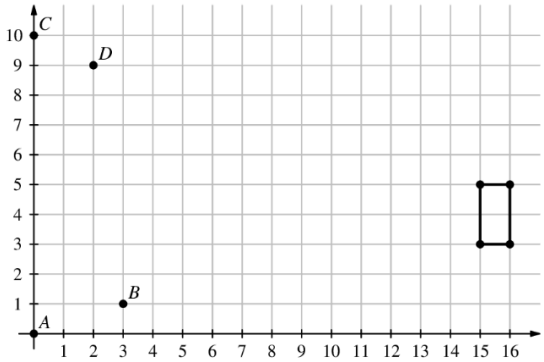
2023

Problem 7

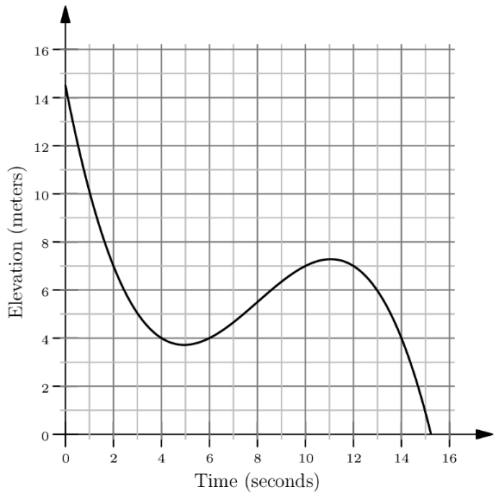
A rectangle, with sides parallel to the x-axis and y-axis, has opposite vertices located at $(15, 3)$ and $(16, 5)$. A line is drawn through points $A(0, 0)$ and $B(3, 1)$. Another line is drawn through points $C(0, 10)$ and $D(2, 9)$. How many points on the rectangle lie on at least one of the two lines?



(A) 0 **(B)** 1 **(C)** 2 **(D)** 3 **(E)** 4

Problem 9

Malaika is skiing on a mountain. The graph below shows her elevation, in meters, above the base of the mountain as she skis along a trail. In total, how many seconds does she spend at an elevation between 4 and 7 meters?



(A) 6 **(B)** 8 **(C)** 10 **(D)** 12 **(E)** 14

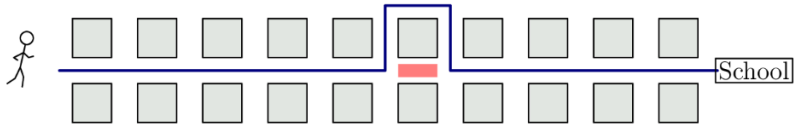
Problem 11

NASA's Perseverance Rover was launched on July 30, 2020. After traveling $292{,}526{,}838$ miles, it landed on Mars in Jezero Crater about 6.5 months later. Which of the following is closest to the Rover's average interplanetary speed in miles per hour?

(A) 6,000 **(B)** 12,000 **(C)** 60,000 **(D)** 120,000 **(E)** 600,000

Problem 15

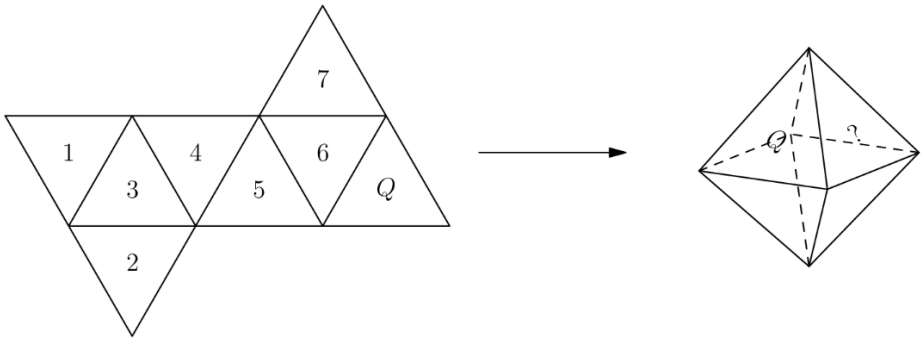
Viswam walks half a mile to get to school each day. His route consists of 10 city blocks of equal length and he takes 1 minute to walk each block. Today, after walking 5 blocks, Viswam discovers he has to make a detour, walking 3 blocks of equal length instead of 1 block to reach the next corner. From the time he starts his detour, at what speed, in mph, must he walk, in order to get to school at his usual time?



(A) 4 **(B)** 4.2 **(C)** 4.5 **(D)** 4.8 **(E)** 5

Problem 17

A *regular octahedron* has eight equilateral triangle faces with four faces meeting at each vertex. Jun will make the regular octahedron shown on the right by folding the piece of paper shown on the left. Which numbered face will end up to the right of Q?



