

Symbol	Meaning	Value
$\zeta(3)$	Apery's constant	1.202...
B	Backhouse's constant	1.456...
e	Base of the natural logarithm	2.718...
K	Catalan's constant	0.915...
π	Circle constant	3.141...
γ	Euler-Mascheroni constant	0.577...
α	Feigenbaum's alpha	2.502...
δ	Feigenbaum's delta	4.669...
ξ	Foias constant	1.187...
F	Fransén-Robinson constant	2.807...
G	Gauss's constant	0.834...
A	Glaisher-Kinkelin constant	1.282...
ϕ	Golden ratio	1.618...
η	Grossman's constant	0.737...
ρ	Kepler-Bouwkamp constant	0.114...
K_0	Khinchin's constant	2.685...
q	Komornik-Loreti constant	1.787...
K_{LR}	Landau-Ramanujan constant	0.764...
L	Lemniscate constant	2.622...
M_3	Madelung constant	-1.747...
M	Meissel-Mertens constant	0.261...
C	Niven's constant	1.705...
Ω	Omega constant	0.567...
σ_p	Paper folding constant	0.850...
μ	Ramanujan-Soldner constant	1.451...
ψ	Reciprocal Fibonacci constant	3.359...
σ	Somos' quadratic recurrence constant	1.661...
Π_2	Twin primes constant	0.660...
P	Universal parabolic constant	2.295...

Constant Definitions

0.1 Backhouse's Constant, B

Let p_k be the k th prime. Let

$$P(x) = 1 + \sum_{k=1}^{\infty} p_k x^k$$

and in turn let

$$\begin{aligned} Q(x) &= \frac{1}{P(x)} \\ &= \sum_{k=0}^{\infty} q_k x^k. \end{aligned}$$

Then Backhouse's constant is given by

$$B = \lim_{k \rightarrow \infty} \left| \frac{q_{k+1}}{q_k} \right|.$$

0.2 The Base of the Natural Logarithm, e

The base of the natural logarithm.

0.3 Catalan's Constant, K

$$K = \sum_{n=0}^{\infty} \frac{(-1)^n}{(2n+1)^2}$$

0.4 The Circle Constant, π

The ratio of a circle's circumference to its diameter.

0.5 The Euler-Mascheroni Constant, γ

$$\gamma = \lim_{n \rightarrow \infty} \left(-\ln(n) + \sum_{k=1}^n \frac{1}{k} \right)$$

0.6 Feigenbaum's α and δ Constants

Consider a species where the population of one generation depends on the population of the prior generation according to the recurrence relation

$$P_n = rP_{n-1}(1 - P_{n-1})$$

where r is a constant parameter. As n goes to ∞ , you might expect the population to settle on an equilibrium value. The value of the parameter r controls what this equilibrium value is. For many values of r , we see the population settle on a single value. However, for other values, the population may cycle back and forth between two or three (or more) values with successive generations. This behavior can be visualized in a bifurcation plot, like Figure 1.

When r is less than one, the population drops every generation, settling on 0, as seen in the plot. When r is about 2, the population settles near 0.5. When r is 3.2, the population will vacillate between two different sizes with successive generations. At 3.5, we cycle between

four different sizes. If we pay attention to the values of r at which these splits (bifurcations) happen, we can find the δ constant.

If three consecutive bifurcations occur at r values of r_n , r_{n+1} , and r_{n+2} , then let the lengths

