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Difficult High-Level Math Questions

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Abstract

In this document, I describe fifteen high level math problems.
I explain how to break apart the questions and fully solve each problem. This concept of practicing with complex problems helps us learn how to solve problems in a more intelligent manner, rather than brute forcing.

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Introduction

Equation 1

If we look at the following equation, assuming ψ is ψ(t)

$$\frac{\left[\left(\psi^{\psi}\right)' + \int i^{i}\right]}{\int_{tan(x)\psi}^{-\sigma^{2^{i}}} \left[\iiint x\right]}$$

We can solve for an approximate solution, but first we must focus on finding the derivative of ψ(t)^ψ(t). Doing this we can find the answer to be:

$$\left[\psi(x)^{\psi(x)}\right]' = \left(ln\left(\psi(x)\right)\psi'(x) + \psi'(x)\right)\psi(x)^{\psi(x)}$$

When we plug this result back into the original equation, and simplify some expressions a little bit, we get the following.

$$\frac{\left(ln\left(\psi(x)\right)\psi'(x) + \psi'(x)\right)\psi(x)^{\psi(x)} + \int i^{i}}{\int_{tan(x)\psi(x)}^{-\sigma^{2^{i}}} \int\int\int x\,dx\,dx\,dx\,dx}$$

If we also simplify the indefinite integrals in the equation we get the following.

$$\frac{\left(ln\left(\psi(x)\right)\psi'(x) + \psi'(x)\right)\psi(x)^{\psi(x)} + i^{i}x + c}{\int_{tan(x)\psi(x)}^{-\sigma^{2^{i}}} \frac{x^{4}}{24} + \frac{cx^{2}}{2} + cx + c\,dx}$$

Lastly, we must deconstruct the definite integral.

$$\frac{\left(ln\left(\psi(x)\right)\psi'(x) + \psi'(x)\right)\psi(x)^{\psi(x)} + i^{ix} + c}{\frac{1}{120}\left(-\sigma^{5\cdot 2^{i}} - tan^{5}(x)\psi(x)^{5}\right) + \frac{c}{6}\left(-\sigma^{3\cdot 2^{i}} - tan^{3}(x)\psi(x)^{3}\right) + c\left(\frac{\sigma^{2^{i+1}}}{2} - \frac{1}{2}tan^{2}(x)\psi(x)^{2}\right) - c\sigma^{2^{i}} - c\,tan(x)\psi(x)}$$

Now simplify to yield the final result:

$$\frac{120\left(\left(\left(ln\psi(x)\right)\psi'(x) + \psi'(x)\right)\psi(x)^{\psi(x)} + i^{ix} + c\right)}{-\sigma^{5\cdot 2^{i}} - tan^{5}(x)\psi(x)^{5} + 20c\left(-\sigma^{3\cdot 2^{i}} - tan^{3}(x)\psi(x)^{3}\right) + 60c\left(\sigma^{2^{i+1}} - tan^{2}(x)\psi(x)^{2}\right) - 120c\sigma^{2^{i}} - 120c\,tan(x)\psi(x)}$$

Conclusion: The initial equation may seem complex at first; however, when we break it down into the fundamentals, we see that the equation becomes more approachable. The final equation is a simplified version of the initial equation.

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Equation #2

If we look at the following equation

$$\frac{(\alpha-\beta)^{4-\tan(x)\delta(-x+\cot(x))}}{\frac{-i\sqrt{3i}}{i}} + \left(x^{i^{\infty}}\left(\infty^{-i\cdot\infty\cdot i}\left(i^{-i+i}((i))x\right)\left(\sqrt{\infty}\right)^{-i}\right)x^{i}\right)30^{\circ}$$

Breaking the equation up into two separate fractions gets us the following equation.

$$-\frac{(\alpha-\beta)^{4-\delta tan(x)(-x+cot(x))}}{\sqrt{3}\sqrt{i}} + \frac{180^{\circ} i x^{i+i^{\infty}+1} \infty^{-\frac{i}{2}} \infty^{-\infty\cdot i^{2}}}{6}$$

Simplify the following a little more.

$$-\frac{\sqrt{3}\sqrt{i}(\alpha-\beta)^{-\delta tan(x)(-x+cot(x))+4}}{3i} +$$

$$\frac{180^{\circ} i x^{i+i^{\infty}+1} \infty^{-\frac{i}{2}} \infty^{-\infty\cdot i^{2}}}{6}$$

Simplify and expand anything needed to be expanded.

$$-\frac{(\alpha-\beta)^{\delta tan(x)-\delta tan(x)cot(x)+4}}{3^{\frac{1}{2}} i^{\frac{1}{2}}} +$$

$$\frac{3^{\frac{1}{2}} 180^{\circ} i^{\frac{3}{2}} x^{i+i^{\infty}+1} \infty^{-\frac{i}{2}} \infty^{-\infty-i^{2}}}{6\cdot 3^{\frac{1}{2}} i^{\frac{1}{2}}}$$

Conclusion: We can deduce that the equation above is simplified, through the use of some basic trigonometric concepts and a little rearrangement.

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Equation #3

If we view the following equation

$$\frac{x}{x^{2}} \div \frac{x^{3}}{x^{4}} \div \frac{x^{5}}{x^{6}} \div \frac{x^{7i}+\pi}{x^{8}} \div \frac{9tan(x)}{x^{-i+10}} \div \frac{x^{11}\sqrt{i}}{x^{12}} \div x^{13i}$$

After dividing all possible values, we find a fairly simple fraction. That we can simply further.

$$\frac{\frac{x}{\sqrt{i}\,x^{9tan(x)+61-i}\left(x^{7i}+\pi\right)}}{x^{13i}}$$

Next, we apply the fraction rule, giving us the following.

$$\frac{x}{\left(x^{7i}+\pi\right)\sqrt{i}\,x^{9tan(x)+61-i}x^{13i}}$$

Simplify.

$$\frac{x^{-9tan(x)+i-60}}{\left(x^{7i}+\pi\right)\sqrt{i}\,x^{13i}}$$

Simplify.

$$\frac{x^{-9tan(x)-12i-60}}{\left(x^{7i}+\pi\right)\sqrt{i}}$$

Finally, we find the fully simplified answer to be:

$$\frac{\sqrt{i}\,x^{-9tan(x)-12i-60}}{i\left(x^{7i}+\pi\right)}$$

Conclusion: This question inevitably seems quite daunting because of its size; however, in reality the question is conceptually quite simple.

Equation #4

If we view the following equation

$$\frac{|\beta^2|\left[x^{i^{\sqrt[3]{i+\sqrt{ix+\cot(x)}}}}\right]\phi^{\left[x^{\sqrt[3]{i-3i}+\frac{-3x}{\psi}}\right]}}{\left[|\beta^2|\left[x^{i^{\sqrt[3]{i+\sqrt{ix+\cot(x)}}}}\right]\phi^{\left[x^{\sqrt[3]{i-3i}+\frac{-3x}{\psi}}\right]}\right]^2}$$

Rearrange and simplify.

$$\frac{\beta^2 x^{i^{\sqrt[3]{i+\sqrt{ix+\cot(x)}}}}\phi^{x^{\frac{-3x}{\psi}}-\sqrt[3]{2i}}}{\left(x^{i^{\sqrt[3]{i+\sqrt{ix+\cot(x)}}}}\phi^{x^{\frac{-3x}{\psi}}+\sqrt[3]{i-3i}}|\beta^2|\right)^2}$$

Simplify the absolute value of beta in the denominator.

$$\frac{\beta^2 x^{i^{\sqrt[3]{i+\sqrt{ix+\cot(x)}}}}\phi^{x^{\frac{-3x}{\psi}}-\sqrt[3]{2i}}}{\left(\beta^2 x^{i^{\sqrt[3]{i+\sqrt{ix+\cot(x)}}}}\phi^{x^{\frac{-3x}{\psi}}-\sqrt[3]{2i}}\right)^2}$$

Keep in mind that.

$$\phi^{x^{\frac{-3x}{\psi}}-\sqrt[3]{2i}} = \phi^{x^{\frac{-3x-\sqrt[3]{2}\sqrt[3]{i}\psi}{\psi}}}$$

Knowing this, we can apply it to our problem.

$$\frac{1}{\beta^2 x^{i^{\sqrt[3]{i+\sqrt{ix+\cot(x)}}}}\phi^{x^{\frac{-3x}{\psi}}-\sqrt[3]{2i}}}$$

Dividing everything by psi, we can simplify the power into one fraction.

$$\frac{1}{\beta^2 x^{i^{\sqrt[3]{i+\sqrt{ix+\cot(x)}}}}\phi^{x^{\frac{-3x-\sqrt[3]{2}\sqrt[3]{i}\psi}{\psi}}}}$$

Equation #5

If we view the following equation

$$\sqrt{\frac{\sqrt[-i]{i}}{\sqrt[3]{\int tan(x)}}+\frac{\sqrt[3]{i}\left[tan(x)cot(x)\right]}{\frac{-3i+2}{\int tan(x)}}}$$

Start by solving the integrals.

$$\sqrt{\frac{\sqrt[-i]{i}}{\sqrt[3]{-ln\left|cos(x)\right|+c}}+\frac{\sqrt[3]{i}\,tan(x)cot(x)}{\frac{-3i+2}{-ln\left|cos(x)\right|+c}}}$$

Simplify the i th root.

$$\sqrt{\frac{i^{-\frac{1}{i}}}{\sqrt[3]{-ln\left|cos(x)\right|+c}}+\frac{\sqrt[3]{i}\,tan(x)cot(x)}{\frac{-3i+2}{-ln\left|cos(x)\right|+c}}}$$

Remove the cube root, and apply to the numerator.

$$\sqrt{\frac{i^{-\frac{1}{i}}\left(-ln\left|cos(x)\right|+c\right)^{\frac{2}{3}}}{-ln\left|cos(x)\right|+c}+\frac{\sqrt[3]{i}\,tan(x)cot(x)}{\frac{-3i+2}{-ln\left|cos(x)\right|+c}}}$$

Take the -3i + 2 and apply to the numerator.

$$\sqrt{\frac{i^{-\frac{1}{i}}\left(-ln\left|cos(x)\right|+c\right)^{\frac{2}{3}}}{-ln\left|cos(x)\right|+c}+\frac{\sqrt[3]{i}\,(2+3i)tan(x)cot(x)}{\frac{13}{-ln\left|cos(x)\right|+c}}}$$

Simplify to only two separate fractions.

$$\sqrt{\frac{i^{-\frac{1}{i}}\left(-ln\left|cos(x)\right|+c\right)^{\frac{2}{3}}}{-ln\left|cos(x)\right|+c}+\frac{\sqrt[3]{i}\,tan(x)cot(x)(2+3i)}{13\left(-ln\left|cos(x)\right|+c\right)}}$$

Add fractions together by finding a common denominator.

