e^{\frac{7 i k \pi}{3}}} e^{-i \left( 0.654498 + \frac{7 k \pi}{6} \right)} \left( e^{2 i k \pi} + e^{\frac{13 i k \pi}{3}} - 2 e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \right) k \right) \right) \right) \\
& \left( (5.55112 \times 10^{-17} - 0.707107 i) \left( (3.06162 \times 10^{-17} + 0.5 i) (-1 + e^{2 i k \pi}) - \right. \right. \\
& \quad \left. \left. 2 i \left( (0. + 1.22465 \times 10^{-16} i) - 2 e^{2 i (0.25 + k) \pi} \right) k \right) \operatorname{Csc}[k \pi] - 1.41421 \right. \\
& \quad \left. \left( -1 + \sqrt{1 - \frac{8. k^2}{(4 k \operatorname{Cos}[k \pi] + 0.5 \operatorname{Sin}[k \pi])^2}} \right) (4 k \operatorname{Cos}[k \pi] + 0.5 \operatorname{Sin}[k \pi]) \right) \right) /
\end{aligned}$$

$$\begin{aligned}
& \left( 8 \left( -1 + e^{2 i k \pi} \right) \left( \left( -6.12323 \times 10^{-17} - 1. i \right) - e^{\frac{i k \pi}{3}} + e^{2 i k \pi} + e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \right) k^2 \right) - \\
& \left( \left( 0. + 0.176777 i \right) e^{-i k \pi} \right. \\
& \left( \left( \left( 0. + 0.5 i \right) e^{2 i \left( 0.785398 + \frac{13 k \pi}{6} \right)} - 4 e^{2 i k \pi} k + 2 e^{4 i k \pi} k + 2 e^{\frac{13 i k \pi}{3}} k - \right. \right. \\
& \left. \left. e^{2 i \left( 0.25 + k \right) \pi} \left( \left( 0. + 0.5 i \right) + 2 k \right) - e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \left( \left( 0. + 0.5 i \right) + 2 k \right) + \right. \right. \\
& \left. \left. \left( 6.12323 \times 10^{-17} + 1. i \right) \left( \left( 0. + 0.5 i \right) + 4 k \right) \right) \right. \\
& \left( e^{-\frac{5}{6} i \left( 0.25 + k \right) \pi} - 1 / k \left( 0.25 + 0.25 i \right) \left( \left( 0. - 0.5 i \right) e^{-\frac{5}{6} i \left( 0.25 + k \right) \pi} - \right. \right. \\
& \left. \left. e^{-\frac{5}{6} i \left( 0.25 + k \right) \pi} k + \frac{2 e^{-i \left( 2.22529 + \frac{5 k \pi}{6} \right)} \left( -1 + e^{2 i \left( 0.25 + k \right) \pi} \right) k}{-1 + e^{2 i k \pi}} + \right. \right. \\
& \left. \left. \frac{1}{-1 + e^{\frac{7 i k \pi}{3}}} e^{-i \left( 0.654498 + \frac{7 k \pi}{6} \right)} \left( e^{\frac{i k \pi}{3}} + e^{\frac{8 i k \pi}{3}} - 2 e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \right) k \right) \right) + \\
& \left( \left( 0. + 0.5 i \right) e^{2 i \left( 0.25 + k \right) \pi} + \left( 0. + 0.5 i \right) e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} + 2 e^{\frac{i k \pi}{3}} k + \right. \\
& \left. 2 e^{2 i k \pi} k - 2 e^{\frac{7 i k \pi}{3}} k - 2 e^{\frac{13 i k \pi}{3}} k + e^{2 i \left( 0.785398 + \frac{13 k \pi}{6} \right)} \left( \left( 0. - 0.5 i \right) + 2 k \right) - \right. \\
& \left. \left( 6.12323 \times 10^{-17} + 1. i \right) \left( \left( 0. + 0.5 i \right) + 2 k \right) \right) \\
& \left( e^{\frac{5}{6} i \left( -0.25 + k \right) \pi} - 1 / k \left( 0.25 + 0.25 i \right) \left( \left( 0. - 0.5 i \right) e^{\frac{5}{6} i \left( -0.25 + k \right) \pi} + \right. \right. \\
& \left. \left. e^{\frac{5}{6} i \left( -0.25 + k \right) \pi} k + \frac{2 e^{i \left( -2.22529 + \frac{5 k \pi}{6} \right)} \left( -1 + e^{2 i \left( 0.25 + k \right) \pi} \right) k}{-1 + e^{2 i k \pi}} + \frac{1}{-1 + e^{\frac{7 i k \pi}{3}}} \right. \right. \\
& \left. \left. e^{-i \left( 0.654498 + \frac{7 k \pi}{6} \right)} \left( e^{2 i k \pi} + e^{\frac{13 i k \pi}{3}} - 2 e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \right) k \right) \right) \right) \\
& \left( 0.5 + 2.82843 k \operatorname{Csc}[k \pi] \operatorname{Sin}[(0.25 + k) \pi] \right) \Bigg/ \left( \left( -1 + e^{2 i k \pi} \right) \right. \\
& \left. \left( \left( -6.12323 \times 10^{-17} - 1. i \right) - e^{\frac{i k \pi}{3}} + e^{2 i k \pi} + e^{2 i \left( 0.785398 + \frac{7 k \pi}{6} \right)} \right) k^2 \right) \Bigg)
\end{aligned}$$