$$L_n = r_{n+1} - r_n \text{ and}$$

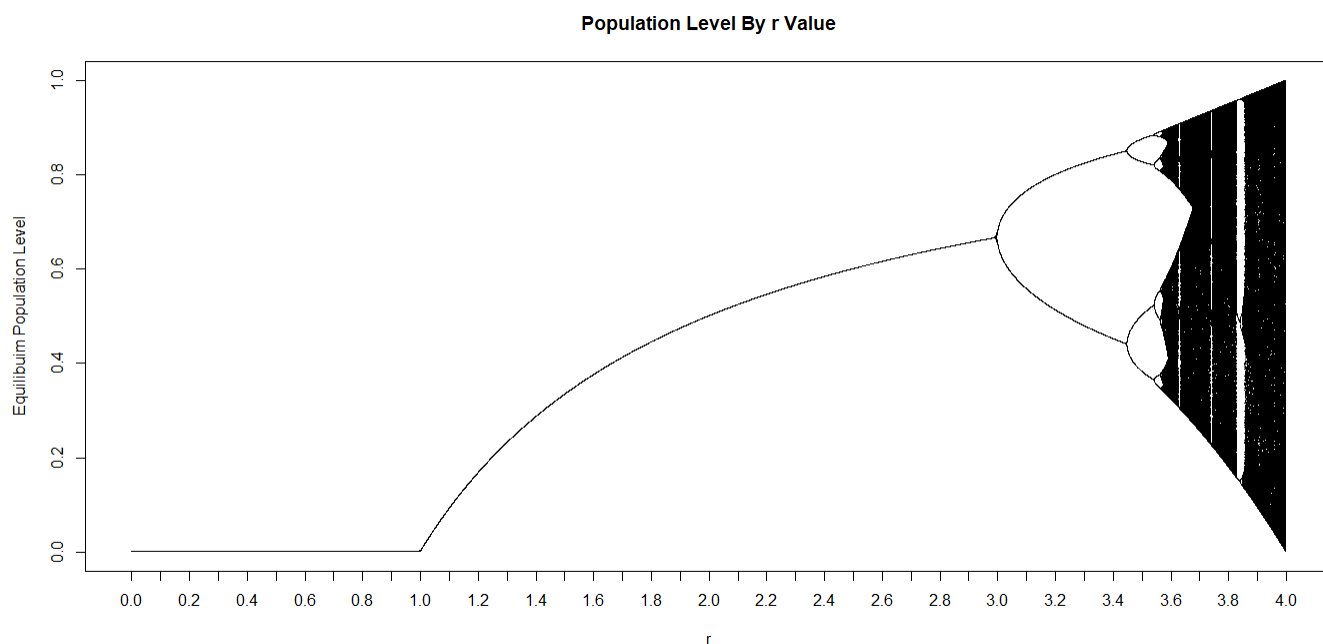
$$L_{n+1} = r_{n+2} - r_{n+1}.$$

We then get

$$\delta = \lim_{n \rightarrow \infty} \frac{L_n}{L_{n+1}}.$$

The α constant is found similarly. When a bifurcation occurs, two “tines” arise. If we then increase r until just before the next bifurcation occurs, we can record the distance between the tips of those two tines. The ratio of these distances for successive bifurcations converges to the α constant.

Figure 1: Bifurcation diagram for the logistic map



0.7 Foias Constant, ξ

Let $x_1 > 0$ and

$$x_{n+1} = \left(1 + \frac{1}{x_n}\right)^n.$$

Then there is exactly one value of $x_1 = \xi$ such that $x_n \rightarrow \infty$.

0.8 The Fransén-Robinson Constant, F

$$F = \int_0^\infty \frac{dx}{\Gamma(x)}$$

Where

$$\Gamma(x) = \int_0^\infty t^{x-1} e^{-t} dt$$

0.9 Gauss's Constant, G

$$G = \frac{1}{\operatorname{agm}(1, \sqrt{2})}$$

Where $\operatorname{agm}(a, b)$ is the arithmetic-geometric mean of a and b .

0.10 The Golden Ratio, ϕ

The greater of the two solutions to $x^2 = x + 1$, namely

$$\frac{1 + \sqrt{5}}{2}.$$

0.11 Grossman's Constant, η

Define the sequence $a_0 = 1$, $a_1 = x$, and

$$a_n = \frac{a_{n-2}}{1 + a_{n-1}}.$$

This sequence converges for exactly one value of $x = \eta$.