$$\sqrt{\frac{(2+3i)\left(i^{i}(2-3i)+\sqrt[3]{i}\tan(x)\cot(x)\left(-\ln\left|\cos(x)\right|+c\right)\sqrt[3]{-\ln\left|\cos(x)\right|+c}\right)}{13\sqrt[3]{-\ln\left|\cos(x)\right|+c}}}$$

Simplify even more.

$$\sqrt{\frac{(2+3i)\left(i^{i}(2-3i)+\sqrt[3]{i}\tan(x)\cot(x)\left(-\ln\left|\cos(x)\right|+c\right)\sqrt[3]{-\ln\left|\cos(x)\right|+c}\right)\left(-\ln\left|\cos(x)\right|+c\right)^{\frac{2}{3}}}{-13\ln\left|\cos(x)\right|+13c}}$$

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Equation #6

You are given a 3rd degree polynomial function, with the terms listed below. You are tasked with simplifying the expression into a binomial. You then must take the partial derivative of each of the terms in the original polynomial. Once this is completed, you must plug each partial derivative into a Jacobian, then back into the original polynomial. After this is done simply solve for x.

$$ax^3 + x^2b + \frac{a^2x}{dc} + \frac{2ab}{dc} + \frac{b^2}{xdc} = 0$$

Try to find something that can multiply to give ax + b on both sides.

$$x^2(ax+b) + \frac{cd}{dc}(cx+d) = 0$$

We have ax + b meaning we can combine the outer parts.

$$x^2(ax+b) + \frac{ax+b}{dcx}(ax+b) = 0$$

This gives us:

$$\left(x^2 + \frac{ax+b}{dcx}\right)(ax+b) = 0$$

Now we take the derivative of each part within the initial equation.

$$f(x) = ax^3 \; f'(x) = 3ax^2$$

$$f(x) = x^2b \; f'(x) = 2bx$$

$$f(x) = \frac{a^2x}{dc} \; f'(x) = \frac{a^2}{dc}$$

$$f(x) = \frac{2ab}{dc} \; f'(x) = 0$$

$$f(x) = \frac{b^2}{xdc} \; f'(x) = -\frac{b^2}{x^2dc}$$

Then, take the Jacobian.

$$J = \left[3ax^2, 2bx, \frac{a^2}{dc}, 0, -\frac{b^2}{x^2dc}\right]$$

Next set each part of the Jacobian equal to the initial equation, then solve for x.

$$3ax^2 = ax^3 + x^2b + \frac{a^2x}{dc} + \frac{2ab}{dc} + \frac{b^2}{xdc}$$

Divide everything by (3a).

$$x^2 = \frac{ax^3}{3a} + \frac{x^2 b}{3a} + \frac{\frac{a^2 x}{dc}}{3a} + \frac{\frac{2ab}{dc}}{3a} + \frac{\frac{b^2}{xdc}}{3a}$$

Simplify.

$$x^2 = \frac{1}{3}x^3 + \frac{1}{3a}x^2 b + \frac{1}{dc}3a^3 x + \frac{1}{3dc}2b + \frac{1}{3xadc}b^2$$

Square root everything to remove the square applied to the x.

$$x = \sqrt{\frac{1}{3}x^2 + \frac{1}{3a}x^2 b + \frac{1}{dc}3a^3 x + \frac{1}{3dc}2b + \frac{1}{3xadc}b^2}$$

Put it into one fraction.

$$x = \sqrt{\frac{ax^4 dc + x^3 bdc + 9a^4 x^2 + 2axb + b^2}{3axdc}}$$

2nd part of the Jacobian.

$$2bx = ax^3 + x^2 b + \frac{a^2 x}{dc} + \frac{2ab}{dc} + \frac{b^2}{xdc}$$

Divide everything by (2b).

$$x = \frac{ax^3}{2b} + \frac{x^2 b}{2b} + \frac{\frac{a^2 x}{dc}}{2b} + \frac{\frac{2ab}{dc}}{2b} + \frac{\frac{b^2}{xdc}}{2b}$$

Simplify to one fraction.

$$x = \frac{ax^4 dc + x^3 bdc + a^2 x^2 + 2axb + b^2}{2xbdc}$$

3rd part of the Jacobian.

$$\frac{a^2}{dc} = ax^3 + x^2 b + \frac{a^2 x}{dc} + \frac{2ab}{dc} + \frac{b^2}{xdc}$$

Multiply everything by (dc).

$$a^2 = ax^3 dc + x^2 bdc + a^2 x + 2ab + \frac{b^2}{x}$$

Put it into one fraction.

$$a^2 = \frac{x\left(ax^2 dc + xbdc + a^2 + \frac{2ab}{x} + b^2\right)}{x}$$

Divide (a) squared by the x in the denominator.

$$\frac{a^2}{x} = ax^2 dc + xbdc + a^2 + \frac{2ab}{x} + b^2$$

Multiply by (a) squared on both sides.

$$x = \frac{ax^2dc + xbdc + a^2 + \frac{2ab}{x} + b^2}{a^2}$$

Solve for x.

$$x = \frac{ax^3dc + x^2bdc + a^2x + 2ab + xb^2}{a^2x}$$

4th part of the Jacobian.

$$0 = ax^3 + x^2b + \frac{a^2x}{dc} + \frac{2ab}{dc} + \frac{b^2}{xdc}$$

Combine (dc).

$$0 = ax^3 + x^2b + \frac{a^2x + 2ab}{dc} + \frac{b^2}{xdc}$$

Combine (dc) and (xdc) into one fraction.

$$0 = x^2(ax + b) + \frac{x\left(a^2x + 2ab\right) + b^2}{xdc}$$

Divide everything by ax + b.

$$\frac{-x^2(ax + b)}{ax + b} = \frac{x\left(a^2x + 2ab\right) + b^2}{xdc} \div \frac{ax + b}{1}$$

Solve for x squared.

$$x^2 = \frac{x\left(a^2x + 2ab\right) + b^2}{-adcx^2 - xdcb}$$

Take the root.

$$x = \sqrt{\frac{x\left(a^2x + 2ab\right) + b^2}{-adcx^2 - xdcb}}$$

Find the imaginary part and place it outside the root.

$$x = i\sqrt{\frac{ax + b}{xdc}}$$

5th part of the Jacobian.

$$-\frac{b^2}{x^2dc} = ax^3 + x^2b + \frac{a^2x}{dc} + \frac{2ab}{dc} + \frac{b^2}{xdc}$$

Divide everything by x squared multiplied by (dc).

$$-b^2 = ax^5dc + x^4dcb + a^2x^3 + 2abx^2 + b^2x$$

Set the equation equal to zero by adding (b) squared to the opposing side.

$$0 = ax^5dc + x^4dcb + a^2x^3 + 2abx^2 + b^2x + b^2$$

Solve for x.

$$-b^2x = ax^5dc + x^4dcb + a^2x^3 + 2abx^2 + b^2$$

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Divide by negative (b) squared.

$$x = \frac{ax^5dc}{-b^2} + \frac{x^4dcb}{-b^2} + \frac{a^2x^3}{-b^2} + \frac{2abx^2}{-b^2} + \frac{b^2}{-b^2}$$

Simplify down to one fraction.

$$x = -\frac{ax^5dc + x^4bdc + a^2x^3 + 2ax^2b + b^2}{b^2}$$

Use capital pi to find the product.

$$\prod\left[\frac{\sqrt{3}\sqrt{a}\left(ax^4dc + x^3bdc + a^2x + 2axb + b^2\right)}{6abx^{\frac{3}{2}}dc^{\frac{3}{2}}}\right] + \left[\frac{\sqrt{ax^4dc + x^3bdc + 9a^4x^2 + 2axb + b^2}}{6abx^{\frac{3}{2}}dc^{\frac{3}{2}}}\right] \cdot \left[\frac{ax^3dc + x^2bdc + a^2x + 2ab + xb^2}{a^2x}\right]$$

Continue to break down and simplify.

$$\prod\left[\frac{\left(adcx^4 + dcbx^3 + a^2x + 2abx + b^2\right)}{2\cdot 3^{\frac{1}{2}}dba^{\frac{5}{2}}c^{\frac{3}{2}}x^{\frac{5}{2}}}\right] + \left[\frac{\left(adcx^3 + dcbx^2 + a^2x + b^2x + 2ab\right)}{2\cdot 3^{\frac{1}{2}}dba^{\frac{5}{2}}c^{\frac{3}{2}}x^{\frac{5}{2}}}\right] + \left[\frac{\left(adcx^4 + dcbx^3 + 9a^4x^2 + 2abx + b^2\right)^{\frac{1}{2}}}{2\cdot 3^{\frac{1}{2}}dba^{\frac{5}{2}}c^{\frac{3}{2}}x^{\frac{5}{2}}}\right] \cdot \left[i\sqrt{\frac{ax+b}{xdc}}\right]$$

Simplify more.

$$\prod\left[\frac{i\left(ax^4dc + bx^3dc + a^2x + 2abx + b^2\right)}{2\cdot 3^{\frac{1}{2}}a^{\frac{5}{2}}c^{\frac{3}{2}}x^3dbdc^{\frac{1}{2}}}\right] + \left[\frac{\left(ax^3dc + bx^2dc + a^2x + b^2x + 2ab\right)(ax+b)^{\frac{1}{2}}}{2\cdot 3^{\frac{1}{2}}a^{\frac{5}{2}}c^{\frac{3}{2}}x^3dbdc^{\frac{1}{2}}}\right] + \left[\frac{\left(ax^4dc + bx^3dc + 9a^4x^2 + 2abx + b^2\right)^{\frac{1}{2}}}{2\cdot 3^{\frac{1}{2}}a^{\frac{5}{2}}c^{\frac{3}{2}}x^3dbdc^{\frac{1}{2}}}\right]$$

$$\cdot\left[-\frac{\left(ax^5dc + x^4bdc + a^2x^3 + 2ax^2b + b^2\right)}{b^2}\right]$$

Now Put it in capital pi format.

$$\prod\left[-\frac{i\left(adcx^4 + dcbx^3 + a^2x + 2abx + b^2\right)(x)(y)(z)^{\frac{1}{2}}(h)^{\frac{1}{2}}}{2\cdot 3^{\frac{1}{2}}d^2c^2b^3\sqrt{a}\,x^3}\right]$$

$$x = \left(adcx^3 + dcbx^2 + a^2x + b^2x + 2ab\right)$$

$$y = \left(adcx^5 + dcbx^4 + a^2x^3 + 2abx^2 + b^2\right)$$

$$z = \left(ax + b\right)$$

$$h = \left(adcx^4 + dcbx^3 + 9a^4x^2 + 2abx + b^2\right)$$

Equation #7

You are given a specified polynomial that can be seen below. You must solve for delta first, then use common properties of delta to solve for x

$$\Delta x^2\hbar + \Delta\hbar y + \Delta^2 x^3 + \Delta^2 xy - \Delta y + \Psi = 0$$

