1.

If $2015 + a = b$ for positive integers a and b, both of which are palindromes, what is the smallest possible value of a?

2.

How many positive integers have the same digits in the same order when written in base 7 and in base 13?

3.

The domain of $f(x) = x^2 - 3$ is $\{-4, -3, ..., 3, 4\}$. How many integers are in both the range and the domain of f?

4.

For non-negative integers m and n, $\frac{m+n}{m-n} = \frac{25}{4}\left(\frac{m-n}{m+n}\right)$ and $m > n$. What is the value of $\frac{m}{n}$? Express your answer as a common fraction.

5.

A path crosses a rectangular field on a diagonal. If someone travels across the field on the diagonal, instead of walking along the sides, what is the greatest possible percent reduction in total distance traveled? Express your answer to the nearest whole number.

6.

If $(2a - 3b)^{\sqrt{x}} = 16a^4 - 96a^3b + 216a^2b^2 - 216ab^3 + 81b^4$, what is the value of x?

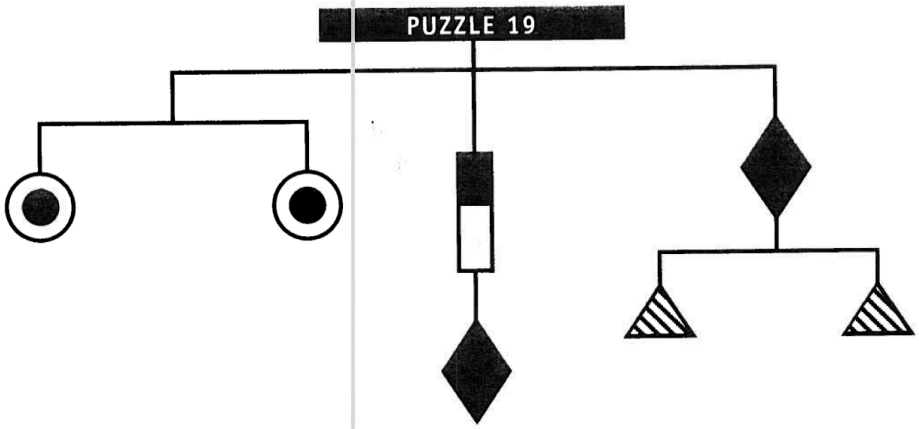
7.

The ratio of width to height for Carl's TV screen is 16:9. Carl's TV screen has a 37-inch diagonal. What is the width of his TV screen? Express your answer as a decimal to the nearest tenth.

8.

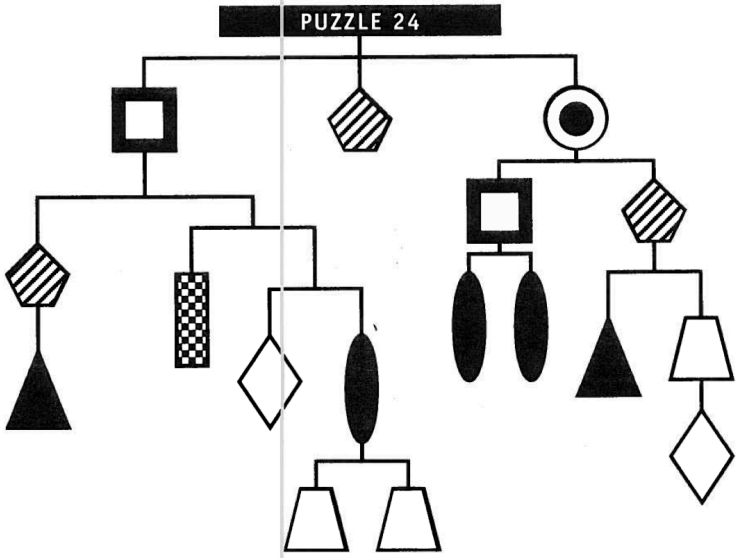
If $(x + y)^2 = x^2 + y^2$, what is the value of xy?

9.



Discover the value of each shape. The total weight is 43. Use only single-digit numbers. There is only one even-numbered weight.

