2019 MathSoc Integration Bee
Qualifiers Questions

1. [2] $\displaystyle\int e^x \ln x + \frac{e^x}{x}\,\mathrm{d}x$
2. [3] $\displaystyle\int_{-1}^{1} \cos^{-1} x + \sin^{-1} x\,\mathrm{d}x$
3. [4] $\displaystyle\int_{1160}^{1163} 2x\,\mathrm{d}x$
4. [5] For $n \in \mathbb{Z}_+$, $\displaystyle\int_0^\infty x^n e^{-x}\,\mathrm{d}x$
5. [5] $\displaystyle\int_0^\infty \frac{e^{2x}}{1+e^{4x}}\,\mathrm{d}x$
6. [5] $\displaystyle\int e^{2019x}\cos 2019x\,\mathrm{d}x$
7. [5] $\displaystyle\int_{-2019}^{0} \sqrt{4076361 - x^2}\,\mathrm{d}x$
8. [6] $\displaystyle\int 2019^{2019x}\,\mathrm{d}x$
9. [6] $\displaystyle\int \frac{\sin 4x}{\sin x}\,\mathrm{d}x$
10. [7] $\displaystyle\int_{-\pi/2}^{\pi/2} \frac{2x\sin|x|}{5+\cos 4x}\,\mathrm{d}x$
11. [7] $\displaystyle\int_0^{\pi/2} \frac{5\cos x}{3\sin x + 4}\,\mathrm{d}x$
12. [7] $\displaystyle\int \cos x \cos(\sin x)\cos(\sin(\sin x))\,\mathrm{d}x$
13. We messed this one up... Sorry!!!
14. [8] $\displaystyle\int_{-9\pi}^{2019\pi} \sin^{-1}(\sin x)\,\mathrm{d}x$
15. [9] $\displaystyle\int_0^1 x^3(1-x)^7\,\mathrm{d}x$
16. [9] $\displaystyle\int_0^{\pi/2} \sin x \sin 2x \sin 3x\,\mathrm{d}x$
17. [9] $\displaystyle\int_0^{\pi/2} \ln(\tan x)\,\mathrm{d}x$
18. [10] $\displaystyle\int_{-\pi/4}^{\pi/24} 8\cot 8x + 4\tan 4x + 2\tan 2x + \tan x - \cot x\,\mathrm{d}x$
19. [10] $\displaystyle\int \frac{\mathrm{d}x}{(x^2-2x)(x^2-2x+1)(x^2-2x+2)}$

20. [12] $\displaystyle\int_{-3}^{3} \frac{x^4}{e^x+1}\,\mathrm{d}x$

21. [13] $\displaystyle\int_{-2}^{2} \frac{|x-2|+|x|+|x+2|}{|x-1|+|x+1|}\,\mathrm{d}x$

22. [13] $\displaystyle\int_{-1}^{1} \frac{e^{2x}+1-(x+1)(e^x+e^{-x})}{x(e^x-1)}\,\mathrm{d}x$

23. [14] For $x>0$, $\displaystyle\int \sqrt{1+\frac{1}{x}}\,\mathrm{d}x$

24. [14] $\displaystyle\int_{0}^{\pi/4} \sec^5 x\,\mathrm{d}x$

25. [16] $\displaystyle\int_{-4}^{0} \frac{\sqrt{\ln(5-2x)}}{\sqrt{\ln(5-2x)}+\sqrt{\ln(2x+13)}}\,\mathrm{d}x$

26. [17] $\displaystyle\int \frac{x\cos x+1}{\sqrt{2x^3e^{\sin x}+x^2}}\,\mathrm{d}x$

27. [17] $\displaystyle\int_{0}^{\pi/2} \sqrt{\tan x}\,\mathrm{d}x$

28. [19] $\displaystyle\int_{0}^{\pi} \frac{\sin\frac{2019x}{2}}{\sin\frac{x}{2}}\,\mathrm{d}x$