Find common multiples and take them out.

$$\Delta\hbar\left(x^2 + y\right) + \Delta^2 x\left(x^2 + y\right) - \Delta y + \psi = 0$$

Combine outer parts.

$$\left(\Delta\hbar + \Delta^2 x\right)\left(x^2 + y\right) - \Delta y + \psi = 0$$

Add the part that's not multiplied to the other side.

$$\frac{\left(\Delta\hbar + \Delta^2 x\right)\left(x^2 + y\right)}{x^2 + y} = \frac{\Delta y - \psi}{x^2 + y}$$

Divide by x squared add y on both sides.

$$\Delta\hbar + \Delta^2 x = \frac{\Delta y - \psi}{x^2 + y}$$

Take the delta out and divide to simplify.

$$\frac{\Delta(\hbar + \Delta x)}{\hbar + \Delta x} = \frac{\Delta y - \psi}{x^2 + y} \div \frac{\hbar + \Delta x}{1}$$

Solve.

$$\Delta = \frac{\Delta y - \psi}{x^2 + y} \cdot \frac{1}{\hbar + \Delta x}$$

Simplify.

$$\Delta = \frac{\Delta y - \psi}{\hbar x^2 + \Delta x^3 + y\hbar + \Delta xy}$$

The definition of delta x.

$$\Delta x = x_2 - x_1$$

Apply this logic to the answer we found for delta

$$\left(\frac{\Delta y - \psi}{\hbar x^2 + \Delta x^3 + y\hbar + \Delta xy}\right)x = x(1 - 1)$$

Solve for x.

$$x = \frac{x(1-1)}{1} \div \frac{\Delta y - \psi}{\hbar x^3 + \Delta x^3 + y\hbar + \Delta xy}$$

Simplify.

$$x = \frac{x(1-1)}{1} \cdot \frac{\hbar x^3 + \Delta x^3 + y\hbar + \Delta xy}{\Delta y - \psi}$$

We then find the answer to be.

$$x = 0$$

Conclusion: Understanding all the aspects of the equation, makes re-substitution and simplification a lot easier. We found that although the equation seemed like a regular factoring problem, understanding the way delta works and how to isolate properly becomes a noticeable difficulty.

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Equation #8

You are given an integral and a derivative, as seen below. Add them together and solve for the products of all x values in a capital pi function.

$$derivative\, f(x) = cos(x) + Ae^{ix}\left|\psi\left(x^2 + 4\phi\right)\right|^4$$

$$\int \frac{\psi\phi}{i\hbar 2mxy^2}dx \quad +12$$

Solve the integral.

$$\int \frac{\psi\phi}{i\hbar 2mxy^2}dx = \frac{\psi^2\phi}{4mxy^2(0+1i)\hbar} + c$$

Then, find the derivative of the initial function.

$$f'(x) = cos(x) + Ae^{ix}\left|\psi\left(x^2 + 4\phi\right)\right|^4$$

$$= iAe^{ix} + 8x\psi^{(1)}\left(x^2+4\phi\right)\psi^{(0)}\left(x^2+4\phi\right)^3 - sin(x)$$

Create a quadratic equation with the results of both the integral, derivative, and the constant 12.

$$\left(\frac{\psi^2\phi}{4mxy^2(0+1i)\hbar}\right)x^2$$

$$+\left(iAe^{ix} + 8x\psi^{(1)}\left(x^2+4\phi\right)\psi^{(0)}\left(x^2+4\phi\right)^3 - sin(x)\right)x + 12$$

Solve for x

$$x = \frac{-\left(iAe^{ix} + 8x\psi^{(1)}\left(x^2+4\phi\right)\psi^{(0)}\left(x^2+4\phi\right)^3 - sin(x)\right)}{2\left(\frac{\psi^2\phi}{4mxy^2(0+1i)\hbar}\right)}$$

$$\frac{\pm\sqrt{\left(iAe^{ix} + 8x\psi^{(1)}\left(x^2+4\phi\right)\psi^{(0)}\left(x^2+4\phi\right)^3 - sin(x)\right)^2}}{2\left(\frac{\psi^2\phi}{4mxy^2(0+1i)\hbar}\right)}$$

Add this under the square root

$$\frac{-4\left(\frac{\psi^2\phi}{4mxy^2(0+1i)\hbar}\right)(12)}{2\left(\frac{\psi^2\phi}{4mxy^2(0+1i)\hbar}\right)}$$

We then expand part of the function.

$$\left(iAe^{ix} + 8x\psi^{(1)}\left(x^2+4\phi\right)\psi^{(0)}\left(x^2+4\phi\right)^3 - sin(x)\right)^2$$

Expanded Form.

$$-A^2e^{2ix}+16iAe^{ix}\psi x^9+256iAe^{ix}\psi x^7\phi+1536iAe^{ix}\psi x^5\phi^2+4096iAe^{ix}\psi x^3\phi^3+4096iAe^{ix}\psi x\phi^4-2iAe^{ix}sin(x)+64\psi^2x^{18}+2048\psi^2x^{16}\phi+28672\psi^2x^{14}\phi^2+229376\psi^2x^{12}\phi^3+1146880\psi^2x^{10}\phi^4-16\psi x^9 sin(x)+3670016\psi^2x^8\phi^5-256\psi x^7\phi sin(x)+7340032\psi^2x^6\phi^6-1536\psi x^5\phi^2 sin(x)+8388608\psi^2x^4\phi^7-4096\psi x^3\phi^3 sin(x)+4194304\psi^2x^2\phi^8-4096\psi x\phi^4 sin(x)+sin^2(x)$$

Expand.

$$-4\left(\frac{\psi^2\phi}{4mxy^2(0+1i)\hbar}\right)(12)$$

Simplify

$$-4\left(\frac{\psi^2(0-4.854i)\hbar}{mxy^2}\right)$$

$$=\frac{\psi^2(0+19.42i)\hbar}{mxy^2}$$

Solve.

$$2\left(\frac{\psi^2\phi}{4mxy^2(0+1i)\hbar}\right)$$

$$=\frac{\psi^2(0-0.809i)\hbar}{mxy^2}$$

Expansion is an expanded form of.

$$\left(iAe^{ix}+8x\psi^{(1)}\left(x^2+4\phi\right)\psi^{(0)}\left(x^2+4\phi\right)^3-sin(x)\right)^2$$

Continue solving.

$$x=\frac{-Ae^{ix}-8x\psi\left(x^2+4\phi\right)^4+sin(x)\pm}{\frac{\psi^2(0-0.809i)\hbar}{mxy^2}}+\frac{\sqrt{[Expansion]-\frac{\psi^2(0+19.42i)\hbar}{mxy^2}}}{\frac{\psi^2(0-0.809i)\hbar}{mxy^2}}$$

This gives us.

$$\left[x=\frac{1}{\psi^2}mxy^2(0+1.236i)\hbar\right]$$

Multiplied by.

$$\left[\frac{\psi^2(0-19.42i)\hbar}{mxy^2}+\sqrt{\left(iAe^{ix}+8x\psi\left(x^2+4\phi\right)^4-sin(x)\right)^2}\right]$$

$$-Ae^{ix} - 8x\psi\left(x^2 + 4\phi\right)^4 + sin(x)$$

Simplify

$$\left[x = \frac{1}{\psi^2} mxy^2 (0 + 1.236i)\hbar\right]$$

$$\left[\frac{\psi^2 (0 - 19.42i)\hbar}{mxy^2} + \sqrt{\left(iAe^{ix} + 8x\psi\left(x^2 + 4\phi\right)^4 - sin(x)\right)^2}\right]$$

$$-Ae^{ix} - 8x\psi\left(x^2 + 4\phi\right)^4 + sin(x)$$

Simplify.

$$x = \frac{1}{\psi^2} mxy^2 (0 + 1.236i)\hbar$$

$$\left\{\frac{\psi^2 (0 - 19.42i)\hbar}{mxy^2} + 8x\psi\left(x^2 + 4\phi\right)^4 exp[i\pi[T]]\right\}$$

$$T = \frac{1}{2} - \frac{arg\left(8x\psi\left(x^2 + 4\phi\right)^4 + iAe^{ix} - sin(x)\right)}{\pi}$$

$$+iAexp[i\pi(T) + ix] + sin(x)exp[i\pi(1 + T)]$$

$$-Ae^{ix} - 8x\psi\left(x^2 + 4\phi\right)^4 + sin(x)$$

Simplify.

$$x = \frac{1}{\psi^2} mxy^2 \left(8.18974 \cdot 10^{-34} i\right)$$

Simplify.

$$\left[\frac{\psi^2\left(1.28677 \cdot 10^{-32} i\right)}{mxy^2} + Expand(exp)(i(3.14)(U))\right]$$

Simplify.

$$U = \frac{1}{2} - \frac{arg\left(Expand + iAe^{ix} - sin(x)\right)}{(3.14)}$$

Simplify.

$$+iAexp(i(3.14)(U) + ix) + sin(x)exp(i(3.14)(1 + (U)))$$

$$-Ae^{ix} - (Expand) + sin(x)$$

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Equation #9

You are given the following equation, create a series representation.

$$\eta(\tau)^{\zeta(\infty)} + \zeta(1+2)$$

First Series Representation

$$\eta(\tau)^{\sum_{k=0}^{A} \frac{\left((\infty - s_0)^k \zeta^{(k)}(s_0)\right)}{k!}} + \sum_{k=0}^{A} \left(\frac{(3-s_0)^k \zeta^{(k)}(s_0)}{k!} \right)$$

$$For\ s_0 \neq 1$$

Second Series Representation

$$\eta(\tau)^{\zeta(\infty)} + \zeta(1+2) = \frac{1}{2}\left(2\left(e^{\frac{i\pi\tau}{12} - \sum_{n=1}^{A}\sum_{k=1}^{A}\frac{e^{2ikn\pi\tau}}{k}}\right)^{\left(\sum_{n=0}^{A}\frac{\sum_{k=0}^{n}(-1)^k(1+k)^{1-\infty}\binom{n}{k}}{1+n}\right)/(-1+\infty)} + \sum_{n=0}^{A}\frac{\sum_{k=0}^{n}\frac{(-1)^k\binom{n}{k}}{(1+k)^2}}{1+n} \right)$$

Third Series Representation

$$\eta(\tau)^{\zeta(\infty)} + \zeta(1+2) = \left(e^{\frac{i\pi\tau}{12} - \sum_{n=1}^{A}\sum_{k=1}^{A}\frac{e^{2ikn\pi\tau}}{k}}\right)^{\sum_{k=0}^{A}\left((\infty - s_0)^k \zeta^{(k)}(s_0)\right)/k!} + \sum_{k=0}^{A}\frac{(3-s_0)^k \zeta^{(k)}(s_0)}{k!}$$

$$For\ s_0 \neq 1$$

Equation #10

Solve the following integral:

$$\int_0^{\frac{\pi}{2}} cos^{-1}\left(\frac{cos(x)}{1+2cos(x)}\right)dx$$

Multiply by 2.