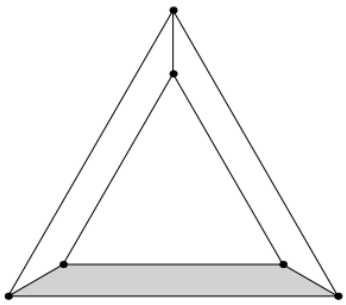
(A) 1 **(B)** 2 **(C)** 3 **(D)** 4 **(E)** 5

Problem 18

Greta Grasshopper sits on a long line of lily pads in a pond. From any lily pad, Greta can jump 5 pads to the right or 3 pads to the left. What is the fewest number of jumps Greta must make to reach the lily pad located 2023 pads to the right of her starting point?

(A) 405 **(B)** 407 **(C)** 409 **(D)** 411 **(E)** 413

19 An equilateral triangle is placed inside a larger equilateral triangle so that the region between them can be divided into three congruent trapezoids, as shown below. The side length of the inner triangle is $\frac{2}{3}$ the side length of the larger triangle. What is the ratio of the area of one trapezoid to the area of the inner triangle?



(A) $1:3$ **(B)** $3:8$ **(C)** $5:12$ **(D)** $7:16$ **(E)** $4:9$

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20 Two integers are inserted into the list $3, 3, 8, 11, 28$ to double it's range. The mode and median remain unchanged. What is the maximum possible sum of two additional numbers?

(A) 56 **(B)** 57 **(C)** 58 **(D)** 60 **(E)** 61

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21 Alina writes the numbers $1, 2, \ldots, 9$ on separate cards, one number per card. She wishes to divide the cards into 3 groups of 3 cards so that the sum of the number in each group will be the same. In how many ways can this be done?

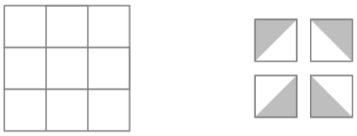
(A) 0 **(B)** 1 **(C)** 2 **(D)** 3 **(E)** 4

22 In a sequence of positive integers, each term after the second is the product of the previous two terms. The sixth term in the sequence is 4000. What is the first term?

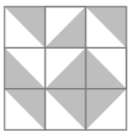
(A) 1 **(B)** 2 **(C)** 4 **(D)** 5 **(E)** 10

Problem 23

Each square in a 3×3 grid is randomly filled with one of the 4 gray and white tiles shown below on the right.



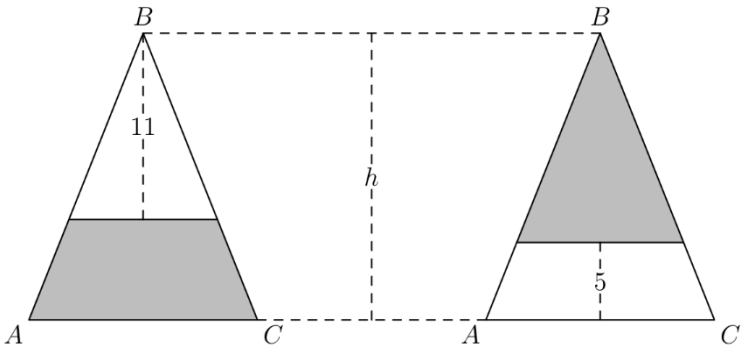
What is the probability that the tiling will contain a large gray diamond in one of the smaller 2×2 grids? Below is an example of such tiling.



(A) $\frac{1}{1024}$ **(B)** $\frac{1}{256}$ **(C)** $\frac{1}{64}$ **(D)** $\frac{1}{16}$ **(E)** $\frac{1}{4}$

Problem 24 [edit]

Isosceles triangle ABC has equal side lengths AB and BC. In the figures below, segments are drawn parallel to $\overline{AC}$ so that the shaded portions of $\triangle ABC$ have the same area. The heights of the two unshaded portions are 11 and 5 units, respectively. What is the height h of $\triangle ABC$?



(A) 14.6 **(B)** 14.8 **(C)** 15 **(D)** 15.2 **(E)** 15.4

Problem 25 [edit]

Fifteen integers $a_1, a_2, a_3, \ldots, a_{15}$ are arranged in order on a number line. The integers are equally spaced and have the property that

$$1 \leq a_1 \leq 10, \ 13 \leq a_2 \leq 20, \ \text{and} \ 241 \leq a_{15} \leq 250.$$

What is the sum of digits of a_{14}?

(A) 8 **(B)** 9 **(C)** 10 **(D)** 11 **(E)** 12