

2005 UW Integration Bee

Preliminary Competition

February 1, 2005

Welcome to the second annual UW Integration Bee! Only a writing implement will be necessary. Specifically, no textbooks, notes, tables of integrals, calculators, math T-shirts, tattoos, or copies of Teixeira's "Winning Integration Competitions Made Easy" are allowed. You will have 60 minutes to work on the 50 integrals in the exam. Answers must be circled. No partial credit will be given. All problems count equally. You may not start writing until told to begin, and you must stop writing when time is called. Answers will be posted Thursday, 2/3 outside 1501 Sterling. The top 10 scores advance to the finals. If you are one of the top 10, you will be notified by phone or e-mail Friday evening.

Note: $\ln x$ denotes the natural logarithm, to the base e ($=2.71828\dots$)

Name:

e-mail:

Phone:

undergraduate/graduate (circle one)

1. $\int x^{2005} dx$

$\frac{x^{2006}}{2006} + c$

2. $\int (e^x + e^{-x})^2 dx$

$$\sinh 2x + 2x + c$$

3. $\int \frac{dx}{1/x}$

$$\frac{x^2}{2} + c$$

4. $\int \left(x - \left(\frac{-3 + \sqrt{9 + 28}}{2} \right) \right) \left(x - \left(\frac{-3 - \sqrt{9 + 28}}{2} \right) \right) dx$