$$2\cdot\int_0^{\frac{\pi}{2}} cos^{-1}\left(\sqrt{\frac{1+\frac{cos(x)}{1+2cos(x)}}{2}}\right)dx$$

Simplify.

$$2\cdot\int_0^{\frac{\pi}{2}} cos^{-1}\left(\sqrt{\frac{1+3cos(x)}{2+4cos(x)}}\right)dx$$

Keep in mind that.

$$tan(z)=\sqrt{\frac{sin^2(z)}{cos^2(z)}}$$

We can apply this.

$$\sqrt{\frac{1-\left(cos^2(z)\right)^2}{\left(cos^2(z)\right)^2}}$$

Expand and simplify

$$\sqrt{\frac{1-\frac{1+3cos(x)}{2+4cos(x)}}{\frac{1+3cos(x)}{2+4cos(x)}}}$$

Use identities.

$$cos(2x)=cos^2(x)-sin^2(x)=2cos^2(x)-1$$

We can then find this expression.

$$2x=cos^{-1}\left(2cos^2(x)-1\right)$$

$$let\ t=cos(x)$$

Apply.

$$2x=cos^{-1}\left(2t^2-1\right)=2cos^{-1}(t)$$

$$cos^{-1}(z)=2cos^{-1}\left(\sqrt{\frac{z+1}{2}}\right)$$

$$z=2t^2-1$$

$$t = \pm\sqrt{\frac{z+1}{2}}$$

$$cos(\phi) = z$$

$$\phi = cos^{-1}(z)$$

$$tan(\phi) = t$$

$$\phi = tan^{-1}(t)$$

Simplify within the initial expression.

$$\sqrt{\frac{1+cos(x)}{1+3cos(x)}}$$

$$2\cdot\int_0^{\frac{\pi}{2}} tan^{-1}\left(\sqrt{\frac{1+cos(x)}{1+3cos(x)}}\right)dx$$

$$4\int_0^{\frac{\pi}{4}} tan^{-1}\left(\sqrt{\frac{1+cos(2t)}{1+3cos(2t)}}\right)dt$$

$$4\int_0^{\frac{\pi}{4}} tan^{-1}\left(\sqrt{\frac{2cos^2(t)}{1+3-6sin^2(t)}}\right)dt$$

$$let\ x = 2t$$

$$dx = 2dt$$

$$1+cos(2t) = 2cos^2(t)$$

$$cos(2t) = 1-2sin^2(t)$$

Simplify.

$$4\int_0^{\frac{\pi}{4}} tan^{-1}\left(\sqrt{\frac{cos^2(t)}{2-3sin^2(t)}}\right)dt$$

$$4\int_0^{\frac{\pi}{4}} tan^{-1}\left(\frac{cos(t)}{\sqrt{2-3sin^2(t)}}\right)dt$$

Evaluate from 1 to 0

$$\frac{1}{a}tan^{-1}\left(\frac{1}{a}\right) = \frac{1}{a}tan^{-1}\left(\frac{k}{a}\right)$$

$$a\int_0^1 \frac{dx}{x^2+a^2}$$

$$4\int_0^{\frac{\pi}{4}}\int_0^1 \frac{\sqrt{2-3sin^2(t)}}{cos(t)}\frac{1}{x^2+\frac{2-3sin^2(t)}{cos^2(t)}}\,dxdt$$

Simplify.

$$4\int_0^{\frac{\pi}{4}}\int_0^1 \frac{\sqrt{2-3sin^2(t)}\,cos(t)}{x^2cos^2(t)+2-3sin^2(t)}\,dxdt$$

$$4\int_0^{\frac{\pi}{4}}\int_0^1 \frac{\sqrt{2-3sin^2(t)}\,cos(t)}{x^2-x^2sin^2(t)+2-3sin^2(t)}dxdt$$

$$4\int_0^{\frac{\pi}{4}}\int_0^1 \frac{\sqrt{2-3sin^2(t)}\,cos(t)}{\left(x^2+2\right)-sin^2(t)\left(x^2+3\right)}dxdt$$

$$let\ sin(t)=\sqrt{\frac{2}{3}}\,sin(\phi)$$

$$cos(t)dt=\sqrt{\frac{2}{3}}\,cos(\phi)d\phi$$

Simplify.

$$I=4\int_0^{\frac{\pi}{3}}\int_0^1 \frac{\sqrt{2-3\cdot\frac{2}{3}sin^2(\phi)}\,\sqrt{\frac{2}{3}}\,cos(\phi)}{\left(x^2+2\right)-\frac{2}{3}sin^2(\phi)\left(x^2+3\right)}\,dxd\phi$$

$$4\int_0^{\frac{\pi}{3}}\int_0^1 \sqrt{3}\,\frac{\sqrt{2}\,cos(\phi)\sqrt{2}\,cos(\phi)}{3x^2+6-2\left(1-cos^2(\phi)\right)\left(x^2+3\right)}dxd\phi$$

$$I=\int_0^{\frac{\pi}{3}}\int_0^1 8\sqrt{3}\,\frac{cos^2(\phi)}{x^2+2cos^2(\phi)\left(x^2+3\right)}dxd\phi$$

$$let\ u=tan(\phi)$$

$$du=sec^2(\phi)d\phi$$

$$\left(1+tan^2(\phi)\right)d\phi$$

$$d\phi=\frac{du}{1+u^2}$$

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$$8\sqrt{3}\int_0^{\sqrt{3}}\int_0^1 \frac{\frac{1}{1+u^2}}{x^2+2\frac{1}{1+u^2}\left(x^2+3\right)}\frac{1}{1+u^2}dxdu$$

$$8\sqrt{3}\int_0^{\sqrt{3}}\int_0^1 \frac{1}{\left(1+u^2\right)\left(u^2x^2+x^2+2x^2+6\right)}dxdu$$

$$8\sqrt{3}\int_0^1 \frac{1}{2x^2+6}\left[\int_0^{\sqrt{3}} \frac{du}{u^2+1}-\frac{x^2}{x^2}\int_0^{\sqrt{3}} \frac{du}{\frac{u^2x^2}{x^2}+\sqrt{\frac{3x^2+6}{x^2}}2}\right]$$

$$=\frac{x}{\sqrt{3x^2+6}}tan^{-1}\left(\frac{ux}{\sqrt{3x^2+6}}\right)|_0^{\sqrt{3}}$$

$$8\sqrt{3}\int_0^1 \frac{\pi}{3}\frac{1}{2x^2+6}dx-\int_0^1 \frac{8x}{\sqrt{x^2+2}}tan^{-1}\left(\frac{x}{\sqrt{x^2+2}}\right)dx$$

$$I=\frac{4\pi}{\sqrt{3}}\int_0^1\frac{dx}{x^2+\sqrt{3}^2}-4\int_0^1\frac{x}{\left(x^2+3\right)\sqrt{x^2+2}}tan$$
$$^{-1}\left(\frac{x}{\sqrt{x^2+2}}\right)dx$$

Use DI method.

$$D: tan^{-1}\left(\frac{x}{\sqrt{x^2+2}}\right)=\frac{1}{\left(x^2+1\right)\sqrt{x^2+2}}$$

$$I:\frac{x}{\left(x^2+3\right)\sqrt{x^2+2}}=tan^{-1}\left(\sqrt{x^2+2}\right)$$

$$\frac{1}{\sqrt{3}}tan^{-1}\left(\frac{x}{\sqrt{3}}\right)|_0^1$$

$$=\frac{1}{\sqrt{3}}\frac{\pi}{6}$$

$$\frac{2\pi^2}{9}-4tan^{-1}\left(\frac{x}{\sqrt{x^2+2}}\right)tan^{-1}\left(\sqrt{x^2+2}\right)|_0^1$$

Evaluate.

$$4\int_0^1 \frac{tan^{-1}\left(\sqrt{x^2+2}\right)}{\left(x^2+1\right)\sqrt{x^2+2}}dx$$

$$I = 4 \cdot \frac{5\pi^2}{96}$$

Final answer.

$$I = \frac{5\pi^2}{24}$$

Conclusion: Integration can be extremely difficult and time consuming; however, understanding fundamental theorems and concepts can help make the process a lot more digestible.

Equation #11

Find the most precise volume for a 4th dimensional Euclidean ball with Radius:

$$\sum x\Psi^{1-i}cos(x)$$

$$= \frac{\pi^2}{2}R^4 \approx 4.935 \cdot R^4$$

$$\frac{(2V)^{\frac{1}{4}}}{\sqrt{\pi}} \approx 0.671 \cdot V^{\frac{1}{4}}$$

$$4.935 \cdot [R]^4 = 6.90681\psi$$
$$4(-i+1)\Big(-0.95885ncos\Big(\frac{2n+1-\pi}{2}\Big) - (A) + (B)\Big)^4$$

$$A = 0.95885cos\Big(\frac{2n+1-\pi}{2}\Big)$$

$$B = 1.49675 - cos(n+1)$$

Find a more specific result.

$$Radius = \sum x\psi^{1-i}cos(x)$$

Using the Partial Sum Formula, we find.

$$\sum_{x=2}^{n}\big(\psi^{1-i}xcos(x)\big)$$

$$-\frac{1}{4}csc\Big(\frac{1}{2}\Big)\psi$$
$$1-i\Big(-2ncos\Big(\frac{1}{2}(2n-\pi+1)\Big) - (A) - (B) + (C) + (D)\Big)$$

$$A = 2cos\Big(\frac{1}{2}(2n-\pi+1)\Big)$$

$$B = csc\Big(\frac{1}{2}\Big)cos(n+1)$$

$$C = 4cos\Big(\frac{3-\pi}{2}\Big)$$

$$D = cos(2)csc\Big(\frac{1}{2}\Big)$$

Simplify.

$$R_{2k+1}(V) = (2k+1)^{\frac{1}{(2k+1)}}\Big(V \cdot (2k-1)!!\sqrt{\frac{\pi}{2}}\Big)^{-\frac{2}{(4k^2-1)}}R$$
$$2k-1(V)$$

$$f_n \doteq 2f_{n-\frac{2}{n}}$$

$$Where\ f_0 \doteq 1\ and\ f_1 \doteq 2$$

$$V_n(R) = \pi^{\left[\frac{n}{2}\right]} f_n R^n$$

$$S_n(R) = n\pi^{\left[\frac{n}{2}\right]} f_n R^{n-1}$$

$$V_n \sim \frac{1}{\sqrt{n\pi}}\left(\frac{2\pi e}{n}\right)^{\frac{n}{2}} R^n$$

$$V_4(R) \sim \frac{1}{\sqrt{4\pi}}\left(\frac{2\pi e}{4}\right)^{\frac{4}{2}} R^4$$

