# 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 aŲempted 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**

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

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

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

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

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**

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

$$= -\int \frac{1}{\sqrt{u}}\,du \qquad \begin{cases} u = \\ \quad u = \\ \qquad u \end{cases}$$

INTEGRAL #5

# READY,

# GET SET,...

# 2:30

INTE[redacted]

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

# 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**

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

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

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

$$= -\frac{1}{\phantom{x}}$$

INTEGRAL #7

# READY,

# GET SET,...

# 2:30

**INTEGRAL #7**

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

**2:30**

**INTEGRAL #7**

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

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

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

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

INTEGRAL #8

# READY,

# GET SET,...

# 2:30

**INTEGRAL #8**

$\int$ se

# 2:30

## 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

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

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

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

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

INTEGRAL #10

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

2:30

**INTEGRAL #10**

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

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

INTEGRAL #11

# READY,

# GET SET,...

# 2:30

2:30

INTEGRAL #12

# READY,

# GET SET,...

# 2:30

2:30

**INT** [redacted]

$\int (\mathrm{si}$ [redacted] $+ \cos x)^2 \, dx$

$=$ [redacted] $+ \cos x; \quad du = (\cos x - \sin x)\, dx$ i

$=$ [redacted]

$=$ [redacted] $\cos$ i

INTEGRAL #13

# READY,

# GET SET,...

# 2:30

INTEGRAL #13

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

2:30

**INTEGRAL #13**

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

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

$$= -\int \Big( \cos x - 2\sin^2 x \cos x_{x \cos x}$$

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 #14

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

$$= -\frac{1}{2}\int u^{1/3}\,du \quad \left\{ u = 1+\frac{1}{x^2}; \quad du = -\frac{2}{x^3}\,dx \right.$$

INTEGRAL #15

# READY,

# GET SET,...

# 2:30

2:30

INTEGRAL #15

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

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

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

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