0.12 The Kepler-Bouwkamp Constant, ρ

$$\rho = \prod_{k=3}^{\infty} \cos\left(\frac{\pi}{k}\right)$$

0.13 Khinchin's Constant, K_0

The coefficients of the continued fraction expansion of a real number almost always have a finite geometric mean which converges to this constant. That is, if

$$x = a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \dots}},$$

then it is almost always true that

$$\lim_{n \rightarrow \infty} (a_1 a_2 \dots a_n)^{1/n} = K_0.$$

0.14 The Komornik-Loreti Constant, q

The Thue-Morse sequence is defined by the recurrence relation

$$\begin{aligned}t_0 &= 0 \\t_{2n} &= t_n \\t_{2n+1} &= 1 - t_n\end{aligned}$$

The Komornik-Loreti constant, q , is the solution to

$$1 = \sum_{n=1}^{\infty} \frac{t_n}{q^n}$$

0.15 The Meissel-Mertens Constant, M

The value of the limit

$$\lim_{n \rightarrow \infty} \left(-\ln(\ln(n)) + \sum_{p \leq n} \frac{1}{p} \right)$$

for primes p .

0.16 Niven's Constant, C

If the prime factorization of an integer m is written as

$$m = (p_1^{a_1})(p_2^{a_2})(p_3^{a_3}) \dots,$$

then we define the function H as

$$H(m) = \max(a_1, a_2, a_3, \dots).$$

Niven's constant is then given by the limit

$$C = \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{m=1}^n H(m).$$

So C is the “average” greatest number of times a prime occurs in the prime factorization of an integer.

0.17 The Ω Constant

The solution to

$$xe^x = 1.$$

0.18 The Paper Folding Constant, σ_p

Take a strip of paper and fold it in half, right over left, infinitely often. Upon unfolding it, assign each “valley” crease a 1, and each “mountain” crease a 0. That sequence begins:

$$a = \{1, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, \dots\}$$

Then,

$$\sigma_p = \sum_{n=1}^{\infty} \frac{a_n}{2^n}$$

0.19 The Ramanujan-Soldner Constant, μ

The Ramanujan-Soldner constant, μ , is the unique positive solution to

$$\int_0^x \frac{dt}{\ln(t)} = 0$$

0.20 The Reciprocal Fibonacci Constant, ψ

The value of the summation

$$\sum_{n=1}^{\infty} \frac{1}{F_n}$$

where F_n is the n th Fibonacci number.

0.21 Somos' Quadratic Recurrence Constant, σ

$$\begin{aligned} \sigma &= \sqrt{1\sqrt{2\sqrt{3}\dots}} \\ &= \prod_{n=1}^{\infty} \left(\frac{1+n}{n}\right)^{2^{-n}} \end{aligned}$$

0.22 The Universal Parabolic Constant, P

The latus rectum of a parabola is the line segment whose end points lie on the parabola and which passes through its focus parallel to its directrix. The focal parameter of a parabola is the distance from its directrix to its focus. Let A be the arc length of the parabolic segment formed by the latus rectum of a parabola and p be the focal parameter of that parabola. The universal parabolic constant is

$$\begin{aligned} P &= \frac{A}{p} \\ &= \ln(1 + \sqrt{2}) + \sqrt{2}. \end{aligned}$$

1 January

$$1.01 = \sqrt[\kappa]{e - C}$$

$$1.02 = -\left(\frac{M_3}{C}\right)$$

$$1.03 = \csc(\gamma\pi)$$

$$1.04 = \mu^\rho$$

$$1.05 = \sqrt[\sigma]{\frac{1}{K}}$$

$$1.06 = \cosh\left(\sqrt[M]{K_{LR}}\right)$$

$$1.07 = \frac{1}{\gamma\phi}$$

$$1.08 = \ln(\cosh(M_3))$$

$$1.09 = \frac{1}{K}$$

$$1.10 = \gamma^{\ln(G)} \quad \text{or} \quad \tan(G)$$

$$1.11 = P \log_G(K)$$

$$1.12 = \sqrt{P - \ln(F)} \quad \text{or} \quad \gamma - \ln(\gamma) \quad \text{or} \quad \cosh^{-1}(C)$$