Simplify.

$$\frac{1\cdot\left(\frac{2\pi e}{4}\right)^{\frac{4}{2}}}{\sqrt{4\pi}}\left(-\frac{1}{4}csc\left(\frac{1}{2}\right)\psi^{-i+1}\left(E-(A)+(B)+(C)-D\right)\right)$$

$$E = -2ncos\left(\frac{1}{2}\left(2n+1-\pi\right)\right)$$

(A, B, C, and D Have already been defined)

$$\frac{e^2\pi^{\frac{3}{2}}}{8}\left(-\frac{1}{4}csc\left(\frac{1}{2}\right)\psi^{-i+1}\left(E-(A)+(B)+(C)-(D)\right)\right)^4$$

$$= \frac{e^2\pi^{\frac{3}{2}}}{8}\cdot\frac{\psi^{4(-i+1)}\left(A^I - B^I - C^I + D^I - E^I\right)^4}{4^4 sin^8\left(\frac{1}{2}\right)}$$

$$A^I = 4sin\left(\frac{1}{2}\right)cos\left(\frac{-\pi+3}{2}\right)$$

$$B^I = 2sin\left(\frac{1}{2}\right)ncos\left(\frac{2n+1-\pi}{2}\right)$$

$$C^I = 2sin\left(\frac{1}{2}\right)cos\left(\frac{2n+1-\pi}{2}\right)$$

$$D^I = cos(2)$$

$$E^I = cos(n+1)$$

(A, B, C, D, and E Have already been defined)

$$\frac{e^2\pi^{\frac{3}{2}}\psi^{4(-i+1)}\left(A^I - B^I - C^I + D^I - E^I\right)^4}{2048sin^8\left(\frac{1}{2}\right)}$$

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Equation #12

You are given three integrals, listed below: 1, 2, 3. You must simply simplify all three then multiply the products yielded in the form abc. (Each one will be labelled a, b, and c).

1 $$\int\int\int tanh^2(x)dx$$

2 $$\int \frac{dx}{2x\sqrt{1-x}\sqrt{2-x+\sqrt{1-x}}}$$

3 $$\int_{4\pi r^2}^{\psi(-i\hbar)} - ln(2x+\psi)\Omega^{i^{\sqrt{3}}} dx$$

First Integral.

$$\int tanh^2(x)dx = x - tanh(x) + C$$

$$\int\int tanh^2(x)dx = \frac{1}{2}x(2C+x) - log(cosh(x)) + C$$

$$\int\int\int tanh^2(x)dx =$$
$$\frac{1}{6}\left(x\left(3Cx+6C+x^2+3x+6log\left(e^{-2x}+1\right)-6log(coshx)\right)\right)$$
$$-3Li_2\left(-e^{-2x}\right)+C$$

Second Integral.

$$\frac{1}{2}\left[tanh^{-1}\left(\frac{1-\sqrt{1-x}}{2\sqrt{-x+\sqrt{1-x}+2}}\right)-A\right]+C$$

$$A = \frac{tanh^{-1}\left(\frac{\sqrt{3}\left(\sqrt{1-x}+1\right)}{2\sqrt{-x+\sqrt{1-x}+2}}\right)}{\sqrt{3}}$$

Third Integral.

$$\left[\frac{1}{2}\Omega^{i^{\sqrt{3}}}\left(2x-(\psi+2x)ln(\psi+2x)\right)\right]_{4\pi r^2}^{\psi(-i\hbar)}$$

$$\frac{1}{2}\Omega^{i^{\sqrt{3}}}\left(2(\psi(-i\hbar))-(\psi+2(\psi(-i\hbar)))\right)ln$$
$$\left(\psi+2(\psi(-i\hbar))\right)$$

$$-\left[\frac{1}{2}\Omega^{i^{\sqrt{3}}}\left(2\left(4\pi r^2\right)-\left(\psi+2\left(4\pi r^2\right)\right)\right)ln\left(\psi+2\left(4\pi r^2\right)\right)\right]$$

$$\frac{1}{2}\Omega^{i^{\sqrt{3}}}\left(2\psi^{0}((0-1i)\hbar)\right)-\left(\psi+2\psi^{0}((0-1i)\hbar)\right)ln$$
$$\left(\psi+2\psi^{0}((0-1i)\hbar)\right)$$
$$-\left[-4\pi r^{2}\Omega^{i^{\sqrt{3}}}ln\left(\psi+8\pi r^{2}\right)-\frac{1}{2}\psi\Omega^{i^{\sqrt{3}}}+4\pi r^{2}\Omega^{i^{\sqrt{3}}}\right]$$

Combine (Integral 1 is a, integral 2 is b, and integral 3 is c)
ab equals

$$\left[\frac{1}{6}\left(x\left(3Cx+6C+x^{2}+3x+6log\left(e^{-2x}+1\right)-A-B\right)\right)\right]$$
$$A=6log(cosh(x))$$
$$B=3Li_{2}\left(-e^{-2x}\right)$$

(Plus, constant C)

$$\cdot\left\{\frac{1}{2}\left(tanh^{-1}\left(\frac{1-\sqrt{1-x}}{2\sqrt{-x+\sqrt{1-x}+2}}\right)-A\right)\right\}$$
$$A=\frac{tanh^{-1}\left(\frac{\sqrt{3}\left(\sqrt{1-x}+1\right)}{2\sqrt{-x+\sqrt{1-x}+2}}\right)}{\sqrt{3}}$$

Expanding we get.

$$\frac{Cx^{2}}{2}+Cx+C-\frac{1}{2}Li_{2}\left(-e^{-2x}\right)+\frac{x^{3}}{6}+\frac{x^{2}}{2}+xlog$$
$$\left(e^{-2x}+1\right)-xlog(cosh(x))$$

Multiplied by

$$C+\frac{1}{2}tanh$$
$$^{-1}\left(\frac{1}{2\sqrt{-x+\sqrt{1-x}+2}}-\frac{\sqrt{1-x}}{2\sqrt{-x+\sqrt{1-x}+2}}\right)-$$
$$\frac{\sqrt{1-x}\,tanh^{-1}x}{4\sqrt{-x+\sqrt{1-x}+2}}-\frac{tanh^{-1}x}{4\sqrt{-x+\sqrt{1-x}+2}}$$

We then get.

$$Cx^{2}+x^{2}-xtanh^{-1}\left(\frac{\left(-\sqrt{-x+1}+1\right)\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)ln$$
$$\frac{(cosh(x))+Li_{2}e^{-2x}}{2}$$

$$+Cx + C + \frac{x^3}{6} + xln\left(e^{-2x}+1\right) - Cxln\left(cosh(x)\right) + \frac{xtanh^{-1}(x)ln\left(cosh(x)\right)\left(\sqrt{-x+1}+1\right)\sqrt{-x+\sqrt{-x+1}+2}}{-4x+4\sqrt{-x+1}+8}$$

Multiply by third integral result (abc)

$$let\ \psi = a$$

$$let\ \hbar = b$$

$$let\ \Omega = c$$

Apply.

$$\cdot\ -(\psi+(0-2i)\hbar)ln(\psi+(0-2i)\hbar) + 4\pi r^2\Omega^{i^{i^{\sqrt{3}}}} ln\left(\psi+8\pi r^2\right) + \frac{1}{2}\psi\Omega^{i^{i^{\sqrt{3}}}} + \Omega^{i^{i^{\sqrt{3}}}}(0-1i)\hbar - 4\pi r^2\Omega^{i^{i^{\sqrt{3}}}}$$

Simplify.

$$-ln(a-2bi)(a-2bi) + 4\pi c^{i^{i^{\sqrt{3}}}} r^2 ln\left(8\pi r^2+a\right) + \frac{ac^{i^{i^{\sqrt{3}}}}}{2} - bic^{i^{i^{\sqrt{3}}}} - 4\pi c^{i^{i^{\sqrt{3}}}} r^2$$

$$let\ A_2 = Li_2$$

$$\frac{Cx^2 + x^2 - Li_2 e^{-2x} xtanh^{-1}\left(-\frac{\sqrt{-x+1}\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)ln\left(cosh(x)\right)\left(-x+\sqrt{-x+1}+2\right) + xtanh^{-1}(\pi)ln\left(cosh(x)\right)\left(\sqrt{-x+1}\right)\sqrt{-x+\sqrt{-x+1}+2}\cdot\left(-aln(a-2bi)+2biln(a-2bi)\right)}{2\left(-x+\sqrt{-x+1}+2\right)}$$

Simplify.

$$2\pi c^{i^{i^{\sqrt{3}}}} r^2 \ln\left(8\pi r^2+a\right)\Bigg(cx^2 + x^2 + x\mathrm{arctanh}(x)\ln(\cosh(x))\left(\sqrt{-x+1}+1\right)\sqrt{-x+\sqrt{-x+1}+2} - a_2 e^{-2x} x\mathrm{arctanh}\left(-\frac{\sqrt{-x+1}\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)\ln(\cosh(x))\left(-x+\sqrt{-x+1}+2\right)\Bigg) \div \left(-x+\sqrt{-x+1}+2\right)$$

$$let\ Li_2 = D_2$$

Simplify.

$$cx^2+x^2-d_2e^{-2x}\text{xarctanh}\left(-\frac{\sqrt{-x+1}\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)\ln(\cosh(x))$$

$$\left(-\pi+\sqrt{-x+1}+2\right)+\text{xarctanh}(x)\ln(\cosh(x))\left(\sqrt{-x+1}+1\right)\sqrt{-x+\sqrt{-x+1}+2}$$

$$\left(-a\ln(a-2bi)+2bi\ln(a-2bi)\right)$$

$$2\left(2\pi c^{i^{\sqrt{3}}}r^2\ln\left(8\pi r^2+a\right)\left(cx^2+x^2+\text{xarctanh}(x)\ln(\cosh(x))\left(\sqrt{-x+1}+1\right)\right.\right.$$

$$\left.\left.\sqrt{-x+\sqrt{-x+1}+2}\right)\right)-d_2e^{-2x}\text{xarctanh}\left(-\frac{\sqrt{-x+1}\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)\ln(\cosh(x))$$

$$\left(-x+\sqrt{-x+1}+2\right)$$

Everything divided by

$$\div\left(2\left(-x+\sqrt{-x+1}+2\right)\right)$$

Simplify.

$$4\pi c^{i^{\sqrt{3}}}r^2\ln\left(8\pi r^2+a\right)\left(cx^2+x^2+\text{xarctanh}(x)\ln(\cosh(x))\right)\left(\sqrt{-x+1}+1\right)$$

$$\sqrt{-x+\sqrt{-x+1}+2}$$

Everything divided by

$$\div\left(2\left(-x+\sqrt{-x+1}+2\right)\right)$$

$$-\frac{2d_2\text{xarctanh}\left(-\frac{\sqrt{-x+1}}{2\sqrt{-x+\sqrt{-x+1}+2}}\right)\ln(\cosh(x))\left(-x+\sqrt{-x+1}+2\right)}{e^{2x}}$$

