Integration Bee

Semi-Finals

Mathematics Club

CFI, IITM

September 15, 2025

Question 1

Semi-Final 1

Evaluate:

$$\int_{-1}^{1} e^{-x} \frac{\cos\left(\sqrt{1-x^2}\right)}{\sqrt{1-x^2}} \, \mathrm{d}x$$

Question 2

Find the value of

$$\sum_{n=0}^{\infty} \int_{0}^{2^{2025}} \left\lfloor \frac{x + 2^{n-1}}{2^n} \right\rfloor \, \mathrm{d}x$$

Question 3

$$\mathsf{A} = \int_0^\infty \frac{e^{-x^2}}{x^2+1}\,\mathrm{d}x \quad , \quad \mathsf{B} = \int_1^\infty \frac{e^{-x}}{\sqrt{x}}\mathrm{d}x$$

Evaluate $\dfrac{A}{B}$

Question 4

Semi-Final 1 Tie Breaker

$$\int \ln(x) \ln(1 - \ln(x)) \, \mathrm{d}x$$

Question 5

Semi-Final 1 First to solve

$$\int_{\frac{1}{4}}^{\frac{9}{4}} \left(x-\frac{1}{4}\right)^{\frac{1}{2}} \left(\frac{9}{4}-x\right)^{\frac{3}{2}} \mathrm{d}x$$

Question 6

Semi-Final 2

$$\int e^{e^x} e^x \left(\cos(e^{e^x}) + \cos(e^x) \right) dx$$

Question 7

Let $F(a,b) : \mathbb{R}^2 \to \mathbb{R}$ be a function defined as

$$F(a,b) = \int_0^\infty \frac{\ln(a^2 + b^2x^2)}{1+x^2}\,\mathrm{d}x$$

What is the value of $F(20,-5)$

Question 8

$$\int_0^\infty \frac{e^{\frac{x}{3}}}{e^x + 1}\,\mathrm{d}x$$

Question 9

Semi-Final 2 Tie Breaker

$$f(y) = \int_0^1 \frac{1}{(1+xy)(\sqrt{1-x^2})}\mathrm{d}x$$

Find $\int_0^1 f(y)\,\mathrm{d}y$

Question 10

Semi-Final 2 First to solve

$$\int_0^{\frac{\pi}{2}} \cos^4(x)\,\sin(6x)\,\mathrm{d}x$$