

# 2024 Troy Integration Bee Qualifying Exam

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You have 20 minutes to complete as many of the following integrals as possible. The only allowed materials are a pencil, eraser, and scratch paper – no calculators. For indefinite integrals, the  $+C$  term need not be included. Both  $\ln(x)$  and  $\log(x)$  will be, by default, interpreted as being in base  $e$ . The denominators of fractions need not be rationalized, but otherwise, answers must be in simplest form. Scratch work will not be considered and there is no partial credit; only your final answer on this sheet matters. Ties will be broken via reverse sudden death.

1.  $\int \frac{dx}{\sqrt[10]{x^9}}$
2.  $\int_0^{2\sqrt{22}} \sqrt{2024 - 23x^2} dx$
3.  $\int_{-2024}^0 |x| + \lfloor x \rfloor dx$
4.  $\int \frac{x+2}{x^3+8} dx$
5.  $\int_{-\pi}^0 \cos^5(x) dx$
6.  $\int_0^\infty x e^{-x/3} dx$
7.  $\int_0^{1/2} \cos^{-1}(x) dx$
8.  $\int_{\pi/4}^{\pi/6} \tan^2(x) - \cot^2(x) dx$
9.  $\int_{-\pi/4}^0 \frac{d}{dx} \left( \frac{\sin(x) + \cos(x)}{\cos(2x)} \right)$
10.  $\int x(e-x)^{2024} dx$
11.  $\int_0^3 (6x^2 + 2x + 1)(2x^3 + x^2) dx$
12.  $\int_{-\pi/2}^{\pi/2} e^{2x} x \sin(x) dx$
13.  $\int_{-1}^0 \frac{x+1}{(x^2-1)\sqrt{x^2-2x}} dx$
14.  $\int x \sqrt[3]{x \sqrt[3]{x \sqrt[3]{\dots}}} dx$
15.  $\int_{-\infty}^\infty \sqrt{2x} e^{-2x^4} dx$
16.  $\int e^{(1+i)x} + e^{(1-i)x} dx$
17.  $\int_{-\infty}^0 \begin{bmatrix} 24 & 0 \\ 0 & 24 \end{bmatrix}^x dx$
18.  $\int_{-\infty}^\infty \frac{16}{x^4+4} dx$
19.  $\int_0^{2024} 2024^{\lfloor x/2024 \rfloor} dx$
20.  $\int_0^\pi \frac{256}{(5+3\cos(x))^2} dx$