

UK University Integration Bee 2021

$$1. \int \sqrt{x \sqrt[3]{x \sqrt[4]{x \sqrt[5]{x} \cdots}}} dx$$

$$2. \int \frac{\tan x}{\sqrt{\sec^3 x + 1}} dx$$

$$3. \int_0^{\frac{\pi}{2}} \frac{\sin^3 x}{2 + \sin x} dx$$

$$4. \int_0^1 \frac{dx}{1 + \lfloor \frac{1}{x} \rfloor}$$

$$5. \int_0^1 \frac{\sin(\ln x)}{\ln x} dx$$

$$6. \int_0^4 \frac{\ln(x)}{\sqrt{4x - x^2}} dx$$

$$7. \int_0^{2\pi} e^{\cos x} \cos(\sin x) \cos(5x) dx$$

$$8. \int_0^{2\pi} \cos^{420}(x) dx$$

$$9. \int_0^{\frac{\pi}{2}} \frac{\{\tan(x)\}}{\tan(x)} dx \text{ Here, } \{x\} \text{ is the fractional part of } x$$

$$10. \int \frac{dx}{1 + 2x^2 - 2\sqrt{x^2 + x^4}}$$

$$11. \int_0^{\frac{\pi}{2}} \frac{\cos x}{(1 + \sqrt{\sin(2x)})^2} dx$$

$$12. \int_0^{\frac{\pi}{2}} \frac{\sqrt{\cos \theta}}{(\sqrt{\cos \theta} + \sqrt{\sin \theta})^5} d\theta$$

$$13. \int_{-\infty}^{\infty} \frac{dx}{(x^3 + \frac{1}{x^3})^2}$$

$$14. \int (\sec x)^{(1+\sec x)} (\tan x + \sin x) dx$$

$$15. \int \frac{x-1}{(x+1)\sqrt{x^3+x^2+x}} dx$$

$$16. \int_3^5 \ln \Gamma(x) dx$$

$$17. \int_0^1 \frac{x}{\sin(x)} dx$$

$$18. \int_0^{\frac{\pi}{2}} \frac{\ln(\cos x)}{\sin x} dx$$

$$19. \int_0^\infty \frac{\sin x}{x^n} dx \quad (0 < n < 2)$$

$$20. \int_0^\infty \frac{\arctan(x)}{x(\log(x)^2 + 1)} dx$$

$$21. \int_1^\infty \left(\frac{\ln x}{x} \right)^{2011} dx$$

$$22. \int \sqrt{\frac{1}{x} - 1} dx$$

$$23. \int_{-\infty}^\infty \frac{dx}{\cosh^2(x)}$$

$$24. \int_0^1 \frac{\arctan^2 x}{x} dx$$

$$25. \int_0^1 \frac{\arctan x}{1+x} dx$$

$$26. \int_{\frac{\pi}{4}}^{\frac{\pi}{3}} \cot x^{\tan x^{\cot x}} - \tan x^{\cot x^{\tan x}} dx$$

$$27. \int_0^\infty \left(\frac{\ln x}{1+x} \right)^2 dx$$

$$28. \int_0^\infty [x] e^{-x} dx$$

$$29. \int_0^\infty \frac{\ln(x)}{x^2 + 2x + 2} dx$$

$$30. \int_0^{\frac{\pi}{2}} \ln(7997 \sin^2 \theta + 7945 \cos^2 \theta)$$

$$31. \int_0^1 \frac{\arctan(x^2)}{1+x^2} dx$$

$$32. \int_0^1 W(x) dx \text{ (W is the Lambert W function, the solution to } W(x)e^{W(x)} = x)$$

$$33. \int_0^{2\pi} e^{3 \cos \theta} \cos(3 \sin \theta) d\theta$$

$$34. \int_0^\infty \frac{\cos(ax) - \cos(bx)}{x^2} dx \text{ I really want this}$$

$$35. \int_0^a \frac{x dx}{\cos(x) \cos(a-x)}$$

$$36. \int \frac{dx}{\sin^4(x) + \cos^4(x)}$$

$$37. \int \frac{dx}{\csc x + 1}$$

$$38. \int_0^\infty \frac{\cos(\ln x)}{(1+x)^2} dx$$

$$39. \int_1^e \frac{x - \ln x + 1}{x(x+1)^2 + x \ln^2 x} dx$$

$$40. \int_0^\infty \frac{\cos(ax)}{x^2 + b^2} dx$$

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