

# NOVEMBER

Kierra is flying her kite on a sunny day. She is 60 in. tall, and her shadow is 2 ft. long. Kierra's kite is directly above the flagpole, and its shadow is 8 ft. from the flagpole's base. If a wind gust lifts her kite 10 ft. higher than before, how far will the kite's new shadow be from a point directly below the kite?

1

Charlie Cardinal's Athletic Boosters are buying popcorn. The vendor agreed to sell the Boosters a box filled with popcorn—at a very good price—provided that the box met the following requirements: Its length is 10 cm greater than its height, and its width equals 30 cm minus its height. If 1 cup (US) = 236.588 cm<sup>3</sup>, how many whole cups of popcorn will fit into the box of greatest volume?

2

Wearing night vision goggles at the zoo's night animal exhibit, Nate, Alec, and Seth saw opossums, owls, and snakes. Nate noticed that there were twice as many opossums as snakes. Alec counted a total of 64 legs on the creatures. Seth counted 27 animals. The boys saw at least one of each type of animal. How many of each type were in the exhibit?

3

Jerome won \$50 in a charity raffle. His sister, Jill, wants him to share his prize with her. He tells her that she can have the fractional part of his prize that is equal to the solution to the equation  $(2x + 9)^{5x-2} = 1$  if she can solve the equation. If Jill solves the equation, how much money will she receive?

4

Rhonda hears a rumor at 8:00 a.m. She immediately tells it to her two best friends. One hour later, Rhonda's friends have each told two other friends. This pattern continues each hour, with each friend reporting the rumor to two friends who have not already heard it. By 8:00 p.m. that evening, how many people have heard the rumor?

5

You have forgotten your locker combination. The lock has the numbers 0-24 on the dial, and the combination is a sequence of three numbers (repeated numbers allowed). How many fewer options—mathematical permutations—will you have to try if you can remember just one of the three numbers?

6

The 15 students (editors and staff) on the yearbook committee will ask local companies to buy ads. Each editor must approach 10% of the firms. Staff members with and without part-time jobs must each ask 8% and 5% of the firms, respectively. If at least one student is in each category and there are 200 companies that can be divided up exactly, how many firms must the editors approach collectively?

7

The gas gauge on your car indicates that you have about 1/4 tank of gas remaining. You buy \$42 worth of gas at \$3.949 per gallon, and now the gauge indicates that you have about 7/8 of a tank of gas. What is a reasonable estimate of the size of the gas tank?

8

A 2 m seesaw is balanced with the fulcrum in the middle, 1 m from each end. Nick and his two younger brothers want to play on it. One brother is half Nick's weight, and the other is 3/4 his weight. If Nick sits at one end, where should the brothers sit so that they can balance Nick?



9

Jane wants to connect the top of a 50 ft. tower to the top of a 30 ft. tower with a zip line. To walk from the first tower to the second, Jane must walk 300 ft. due east and then 200 ft. due north. How long will the cable be that connects the two towers?

10

Jane wants to build another tower 200 ft. east of the 30 ft. tower (see the problem for November 10). If she plans to connect the two towers with another zip line that has the same slope as the first zip line, how tall must the new tower be?

11

Find the total number of squares, of any size, on an  $n \times n$  checkerboard.

12

A standard roll of paper towels has 200 towels. The paper towels are sold in rolls with a 4 in. radius; the interior cardboard tube has a 1 in. diameter. The manufacturer runs a promotion selling rolls with 50% more towels than the standard roll. What is the radius of the special roll?

13

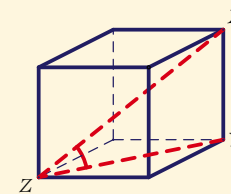
The sequence

$6, a, b, c, 14406$

is a geometric sequence. What is the arithmetic mean of  $a, b$ , and  $c$ ?

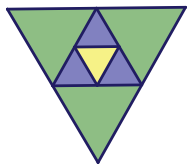
14

Find the measure of the angle formed by a space diagonal of a cube with the base of the cube.



15

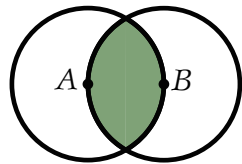
An equilateral triangle has side length 1. Construct an equilateral triangle about the first so that the midpoints of its sides coincide with the vertices of the first triangle. Repeat, constructing several more equi-



lateral triangles. Find a formula for the perimeter  $T_n$  of the  $n$ th triangle in the sequence.

16

Circle A and circle B are congruent circles with radius 1. Each passes through the center of the other. Find the area of the shaded region, called a *vesica piscis* (fish bladder).



17

On a 36-question test, a correct answer is worth 1 point, an incorrect answer results in a deduction of  $\frac{1}{3}$  point, and there is no penalty for leaving an answer blank. Andrew left 6 questions unanswered and got 6 questions wrong. Blake did not leave any blank but earned  $\frac{2}{3}$  as many points on the test as Andrew. How many questions did Blake get wrong?

18

The second-period algebra class has 28 students, and the ratio of boys to girls is 3:4. If the number of boys in the class remains the same, how many girls must join this class to change the ratio to 3:5?

19

What is the smallest positive integer  $x$  such that

$$\sqrt{1050x}$$

will be a whole number?

20

Tom is going to Mark's house after school, but he cannot remember the exact route. He knows that the route is 3 blocks to the first turn, 2 blocks to the second turn, and then 1 block farther. Tom can walk east, west, or north when he leaves the school, and all blocks are  $\frac{1}{8}$  mile long. What is the farthest distance from Mark's house that Tom could end up?

21

An electric utility receives bids for coal from three different coal mines. The coal from mine A costs \$42 per ton and contains 11,000 BTU per pound. The coal from mines B and C costs \$43 and \$41 per ton, respectively, and contains 11,500 and 10,800 BTU per pound. Rank the bids from lowest to highest cost per million BTU.

22

The electric utility mentioned in problem for November 22 must also consider the transportation costs from each coal mine to the utility's power plant. The transportation costs from coal mines A, B, and C are \$4, \$7, and \$5 per ton, respectively. Which bid should the utility accept? Why?

23

Loading a 100-car coal train at the mine takes 6 hours. A fully loaded train can travel from the mine to the power plant in 14 hours. An empty train takes 20% less time for the return trip. The power plant can unload one rail car in 3 minutes. Find the maximum number of round trips one train can make during November.

24

Find all the ordered pairs of integers that are exactly 5 units from  $(-1, -3)$ .

25

What would be the diameter of a tire, measured in inches, that revolves 615 times per mile? (Assume that the weight of the car does not change the shape of the tire.)

26

Big Ben is the bell in the famous clock tower in London. The clock on the tower has a minute hand that is 14 ft. long and an hour hand that is 9 ft. long. Find the average speed (in mph) of the tip of the minute hand.

27

If we were to build a clock whose minute hand traveled an average speed of 1 mph at the tip, how long in feet would the minute hand have to be?

28

Ted filled his gas tank with 10 gallons of gas and purchased 2 Super Slurps for \$33.10. Becky paid \$24.85 for 7 gallons of gas and 3 Super Slurps for herself and her two brothers. Frank bought his gas and Super Slurps with two bills no larger than \$20 bills and received no change. What possible combinations of gas and Super Slurps could Frank have purchased?

29

Donald filled a 120-gallon dunk tank for the fall carnival. Daisy filled the duck-pull pond. She used a hose with one-fifth the fill rate and finished in half the time that Donald needed. How many gallons does the duck-pull pond contain?

30