$$1.13 = \ln^\gamma\left(\pi + \frac{1}{\pi}\right)$$

$$1.14 = \ln(\phi \cosh(A)) \quad \text{or} \quad \sinh(\tanh(P))$$

$$1.15 = \left(1 + {}^{(e-\pi)}\sqrt[e]{e}\right)^\phi$$

$$1.16 = \frac{e^{\sqrt[\phi]{\phi}}}{\pi}$$

$$1.17 = \sec(\ln \gamma)$$

$$1.18 = \phi - \frac{1}{2 \ln \pi}$$

$$1.19 = \tan^{-1}\alpha \quad \text{or} \quad \frac{\sqrt{2}}{\xi} \quad \text{or} \quad \sqrt[e]{\phi}$$

$$1.20 = \zeta(3) \quad \text{or} \quad \frac{\ln 2}{\gamma} \quad \text{or} \quad \sqrt{\mu}$$

$$1.21 = \ln \psi \quad \text{or} \quad \tan^{-1} K_0$$

$$1.22 = \frac{\mu}{\xi} \quad \text{or} \quad \frac{\sqrt{\pi}}{\mu}$$

$$1.23 = \sqrt{\frac{1}{\Pi_2}} \quad \text{or} \quad \sqrt{\pi - \phi}$$

$$1.24 = \frac{1}{\sinh \eta}$$

$$\begin{aligned}
1.25 &= \sqrt{1 + \Omega} \quad \text{or} \quad \frac{\pi}{\alpha} \\
1.26 &= e - B \quad \text{or} \quad \csc(K) \\
1.27 &= \gamma + \ln 2 \quad \text{or} \quad K_0 - \sqrt{2} \quad \text{or} \quad \sqrt{\phi} \\
1.28 &= A \quad \text{or} \quad \log_B(\phi) \\
1.29 &= \cosh(\sigma - K) \quad \text{or} \quad \tan^{-1}(eA) \\
1.30 &= \frac{\cosh^{-1}\phi}{\gamma\sqrt{2}} \quad \text{or} \quad \tan K \\
1.31 &= \ln(\phi P) \quad \text{or} \quad \frac{\zeta(3)}{K}
\end{aligned}$$

2 February

$$\begin{aligned}
2.01 &= \sqrt[\xi]{P} \quad \text{or} \quad \cosh^{-1}(1+F) \\
2.02 &= A(\gamma+1) \quad \text{or} \quad \Omega+B \\
2.03 &= \sqrt{\phi+\alpha} \\
2.04 &= \sqrt{B+e} \quad \text{or} \quad \frac{L}{A} \\
2.05 &= \mu\sqrt{2} \quad \text{or} \quad \log_{\phi}(K_0) \\
2.06 &= \frac{L}{\sqrt{\phi}} \\
2.07 &= e^{\gamma^{\gamma}} \quad \text{or} \quad \pi\Pi_2 \\
2.08 &= \cosh^{-1}(\mu F) \quad \text{or} \quad \sqrt{\xi+\pi} \\
2.09 &= \frac{\mu}{\ln 2} \\
2.10 &= e - \frac{1}{\phi} \quad \text{or} \quad \frac{B}{\ln 2} \\
2.11 &= \frac{\gamma}{\sigma_p - \gamma} \quad \text{or} \quad \sqrt{CL} \\
2.12 &= B^2 \quad \text{or} \quad \ln(\tan \mu) \\
2.13 &= \cos^{-1}\left(\frac{1}{G-e}\right) \quad \text{or} \quad \sqrt[\kappa]{2} \\
2.14 &= \frac{\sqrt{2}}{\Pi_2} \\
2.15 &= e - \Omega \\
2.16 &= \sqrt{\delta} \quad \text{or} \quad \delta - \alpha \\
2.17 &= \cos(M) + \tan^{-1}(L) \\
2.18 &= \sqrt[A]{e} \quad \text{or} \quad \frac{1+e}{C} \\
2.19 &= \frac{1}{B-1} \\
2.20 &= \sqrt{\pi \ln \delta} \\
2.21 &= \pi^{\ln(2)} \\
2.22 &= \cosh^{-1}(\delta) \quad \text{or} \quad \phi^{\sigma} \\
2.23 &= (1+\Omega)^q \quad \text{or} \quad \log_{\mu}(P) \\
2.24 &= \sqrt[\sigma]{\frac{1}{M}} \\
2.25 &= \sqrt{\alpha+K+\sigma} \\
2.26 &= \frac{e}{\zeta(3)}
\end{aligned}$$

