



Universitat Politècnica de Catalunya
2nd UPC INTEGRATION BEE

First round
Date: May 2nd, 2024

Timing: 15:15 to 16:00 PM

Code:

1.

$$\int \sin(x) \sin(\cos(x)) dx = \cos(\cos(x))$$

2.

$$\int_{-1}^4 \frac{|x|}{1 + \lceil x \rceil} dx = \frac{103}{40}$$

3.

$$\int \frac{\cos(x^2 + 1)^{\ln(3x+1)}}{(3x + 1)^{\ln(\cos(x^2+1))}} dx = x$$

4.

$$\int \sin^2 x + \cos^2 x + \cot^2 x dx = -\cot x$$

5.

$$\int_0^\infty \frac{1}{x^4 + 2x^2 + 1} dx = \frac{\pi}{4}$$

6.

$$\int_0^1 (3+x)^3 + (7-x^2)^3 + (x^2-x-10)^3 - 3(3+x)(7-x^2)(x^2-x-10) dx = 0$$

7.

$$\int_{-\infty}^{\infty} \frac{1}{9x^2 - 12x + 5} dx = \frac{\pi}{3}$$

8.

$$\int_0^{\ln \pi} \tanh^2 x dx = \frac{1 - \pi^2}{1 + \pi^2} + \ln \pi$$

9.

$$\int_0^3 \arctan [x] dx = \pi$$

10.

$$\int_2^3 e^{x^2-5x+6} e^{e^{x^2-5x+6}} (2x-5) dx = 0$$

11.

$$\int_{-1}^1 \prod_{i=0}^{2024} (-1)^i \frac{x^{2i+1}}{i+1} dx = 0$$

12.

$$\int_{-1}^1 \ln(\sqrt{1+x^2}) dx = \ln 2 - 2 + \frac{\pi}{2}$$

13.

$$\int_0^2 \frac{x}{1 - \frac{4^{-1}}{1 - \frac{4^{-1}}{1 - \frac{4^{-1}}{1 - \frac{4^{-1}}{\dots}}}}} dx = 4$$

14.

$$\int e^x \sin(2x) dx = \frac{1}{5}e^x(\sin(2x) - 2 \cos(2x))$$

15.

$$\int 16^x 3^{2x} dx = \frac{144^x}{\ln 144}$$

16.

$$\int \sinh^2(x) + \cosh^2(x) dx = \sinh x \cosh x = \frac{1}{2} \sinh 2x = \frac{e^{2x} - e^{-2x}}{4}$$

17.

$$\int \sum_{k=0}^{\infty} kx^k dx = \ln(x-1) + \frac{1}{1-x}$$

18.

$$\int x^x(x^{-1} + \ln^2 x + \ln x) dx = x^x \ln x$$

19.

$$\int_0^{2\pi} \lfloor \sin \lceil x \rceil \rfloor dx = -3$$

20.

$$\int \frac{1 - 2 \cos^2 x}{\cos x \sin x} dx = -\ln(\sin(2x)) = -\ln(\sin(2x)/2) = -\ln(\cos(x) \sin(x))$$

21. Bonus:

$$\int_{-\infty}^{\infty} \sin(e^x) dx = \frac{\pi}{2}$$

Instructions:

You have 45 minutes to solve 20+1 integrals.

No electronic devices or notes are allowed during the contest.

Only the final result will be taken into account for the final scores, and the intermediate steps in case of a tie.

It is not necessary to add the constant of integration to the answer, but it is mandatory to write the answer on the questions document.