THE UK UNIVERSITY INTEGRATION BEE 2022/23

$$\int$$

ROUND ONE MIT TIEBREAKER

Monday, 12 December 2022

1. $\displaystyle\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\cos x}{1+e^x}\,\mathrm{d}x$

2. $\displaystyle\int \sqrt{x\sqrt[3]{x\sqrt[4]{x\sqrt[5]{x\cdots}}}}\,\mathrm{d}x$

3. $\displaystyle\int_0^1 x^{\frac{1}{\ln x}}\,\mathrm{d}x$

4. $\displaystyle\int e^{x+e^x}\,\mathrm{d}x$

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

6. $\displaystyle\int_0^\infty \frac{1}{1+e^{ax}}\,\mathrm{d}x$

7. $\displaystyle\int_0^{2\pi} \sin(\sin(x)-x)\,\mathrm{d}x$

8. $\displaystyle\int_0^{\frac{\pi}{2}} \frac{\mathrm{d}x}{\tan^{\sqrt{2}}(x)+1}$

9. $\displaystyle\int_0^\infty \frac{\arctan x}{1+x}\frac{\mathrm{d}x}{\sqrt{x}}$

10. $\displaystyle\int_1^{\sqrt{3}} \frac{\arctan x + \operatorname{arccot} x}{x}\,\mathrm{d}x$

11. $\displaystyle\int \frac{\ln(2x)}{x\ln x}\,\mathrm{d}x$

12. $\displaystyle\int_0^1 \sqrt{-\ln x}\,\mathrm{d}x$ - make sure they know formulas including Gaussian integral.

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

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

15. $\displaystyle\int \sqrt{1+\sin\frac{x}{2}}$

16. $\displaystyle\int_0^1 \ln x \ln(1-x)\,\mathrm{d}x$

17. $\displaystyle\int \frac{x^n}{1+x+\frac{x^2}{2!}+\cdots+\frac{x^n}{n!}}\,\mathrm{d}x$ - maybe replace this with Finn's question

18. $\displaystyle\int_{-2}^2 \left(x^3\cos\frac{x}{2}+\frac{1}{2}\right)\sqrt{4-x^2}\,\mathrm{d}x$

19. $\displaystyle\int \frac{\mathrm{d}x}{1-\sin x}$

20. $\displaystyle\int_0^\infty \lfloor x\rfloor e^{-x}\,\mathrm{d}x$

21. $\displaystyle\int_0^1 \frac{x^5 - 1}{\ln x}\,\mathrm{d}x$

22. $\displaystyle\int_0^{2\pi} \cos^{2022}(x)\,\mathrm{d}x$

23. $\displaystyle\int \ln(x^2) - 2\ln(2x)\,\mathrm{d}x$

24. $\displaystyle\int_{-2}^0 x^3 + 3x^2 + 3x + 1\,\mathrm{d}x$

25. $\displaystyle\int_0^{169} \frac{\pi \sin(\pi\sqrt{x})}{\sqrt{x}}\,\mathrm{d}x$

26. $\displaystyle\int_0^\infty x^3 e^{-x^2}\,\mathrm{d}x$

27. $\displaystyle\int \frac{\ln(\ln(x))}{x\ln x}\,\mathrm{d}x$

28. $\displaystyle\int_1^\infty \frac{\mathrm{d}x}{x(x^2 + 1)}$

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

30. $\displaystyle\int_0^1 \sin(\cos^{-1}(x))\,\mathrm{d}x$