Name:

Qualifiers Round 1

Write ONLY your final answers on this sheet. You may omit the constant of integration.

1. [3] $\displaystyle\int \frac{1}{x \log_{10} x}\,\mathrm{d}x$

2. [2] $\displaystyle\int_0^{2\pi} (x-\pi)^3 \cos x\,\mathrm{d}x$

3. [2] $\displaystyle\int_{-2}^{4} e^{|x|}\,\mathrm{d}x$

4. [2] $\displaystyle\int \left(\tan^{-1} x + \frac{x}{1+x^2}\right)\,\mathrm{d}x$

5. [3] $\displaystyle\int \sec^2(\sqrt{x})\,\mathrm{d}x$

6. [3] $\displaystyle\int_0^{\pi/2} \left(\log(\sec x - 1) + \log(\sec x + 1)\right)\,\mathrm{d}x$

7. [4] $\displaystyle\int \frac{\sin x - x}{1-\cos x}\,\mathrm{d}x$

8. [4] $\displaystyle\int \frac{1}{1+\cos^2 x}\,\mathrm{d}x$

9. [4] $\displaystyle\int_0^{\pi} \frac{x \sin x}{1+\cos^2 x}\,\mathrm{d}x$

10. [3] $\displaystyle\int_{\sqrt[3]{2}}^{\sqrt[3]{3}} \left(3x^{14} - 12x^{11} + 18x^8 - 12x^5 + 3x^2\right)\,\mathrm{d}x$

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Qualifiers Round 2

Write ONLY your final answers on this sheet. You may omit the constant of integration.

1. $\displaystyle\int \frac{1}{\sqrt{1+e^x}}\,\mathrm{d}x$

2. $\displaystyle\int e^{\sin x}(\cos^2 x - \sin x)\,\mathrm{d}x$

3. $\displaystyle\int_{-\pi}^{\pi} \lfloor \sin(\sin 2x) \rfloor\,\mathrm{d}x$

4. $\displaystyle\int \frac{1}{x^{101}+x}\,\mathrm{d}x$

5. $\displaystyle\int_0^{\frac{\pi}{4}} \frac{\sec x}{\sqrt{1+\sin 2x}}\,\mathrm{d}x$

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Finals Questions

1. $\displaystyle\int \frac{x^2+1}{x\sqrt{x^4-3x^2+1}}\,\mathrm{d}x$
2. $\displaystyle\int e^{\sin x}(\tan x \sec x + 1)\,\mathrm{d}x$
3. $\displaystyle\int_{-\pi/2}^{\pi/2} \frac{x \sin x \cos x}{e^x+1}\,\mathrm{d}x$
4. $\displaystyle\int \frac{1-x^2}{x^4+3x^2+1}\,\mathrm{d}x$
5. $\displaystyle\int_0^1 \frac{\tan^{-1} x}{1+x}\,\mathrm{d}x$
6. $\displaystyle\int_{-\pi/4}^{\pi/4} \tan^{-1}(e^{\tan x})\,\mathrm{d}x$
7. $\displaystyle\int \frac{1}{\prod_{k=1}^{2021}(x+k)}\,\mathrm{d}x$
8. $\displaystyle\int \frac{1}{\sin^4 x + \cos^4 x}\,\mathrm{d}x$
9. $\displaystyle\int_0^1 \frac{x^2-1}{x^3+(1-x^2)^{\frac{3}{2}}}\,\mathrm{d}x$
10. $\displaystyle\int e^x x^{e^x-1}(x\log x + 1)\,\mathrm{d}x$

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Qualifiers Round 1 Solutions

1. $\log 10 \log(|\log x|)$
2. 0
3. $e^4 + e^2 - 2$
4. $x \tan^{-1} x$
5. $2\sqrt{x}\tan(\sqrt{x}) + 2\log(|\cos(\sqrt{x})|)$
6. 0
7. $x \cot(\frac{x}{2})$
8. $\frac{1}{\sqrt{2}} \tan^{-1}(\frac{\tan x}{\sqrt{2}})$
9. $\frac{\pi^2}{4}$
10. $\frac{2^5-1}{5} = \frac{31}{5}$

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Qualifiers Round 2 Solutions

1. $-\log(e^{-x} + \frac{1}{2} + \sqrt{e^{-x} + e^{-2x}})$
2. $e^{\sin x} \cos x$
3. $-\pi$
4. $\frac{1}{100} \log\left(\left|\frac{x^{100}}{x^{100}+1}\right|\right)$
5. $\log 2$

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Finals Solutions

1. $\log\left|x - \frac{1}{x} + \frac{\sqrt{x^4-3x^2+1}}{x}\right|$
2. $e^{\sin x}\sec x$
3. $\frac{\pi}{8}$
4. $-\tan^{-1}\left(x + \frac{1}{x}\right)$
5. $\frac{\pi}{8}\log 2$
6. $\frac{\pi^2}{8}$
7. $\frac{1}{2020!}\sum_{k=1}^{2021}(-1)^{k+1}\binom{2020}{k-1}\log(|x+k|)$
8. $\frac{1}{\sqrt{2}}(\tan^{-1}(\sqrt{2}\tan x + 1) + \tan^{-1}(\sqrt{2}\tan x - 1))$
9. $-\frac{\pi}{4}$
10. x^{e^x}