THE HIGH SCHOOL FINALS

The Finals will be conducted in rounds. One at a time, each remaining contestant will have **two and a half minutes** to compute an indefinite integral. If answered correctly, the contestant remains in the competition. Once every remaining contestant has aȚempted one problem, a round is completed. If during any round, all contestants are unable to complete a problem correctly, all contestants will remain in the competition for another round.

The last person remaining wins an additional $75 and will be crowned the **Integration Champion**!

INTEGRAL #1

READY,
GET SET,...

2:30

INTEGRAL #1

$$\int (x-2)(x+2)(x^2+4)\,dx$$

2:30

INTEGRAL #1

$$\int (x-2)(x+2)(x^2+4)\,dx$$

$$= \int (x^2-4)(x^2+4)\,dx$$

$$= \int (x^4-16)\,dx$$

$$= \boxed{\frac{x^5}{5} - 16x + C}$$

INTEGRAL #2

READY,
GET SET,...

2:30

INTEGRAL #2

$$\int x^2 \sin\left(x^3\right)\, dx$$

2:30

INTEGRAL #2

$$\int x^2 \sin\left(x^3\right)\, dx$$

$$= \frac{1}{3}\int \sin u \, du \quad \{u = x^3; \quad du = 3x^2\, dx\}$$

$$= \frac{1}{3}(-\cos u) + C$$

$$= \boxed{-\frac{\cos\left(x^3\right)}{3} + C}$$

INTEGRAL #3

READY,
GET SET,...

2:30

INTEGRAL #3

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

2:30

INTEGRAL #3

$$\int \left(\frac{x^2}{2} \right.$$

INTEGRAL #4

READY,
GET SET,...

2:30

INTEGRAL #4

$$\int \frac{\sin x}{\sqrt{2+\cos x}}\,dx$$

2:30

INTEGRAL #4

$$\int \frac{\sin x}{\sqrt{2+\cos x}}\,dx$$

$$= -\int \frac{1}{\sqrt{u}}\,du \quad \{u = \quad u = \quad u$$

INTEGRAL #5

READY,
GET SET,...

2:30

INTEGRAL #5

$$\int \frac{x}{e^x}\,dx$$

2:30

INTEGRAL #6

READY,
GET SET,...

2:30

INTEGRAL #6

$$\int \left(\frac{x+1}{x^2+2x+2013}\right)^5$$

2:30

INTEGRAL #6

$$\int \left(\frac{x+1}{x^2+2x+2013}\right)^5 dx$$

$$= \frac{1}{2}\int \frac{1}{u^5}\, du$$

$$\left[u = x^2+2x+2013; \quad du = (2x+2)\,dx = 2(x+1)\,dx\right]$$

$$= -\frac{1}{\quad}$$

INTEGRAL #7

READY,
GET SET,...

2:30

INTEGRAL #7

$$\int \frac{1}{\sqrt{x}\,(2013+\sqrt{x})^5}\,dx$$

2:30

INTEGRAL #7

$$\int \frac{1}{\sqrt{x}\,(2013+\sqrt{x})^5}\,dx$$

$$= 2\int \frac{1}{u^5}\,du \quad \left\{ u = 2013+\sqrt{x}; \quad du = \frac{1}{2\sqrt{x}}\,dx \right\}$$

$$= 2\int u^{-5}\,du = \frac{2u^{-4}}{-4} + C = -\frac{1}{2u^4} + C$$

$$= \boxed{-\frac{1}{2\left(2013+\sqrt{x}\right)^4} + C}$$

INTEGRAL #8

READY,
GET SET,...

2:30

INTEGRAL #8

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INTEGRAL #8

$$\int \frac{\sec\sqrt{x}\tan\sqrt{x}}{\sqrt{x}}\,dx$$

$$= 2\int \sec u \tan u \, du \qquad \left[\, u = \sqrt{x}; \quad du = \frac{1}{2\sqrt{x}}\,dx \,\right]$$

$$= 2\sec u + C$$

$$= \boxed{2\sec\sqrt{x} + C}$$

INTEGRAL #9

READY,
GET SET,...

2:30

INTEGRAL #9

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

2:30

INTEGRAL #9

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

$$= \frac{1}{2}\int \sqrt{u}\, du \quad [\, u = e^{2x}+1; \quad du = 2e^{2x}\, dx \,]$$

$$= \frac{u^{3=2}}{3} + C$$

$$= \boxed{\frac{(e^{2x}+1)^{3=2}}{3} + C}$$

INTEGRAL #10

$$\int (\sin x + \cos x)^2 \, dx$$

2:30

INTEGRAL #10

$$\int (\sin x + \cos x)^2 \, dx$$

$$= \int (\sin^2 x + 2 \sin x \cos$$

INTEGRAL #11

READY,
GET SET,...

2:30

2:30

INTEGRAL #12

READY,
GET SET,...

2:30

2:30

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$$\int (\sin x + \cos x)^2 \, dx$$

$$= \int \qquad + \cos x; \quad du = (\cos x - \sin x)\, dx$$

$$= \int$$

$$= \int \qquad \cos$$

INTEGRAL #13

READY,
GET SET,...

2:30

INTEGRAL #13

$$\int \cos x \cos 2x \, dx$$

2:30

INTEGRAL #13

$$\int \cos x \cos 2x \, dx$$

$$= \int \cos x \left(1 - 2\sin^2 x\right) dx$$

$$= -\int \left(\cos x - 2\sin^2 x \cos x\right)_{x \cos x}$$

INTEGRAL #14

READY,
GET SET,...

2:30

INTEGRAL #14

$$\int \frac{1}{x^3} \sqrt[3]{1+\frac{1}{x^2}}\, dx$$

2:30

INTEGRAL #15

READY,
GET SET,...

2:30

2:30

INTEGRAL #15

$$\int x \cos^2\left(x^2\right) \sin\left(x^2\right)\, dx$$

$$= -\frac{1}{2}\int u^2\, du \quad \left\{u = \cos\left(x^2\right);\quad du = -2x \sin\left(x^2\right)\, dx\right\}$$

$$= -\frac{u^3}{6} + C$$

$$= \boxed{-\frac{\cos^3\left(x^2\right)}{6} + C}$$