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 aUempted 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**ç wins an additional ℨ

INTEGRAL #1

READY,

GET SET,...

2:30

INTEGRAL #1

2:30

INTEGRAL #1

$$\int \sin x \sqrt{\cos x}\, dx$$

$$= -\int \sqrt{u}\, du \qquad u = \cos x; \quad du = -\sin x\, dx$$

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

$$= \boxed{-\frac{2\cos^{3=2} x}{3} + C}$$

INTEGRAL #2

READY,
GET SET,...

2:30

INTEGRAL #2

$$\int \frac{1}{\sqrt{x}\,(2012+\sqrt{x})^{5}}\,dx$$

2:30

INTEGRAL #2

$$\int \frac{1}{\sqrt{x}\,(2012+\sqrt{x})^5}\,dx$$

$$= 2\int \frac{1}{u^5}\,du \qquad \left[u = 2012+\sqrt{x}; \quad du = \frac{1}{2\sqrt{x}}\,dx\right.$$

$$= 2\left(-\frac{1}{4u^4}\right) + C$$

$$= \boxed{-\frac{1}{2\,(2012+\sqrt{x})^4} + C}$$

INTEGRAL #3

READY,
GET SET,...

2:30

INTEGRAL #3

$$\int x\left(2x^3+1\right)^2\,dx$$

2:30

INTEGRAL #3

$$\int x\left(2x^3+1\right)^2\,dx$$

$$= \int x\left(4x^6+4x^3+1\right)\,dx$$

$$= \int \left(4x^7+4x^4+x\right)\,dx$$

$$= \boxed{\frac{x^8}{2}+\frac{4x^5}{5}+\frac{x^2}{2}+C}$$

INTEGRAL #4

READY,
GET SET,...

2:30

INTEGRAL #4

$$\int \frac{x+1}{(x^2+2x+2012)^9}$$

2:30

INTEGRAL #4

$$\int \frac{x+1}{(x^2+2x+2012)^9}$$

$$= \frac{1}{2}\int \frac{du}{u^9} \qquad u = x^2+2x+2012; \quad dx = 2(x+1)\,dx$$

$$= \frac{1}{2}\left(-\frac{1}{8u^8}\right) + C$$

$$= \boxed{-\frac{1}{16(x^2+2x+2012)^8} + C}$$

INTEGRAL #5

READY,
GET SET,...

2:30

INTEGRAL #5

$$\int \frac{x}{\sqrt{7x^2+7}}\,dx$$

2:30

INTEGRAL #6

READY,
GET SET,...

2:30

INTEGRAL #6

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

2:30

INTEGRAL #6

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

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

$$= -\frac{1}{2}\cdot\frac{3u^{4=3}}{4} + C$$

$$= \boxed{-\frac{3}{8}}$$

INTEGRAL #7

INTEGRAL #7

$$\int \frac{\sin \sqrt{x}}{\sqrt{x}} \, dx$$

2:30

INTEGRAL #7

$$\int \frac{\sin\sqrt{x}}{\sqrt{x}}\,dx$$

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

$$= -2\cos u$$

INTEGRAL #8

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

2:30

INTEGRAL #9

0

READY,

GET SET,...

2:30

INTEGRAL #9

$$\int x^5 \sqrt{x^3 + 1}\, dx$$

2:30

INTEGRAL #9

$$\int x^5 \sqrt{x^3+1}\, dx$$

one of many possible subs: $u = x^3 + 1; \quad du = 3x^2\, dx$

$$= \frac{1}{3}\int (u-1)\sqrt{u}\, du = \frac{1}{3}\int \left(u^{3=2} - u^{1=2}\right) du$$

$$= \boxed{\frac{1}{3}\left(\frac{2(x^3+1)^{5=2}}{5} - \frac{2(x^3+1)^{3=2}}{3}\right) + C}$$

INTEGRAL #10

READY,
GET SET,...

2:30

INTEGRAL #10

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

2:30

INTEGRAL #11

READY,
GET SET,...

2:30

INTEGRAL #11

$$\int \frac{1}{x\sqrt{x}} \left(2 + \frac{1}{\sqrt{x}}\right)^4 dx$$

2:30

INTEGRAL #11

$$\int \frac{1}{x\sqrt{x}}\left(2+\frac{1}{\sqrt{x}}\right)^4 dx$$

$$= -2\int u^4\, du \quad \left[u = 2+\frac{1}{\sqrt{x}};\quad du = -\frac{1}{x\sqrt{x}}\right.$$

$$= \frac{-2u^5}{5} + C$$

$$= \boxed{-\frac{2}{5}\left(2+\frac{1}{\sqrt{x}}\right)^5 + C}$$

INTEGRAL #12

READY,
GET SET,...

2:30

INTEGRAL #12

$$\int \frac{\sin 2x}{\cos^3 x}\, dx$$

2:30

INTEGRAL #12

$$\int \frac{\sin 2x}{\cos^3 x}\,dx$$

$$= \int \frac{2 \sin x \cos x}{\cos^3 x}\,dx = 2 \int \frac{\sin x}{\cos x} \cdot \frac{1}{\cos x}\,dx$$

$$= 2 \int \sec x \tan$$