$$2.27 = q^{\sqrt{2}}$$

$$2.28 = K_0^G$$

$$2.29 = P$$

3 March

$$\begin{aligned}
3.01 &= \phi^{\alpha K} \\
3.02 &= \phi^{B+\sin(1)} \\
3.03 &= \frac{1}{\rho - \cos(q)} \\
3.04 &= \frac{\pi}{\ln F} \\
3.05 &= \delta - \phi \\
3.06 &= \phi + \frac{1}{\ln 2} \quad \text{or} \quad \pi^{\sqrt[4]{K}} \\
3.07 &= \alpha + \Omega \\
3.08 &= \delta \Pi_2 \quad \text{or} \quad L + \frac{B}{\pi} \\
3.09 &= P^{\frac{e}{2}} \\
3.10 &= \pi \ln K_0 \\
3.11 &= \log_{\mu}(L + \Omega) \\
3.12 &= -\frac{\ln \pi}{\ln(\ln 2)} \\
3.13 &= K_0^{\frac{\pi}{e}} \\
3.14 &= \pi \quad \text{or} \quad \zeta(3) + \frac{\phi}{G} \\
3.15 &= \gamma + \sqrt[4]{\psi} \\
3.16 &= C + B \quad \text{or} \quad \pi B - \sqrt{2} \\
3.17 &= \frac{\alpha}{C - K} \\
3.18 &= e^{\sin^{-1}(K)} \quad \text{or} \quad \sqrt{\pi} + \sqrt{2} \\
3.19 &= P\sqrt{\sinh \sqrt{2}} \quad \text{or} \quad K_0\sqrt[4]{2} \\
3.20 &= \sqrt[e]{\frac{e}{\rho}} \quad \text{or} \quad \frac{1}{e\rho} \\
3.21 &= \frac{\delta\sqrt{\gamma + \Pi_2}}{\phi} \quad \text{or} \quad K + P \\
3.22 &= \pi - \ln(\tanh \phi) \\
3.23 &= \delta - \sqrt[e]{K_0} \quad \text{or} \quad \frac{\tan B}{K_0} \\
3.24 &= q \cosh(\zeta(3)) \quad \text{or} \quad B + q \\
3.25 &= \cosh(\xi + \Pi_2) \quad \text{or} \quad B^{\pi} \\
3.26 &= F^{\ln \pi} \quad \text{or} \quad \eta^2 + e
\end{aligned}$$

$$3.27 = \sinh^{-1}((\gamma + F)\sqrt[3]{e}) \quad \text{or} \quad \xi A - M_3$$

$$3.28 = e\sqrt{B} \quad \text{or} \quad \sigma + \sqrt{L}$$

$$3.29 = e - \frac{1}{M_3} \quad \text{or} \quad e + \gamma$$

$$3.30 = \frac{e}{\tan\left(\frac{1}{\mu}\right)} \quad \text{or} \quad \frac{F}{\sigma_p}$$

$$3.31 = \sqrt{A} + \cosh \sqrt{2} \quad \text{or} \quad L + \frac{1}{\mu}$$

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$$5.12 = \sigma^{\delta/\mu} \quad \text{or} \quad \pi + \Omega + \sqrt{2}$$

$$5.13 = -\tan\left(\frac{1}{\Omega}\right)$$

$$5.14 = K_0^{\cosh^{-1}(e)} \quad \text{or} \quad e^{\sqrt{K_0}}$$

$$5.15 = \alpha^q \quad \text{or} \quad \frac{\tan(\mu)}{\phi} \quad \text{or} \quad \delta \tan(G)$$