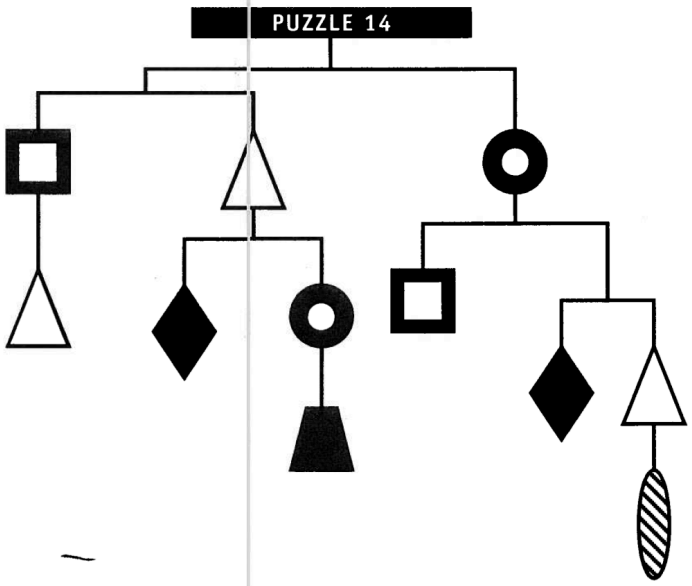
10.



Discover the value of each shape. The total weight is 143. Additional clues:

◇ x ◇ = ◘ ▮ = ▱ x ◇

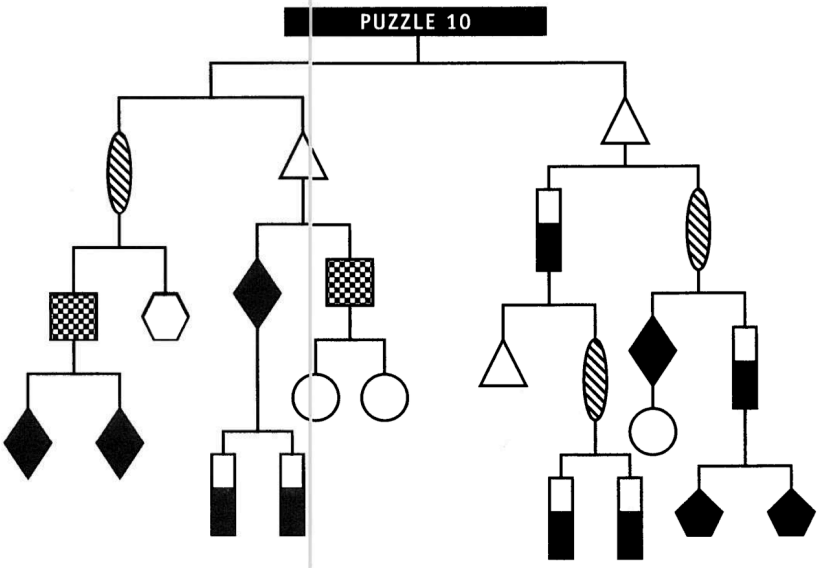
11.



Discover the value of each shape. The total weight is 124. Clue:

♦ + ▨ = 2▲ + 3

12.



Discover the value of each shape. The total weight is 216. Clue:

4 ▩ = ▨ = 3▮

13.

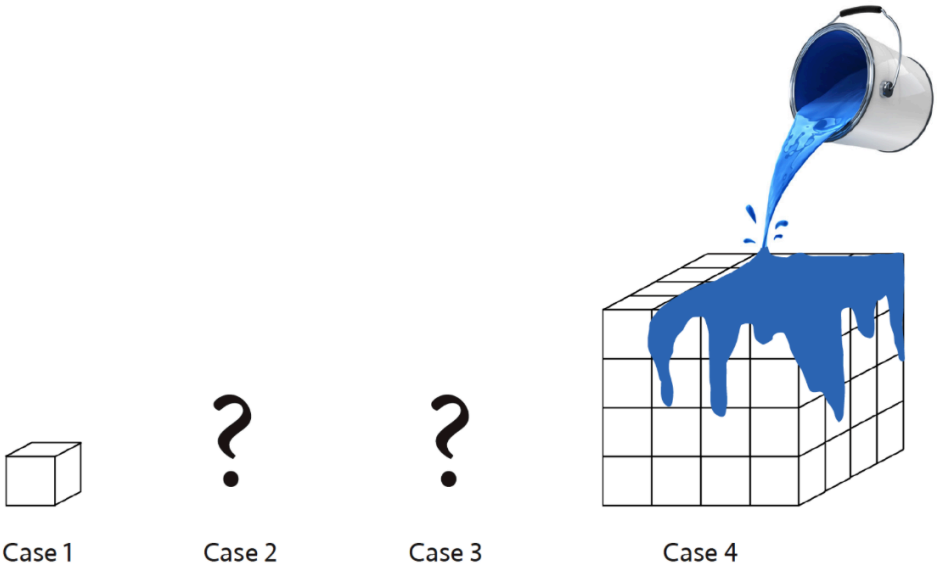
Can you find every number between 1 and 20 using only four 4's and any operation?

