THE UK UNIVERSITY INTEGRATION BEE 2023/2024

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ROUND ONE

Sponsored by

Jane Street

1. $\int_{-1}^{1} \sqrt{1-x^2}\,\mathrm{d}x$
2. $\int \frac{1}{1-\sin(x)} + \frac{1}{1+\sin(x)}\,\mathrm{d}x$
3. $\int_{0}^{\infty} 4^{-\lfloor x \rfloor}\,\mathrm{d}x$
4. $\int 2x\,\mathrm{d}X$
5. $\int_{1_{\mathbb{Q}}(e+\pi)}^{1_{\mathbb{Q}}(e\pi)} \cos(\pi x)\,\mathrm{d}x$, where $1_{\mathbb{Q}}(x) = \begin{cases} 1 & \text{if } x \in \mathbb{Q} \\ 0 & \text{else} \end{cases}$.
6. $\int_{-\infty}^{\infty} e^{-x^2+4x+1}\,\mathrm{d}x$
7. $\int_{-1}^{1} \frac{1}{3^x+1}\,\mathrm{d}x$
8. $\int_{0}^{1} \sqrt{2^x\sqrt{4^x\sqrt{8^x\sqrt{16^x\sqrt{\dots}}}}}\,\mathrm{d}x$
9. $\int_{0}^{\infty} (-\{x\})^{\lfloor x \rfloor}\,\mathrm{d}x$, where $\{x\} \stackrel{\text{def}}{=} x - \lfloor x \rfloor$.
10. $\int_{0}^{1} \frac{\sin(a\ln(x))}{\ln(x)}\,\mathrm{d}x$
11. $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \sec(x)\,\mathrm{d}x$
12. $\int_{420}^{1672} \frac{\sqrt{\ln(2023-x)}}{\sqrt{\ln(2023-x)}+\sqrt{\ln(x-69)}}\,\mathrm{d}x$
13. $\int_{-1}^{0} 5\left(x^6+x\right)^4\,\mathrm{d}x$
14. $\int_{0}^{1} (\ln(\ln(x)))^{\frac{\ln(\ln(x))}{\ln(\ln(\ln(x)))}}\,\mathrm{d}x$
15. $\int_{1}^{\infty} \frac{1+2x\ln(2)}{x\sqrt{x4^x-1}}\,\mathrm{d}x$
16. $\int \frac{\mathrm{d}x}{x^{23}+x}$
17. $\int_{1}^{\infty} \frac{e^{\sec^{-1}(\sqrt{x})}}{x\sqrt{x}}\,\mathrm{d}x$
18. $\int_{0}^{1} \frac{\mathrm{d}x}{\Gamma(x)^2+\pi\csc(\pi x)}$
19. $\int_{0}^{\infty} \frac{1}{x^4+4}\,\mathrm{d}x$

20. $\int_{\frac{1}{4}}^{\frac{3}{4}} f(f(x))\,\mathrm{d}x$ where $f(x) = \dfrac{4^x}{2+4^x}$.

21. $\displaystyle\int \frac{2023^x}{2023^x + 2024^x}\,\mathrm{d}x$

22. $\displaystyle\int_0^\infty \frac{x+\sin(x)}{\sqrt{e^x}}\,\mathrm{d}x$

23. $\displaystyle\int_0^\infty \sin\left(\frac{1}{x}\right)\sin\left(\frac{1}{3x}\right)\,\mathrm{d}x$

24. $\displaystyle\int_0^\infty \frac{1}{x^4 - x^2 + 1}\,\mathrm{d}x$

25. $\displaystyle\int_0^{e^{1+e}} \frac{W(W(x))}{x}\,\mathrm{d}x$ where $W(x)$ is the inverse function of xe^x.

26. $\displaystyle\int_0^\infty \frac{\tan^{-1}(x)}{x^{\frac{4}{3}}}\,\mathrm{d}x$

27. $\displaystyle\int_0^1 \frac{x^3 + x + 1}{3x^2 - 3x + 4}\,\mathrm{d}x$

28. $\displaystyle\int_0^7 \left(\sqrt[3]{\sqrt{x^2+1}+x} - \sqrt[3]{\sqrt{x^2+1}-x}\right)\,\mathrm{d}x$

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

30. $\displaystyle\int_0^1 \frac{1}{1-x}\sqrt{\frac{\{1/x\}}{1-\{1/x\}}}\,\mathrm{d}x$