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$$7.27 = \pi^{\rho+\phi}$$

$$7.28 = e^{\sqrt{K_0}}\sqrt{2}$$

$$7.29 = \frac{G}{\tanh(\rho)}$$

$$7.30 = \sqrt{\sinh(\delta)}$$

$$7.31 = \alpha^\sigma + e \quad \text{or} \quad Ce^B$$

8 August

$$8.01 = **$$

$$8.02 = **$$

$$8.03 = \ln(2) \cosh(\pi)$$

$$8.04 = e^{\sqrt{\phi K_0}}$$

$$8.05 = \frac{\alpha K_0}{G}$$

$$8.06 = \sinh\left(\frac{\psi}{\sqrt{B}}\right)$$

$$8.07 = \sinh \sqrt{\sigma \delta}$$

$$8.08 = **$$

$$8.09 = **$$

$$8.10 = B^{\frac{B}{M}}$$

$$8.11 = \phi^{\frac{1}{2\rho}} \quad \text{or} \quad \alpha^{A+1}$$

$$8.12 = \frac{\alpha^\psi}{K_0} \quad \text{or} \quad \delta^{\frac{\epsilon}{2}}$$

$$8.13 = -\frac{K_0 M_3}{\gamma} \quad \text{or} \quad -\tan(1 + \ln(2))$$

$$8.14 = e^P - q$$

$$8.15 = **$$

$$8.16 = **$$

$$8.17 = e^{\frac{B}{\ln(2)}}$$

$$8.18 = K_0 \log_B(\pi) \quad \text{or} \quad (\sinh^{-1} P)^\delta$$

$$8.19 = 2^{\frac{\sinh \alpha}{2}} \quad \text{or} \quad \sigma^\psi + K_0$$

$$8.20 = \cosh(F) - \rho \quad \text{or} \quad \frac{\log_\phi F}{M}$$

$$8.21 = \alpha^P \quad \text{or} \quad K + \sinh(K_0)$$

$$8.22 = **$$

$$8.23 = \left(\frac{\pi}{2}\right)^\delta \quad \text{or} \quad e^{(K+F)\Omega}$$

$$8.24 = B^{q\pi} \quad \text{or} \quad e \log_\sigma(\delta)$$

$$8.25 = \sinh(F) \quad \text{or} \quad \log_K\left(\frac{1}{e}\right) - \pi$$

$$8.26 = \frac{Ke}{\rho L} \quad \text{or} \quad \psi - FM_3$$

$$8.27 = \delta\sqrt{\pi} \quad \text{or} \quad e^{\mu B} \quad \text{or} \quad \frac{-\log(\rho)}{M}$$

$$8.28 = \frac{q - G}{\rho}$$

$$8.29 = **$$

$$8.30 = **$$

$$8.31 = \cosh(F) \quad \text{or} \quad K - \tan(C) \quad \text{or} \quad \psi^{-M_3}$$