Going beyond ...

Can you find more than one way to make each number with four 4's?

$$\sqrt{4} + \sqrt{4} + 4/4 = 5$$

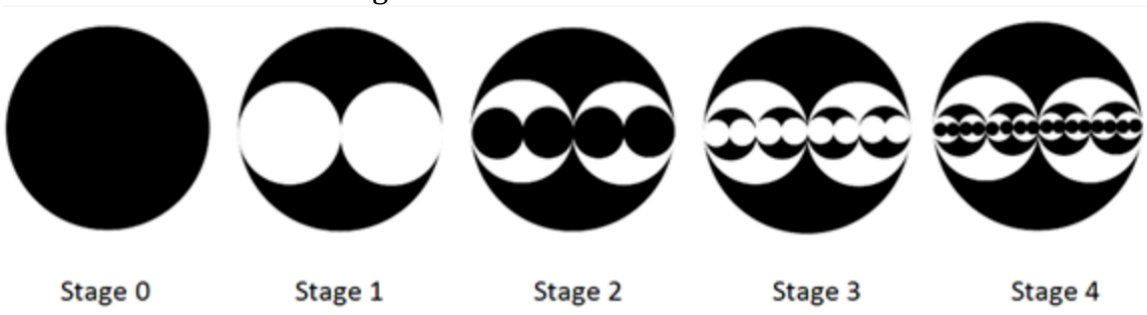
14.



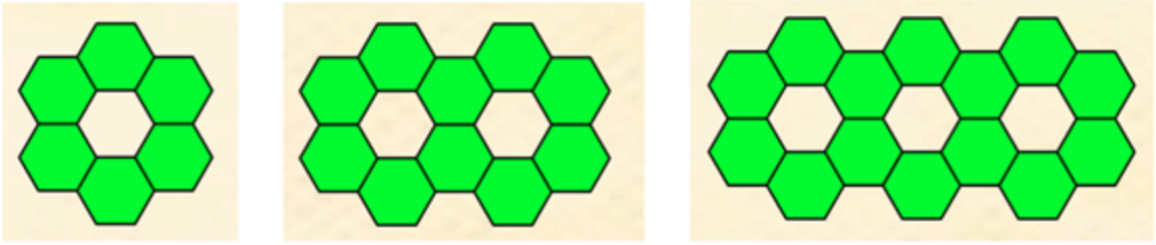
Task Instruction

Imagine that we paint a 4 x 4 x 4 cube blue on every side. How many of the small cubes have 3 blue faces? How many have 2 blue faces? How many have 1 blue face? How many have not been painted at all? How many faces would be painted in a cube of any size? Think visually!

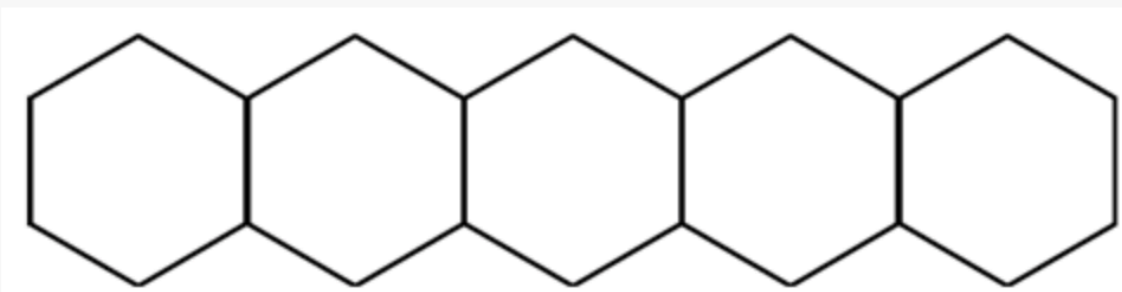
15. What fraction of the original circle is black?



