THE UK UNIVERSITY INTEGRATION BEE 2022/23

$$\int$$

ROUND ONE

Wednesday, 7 December 2022

Sponsored by

Jane Street

1. $\displaystyle\int_0^1 \frac{1}{\sqrt{x-x^2}}\mathrm{d}x$

2. $\displaystyle\int_0^{100} \lceil x \rceil \lfloor x \rfloor \mathrm{d}x$, where $\lfloor x \rfloor \& \lceil x \rceil$ are the greatest integer less than x and the smallest integer greater than x, respectively.

3. $\displaystyle\int_0^{\pi} \cos(x+\cos(x))\mathrm{d}x$

4. $\displaystyle\int_0^1 \sqrt{x+\sqrt{x+\sqrt{x+\sqrt{x+\ldots}}}}\mathrm{d}x$

5. $\displaystyle\int_0^1 \frac{1}{x} - \left\lfloor \frac{1}{x} \right\rfloor \mathrm{d}x$

6. $\displaystyle\int_0^1 \frac{\arctan x + \operatorname{arccot} x}{x^2+1}\mathrm{d}x$

7. $\displaystyle\int_0^{\frac{\pi}{2}} x \prod_{i=1}^{\infty} \cos\left(\frac{x}{2^i}\right)\mathrm{d}x$

8. $\displaystyle\int_0^{\frac{\pi}{4}} \ln(\cot x - 1)\mathrm{d}x$

9. $\displaystyle\int_0^{\frac{\pi}{2}} \frac{\tan^{-1}(b\sin x)}{\sin x}\mathrm{d}x$

10. $\displaystyle\int_0^{\infty} \frac{x^3}{e^x+1}\mathrm{d}x$

11. $\displaystyle\int_0^{\frac{1}{4}} \sum_{n=0}^{\infty} \binom{2n}{n} x^n \mathrm{d}x$

12. $\displaystyle\int_0^{\infty} \cos(x^2)\mathrm{d}x$

13. $\displaystyle\int_0^{\infty} \frac{\ln x}{1-x^2}\mathrm{d}x$

14. $\displaystyle\int_0^{\frac{\pi}{2}} \frac{\ln(\sin x)}{\cos^2 x}\mathrm{d}x$

15. $\displaystyle\int_0^{\frac{\pi}{2}} \frac{\cos^2 x(1+\cos x)}{(1+\cos x+\sin x)^2}\mathrm{d}x$

16. $\displaystyle\int_1^{\infty} \frac{x-\lfloor x \rfloor}{x^2}\mathrm{d}x$

17. $\displaystyle\int_{-\infty}^{\infty} \frac{\cos t}{\cosh t}\mathrm{d}t$

18. $\displaystyle\int_0^{\infty} \frac{\ln(x+1)}{x^2+1}\mathrm{d}x$

19. $\displaystyle\int_0^{\pi} \sec x \ln\left(1+\frac{\cos x}{3}\right)$

20. $\displaystyle\int_0^1 \frac{\ln(1+x+x^2)}{x}\mathrm{d}x$

21. $\displaystyle\int_{\frac{1}{e}}^\infty \frac{\sqrt{\ln x+1}}{x^2}\mathrm{d}x$

22. $\displaystyle\int_0^\infty \ln\left(\frac{e^x+1}{e^x-1}\right)$

23. $\displaystyle\int_0^1 \sqrt[4]{\frac{1}{x}-1}\mathrm{d}x$

24. $\displaystyle\int_0^{2\pi} e^{\cos x}\cos(nx-\sin x)\mathrm{d}x, n\in\mathbb{Z}$

25. $\displaystyle\int_0^\infty \frac{\ln x\sin x}{x}\mathrm{d}x$

26. $\displaystyle\int_0^1 \frac{x-1}{(x+1)\ln x}\mathrm{d}x$

27. $\displaystyle\int_0^1 \frac{\sin(\log x)-\log x}{\log^2 x}\mathrm{d}x$

28. $\displaystyle\int_0^1 \frac{1}{\sqrt{1-x^2}}\ln\left(\frac{\sqrt{1+x}+1}{\sqrt{1+x}-1}\right)\mathrm{d}x$

29. $\displaystyle\int_0^{\frac{1}{2}} \ln(\sqrt{1-x}-\sqrt{x})\mathrm{d}x$

30. $\displaystyle\int_0^\infty \frac{\arctan x\ln(1+x^2)}{x(a^2+x^2)}\mathrm{d}x$