MIT Integration Bee
11 January 2013
Qualifying Round

Name: ____________________

MIT Email: ____________________

This is the qualifying test for the 2013 Integration Bee, held on Friday, the 11th of January at 4:00 PM - 6:00 PM in room 4-145. Finalists will be notified by email by midnight tomorrow night (12:00 AM, Sunday, January 13th). You have 20 minutes to solve as many of the given 25 integrals as you can. Each integral is worth 1 point. In order to receive full credit you must express your answer in terms of x for indefinite integrals or simplified expressions in terms of constants for definite integrals, and **your answer must be circled**. There is no partial credit. The "log" symbol denotes the natural logarithm. In your answers, it is not necessary to include the arbitrary constant C nor the absolute value sign around the argument of a logarithm.

1 $\int \log(x^2) - 2\log(2x)\, dx = -x\log(4) + C$

2 $\int_{-1}^{3} e^{|x|}\, dx = e^3 + e - 2$

3 $\int \frac{(\log x)(\cos x) - (\sin x)(1/x)}{(\log x)^2}\, dx = \frac{\sin x}{\log x} + C$

4 $\int_{1}^{11} x^3 - 3x^2 + 3x - 1\, dx = 2500$

5 $\int_{0}^{2} \sqrt{12 - 3x^2}\, dx = \pi\sqrt{3}$

6 $\int_{0}^{6} x + (x-3)^7 + \sin(x-3)\, dx = 18$

7 $\int \sin x\sqrt{1 + \tan^2 x}\, dx = -\log\cos x + C$

8 $\int \frac{x^5 - x^3 + x^2 - 1}{x^4 - x^3 + x - 1}\, dx = \frac{x^2}{2} + x + C$

9 $\int_{0}^{1} \log x\, dx = -1$

10 $\int \frac{1}{1 - e^{-x}}\, dx = \log\left(1 - e^x\right) + C$

11 $\int_{0}^{\pi} \sin^2 x \cos^2 x\, dx = \pi/8$

12 $\int_{0}^{441} \frac{\pi \sin(\pi\sqrt{x})}{\sqrt{x}}\, dx = 4$

13 $\int \tan^2 x\, dx = -x + \tan x + C$

14 $\int_{0}^{256} (x - \lfloor x \rfloor)^2\, dx = 256/3$

15 $\int e^{\sqrt[4]{x}}\, dx = e^{\sqrt[4]{x}}\left(4x^{3/4} - 12\sqrt{x} + 24\sqrt[4]{x} - 24\right) + C$

16 $\int \cos x \cot x\, dx = \cos x - \log\cos(x/2) + \log\sin(x/2) + C$

17 $\displaystyle\int 2\log x + (\log x)^2\,dx = x(\log x)^2 + C$

18 $\displaystyle\int \frac{x^3}{1+x^2}\,dx = \frac{x^2}{2} - \frac{1}{2}\log\left(x^2+1\right) + C$

19 $\displaystyle\int \frac{1}{2-2x+x^2}\,dx = -\tan^{-1}(1-x) + C$

20 $\displaystyle\int \sin x \log(\sin x)\,dx = \cos(x) + \log\left(\tan\left(\frac{x}{2}\right)\right) - \cos(x)\log(\sin(x)) + C$

21 $\displaystyle\int \frac{x}{1-x^4}\,dx = \frac{1}{4}(\log(1+x^2) - \log(1-x^2)) + C$

22 $\displaystyle\int \sqrt{12-3x^2}\,dx = \frac{\sqrt{3}}{2}\left(x\sqrt{4-x^2} + 4\sin^{-1}\left(\frac{x}{2}\right)\right) + C$

23 $\displaystyle\int \sec^5 x \tan^3 x\,dx = \frac{1}{35}\sec^5(x)\left(5\sec^2(x) - 7\right)$

24 $\displaystyle\int_{-\pi/4}^{\pi/4} \frac{1}{1-\sin x}\,dx = 2$

25 $\displaystyle\int \frac{1}{x\sqrt{x^2-2}}\,dx = -\frac{\tan^{-1}\left(\frac{\sqrt{2}}{\sqrt{x^2-2}}\right)}{\sqrt{2}} + C$