Simplify.

$$cx^2+x^2-d_2e^{-2x}\text{xarctanh}\left(-\frac{\sqrt{-x+1}\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)\ln(\cosh(x))\left(-x+\sqrt{-x+1}+2\right)$$

$$+\text{xarctanh}(x)\ln(\cosh(x))\left(\sqrt{-x+1}+1\right)\left(\sqrt{-x+\sqrt{-x+1}+2}\right)$$

$$\left(-a\ln(a-2bi)+2bi\ln(a-2bi)\right)$$

Everything divided by

$$\div\left(2\left(-x+\sqrt{-x+1}+2\right)\right)$$

$$2\left(2\pi c^{i^{\sqrt{3}}}r^2\ln\left(8\pi r^2+a\right)\left(cx^2+x^2+\text{xarctanh}(x)\ln(\cosh(x))\right)\left(\sqrt{-x+1}+1\right)\right.$$

$$\left.\sqrt{-x+\sqrt{-x+1}+2}\right)$$

Everything divided by

$$\div\left(-x+\sqrt{-x+1}+2\right)$$

$$+\frac{d_2e^{-2x}xtanh^{-1}\left(-\frac{\sqrt{-x+1}\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)ln\left(cosh(x)\right)}{2}$$

Simplify.

$$cx^2+x^2-d_2e^{-2x}\text{xarctanh}\left(-\frac{\sqrt{-x+1}\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)\ln\left(\cosh(x)\right)\left(-x+\sqrt{-x+1}+2\right)$$

$$+\text{xarctanh}(x)\ln\left(\cosh(x)\right)\left(\sqrt{-x+1}\right)\left(-x+\sqrt{-x+1}+2\right)\left(-a\ln(a-2bi)+2bi\ln(a-2bi)\right)$$

$$4\pi\omega^{i^{j^{\sqrt{3}}}}r^2\ln\left(8\pi r^2+\psi\right)\left(cx^2+x^2+\text{xarctanh}(x)\ln\left(\cosh(x)\right)\right)\left(\sqrt{-x+1}+1\right)$$

$$\sqrt{-x+\sqrt{-x+1}+2}$$

$$1+d_2e^{-2x}\text{xarctanh}\left(-\frac{\sqrt{-x+1}\sqrt{-x+\sqrt{-x+1}+2}}{-2x+2\sqrt{-x+1}+4}\right)\ln\left(\cosh(x)\right)\left(-x+\sqrt{-x+1}+2\right)$$

Everything divided by

$$\div\left(2\left(-x+\sqrt{-x+1}+2\right)\right)$$

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Equation #13

$$\int \aleph \Xi \Phi^{\psi^{\phi}} d\psi$$

$$-\frac{\Xi\psi\aleph\left(-\psi^{\phi}log(\Phi)^{-\frac{1}{\phi}}\Gamma\left(\frac{2}{1+\sqrt{5}}, -\psi^{\phi}log(\Phi)\right)\right)}{\phi} + C$$

$$f(x)^{-1} = -\frac{\phi\aleph^{\phi}\sqrt{-\psi^{\phi}log(\Phi)}}{\Xi\psi\Gamma\left(\frac{2}{1+\sqrt{5}}, -\psi^{\phi}log(\Phi)\right)} = R$$

$$let\ V_n = volume$$

$$R = radius$$

$$V_n = \int_0^R S_n r^{n-1} dr = \frac{S_n R^n}{n}$$

$$S_n \int_0^{\infty} e^{-r^2} r^{n-1} dr$$

$$= \int_{-\infty}^{\infty} \ldots\ldots \int_{-\infty}^{\infty} e^{-\left(x_1^2 + \ldots x_n^2\right)} dx_1 \ldots dx_n$$

$$= \left(\int_{-\infty}^{\infty} e^{-x^2} dx\right)^n$$

Hyper Sphere.

$$x_1^2 + x_2^2 + \ldots + x_n^2 = R^2$$

Set of all points.

$$x = \left(x_1, x_2 \ldots x_{n+1}\right) in\ E^{n+1}$$

$$x_1^2 + \ldots + x_{n+1}^2 = 1$$

$$\left\{x \in R^n | d(x,0) = 1\right\}$$

$$x_1^2 + x_2^2 = R^2$$

$$x_1^2 + x_2^2 + x_3^2 = R^2$$

$$r = Rsin\psi$$

$$d_s^3 = \frac{dr^2}{\left(1 - \frac{r^2}{R^2}\right)} + r^2\left(d\phi^2 + sin^2\phi d\theta^2\right)$$

$$\frac{dS_n}{dn} = \frac{\pi^{\frac{n}{2}}\left[ln\pi - \psi_0\left(\frac{1}{2}n\right)\right]}{\Gamma\left(\frac{1}{2}n\right)} = 0$$

$$\psi_0(x) = \Psi(x)$$

Spherical coordinate.

$$x_1 = Rsin(\psi)sin(\phi)cos(\theta)$$

$$x_2 = Rsin(\psi)sin(\phi)sin(\theta)$$

$$x_3 = Rsin(\psi)cos(\phi)$$

$$x_4 = Rcos(\psi)$$

$$x_1^2 + x_2^2 + x_3^2 + x_4^2 = R^2$$

$$ds^2 = R^2\left[d\psi^2 + sin^2\psi\left(d\phi^2 + sin^2\phi d\theta\right)\right]$$

SA reaches maximum, then decreases towards zero as n increases

Apply Gamma.

$$\Gamma(m) = 2\int_0^{\infty} e^{-r^2} r^{2m-1} dr$$

Therefore,

$$\frac{1}{2}S_n\Gamma\left(\frac{1}{2}n\right) = \left[\Gamma\left(\frac{1}{2}\right)\right]^n$$

$$= \left(\pi^{\frac{1}{2}}\right)^n$$

$$S_n = \frac{2\pi^{\frac{n}{2}}}{\Gamma\left(\frac{1}{2}n\right)}$$

$$S_n = \begin{cases} \frac{2^{\frac{(n+1)}{2}}\pi^{\frac{(n-1)}{2}}}{(n-2)!!} \text{ for } n \text{ odd} \\ \frac{2\pi^{\frac{n}{2}}}{\left(\frac{1}{2}n-1\right)!} \text{ for } n \text{ even} \end{cases}$$

Hyper Surface Area

$$S_3 = \int_0^{\pi} Rd\psi \int_0^{\pi} Rsin\psi d\phi \int_0^{2\pi} Rsin\psi sin\phi d\theta$$

$$= 2\pi^2 R^3$$

$$2\pi^2\left[-\frac{\phi\aleph\sqrt[\phi]{-\psi^{\phi}log(\Phi)}}{\Xi\psi\Gamma\left(\frac{2}{1+\sqrt{5}},-\psi^{\phi}log(\Phi)\right)}\right]$$

$$2\pi^2\left[-\frac{\phi^3\aleph^3\left(-\psi^{\phi}log(\Phi)\right)^{\frac{3}{\phi}}}{\Xi^3\psi^3\Gamma\left(\frac{1}{2}\left(\sqrt{5}-1\right),-\psi^{\frac{1}{2}\left(1+\sqrt{5}\right)}log(\Phi)\right)^3}\right]$$

$$3-sphere\ to\ dimensions\ n\geq 4$$

Final answer.

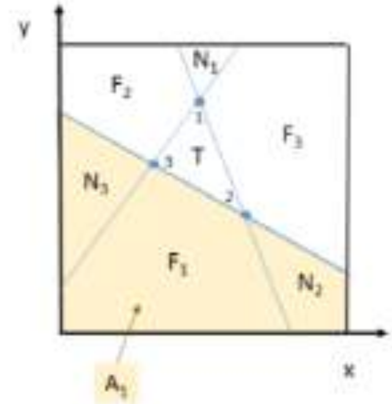
$$SA=\frac{2\pi^2\phi^2\aleph^3\psi^{3\phi-3}log^3(\Phi)}{\Xi^3\Gamma\left(\frac{1}{2}\left(-1+\sqrt{5}\right),-\frac{1}{2}\psi^{1+\sqrt{3}}log(\Phi)\right)^3}$$

Conclusion: The concept of higher dimensional objects has been something pondered by physicists and mathematicians for centuries. Conceptually the idea may seem confusing; however, once you begin to calculate, you begin to understand and notice slight patterns.

Equation #14

Consider a random triangle illustrated below. Regions are labelled near (Ni) and far (Fi) from point i. T is the triangle. If the 4th point falls in regions $F1$, $F2$, or $F3$ a convex quadrilateral will result. The probability that 4 points produce a convex shape is equivalent to the probability that the 4th point will be in one of those regions. That is, $p=E[F1+F2+F3]$ where Fi is the random variable expressing the area of that region.

Also keep in mind: that 35/48π2 ≤ κ ≤ 1/12 , where the minimum is attained only when K is an ellipse and the maximum only when K is a triangle. The upper and lower bounds of κ only differ by about 13%. It has been shown, [2] that κ = 11/144 for K a square.



Consider shaded region $[A_1]$ and $[A_2][A_3]$

$$F_1 + N_2 + N_3 = A_1$$

$$N_1 + F_2 + F_3 + T = 1 - A_1$$

Combine both.

$$F_1 + F_2 + F_3 = 2 - 2T - A_1 - A_2 - A_3$$

Therefore,

$$P = E\left[F_1 + F_2 + F_3\right] = 2 - 2E[T] - 3E[A]$$

$$E[T] = \frac{11}{144}$$

$$f\left(a_{min}\right) = 4a_{min}$$

$$For\ 0 < a_{min} < \frac{1}{2}$$

$$E\left[A_{app}\right] = 16\int_0^{\frac{1}{2}} a_{min}^2\left(1 - a_{min}\right)da_{min} = \frac{5}{12}$$

$$Given\ points\ (2,3)$$

$$A_1 = 1 - a_{min}$$

Distribution for a_{min} is given by f(x) = 2x

$$0 < x < 1$$

$$f\left(a_{min}\right) = -16a_{min}log\left(2a_{min}\right)$$

$$For\ 0 < a_{min} < \frac{1}{2}$$

$$E\left[A_{corner}\right] = -32\int_0^{\frac{1}{2}} a_{min}^2\left(1 - a_{min}\right)log\left(2a_{min}\right)da_{min}$$

$$= \frac{23}{72}$$

$$E\left[A\right] = P\left(A_{opp}\right)E\left[A_{opp}\right] + P\left(A_{corner}\right)E\left(A_{corner}\right)$$

$$= \frac{2}{3}\frac{5}{12} + \frac{1}{3}\frac{23}{72} = \frac{83}{216}$$

$$P = 2 - 2\frac{11}{144} - 3\frac{83}{216} = \frac{25}{36} = \left(\frac{5}{6}\right)^2 = 0.69\overline{4}$$