9 September

$$\begin{aligned}
9.01 &= \cosh(B)^{\gamma\delta} \quad \text{or} \quad \pi^\phi \sqrt{2} \\
9.02 &= \pi F^{G(\alpha-L)} \quad \text{or} \quad \psi K_0 \\
9.03 &= C^{P^C} \\
9.04 &= \sqrt[\Omega]{eA} \quad \text{or} \quad \sigma^{\frac{\alpha}{\gamma}} \quad \text{or} \quad \psi^{\frac{e+K}{2}} \\
9.05 &= ** \\
9.06 &= ** \\
9.07 &= ** \\
9.08 &= ** \\
9.09 &= ** \\
9.10 &= ** \\
9.11 &= ** \\
9.12 &= ** \\
9.13 &= ** \\
9.14 &= \delta + K_0 + q \quad \text{or} \quad \ln(\psi) \sinh(e) \\
9.15 &= B + \sqrt[M]{C} \quad \text{or} \quad \frac{F}{1 - \ln(2)} \quad \text{or} \quad e(\sigma + C) \\
9.16 &= K_0(e + \ln 2) \quad \text{or} \quad \phi + \sinh(e) \\
9.17 &= \phi(1 + \delta) \quad \text{or} \quad \sigma\delta + \sqrt{2} \quad \text{or} \quad Fe\zeta(3) \\
9.18 &= \cosh(B + \mu) \\
9.19 &= \mu \sqrt[\mathcal{G}]{\delta} \quad \text{or} \quad \mu \tan\left(\sqrt{2}\right) \\
9.20 &= \sqrt[\pi]{\rho} + \frac{1}{\rho} \quad \text{or} \quad (\mu + \pi)^B \\
9.21 &= \delta + \phi F \quad \text{or} \quad \sqrt[M]{q} \\
9.22 &= \psi^{\sqrt{\psi}} \quad \text{or} \quad \frac{\pi\psi}{\ln \pi} \\
9.23 &= \frac{\cosh^{-1}(\phi)}{\rho} \quad \text{or} \quad \frac{1}{\rho} + \ln C \\
9.24 &= \frac{1}{\rho} + \sinh^{-1}\Omega \\
9.25 &= \sinh(\pi) - P \quad \text{or} \quad \sqrt[q]{\sinh(\delta)}
\end{aligned}$$

$$9.26 = \frac{1}{\frac{1}{\pi} + \mu - \sigma} \quad \text{or} \quad \frac{\sinh(\phi)}{M}$$

$$9.27 = \gamma + \frac{1}{\rho} \quad \text{or} \quad \sinh\left(\psi - \frac{\xi}{e}\right)$$

$$9.28 = e + \alpha L \quad \text{or} \quad \frac{\pi C}{\gamma}$$

$$9.29 = (\delta + 1)\sqrt{K_0} \quad \text{or} \quad \pi \cosh(M_3)$$

$$9.30 = P(\psi + \ln 2) \quad \text{or} \quad \pi e\sqrt{\xi}$$

10 October

$$\begin{aligned}
10.01 &= \frac{1 + \phi}{M} \\
10.02 &= \frac{e^2}{\eta} \quad \text{or} \quad \frac{L}{M} \\
10.03 &= \pi^{\csc(L)} \\
10.04 &= \frac{B}{\rho} - L \quad \text{or} \quad \alpha + \sinh(e) \\
10.05 &= \tan\left(\frac{G}{\Omega}\right) \quad \text{or} \quad \frac{\sec \mu}{G} \\
10.06 &= \frac{\cosh P}{-K + \sqrt{2}} \\
10.07 &= \delta + e + K_0 \quad \text{or} \quad B \cosh L \\
10.08 &= \sinh\left(\frac{C}{\Omega}\right) \quad \text{or} \quad \cosh\left(\sqrt[e]{\alpha}\right) \\
10.09 &= \frac{\zeta(3)}{\rho} - \frac{1}{e} \quad \text{or} \quad \sinh(\delta - \sigma) \\
10.10 &= -\frac{\phi^2 \sqrt{2}}{\ln \ln 2} \quad \text{or} \quad e(e + 1) \\
10.11 &= \frac{1}{\rho} + \sqrt{2} \\
10.12 &= \frac{\mu}{\rho} - \alpha \\
10.13 &= \sqrt[2]{\gamma} + \pi \\
10.14 &= \cosh(\delta - \sigma) \\
10.15 &= \frac{e}{\tanh^{-1} M} \\
10.16 &= \sinh\left(\alpha + \sqrt{M}\right) \\
10.17 &= \frac{\xi + \sqrt{2}}{\tan^{-1} M} \\
10.18 &= \tan(\cosh^{-1} P) \\
10.19 &= (\sigma + \ln 2)(\pi + \xi) \\
10.20 &= \frac{\delta}{\Pi_2 \ln 2} \\
10.21 &= \sqrt[3]{M}
\end{aligned}$$

