THE UK UNIVERSITY INTEGRATION BEE

2021/22

ROUND TWO SHUTTLE ROUND

Saturday, 20 November 2021











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SHUTTLE A A1

Evaluate

$$\int_0^1 \ln^2(x) \mathrm{d}x.$$

Pass on your answer squared.

a is the number you will receive.

A2

Evaluate

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

Your answer will be of the form π/b , pass on b.

b is the number you will receive.

A3

Evaluate

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

Pass on 4 times your answer.

c is the number you will receive.

A4

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

SHUTTLE B B1

Evaluate

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

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.

c is the number you will receive.

В3

Evaluate

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

Pass on your answer.

B4

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

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

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

Pass on 2 minus your answer.

b is the number you will receive.

C3

Evaluate

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

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

c is the number you will receive.

C4

$$\int_0^{\frac{\pi}{2}} \frac{\cos \theta}{c - \sin 2\theta} \mathrm{d}x$$

SHUTTLE D D1

Evaluate

$$\lim_{n\to\infty}\int_{\frac{5}{6}}^{\infty}e^{-x^n}\mathrm{d}x$$

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

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

Pass on the least integer bigger than your answer.

c is the number you will receive.

D3

Evaluate

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

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

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