CMM 2024 Integration Bee Qualification Test

Name: **Team:**

You will have 10 minutes to complete the following 14 integrals. Since all of the following integrals are definite, please $\boxed{\text{box}}$ your answer next to the corresponding integral so the graders can clearly delineate your answers, which must all be in the **simplest possible form** per the test-taking conventions. You may use the front and back of this page for scratch work as well as additional pieces of paper, but **do not** perform calculations next to the integral. Please do not complete this test unless you intend to compete in the finals. **No computers, calculators, or outside resources are permitted.**

Problem 1. $\displaystyle\int_0^1 (4x - 6x^{2/3})\, dx$

Problem 2. $\displaystyle\int_1^4 \frac{x\sqrt{x}-1}{x}\, dx$

Problem 3. $\displaystyle\int_0^{\pi/4} \frac{2\tan(\theta)}{1+\tan^2(\theta)}\, d\theta$

Problem 4. $\displaystyle\int_1^\infty \frac{e^{1/x}}{x^2}$

Problem 5. $\displaystyle\int_0^{2^{-1/4}} \frac{2x}{\sqrt{1-x^4}}\, dx$

Problem 6. $\displaystyle\int_0^6 |x-3|\, dx$

Problem 7. $\displaystyle\int_{-2}^2 \frac{4+\sin(2x)}{4+x^2}\, dx$

Problem 8. $\displaystyle\int_0^1 \frac{1}{1+\frac{1}{1+\frac{1}{x}}}\, dx$

Problem 9. $\displaystyle\int_e^{e^2} \left(\ln(\ln(x)) + \frac{1}{\ln(x)}\right) dx$

Problem 10. $\displaystyle\int_1^2 \frac{x^3+x^{-3}}{x^1+x^{-1}}\, dx$

Problem 11. $\displaystyle\int_0^3 \frac{3x+4}{x^2+4x+3}\, dx$

Problem 12. $\displaystyle\int_0^1 e^x \cdot (\tan(x) + \tan^2(x) - x)\, dx$

Problem 13. $\displaystyle\int_0^{\pi/4} \tan^2(2\theta - 1)\, d\theta$

Problem 14. $\displaystyle\int_0^{\pi/2} \frac{1}{\sqrt{2}-\cos(\theta)}\, d\theta$

1