16. How many green hexagons are there in step 10, … 43?

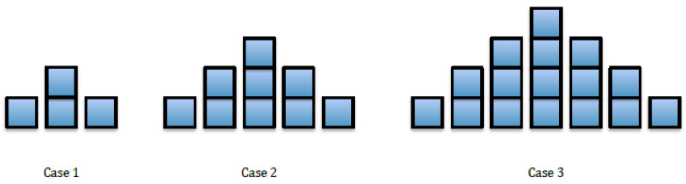


17. What is the perimeter in step 10?



Pattern #42, from Henri Picciotto, Perimeter in step 43 = 174

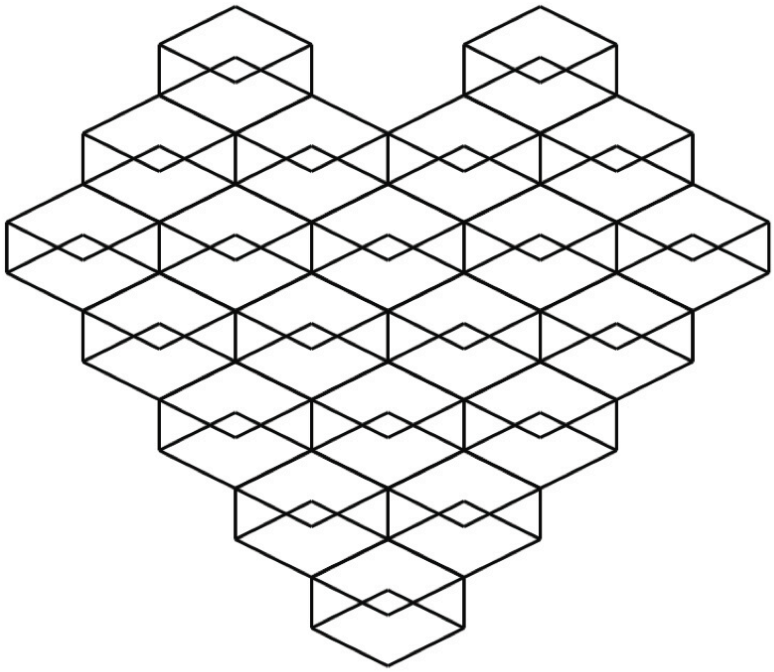
18.



Task Instruction

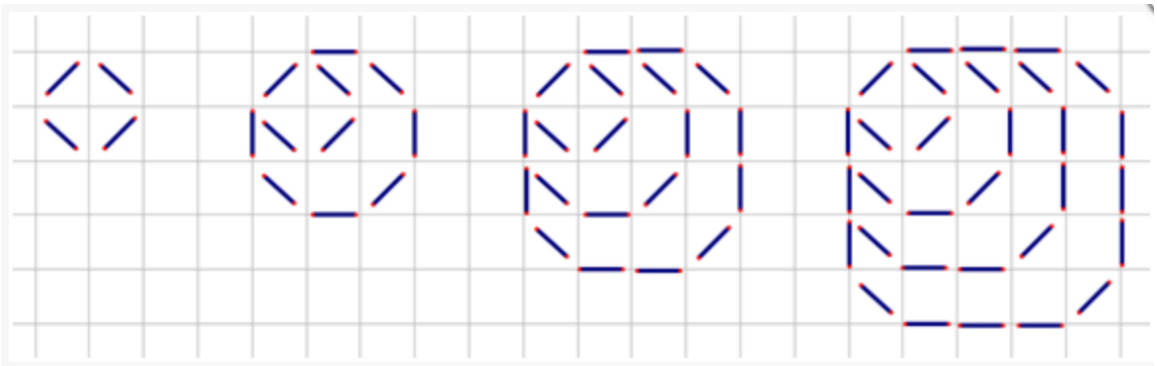
1. What would case 100 look like? How many blocks would it have? How do you know?
2. What does case 0 look like? How do you know?
3. How many blocks would there be in case n? How do you know?

19.



What is the area of the shape?
What is the perimeter of the shape?
How many rhombuses are there"
How many triangles are there?
How many hexagons are there?

20.



Pattern #77, Toothpicks in step 43 = 2020