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Equation #15

Integrate. Brute force calculates (No formulas) (Using Taylor series) (Then puiseux) sum from psi equals zero:

$$\int \psi^{\psi} d\psi$$

Series expansion of the integral at ψ = 0

Some information prerequisites to know

Taylor series E.g.

$$sin(x) = \sum_{n=0}^{\infty}\left(\frac{(-1)^n}{(2n+1)!}x^{2n+1}\right) = x - \frac{x^3}{3!} + \frac{x^5}{5!} + \ldots.$$

$$f(x) = e^x = \sum_{n=0}^{\infty}\left(\frac{x^n}{n!}\right) = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \ldots.$$

$$x^x \rightarrow e^u = 1 + u + \frac{u^2}{2} + \ldots.$$

$$x^x \sim \sum_{k=0}^{\infty}\left(\frac{1}{k!}(xlog(x))^k\right) = 1 + xlogx + \frac{1}{2}x^2 log^2 x + 0$$
$$\left(x^3 log^3 x\right)$$

$$Digamma\ Function\ \psi(x) = lnx - \frac{1}{2x}$$

$$\psi(z) =$$
$$\left[-\Upsilon - \sum_{k=0}^{\infty}\zeta(k)(-z)^k\right]^{\left[\psi(z) = \left[-\Upsilon - \sum_{k=0}^{\infty}\zeta(k)(-z)^k\right]\right]}$$

$$\psi(z)^{\psi(z)} =$$
$$\left[-\Upsilon - \sum_{k=0}^{\infty}\zeta(k)(-z)^k\right]^{\left[-\Upsilon - \sum_{k=0}^{\infty}\zeta(k)(-z)^k\right]}$$

$$\sum_{k=0}^{\infty}\left(\zeta(k)(-z)^k\right)$$

$$(-z)^k\zeta(k) = \frac{(-z)^k\sum_{n=0}^{\infty}\frac{\sum_{j=0}^{n}(-1)^j(1+j)^{1-k}\binom{n}{j}}{1+n}}{-1+k}$$

Taylor series of ψ(x) at z = 1

$$\psi(z+1) = -\Upsilon - \sum_{k=1}^{\infty}\zeta(k+1)(-z)^k$$

$$at\ z = 0$$

$$\psi(z) = -\Upsilon - \sum_{k=0}^{\infty}\zeta(k)(-z)^k$$

I simplified the information into the following equation of psi z to the psi z at psi equals zero.

$$\psi(z)^{\psi(z)} =$$
$$\left[-\Upsilon-\sum_{k=0}^{\infty}\left[\frac{(-z)^k\sum_{n=0}^{\infty}\frac{\sum_{j=0}^{n}(-1)^j(1+j)^{1-k}\binom{n}{j}}{1+n}}{-1+k}\right]\right]$$

To the power of

$$\left[-\Upsilon-\sum_{k=0}^{\infty}\left[\frac{(-z)^k\sum_{n=0}^{\infty}\frac{\sum_{j=0}^{n}(-1)^j(1+j)^{1-k}\binom{n}{j}}{1+n}}{-1+k}\right]\right]$$

$$\sum_{j=0}^{n}(-1)^j(1+j)^{1-s}$$

$$2^{-s}\left[2(-1)^n\left(\zeta\left(s-1,\frac{n+2}{2}\right)-\zeta\left(s-1,\frac{n+3}{2}\right)\right)+A\right]$$

$$A=\left(2^s-4\right)\zeta(s-1)$$

$$\psi(z)^{\psi(z)} =$$
$$\left[-\Upsilon-\sum_{k=0}^{\infty}\zeta(k)(-z)^k\right]^{\left[-\Upsilon-\sum_{k=0}^{\infty}\zeta(k)(-z)^k\right]}$$

$$(-z)^k\zeta(s) =$$
$$\frac{(-z)^k\left[\frac{(n+1)2^{-s}\left[\left((-1)^k+1\right)\zeta\left(-1,\frac{n+2}{2}\right)+s\zeta^{(1,0)}\left(-1,\frac{n+2}{2}\right)+A\right]}{\frac{1}{2}(k+1)(k+2)}\right]}{-1+s}$$

$$A=\frac{1}{2}s^2\zeta^{(2,0)}\left(-1,\frac{n+2}{2}\right)+\frac{1}{6}s^3\zeta^{(3,0)}\left(-1,\frac{n+2}{2}\right)+\frac{1}{24}s^4\zeta^{(4,0)}\left(-1,\frac{n+2}{2}\right)+O\left(s^5\right)-(Big)+$$
$$(n+1)\left(2^s-4\right)\left((n+1)\zeta(s-1)\right)$$

$$Big=\zeta\left(-1,\frac{n+3}{2}\right)+s\zeta^{(1,0)}\left(-1,\frac{n+2}{2}\right)+\frac{1}{2}s^2\zeta^{(2,0)}\left(-1,\frac{n+3}{2}\right)+\frac{1}{6}s^3\zeta^{(3,0)}\left(-1,\frac{n+3}{2}\right)+\frac{1}{24}s^4\zeta^{(4,0)}\left(-1,\frac{n+3}{2}\right)+O\left(s^5\right)$$

$$\sum_{n=0}^{\infty}\left(2^s-4\right)$$

$$\left(2^s - 4\right) \cdot$$
$$-\frac{1}{12} + s\left(\frac{1}{12} - log(A)\right) + \frac{1}{2}s^2\zeta\ ''(-1) + \frac{1}{6}\zeta^{\ 3}(-1)s^3 + \frac{1}{24}\zeta^4(-1)s^4 + \frac{1}{120}\zeta^5(-1)s^5 + O\left(s^6\right)$$

$$\sum_{n=0}^{\infty}$$
$$\frac{2^{-s}(A)}{1+n}$$
$$A = 2(-1)^n\left(\zeta\ \left(s-1, \frac{n+2}{2}\right) - \zeta\ \left(s-1, \frac{n+3}{2}\right)\right) + \left(2^s - 4\right)\zeta\ (s-1)$$
$$(-z)^k\zeta(s) = \frac{(-z)^k\left[\frac{(n+1)2^{-s}\left[\left((-1)^k+1\right)\zeta\left(-1, \frac{n+2}{2}\right) + A\right]}{\frac{1}{2}(k+1)(k+2)}\right]}{-1+s}$$
$$A = s\zeta^{(1,0)}\left(-1, \frac{n+2}{2}\right) + \frac{1}{2}s^2\zeta^{(2,0)}\left(-1, \frac{n+2}{2}\right) + \frac{1}{6}s^3\zeta^{(3,0)}\left(-1, \frac{n+2}{2}\right) + \frac{1}{24}s^4\zeta^{(4,0)}\left(-1, \frac{n+2}{2}\right) + O\left(s^5\right) - (Big) + (n+1)\left(2^s - 4\right)\left((n+1)\zeta(s-1)\right)$$

We can represent that entire equation as Ans. 1

$$\psi(z)^{\psi(z)} = \left[-\Upsilon - \sum_{k=0}^{\infty}[Ans.\ 1]\right]^{\left[-\Upsilon - \sum_{k=0}^{\infty}[Ans.\ 1]\right]}$$

Only partial sum

At ψ(z) = 0 function diverges

$$\left\{\zeta(-s), \frac{1}{2}(n+2)s\right\}$$

Summation of both gives us.

$$\zeta(-s) = (n+1)\zeta(-s)$$
$$\frac{1}{2}(n+2)s = \frac{1}{2}(k+1)(n+2)s$$
$$\psi(z)^{\psi(z)} = \frac{\left[-\Upsilon - \left[\frac{z(-z)^n + 1}{z+1}\right]\left[(k+1)(n+1)2^{-s}\left[\frac{A}{\frac{1}{2}(k+1)(k+2)}\right]\right]\right]}{-1+s}$$
$$\frac{1}{2}s^2\zeta^{(2,0)}\left(-1, \frac{n+3}{2}\right)$$

$$= \left\{ -\frac{1}{2}s^2\zeta(u; g_2, g_3)^2, \frac{1}{4}(n+3)s^2 \right\}$$

First part can be broken down into the following.

$$\left\{ -\frac{1}{2}s^2\zeta(u)^2, -\frac{1}{2}s^2\zeta(g_2)^2, -\frac{1}{2}s^2\zeta(g_3)^2 \right\}$$

$$First = N_1 \ Second = N_2 \ Third = N_3$$

Second part of the original function with ¼(n+3)s²

$$\frac{1}{4}(k+1)(n+3)s^2$$

$$s\zeta^{(1,0)}\left(-1, \frac{n+3}{2}\right)$$

$$= \left\{ \zeta(-s), \frac{1}{2}(n+3)s \right\}$$

$$\{A\}$$

$$A = \frac{1}{2}ln(2\pi) + \frac{36 + (3 - 6ln(2\pi))}{48} - 56 - 12ln(2\pi) + \frac{5}{144} + O(s^7), \frac{1}{2}(k+1)(n+3)s$$

Anything after big O notation is in brackets. So, when subtracting, you must subtract the whole function.

$$(n+1)2^{-s}[A]$$

$$A = ((-1)^k + 1)\zeta\left(-1, \frac{n+2}{2}\right) + s\zeta^{(1,0)}\left(-1, \frac{n+2}{2}\right) + \frac{1}{2}s^2\zeta^{(2,0)}\left(-1, \frac{n+2}{2}\right) + \frac{1}{6}s^3\zeta^{(3,0)}\left(-1, \frac{n+2}{2}\right) + \frac{1}{24}s^4\zeta^{(4,0)}\left(-1, \frac{n+2}{2}\right) + O(s^5) - \zeta\left(-1, \frac{n+3}{2}\right) + s\zeta^{(1,0)}\left(-1, \frac{n+3}{2}\right) + \frac{1}{2}s^2\zeta^{(2,0)}\left(-1, \frac{n+3}{2}\right) + \frac{1}{6}s^3\zeta^{(3,0)}\left(-1, \frac{n+3}{2}\right) + \frac{1}{24}s^4\zeta^{(4,0)}\left(-1, \frac{n+3}{2}\right) + O(s^5) + (n+1)(2^s - 4)((n+1)\zeta(s-1))$$

$$\left[\frac{1}{6}s^3\zeta^{(3,0)}\left(-1, \frac{n+3}{2}\right)\right]$$

$$\left\{ -\frac{1}{6}s^3\zeta(u; g_2, g_3)^3, \frac{1}{12}(n+3)s^3 \right\}$$

Evaluating the summation of the first part gives us.

$$\left\{ \frac{s^3\zeta(u)^3}{6}, \frac{1}{6}s^3\zeta(g_2)^3, \frac{1}{6}s^3\zeta(g_3)^3 \right\}$$