29. [20] $\displaystyle\int_{0}^{1} \ln x \sin^{-1} x\,\mathrm{d}x$

30. [20] $\displaystyle\int_{0}^{\infty} \frac{x-1}{\sqrt{2^x-1}\ln(2^x-1)}\,\mathrm{d}x$

Ro16 Questions

- Group A Question 1:

$$\int_{-2}^{1} \sqrt{e^x}\,\mathrm{d}x$$

- Group A Question 2:

$$\int_{0}^{1} \left(1+x^2\right)\left(1-x^2+x^4-x^6+\cdots-x^{4038}\right)\,\mathrm{d}x$$

- Group B Question 1:

$$\int_{13}^{27} x^2\,\mathrm{d}x$$

- Group B Question 2:

$$\int \frac{x}{\sqrt{x^2+2x+2}}\,\mathrm{d}x$$

- Group C Question 1:

$$\int_{-1}^{1} x+2x^2+3x^3+4x^4+5x^5+6x^6\,\mathrm{d}x$$

- Group C Question 2:

$$\int \frac{\mathrm{d}x}{\sqrt{3x(4-3x)}}$$

- Group D Question 1:

$$\int_{\pi/6}^{\pi/3} \frac{\mathrm{d}x}{\tan x+\cot x}$$

- Group D Question 2:

$$\int_{-5}^{6} |x|^3\,\mathrm{d}x$$

Quarter Final Questions

- Quarter Final Question 1:

$$\int_0^1 x^2\sqrt{4-x^2}\,\mathrm{d}x$$

- Quarter Final Question 2:

$$\int_0^\pi e^x \cos^2 x\,\mathrm{d}x$$

- Quarter Final Question 3:

$$\int_0^1 \left(\cos^{-1} x\right)^2\,\mathrm{d}x$$

- Quarter Final Question 4:

$$\int_0^{3\pi/2} \cos^{-1}(\cos x)\,\mathrm{d}x$$

Semi Final Questions

- Semifinal A Question 1:

$$\int \frac{\mathrm{d}x}{\sum_{k=1}^{2019}(x+k)}$$

- Semifinal A Question 2:

$$\int_0^{10} x^2 + \lceil x \rceil^2 \,\mathrm{d}x$$

- Semifinal B Question 1:

$$\int_0^1 \frac{\exp(-\tan(\sin^{-1} x))\sec^2(\sin^{-1} x)\tan(\sin^{-1} x)}{\sqrt{1-x^2}}\,\mathrm{d}x$$

- Semifinal B Question 2:

$$\int_0^{\pi/4} \sum_{k=0}^{2019} \tan(x + k\pi)\,dx$$

Third Place Questions

- Third Place Question:

$$\int_{-1}^{1} \sin\left(\pi|x|\right) \sin^{-1}\left(\sqrt{|x|}\right) \, \mathrm{d}x$$

- Third Place Easier Question:

$$\int \frac{e^{2x} + 2e^{x} + 1}{e^{2x} - 2e^{x} + 1} \, \mathrm{d}x$$

Grand Finals Questions

- Grand Final Question 1:

$$\int_0^{2019\pi} \sum_{k=0}^{5} \sin^{-1}(\sin kx)\,\mathrm{d}x$$

- Grand Final Question 2:

$$\int \frac{70\sin x + 23\cos x}{5\sin x + 8\cos x}\,\mathrm{d}x$$

- Grand Final Question 3:

$$\int_{-\pi/4038}^{\pi/4038} \frac{\cos^{2019} 2019x}{(2019^{2019x}+1)\left(\sin^{2019} 2019x + \cos^{2019} 2019x\right)}\,\mathrm{d}x$$

- Grand Final Question 4:

$$\int \sqrt{x} e^{\sqrt{x}}\,\mathrm{d}x$$

- Grand Final Question 5:

$$\int e^{2019x+e^{2019x}}\,\mathrm{d}x$$

- Grand Final Question 6:

$$\int_{20}^{89} 3x^2\,\mathrm{d}x$$