$$10.22 = \frac{K_0 F}{\eta}$$

$$10.23 = L + \cosh(e)$$

$$10.24 = L(e + \xi) \quad \text{or} \quad e + \sqrt[3]{\pi}$$

$$10.25 = \psi \csc(F)$$

$$10.26 = e + \sinh(e) \quad \text{or} \quad e\pi\zeta(3)$$

$$10.27 = \frac{1}{G - \eta} \quad \text{or} \quad \frac{e}{\sin^{-1}M}$$

$$10.28 = \frac{\phi\sigma}{M}$$

$$10.29 = \zeta(3)^{B/\rho}$$

$$10.30 = \frac{e}{\rho P}$$

$$10.31 = P^F$$

11 November

$$\begin{aligned}
11.01 &= q^{e+\sqrt{2}} \\
11.02 &= q(\psi + F) \\
11.03 &= \sinh(\pi)\tan^{-1}\sqrt{2} \quad \text{or} \quad e + \cosh F \\
11.04 &= \frac{\pi^\phi}{\gamma} \quad \text{or} \quad \frac{F\delta}{\xi} \\
11.05 &= (\Pi_2 + \delta) \sqrt[\varrho]{\psi} \\
11.06 &= L\sqrt[\gamma]{P} \\
11.07 &= (\pi + \ln 2) \log_C(\delta) \\
11.08 &= \cosh\left(\frac{q}{\gamma}\right) \\
11.09 &= \frac{\psi\delta}{\sqrt{2}} \\
11.10 &= \frac{\alpha}{\ln(B) \tanh(\ln 2)} \\
11.11 &= BFe \\
11.12 &= \Omega M - \tan(\sigma) \\
11.13 &= \gamma + \psi\pi \\
11.14 &= \psi^{\ln(2)}\sqrt[\ln(2)]{P} \\
11.15 &= F^{\frac{F}{\zeta(3)}} \quad \text{or} \quad \frac{A}{\rho} \\
11.16 &= L + \pi e \quad \text{or} \quad L^\alpha \\
11.17 &= \frac{1}{F - e} \\
11.18 &= \sinh(\pi) - \frac{1}{e} \\
11.19 &= \frac{e^2}{\Pi_2} \\
11.20 &= \left(\frac{F}{\xi}\right)^F \quad \text{or} \quad (\delta + e) \sqrt[A]{C} \\
11.21 &= \frac{L \sinh\left(\sqrt{L}\right)}{\Omega} \\
11.22 &= \frac{\sinh e}{\sin \eta} \quad \text{or} \quad \psi + \pi\alpha \\
11.23 &= \psi PB \\
11.24 &= \tan(\phi K) \\
11.25 &= \cosh(e \ln \pi)
\end{aligned}$$

$$11.26 = \cosh (\mu + \sigma) \quad \text{or} \quad \sinh \left(\delta - e + \sqrt[\pi]{\phi} \right)$$

$$11.27 = \frac{M_3 - \ln 2}{\sin \psi}$$

$$11.28 = \psi^2 \quad \text{or} \quad \sqrt[\gamma]{\frac{F}{\ln 2}}$$

$$11.29 = \sinh \left(C + \sqrt{2} \right)$$

$$11.30 = \delta e - \sigma G$$

12 December

$$12.01 = \frac{\pi}{M}$$

$$12.02 = \psi(A + P) \quad \text{or} \quad \frac{\tan(\mu)}{\ln 2}$$

$$12.03 = e(\phi + F) \quad \text{or} \quad \cosh(\pi) + \sin(K_0)$$

$$12.04 = \frac{\cosh(\sigma_p)}{\rho}$$

$$12.05 = \cosh(e + \gamma - \rho) \quad \text{or} \quad {}^{\pi-F}\sqrt{P}$$

$$12.06 = \cosh\left(\frac{1}{M\zeta(3)}\right)$$

$$12.07 = \ln(\phi) + \cosh(\pi)$$

$$12.08 = **$$

$$12.09 = **$$

$$12.10 = **$$

$$12.11 = **$$

$$12.12 = **$$

$$12.13 = **$$

$$12.14 = **$$

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$$12.30 = **$$

$$12.31 = **$$