1. (2004 AMC 10B #10 and 12B #8) A grocer makes a display of cans in which the top row has one can and each lower row has two more cans than the row above it. If the display contains 100 cans, how many rows are there?

(A) 5  (B) 8  (C) 9  (D) 10  (E) 11

2. (2003 AMC 10B #8 and 12B #6) The second and fourth terms of a geometric sequence are 2 and 6. Which of the following is a possible first term?

(A) $-\sqrt{3}$  (B) $-\frac{2\sqrt{3}}{3}$  (C) $-\frac{\sqrt{3}}{3}$  (D) $\sqrt{3}$  (E) 3

3. (2004 AMC 10B #21) Let 1, 4, . . . and 9, 16, . . . be two arithmetic sequences. The set $S$ is the union of the first 2004 terms of each sequence. How many distinct numbers are in $S$?

(A) 3722  (B) 3732  (C) 3914  (D) 3924  (E) 4007

4. (1993 AHSME #21) Let $a_1, a_2, \ldots, a_k$ be a finite arithmetic sequence with

\[
\begin{align*}
a_4 + a_7 + a_{10} &= 17 \\
a_4 + a_5 + a_6 + a_7 + a_8 + a_9 + a_{10} + a_{11} + a_{12} + a_{13} + a_{14} &= 77 \\
a_k &= 13.
\end{align*}
\]

What is $k$?

(A) 16  (B) 18  (C) 20  (D) 22  (E) 24

5. (2004 AMC 10A #18 and 12A #14) A sequence of three real numbers forms an arithmetic sequence whose first term is 9. If the first term is unchanged, 2 is added to the second term, and 20 is added to the third term, then the three resulting numbers form a geometric sequence. What is the smallest possible value for the third term of the geometric sequence?
6. (2002 AMC 12A #21) Consider the sequence of numbers
4, 7, 1, 8, 9, 7, 6, . . . .
For \( n > 2 \), the \( n \)-th term of the sequence is the units digit of the sum of the two previous terms. Let \( S_n \) denote the sum of the first \( n \) terms of this sequence. What is the smallest value of \( n \) for which \( S_n > 10,000 \)?
(A) 1992 (B) 1999 (C) 2001 (D) 2002 (E) 2004

7. (1984 AHSME #12) Suppose that the sequence \( \{a_n\} \) is defined by
\[
a_1 = 2, \quad \text{and} \quad a_{n+1} = a_n + 2n, \quad \text{for} \quad n \geq 1.
\]
What is \( a_{100} \)?
(A) 9900 (B) 9902 (C) 9904 (D) 10100 (E) 10102

8. (1992 AHSME #18) The increasing sequence of positive integers \( a_1, a_2, a_3, \ldots \) has the property that
\[
a_{n+2} = a_n + a_{n+1}
\]
for all \( n \geq 1 \). Suppose that \( a_7 = 120 \). What is \( a_8 \)?
(A) 128 (B) 168 (C) 193 (D) 194 (E) 210

9. Write
\[
\frac{1}{1 \cdot 2} + \frac{1}{2 \cdot 3} + \frac{1}{3 \cdot 4} + \cdots + \frac{1}{99 \cdot 100}
\]
as a fraction in lowest terms.

10. (2000 AMC 12 #14) When the mean, median, and mode of the list
10, 2, 5, 2, 4, 2, \( x \)
are arranged in increasing order, they form a non-constant arithmetic sequence. What is the sum of all possible real values of \( x \)?
(A) 3 (B) 6 (C) 9 (D) 17 (E) 20

11. (2000 AMC 12 #16) A checkerboard of 13 rows and 17 columns has a number written in each square, beginning in the upper left corner, so that the first row is numbered 1, 2, \ldots, 17, the second row 18, 19, \ldots, 34, and so on down the board. If the board is renumbered so that the left column, top to bottom, is 1, 2, \ldots, 13, the second column 14, 15, \ldots, 26, and so on across the board, some square have the same numbers in both numbering systems. Find the sum of the numbers in these squares (under either system).
12. (1999 AHSME #13) Define a sequence of real numbers $a_1, a_2, a_3, \ldots$ by $a_1 = 1$ and $a_{n+1}^3 = 99a_n^3$ for all $n \geq 1$. Then $a_{100}$ equals

(A) $33^{33}$  (B) $33^{99}$  (C) $99^{33}$  (D) $99^{99}$  (E) none of these

13. (1996 AHSME #24) The sequence

$$1, 2, 1, 2, 2, 1, 2, 2, 2, 1, 2, 2, 2, 1, 2, \ldots$$

consists of 1’s separated by blocks of 2’s with $n$ 2’s in the $n$-th block. The sum of the first 1234 terms of this sequence is

(A) 1996  (B) 2419  (C) 2429  (D) 2439  (E) 2449

14. (1997 AHSME #6) Consider the sequence

$$1, -2, 3, -4, 5, -6, \ldots$$

whose $n$th term is $(-1)^{n+1} \cdot n$. What is the average of the first 200 terms of the sequence?

(A) $-1$  (B) $-0.5$  (C) 0  (D) 0.5  (E) 1

15. (1984 AIME #1) Find the value of $a_2 + a_4 + a_6 + \cdots + a_{98}$ if $a_1, a_2, a_3, \ldots$ is an arithmetic progression with common difference 1, and $a_1 + a_2 + \cdots + a_{98} = 137$.

16. (1985 AIME #1) Let $x_1 = 97$, and for $n > 1$, let $x_n = \frac{n}{x_{n-1}}$. Calculate the product $x_1 x_2 \cdots x_8$.

17. (1985 AIME #5) A sequence of integers $a_1, a_2, a_3, \ldots$ is chosen so that

$$a_n = a_{n-1} - a_{n-2}$$

for all $n \geq 3$. What is the sum of the first 2001 terms of this sequence if the sum of the first 1492 terms is 1985, and the sum of the first 1985 terms is 1492?

18. (1986 AIME #6) The pages of a book are numbered 1 through $n$. When the page numbers of the book were added, one of the page numbers was mistakenly added twice, resulting in the incorrect sum of 1986. What was the number of the page that was added twice?
19. (1986 AIME #7) The increasing sequence

\[ 1, 3, 4, 9, 10, 12, 13, \ldots \]

consists of all those positive integers which are powers of 3 or sums of distinct powers of 3. Find the 100th term of this sequence.

20. (2007 Bay Area Mathematical Olympiad) Two sequences of positive integers, \( x_1, x_2, \ldots \) and \( y_1, y_2, \ldots \) are given, such that

\[ \frac{y_{n+1}}{x_{n+1}} > \frac{y_n}{x_n} \]

for each \( n \geq 1 \). Prove that there are infinitely many values of \( n \) such that \( y_n \geq \sqrt{n} \).