MIT Integration Bee: Regular Season (Time limit per integral: 2 minutes)

$$\int_0^\infty \frac{dx}{(x+1+2\sqrt{x})^2}$$

$$\int_0^\infty \frac{dx}{(x+1+2\sqrt{x})^2} = \frac{1}{3}$$

 $\int x^2 \cos(\arccos(x)) \, dx$

$$\int x^2 \cos(\arccos(x)) \, dx = \frac{1}{3} (x^2 - 1)^{3/2}$$

$$\int_0^{1/2025} \left(\sum_{k=1}^\infty \frac{(2025x)^k e^{-2025x}}{k!} \right) \, dx$$

$$\int_0^{1/2025} \left(\sum_{k=1}^\infty \frac{(2025x)^k e^{-2025x}}{k!} \right) \, dx = \frac{1}{2025e}$$

$$\int \frac{dx}{1-x^4}$$

$$\int \frac{dx}{1-x^4} = \frac{1}{2}\arctan(x) + \frac{1}{4}\log(1+x) - \frac{1}{4}\log(1-x)$$

$$\int_{-\pi/2}^{\pi/2} \cos(20x) \cos(25x) \, dx$$

$$\int_{-\pi/2}^{\pi/2} \cos(20x) \cos(25x) \, dx = \frac{2}{9}$$

$$\int_{-2}^{2} \max(x, x^2, x^3) \, dx$$

$$\int_{-2}^{2} \max(x, x^2, x^3) \, dx = \frac{83}{12}$$

 $\int_0^{2025} \left\{ \sqrt{x} \right\} \, dx$

$$\int_0^{2025} \left\{ \sqrt{x} \right\} \, dx = \boxed{1020}$$

$$\int_0^{2\pi} \left| \sin(x) + \frac{1}{2} \right| \, dx$$

$$\int_{0}^{2\pi} \left| \sin(x) + \frac{1}{2} \right| \, dx = \left| 2\sqrt{3} + \frac{\pi}{3} \right|$$

$$\int x \left(\frac{1}{2} + \log x\right) \log(\log x) \, dx$$

$$\int x \left(\frac{1}{2} + \log x\right) \log(\log x) \, dx$$
$$= \frac{1}{2} x^2 \log x \log(\log x) - \frac{1}{4} x^2$$

$$\int \frac{\cos^4(x) - 1}{\sin^8(x)} dx$$

$$\int \frac{\cos^4(x) - 1}{\sin^8(x)} dx = \frac{1}{5}\cot(x)(2\csc^4(x) + \csc^2(x) + 2)$$

$$\int \sqrt{x + \sqrt{x^2 - 1}} \, dx$$

$$\int \sqrt{x + \sqrt{x^2 - 1}} \, dx = \frac{\sqrt{2}}{3} \left((x - 1)^{3/2} + (x + 1)^{3/2} \right)$$

$$\int \frac{x^3 - x}{x^6 - 1} \, dx$$

$$\int \frac{x^3 - x}{x^6 - 1} dx = \boxed{\frac{1}{\sqrt{3}} \arctan\left(\frac{2x^2 + 1}{\sqrt{3}}\right)}$$

$$\int \sqrt{x^2 - 1} \, dx$$

$$\int \sqrt{x^2 - 1} \, dx = \boxed{\frac{1}{2} \left(x \sqrt{x^2 - 1} - \log(x + \sqrt{x^2 - 1}) \right)}$$

$$\int \left(\frac{\sin(x)\sin(\sin(x))\sin(\cos(x))}{+\cos(x)\cos(\sin(x))\cos(\cos(x))} \right) dx$$

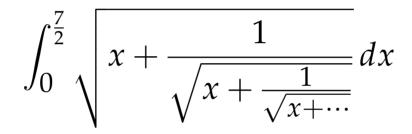
$$\int \left(\begin{array}{c} \sin(x)\sin(\sin(x))\sin(\cos(x)) \\ +\cos(x)\cos(\sin(x))\cos(\cos(x)) \end{array} \right) dx$$
$$= \overline{\sin(\sin(x))\cos(\cos(x))}$$

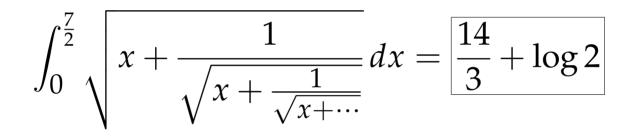
$$\int \left(\frac{\log(x)}{x}\right)^2 dx$$

$$\int \left(\frac{\log(x)}{x}\right)^2 dx = \boxed{-\frac{2 + 2\log(x) + \log^2(x)}{x}}$$

 $\int \sin^2(2x)e^{2x}\,dx$

$$\int \sin^2(2x)e^{2x} dx$$
$$= \left(\frac{1}{4} - \frac{1}{10}\sin(4x) - \frac{1}{20}\cos(4x)\right)e^{2x}$$





$$\int_0^\infty (x+1)^4 e^{-x^2} \, dx$$

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$$\int_0^\infty (x+1)^4 e^{-x^2} \, dx = \frac{4 + \frac{19}{8}\sqrt{\pi}}{4 + \frac{19}{8}\sqrt{\pi}}$$

$$\int_0^{\pi/2} \cos(3x) \cos(5x) \cos(7x) \, dx$$

$$\int_0^{\pi/2} \cos(3x) \cos(5x) \cos(7x) \, dx = \frac{14}{45}$$

$$\int_{-1}^{1} e^{2x} \sin(\sinh x) \, dx$$

$$\int_{-1}^{1} e^{2x} \sin(\sinh x) \, dx$$
$$= 4(\sin(\sinh 1) - \sinh 1 \cos(\sinh 1))$$