

THE UK UNIVERSITY
INTEGRATION BEE

2022/23



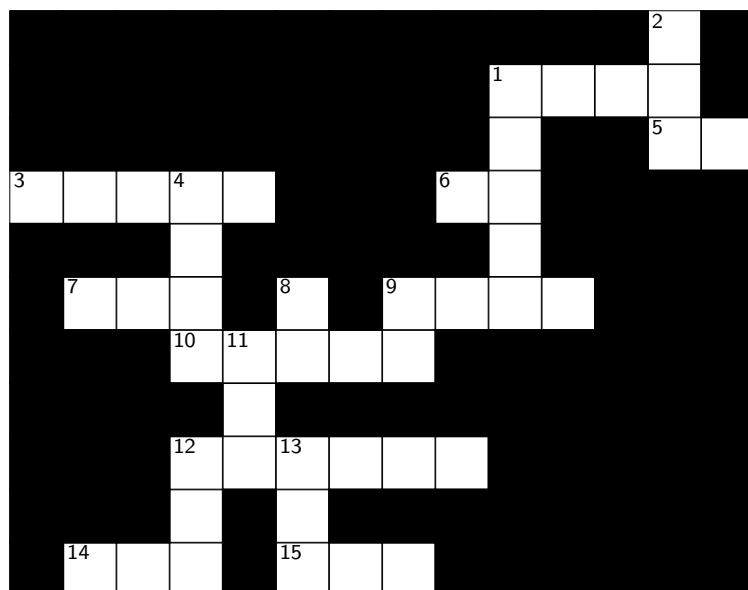
ROUND 2 CROSSNUMBER

Monday, 6 February 2023

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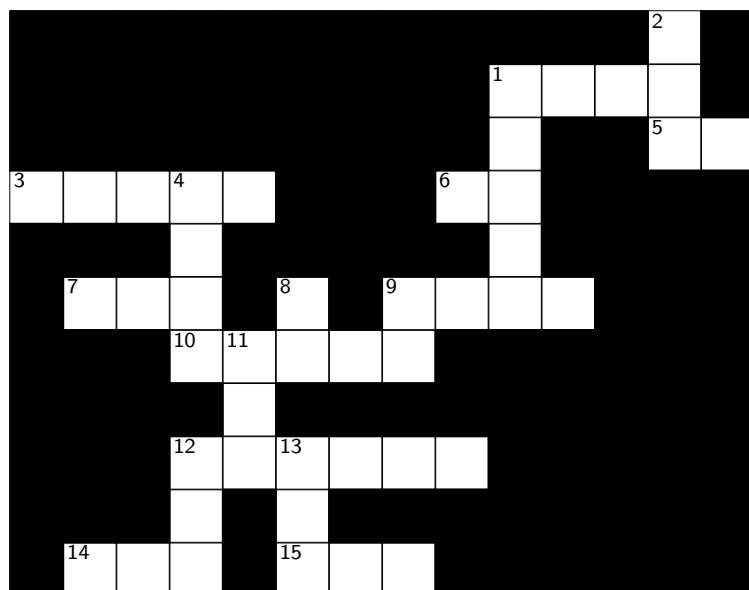


Jane Street



Across

1. $x^3 + y^3 = z^3 + w^3$ for $x < z < w < y$ integers, x = final digit of 4 DOWN, w = product of the last two digits of 12 DOWN.
3. 15 ACROSS \times 8 DOWN.
5. Difference between the other two smallest numbers.
6. $f(x) = 2x(1 - x)$. Let $f_n(x) = f(f(\dots(f(x))))$ where f is applied n times. Let $\int_0^1 f_{\sqrt[3]{9 \text{ DOWN}}}(x) dx = \frac{a}{b}$. Find $a + b$.
7. $\int_0^2 f(x) dx$ where $5 \int_0^1 f(x) dx - 2 \int_0^2 f(x) dx = 23$ and $3 \int_0^2 f(x) dx - 4 \int_1^2 f(x) dx = 82$
9. Palindrome.
10. $\left(\left(\frac{1}{\pi} \int_0^{2\pi} \frac{\sin^2(5x) \sin^2(4x)}{\sin^2 x} dx \right) ! \right)^3$
12. Let $x = 10\sqrt[3]{9 \text{ DOWN}}$. Find $\int_0^x \lceil t \rceil t \lfloor t \rfloor dt$
14. 13 DOWN $-$ 15 ACROSS .
15. $f(21)$ where $f(x) + \int_1^2 f(x) dx = \lfloor x \rfloor^2 + 17$

**Down**

1. Digits are in arithmetic progression.

2. $f(218)$ where $f(x) - \int_3^5 f(t)dt = x + \frac{8 \text{ DOWN}}{2}$.

4. A power of 9.

8. $4 \int_y^{y+1} f_{13 \text{ DOWN}}(x)dx$, $f_n = f(f(\dots f(x)))$ where f is applied n times for $f(x) = 1 - \frac{1}{x}$ and y is the second digit of 9 ACROSS.

9. n^3 where $\int_0^{\frac{\pi}{4}} \frac{1}{x} - \frac{\sin(2x)}{1 - \cos(2x)} dx = \ln\left(\frac{\pi\sqrt{2}}{n}\right)$.

11. A palindrome cube.

12. A square number

13. A multiple of 7 ACROSS whose digits are in decreasing order.