AN INTERMEDIATE ARTICLE

YOUR NAME ◦

ABSTRACT. In this note, we prove that our LaTeX is at an intermediate level.

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Challenge 1 (citing a 1656 paper)**.** $\binom{2n}{n} \sim 4^n/\sqrt{\pi n}$ follows from Wallis's product formula [Wal56].

Challenge 2 (Fatou's lemma)**.** If $f_n \to f$ a.s., then

$$\int f\,d\mu \leq \varliminf_{n\to\infty} \int f_n\,d\mu.$$

Challenge 3 (a summation)**.**

$$\sum_{x\in A}{}' f(x) = \sum_{\substack{x\in A\\ x\neq 0}} f(x).$$

Challenge 4 (a superfluous statement)**.** Consider real-valued functions f_1,f_2, $\ldots$, all defined on

$$R := \left]-\infty, 0\right[\times \{0,1\} \equiv \left\{\, (x,y) \;\middle|\; 0 < x < 1 \text{ and } y \in \{0,1\} \,\right\}.$$

If $f_n = f_m$ a.e. for all $n, m \in \mathbf{N}$, then $f_n \to f$ a.e. for some f.

Challenge 5 (the harmonic series)**.** The harmonic series diverges.

Proof.

$$\begin{aligned}\sum_{n=1}^{\infty} \frac{1}{n} &= \frac{1}{1} + \underbrace{\frac{1}{2} + \frac{1}{3}}_{2} + \underbrace{\frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}}_{4} \\ &\qquad + \underbrace{\frac{1}{8} + \frac{1}{9} + \frac{1}{10} + \frac{1}{11} + \frac{1}{12} + \frac{1}{13} + \frac{1}{14} + \frac{1}{15}}_{8} + \cdots \\ &\geq \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \cdots = \infty.\end{aligned}$$

□

Challenge 6 (a symbol that doesn't exist)**.** $X \perp\!\!\!\perp Y$.

Challenge 7 (Knuth's up-arrow notation)**.**

$$2 \uparrow\uparrow k \stackrel{\text{def}}{=} \left. 2^{2^{\cdot^{\cdot^{\cdot^{2}}}}} \right\}k.$$

Challenge 8 (true/false questions)**.** Answer the following with T or F.

1. There exists a well-order on $\prec$ on $\mathbf{R}$ such that for any $x \in \mathbf{R}$ the set $\{\, y \in \mathbf{R} \mid y \prec x \,\}$ is countable. Ans: ______

2. Apéry's constant Ans: ______

$$\zeta(3) := \sum_{n=1}^{\infty} \frac{1}{n^3}$$

is transcendental.

3. There exists a polynomial-time algorithm that determines if a given graph is 3-colorable. Ans: ______

Challenge 10[1] (a popular number)**.** For each $n \in \mathbf{N}$, let $D(n)$ be the sum of all positive divisors of n. What is $\sum_{n=1}^{9} D(n)$?

Answer: $\boxed{}$

Challenge 11 (countdown)**.** A blade is aiming for the top.

(3) Three!
(2) Two!
(1) One!
(0) Go . . . shoot!

Counting down is not the cup of tea of the other blade.

(2) Three!
(1) Two!
(0) Oh, shoot.

Challenge 12 (a cyclic order)**.** In $dx\,dy$, $dy\,dz$, and $dz\,dx$, the basic 1-forms dx, dy, and dz always appear in cyclic pairs. See Figure 1.

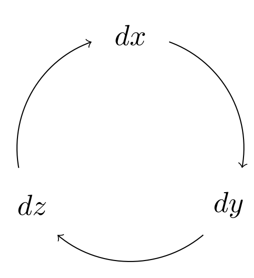

Figure 1. The cyclic order of dx, dy, and dz.

[1] There is no iPhone 9 or Windows 9. Why should we have one?

Challenge 13 (Riemann sums)**.** Some Riemann sums of $f(x) := x^2/3$ over $[0, 3]$ are shown in Figure 2.

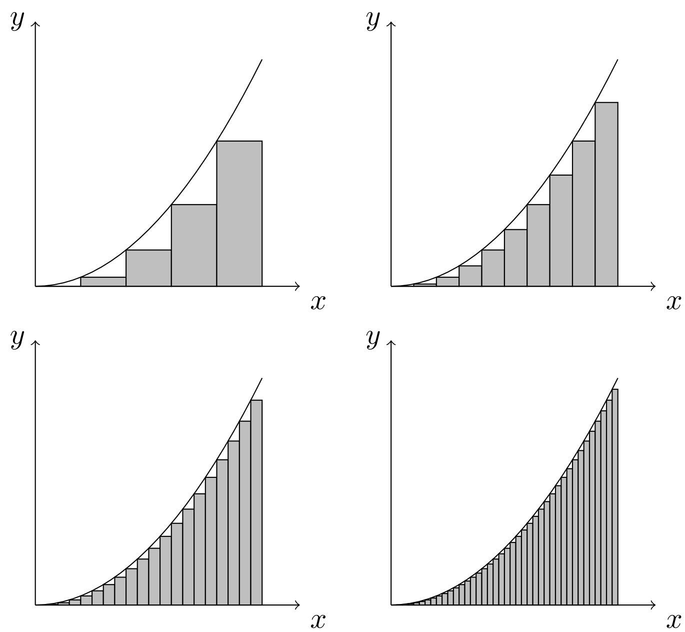

Figure 2. The Riemann sums for $n = 5$, 10, 20, and 40.

References

[Wal56] Wallis, J. (1656). *Arithmetica Infinitorum.* Oxford, England. Available at: archiv.org/details/ArithmeticalInfinitorum/page/n5 Available in English as *The Arithmetic of Infinitesimals* (2004). (Stedall, J. A., trans.) New York, NY: Springer-Verlag.

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