

THE UK UNIVERSITY
INTEGRATION BEE

2021/22



ROUND TWO SHUTTLE ROUND

Saturday, 20 November 2021

Sponsored by



Jane Street

SHUTTLE A

A1

Evaluate

$$\int_0^1 \ln^2(x) dx.$$

Pass on your answer squared.

a is the number you will receive.

A2

Evaluate

$$\int_0^{\frac{\pi}{2}} \frac{\sin(x)}{\sin(x + \frac{\pi}{a})} dx.$$

Your answer will be of the form π/b , pass on b .*b is the number you will receive.*

A3

Evaluate

$$\int_0^{\frac{\pi}{2}} \frac{dx}{1 + \tan^b(x)}.$$

Pass on 4 times your answer.

c is the number you will receive.

A4

Evaluate

$$\int_0^c x \ln(\sin x) dx.$$

SHUTTLE B

B1

Evaluate

$$\int_0^{2\pi} \sin(\sin(x) - x) dx.$$

Pass on the answer.

a is the number you will receive.

B2

Evaluate

$$\int_a^\infty \ln\left(1 + \frac{169}{x^2}\right) dx.$$

Pass on the second digit of your answer.

b is the number you will receive.

B3

Evaluate

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

Pass on your answer.

c is the number you will receive.

B4

Evaluate

$$\int_{\frac{1}{c}}^\infty \frac{\ln x}{x^2 + \pi^2} dx$$

SHUTTLE C

C1

Evaluate

$$\int_{-1}^1 \frac{\sin(\cot^{-1} x) + \cos(\tan^{-1} x)}{x^2 + 1} dx$$

Pass on your answer squared minus 2.

a is the number you will receive.

C2

Evaluate

$$b = \int_0^a x^3 e^{-x} dx$$

Pass on 2 minus your answer.

b is the number you will receive.

C3

Evaluate

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

Pass on the smallest integer greater than the absolute value of your answer.

c is the number you will receive.

C4

Evaluate

$$\int_0^{\frac{\pi}{2}} \frac{\cos x}{c - \sin 2x} dx$$

SHUTTLE D

D1

Evaluate

$$\lim_{n \rightarrow \infty} \int_{\frac{5}{6}}^{\infty} e^{-x^n} dx$$

Your answer should be of the form $\frac{p}{q}$ for coprime $p, q \in \mathbb{Z}^+$, pass on the prime factors of q .

a, b are the numbers you will receive where $a > b$.

D2

Evaluate

$$\int_0^1 \frac{x^a - x^b}{\ln x} dx$$

Pass on the least integer bigger than your answer.

c is the number you will receive.

D3

Evaluate

$$\int_0^1 \frac{1-x}{x^c + (x^c + 1)^c} dx$$

Your answer will be of the form $\frac{r}{s}(\ln(t) - u)$ where $r, s, t, u \in \mathbb{Z}^+$ and r, s are coprime.

Pass on $\frac{r + \sqrt{r+s}}{u}$.

d is the number you will receive.

D4

Evaluate

$$\int_0^{2\pi} \frac{x}{d - \cos^2 x} dx$$

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