$$\frac{x^3}{3} + \frac{3x^2}{2} - 7x + c$$

5. $\int \sin^3 x dx$

$$\frac{\cos^3 x}{3} - \cos x + c$$

6. $\int \cos(\sin(\sin x)) \cos(\sin x) \cos x dx$

$$\sin(\sin(\sin x)) + c$$

7. $\int \frac{x + 49}{x - 49} dx$

$$x + 98 \ln |x - 49| + c$$

8. $\int 8\sin^4 \frac{x}{2} dx$

$$3x - 4\sin x + \frac{\sin 2x}{2} + c$$

9. $\int \ln x dx$

$$x \ln x - x + c$$

10. $\int \frac{dx}{x^2 + 4}$

$$\frac{1}{2} \tan^{-1} \frac{x}{2} + c$$

11. $\int x^5 e^x dx$

$$(x^5 - 5x^4 + 20x^3 - 60x^2 + 120x - 120) e^x + c$$

12. $\int \frac{dx}{x^2 + 12x + 11}$

$$\frac{1}{10} \ln \left| \frac{x+1}{x+11} \right| + c$$

13. $\int \cos 2x \sin 6x dx$

$$\frac{-1}{16} (\cos 8x + 2 \cos 4x) + c$$

14. $\int (\cosh x)^x (\ln(\cosh x) + x \tanh x) dx$

$$(\cosh x)^x + c$$

15. $\int \sec x \tan x dx$

$$\sec x + c$$

16. $\int \frac{dx}{12 + 13 \cos x}$

$$\frac{1}{5} \ln \left| \frac{5 + \tan x/2}{5 - \tan x/2} \right| + c$$

17. $\int \frac{1-x^2}{(x^2+1)^2} dx$

$$\frac{x}{1+x^2} + c$$

18. $\int \frac{\tan \sqrt{x}}{\sqrt{x}} dx$

$$2 \ln |\sec \sqrt{x}| + c$$

19. $\int \sec x \csc x dx$

$$\ln |\tan x| + c$$

20. $\int e^{(e^{e^x} + e^x + x)} dx$

$$e^{(e^{e^x})} + c$$

21. $\int \csc^3 x dx$

$$\frac{1}{2} (\ln |\csc x - \cot x| - \csc x \cot x) + c$$

22. $\int x e^{x^2} dx$

$$\frac{e^{x^2}}{2} + c$$

23. $\int \frac{e^{2x} + e^{-2x}}{e^{2x} - e^{-2x}} dx$

$$\frac{1}{2} \ln |e^{2x} - e^{-2x}| + c$$

24. $\int \tan^{-1} x dx$

$$x \tan^{-1} x - \frac{1}{2} \ln |1 + x^2| + c$$

25. $\int \frac{1}{x - \sqrt{x}} dx$

$$2 \ln |\sqrt{x} - 1| + c$$

26. $\int \frac{x^3 + 3x^2 + 3x}{x^4 + 4x^3 + 6x^2 + 4x + 1} dx$

$$\ln|x+1| + \frac{1}{3} \frac{1}{(x+1)^3} + c$$

27. $\int \frac{\cosh x - \sinh x}{\cosh x + \sinh x} dx$

$$-\frac{1}{2} e^{-2x} + c$$

28. $\int \tan^6 x dx$

$$\frac{\tan^5 x}{5} - \frac{\tan^3 x}{3} + \tan x - x + c$$

29. $\int \frac{x}{\sqrt{29x^2 + 1}} dx$

$$\frac{1}{29} \sqrt{29x^2 + 1} + c$$

30. $\int \cos x \cos 2x dx$

$$\frac{1}{6} \sin 3x + \frac{1}{2} \sin x + c$$

$$31. \int \frac{x \cos x - \sin x}{(x - \sin x)^2} dx$$

$$\frac{1}{2} \frac{x + \sin x}{x - \sin x} + c$$

$$32. \int \sqrt{1-x^2} dx$$

$$\frac{1}{2} (\sin^{-1} x + x\sqrt{1-x^2}) + c$$

$$33. \int (33 + x^{1/33}) dx$$

$$33x + \frac{33}{34} x^{34/33} + c$$

$$34. \int x^{(-\frac{1}{x}-2)} (1 - \ln x) dx$$

$$-\left(\frac{1}{x}\right)^{\frac{1}{x}} + c$$

$$35. \int \frac{dx}{(2x+1)\sqrt{x^2+x}}$$

$$\sec^{-1}(2x+1) + c$$

$$36. \int \frac{\pi}{\sqrt{16-e^2}} dx$$

$$\frac{\pi}{\sqrt{16-e^2}} x + c$$

$$37. \int \frac{dx}{x^6 - 1}$$

$$\frac{1}{12} \left[\ln \left| \frac{(x-1)^2(x^2-x+1)}{(x+1)^2(x^2+x+1)} \right| - 2\sqrt{3} \tan^{-1} \left(\frac{\sqrt{3}x}{1-x^2} \right) \right] + c$$

$$38. \int \frac{dx}{(1-x^2)^{3/2}}$$

$$\frac{x}{\sqrt{1-x^2}} + c$$

$$39. \int \sqrt{\csc x - \sin x} \, dx$$

$$2\sqrt{\sin x} + c$$

$$40. \int \frac{(x+1)}{\sqrt[3]{x^2+2x+2}} \, dx$$

$$\frac{3}{4} (x^2+2x+2)^{2/3} + c$$

$$41. \int \frac{dx}{\sqrt{e^x-1}}$$

$$2\sec^{-1}(e^{x/2}) + c$$

$$42. \int (42+x)^{42} \, dx$$

$$\frac{1}{43} (42+x)^{43} + c$$

43. $\int 2^{\ln x} dx$

$$\frac{x^{\ln 2 + 1}}{\ln 2 + 1} + c$$

44. $\int \frac{dx}{\sec x + \tan x \sin x}$

$$\tan^{-1}(\sin x) + c$$

45. $\int \text{integral } dx$

$$\text{integral } x + c$$

46. $\int \sec^4 x \tan x dx$

$$\frac{\sec^4 x}{4} + c$$

47. $\int e^{(x+\sqrt{2})} dx$

$$e^{(x+\sqrt{2})} + c$$

48. $\int \sin(\cos^{-1} x) dx$

$$\frac{1}{2} \left(x\sqrt{1-x^2} - \cos^{-1} x \right) + c$$

49. $\int \frac{1 - \ln x}{x^2} dx$

$$\frac{\ln x}{x} + c$$

50. $\int (x \sec x)(x \tan x + 2) dx$

$$x^2 \sec x + c$$