Integration Bee Answer Key

HMMT February 2023

Qualifiers

1. $\frac{4052}{2025}$
2. $\log(e^x + ex + e)$
3. $-\frac{\sqrt[x]{2}}{\log 2}$
4. $\log\left(x^2 - x\right)$
5. $\frac{x^2}{2}$
6. $\log 3$
7. $\frac{1}{2024} \cdot e^{(\log x)^{2024}}$
8. $\arctan(\sin x)$
9. $\frac{\pi}{4}$
10. $2(1+x)\sqrt{1-x}$
11. $\frac{1}{2}x^2e^{2/x}$
12. $2024! - 2023!$
13. $\frac{\log 2}{\pi}$
14. $\frac{2}{2023}\arctan\left(\sqrt{x^{2023}-1}\right)$
15. 2023
16. $2\sqrt{1-\frac{1}{x}}$
17. $\frac{1}{2}\log(x + \sin x \cos x)$
18. $e^2 - 1$
19. $2\sqrt{x+\sqrt{1+x^2}}$
20. $\approx 5.535182245 \cdot 10^7$

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Finals

Sample

[1] $\frac{2023}{2}$

[2] $\frac{1}{2024}$

Semifinal 1

[1] $\frac{2023 \cdot 2023!}{2}$

[2] $2 \arctan x - \frac{\log(x^2+1)}{x}$

[3] $\frac{32}{15}$

Semifinal 2

[1] $\frac{1}{3}\sec^3 x - \sec x$

[2] $xe^x e^{e^x}$

[3] $2\sqrt{x+1}\arcsin x + 4\sqrt{1-x}$

Third Place

[1] $\frac{2023^2}{2}$

[2] $4 \arctan \sqrt[4]{x}$

[3] 75π

Final

[1] $\tan x \log(\sin x) - x$

[2] $x^{(\log x)^2-1} = e^{(\log x)^3 - \log x}$

[3] $\frac{3}{16}$

[4] $\frac{\tan x}{x \tan x + 1}$

[5] $\frac{1}{3}$

Sudden Death

[1] 0

[2] $-2525\pi^2$

[3] $\frac{\sin x}{4} + \frac{\sin 3x}{6} + \frac{\sin 5x}{20}$

[4] $\frac{1}{4}\log\left(\frac{x-1}{x+1}\right) + \frac{\arctan(x)}{2}$

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