In[127]:=  **$\theta = 0.25$** 

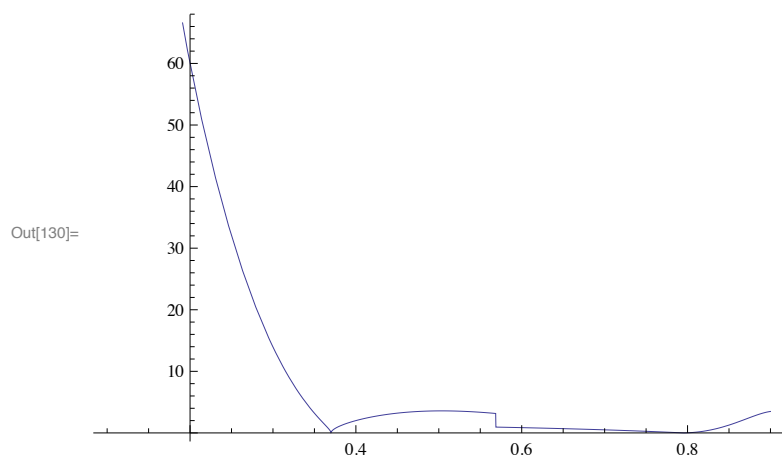
Out[127]= 0.25

In[128]:=  **$\theta = \pi / 6$** Out[128]=  $\frac{\pi}{6}$

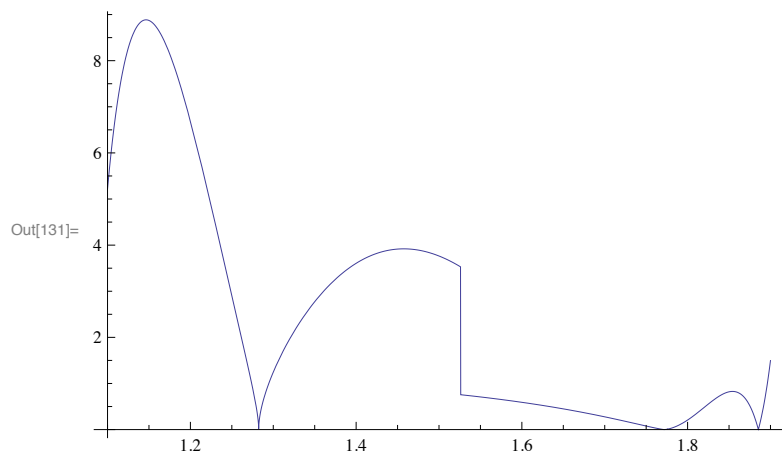
In[129]:=  $\alpha = 0.5$

Out[129]= 0.5

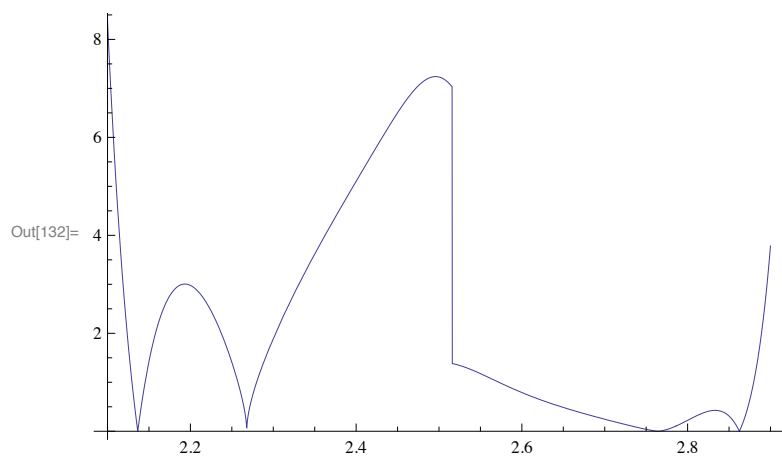
In[130]:= `Plot[Abs[char[x,  $\Xi$ ,  $\theta$ ,  $\alpha$ ]], {x, 0.1, 0.9}]`



In[131]:= `Plot[Abs[char[x,  $\Xi$ ,  $\theta$ ,  $\alpha$ ]], {x, 1.1, 1.9}]`

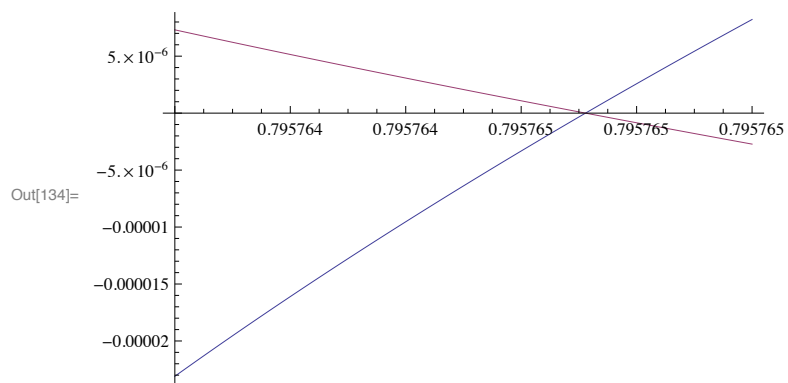


In[132]:= `Plot[Abs[char[x,  $\Xi$ ,  $\theta$ ,  $\alpha$ ]], {x, 2.1, 2.9}]`



In[133]:= (\* Далее будем строить вместе графики обеих частей нашей комплексной функции и смотреть за сближением их корней при изменении параметра \*)

```
In[134]:= Plot[{Re[char[x,  $\mathfrak{E}$ ,  $\theta$ ,  $\alpha$ ]], Im[char[x,  $\mathfrak{E}$ ,  $\theta$ ,  $\alpha$ ]]}, {x, 0.795764, 0.795765}]
```



```
In[136]:= Abs[char[0.795765,  $\mathfrak{E}$ ,  $\theta$ ,  $\alpha$ ]]
```

Out[136]=  $8.65703 \times 10^{-6}$