1. If $a = -2$, what is the largest number in the set $\left\{-3a, 4a, \frac{24}{a}, a^2, 1\right\}$?

2. One proposal for new postage rates for a letter was 30 cents for the first ounce and 22 cents for each additional ounce (or fraction of an ounce). What is the postage for a letter weighing 4.5 ounces?

3. A straight concrete sidewalk is to be 3 feet wide, 60 feet long, and 3 inches thick. How many cubic yards of concrete must a contractor order for the sidewalk if concrete must be ordered in a whole number of cubic yards?

4. Eight friends ate at a restaurant and agreed to share the bill equally. Because Judi forgot her money, each of her seven friends paid an extra $2.50 to cover her portion of the total bill. What was the total bill?

5. Ted's grandfather used his treadmill on 3 days this week. He went 2 miles each day. On Monday he jogged at a speed of 5 miles per hour. He walked at the rate of 3 miles per hour on Wednesday and at 4 miles per hour on Friday. If Grandfather had always walked at 4 miles per hour, he would have spent less time on the treadmill. How many minutes less?

6. Suppose a, b, and c are nonzero real numbers, and $a + b + c = 0$. What are the possible value(s) for $\frac{a}{|a|} + \frac{b}{|b|} + \frac{c}{|c|} + \frac{abc}{|abc|}$?

7. Farmer Yang has a 2023 × 2023 square grid of corn plants. One day, the plant in the very center of the grid becomes diseased. Every day, every plant adjacent to a diseased plant becomes diseased. After how many days will all of Yang's corn plants be diseased?

8. Find the smallest positive integer b such that 1111 in base b is a perfect square. If no such b exists, write "No solution".

There exist unique nonnegative integers A, B between 0 and 9, inclusive, such that

$$(1001 \cdot A + 110 \cdot B)^2 = 57,108,249.$$

Find $10 \cdot A + B$.

9.

Compute the smallest positive integer n such that

$$0 < \sqrt[4]{n} - \lfloor \sqrt[4]{n} \rfloor < \frac{1}{2023}.$$

10.

11. Given n = 2023, sort the 6 values n^{n^2}, $2^{2^{2^n}}$, n^{2^n}, $2^{2^{n^2}}$, 2^{n^n}, and $2^{n^{2^2}}$ from **least** to **greatest**. Give your answer as a 6 digit permutation of the string "123456", where the number i corresponds to the i-th expression in the list, from left to right.

12. Find all pairs of integers (x, y) such that $x \geq 0$ and $(6^x - y)^2 = 6^{x+1} - y$.

Answers:

1. 6
2. $1.18
3. 2
4. 140
5. 4
6. 0
7. 2022
8. 7
9. 75
10. 4097
11. 163542
12. (1,0), (1,11), (4,1215), and (4,1376)