Evaluating the summation of the second part gives us.

$$\frac{1}{12}(k+1)(n+3)_s{}^3$$

Continuing the expansion of the first part yields.

$$-\frac{1}{48}-\frac{ln(2\pi)}{16}+\frac{2(36)}{384}+\frac{2(3-18ln(2\pi))}{384}+56+36ln(2\pi)-\frac{(12-12log_2(\pi)-24ln(2)ln(\pi))}{9216}-12-(-12ln(2\pi))+24ln(2\pi)+46-2304ln(2\pi)+144+384ln(2\pi)+O(u^5)$$

Going back to the first function.

$$\left\{-\frac{1}{2}s^2\zeta(u)^2,\ -\frac{1}{2}s^2\zeta(g_2)^2,\ -\frac{1}{2}s^2\zeta(g_3)^2\right\}$$

$$First\ =N_1\ Second\ =\ N_2\ Third\ =N_3$$

Now evaluating, we find.

$$N_1:-\frac{1}{8}-\frac{ln(2\pi)}{4}+\frac{(n+1)s^2u^2(36)}{96}+\frac{(n+1)s^2u^3(3-12ln(2\pi))}{48}+(12(n+1)y+12)+4+12ln(2\pi)+(n+1)O(u^4)$$

$$N_2:\ -\frac{1}{8}-\frac{ln(2\pi)}{4}+\frac{(n+1)s^2g_2^2(36)}{96}+\frac{(n+1)s^2g_2^3(3-12ln(2\pi))}{48}+(12(n+1)y+12)+4+12ln(2\pi)+(n+1)O(g_2^4)$$

$$N_3:-\frac{1}{8}-\frac{ln(2\pi)}{4}+\frac{(n+1)s^2g_3^2(36)}{96}+\frac{(n+1)s^2g_3^3(3-12ln(2\pi))}{48}+(12(n+1)y+12)+4+12ln(2\pi)+(n+1)O(g_3^4)$$

If something diverges it becomes obsolete.
Series expansion at u = 0.

$$\sum_{k=0}^{\infty}[A]$$

$$A=-\frac{s^2}{8}-\frac{u(s^2log(2\pi))}{4}+\frac{s^2u^2(B)}{96}+\frac{s^2u^3(C)}{48}+O(u^4)$$

$$B=24y_1+12y^2-\pi^2-24log^2(2)-24log^2(\pi)-2log(16777216)log(\pi)$$

$$C = \left(-2\left(-3y_2 - 12y_1 log(2\pi\ ) + 2\zeta(3) + D\right)\right)$$

$$D = log^3(2\pi) + 3log^2(2)log(2\pi) + 3log^2(\pi)log (2\pi) + 6log(2)log(\pi)log(2\pi)$$

$$\psi(z)^{\psi(z)} = \frac{\left[-\Upsilon - \left[\frac{z(-z)^n + 1}{z+1}\right]\left[\frac{A}{\frac{1}{2}(k+1)(k+2)}\right]\right]}{-1+s}$$

$$A = (k+1)(n+1)2^{-s}[B]$$

$$B = \frac{1}{2}\left(2m + (-1)^m + 3\right)\zeta\left(-1, \frac{n+2}{2}\right) + \left\{(n+1)\zeta(-s), \frac{1}{2}(k+1)(n+2)s\right\} - \frac{1}{8} - \frac{ln(2\pi)}{4} + \frac{(n+1)s^2u^2(36)}{96} + \frac{(n+1)s^2u^3(3-12ln(2\pi))}{48} + (12(n+1)y+12) + 4 + 12ln(2\pi) + (n+1)O\left(u^4\right), -\frac{1}{8} - \frac{ln(2\pi\ )}{4} + \frac{(n+1)s^2g_2^2(36)}{96} + \frac{(n+1)s^2g_2^3(3-12ln(2\pi\ ))}{48} + (12(n+1)y+12) + 4 + 12ln(2\pi\ ) + (n+1)O\left(g_2^4\right), -\frac{1}{8} - \frac{ln(2\pi\ \ )}{4} + \frac{(n+1)s^2g_3^2(36)}{96} + \frac{(n+1)s^2g_3^3(3-12ln(2\pi\ \ ))}{48} + (12(n+1)y+12) + 4 + 12ln(2\pi\ \ ) + (n+1)O\left(g_3^4\right), \frac{1}{4}(k+1)(n+2)s^2$$

Adding the following sum.

$$\left\{-\frac{1}{6}s^3\zeta\left(u; g_2, g_3\right)^3, \frac{1}{12}(n+3)s^3\right\}$$

We get the following.

$$\frac{1}{4}(k+1)(n+2)s^2 + [A]$$

$$A=\frac{1}{48}+\left(\frac{1}{16}+\frac{ln(2\pi)}{16}\right)+\frac{2(-36)}{384}-$$
$$\frac{(3-18ln(2\pi))}{384}+56+36ln(2\pi)+$$
$$\frac{2}{9216}\left(12+\left(6log_2(\pi)\right)\right)-4-$$
$$(-12ln(2\pi)+24ln(2\pi))-98+O\left(u^5\right),\frac{1}{48}+$$
$$\left(\frac{1}{16}+\frac{ln(2\pi)}{16}\right)+\frac{2(-36)}{384}-\frac{(3-18ln(2\pi))}{384}+56+36ln$$
$$(2\pi)+\frac{2}{9216}\left(12+\left(6log_2(\pi)\right)\right)-4-$$
$$(-12ln(2\pi)+24ln(2\pi))-98+O\left(g_2^5\right),\frac{1}{48}+$$
$$\left(\frac{1}{16}+\frac{ln(2\pi)}{16}\right)+\frac{2(-36)}{384}-\frac{(3-18ln(2\pi))}{384}+56+36ln$$
$$(2\pi)+\frac{2}{9216}\left(12+\left(6log_2(\pi)\right)\right)-4-$$
$$(-12ln(2\pi)+24ln(2\pi))-98+O\left(g_3^5\right),$$
$$\frac{1}{12}(k+1)(n+2)s^3$$

$$\frac{1}{24}s^4\zeta^{(4,0)}\left(-1,\frac{n+2}{2}\right)$$

$$\left\{-\frac{1}{24}s^4\zeta(u;g_2,g_3)^4,\frac{1}{48}(n+2)s^4\right\}$$

Summation of the second part gives us.

$$\frac{1}{48}(k+1)(n+2)s^4$$

Summation of the first part gives us.

$$\left\{-\frac{1}{24}s^4\zeta(u)^4,\ -\frac{1}{24}s^4\zeta(g_2)^4,\ -\frac{1}{24}s^4\zeta(g_3)^4\right\}$$

$$First\ part\ =\ N_1\ Second\ part\ =\ N_2\ Third\ part\ =\ N_3$$

$$N_1:\ -\frac{1}{384}-\frac{ln(2\pi)}{96}+\frac{2(6)}{384}+$$
$$\frac{2(15+24ln(2\pi)-4+12ln(2\pi))}{576}-\frac{18}{36864}-72log(2)log$$
$$(\pi)-36log(2)log(\pi)+18ln(\pi)+36log^2(\pi)+48+48\pi$$
$$^2-2304ln(2)+2304ln(\pi)+144-384ln(2\pi)+$$
$$\frac{2((12-24ln(2\pi))-56-12ln(2\pi))}{276480}-480$$
$$(-2(-3-12ln(2\pi)))+28+12ln(2\pi)-$$
$$(-12-24ln(2\pi))-56-12ln(2\pi)+O\left(u^6\right)$$

Adding this to the final equation, we get.

$$A = \frac{1}{48} + \left(\frac{1}{16} + \frac{ln(2\pi)}{16}\right) + \frac{2(-36)}{384} - \frac{(3 - 18ln(2\pi))}{384} + 56 + 36ln(2\pi) + \frac{2}{9216}\left(12 + \left(6log_2(\pi)\right)\right) - 4 - (-12ln(2\pi) + 24ln(2\pi)) - 98 + O\left(u^5\right), \frac{1}{48} +$$

$$\left(\frac{1}{16} + \frac{ln(2\pi)}{16}\right) + \frac{2(-36)}{384} - \frac{(3 - 18ln(2\pi))}{384} + 56 + 36ln(2\pi) + \frac{2}{9216}\left(12 + \left(6log_2(\pi)\right)\right) - 4 - (-12ln(2\pi) + 24ln(2\pi)) - 98 + O\left(g_2^5\right), \frac{1}{48} +$$

$$\left(\frac{1}{16} + \frac{ln(2\pi)}{16}\right) + \frac{2(-36)}{384} - \frac{(3 - 18ln(2\pi))}{384} + 56 + 36ln(2\pi) + \frac{2}{9216}\left(12 + \left(6log_2(\pi)\right)\right) - 4 - (-12ln(2\pi) + 24ln(2\pi)) - 98 + O\left(g_3^5\right),$$

$$\frac{1}{12}(k+1)(n+2)s^3 - \frac{1}{384} - \frac{ln(2\pi)}{96} + \frac{2(6)}{384} + \frac{2(15 + 24ln(2\pi) - 4 + 12ln(2\pi))}{576} - \frac{18}{36864} - 72log(2)log(\pi) - 36log(2)log(\pi) + 18ln(\pi) + 36log^2(\pi) + 48 + 48\pi^2 - 2304ln(2) + 2304ln(\pi) + 144 - 384ln(2\pi) + \frac{2((12 - 24ln(2\pi)) - 56 - 12ln(2\pi))}{276480} - 480\left(-2(-3 - 12ln(2\pi))\right) + 28 + 12ln(2\pi) - (-12 - 24ln(2\pi)) - 56 - 12ln(2\pi) + O\left(u^6\right),$$

$$\frac{1}{48}(k+1)(n+2)s^4$$

Combining everything together, we get the following fully simplified expansion. When there is multiplication it means multiplying the whole function.

$$\psi + \frac{1}{4}\psi^{2}(2log(\psi) - 1) + \frac{1}{54}\psi^{3}\left(9log^{2}(\psi) - 6log(\psi) + 2\right) + \frac{1}{768}\psi^{4}\left(32log^{3}(\psi) - 24log^{2}(\psi) + 12log(\psi) - 3\right) + \frac{\psi^{5}\left(625log^{4}(\psi) - 500log^{3}(\psi) + 300log^{2}(\psi) - 120log(\psi) + 24\right)}{75000} + \frac{\psi^{6} \cdot 324log^{5}(\psi) - 270log^{4}(\psi) + 180log^{3}(\psi) - 90log^{2}(\psi) + 30log(\psi) - 5}{233280} + \frac{1}{592950960}\psi^{7} \cdot 117649log^{6}(\psi) - 100842log^{5}(\psi) + 72030log^{4}(\psi) - 41160log^{3}(\psi) + 17640log^{2}(\psi) - 5040log(\psi) + 720 + O\left(\psi^{8}\right) + C$$