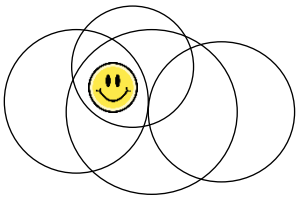
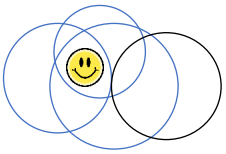
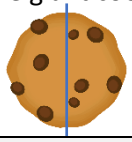
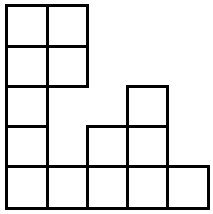
First Name: _____ **Last Name:** _____ **Grade:** _____

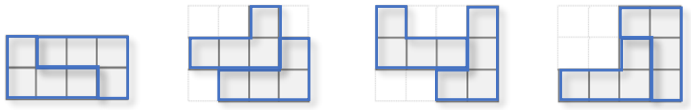
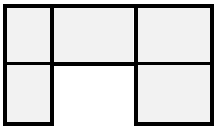
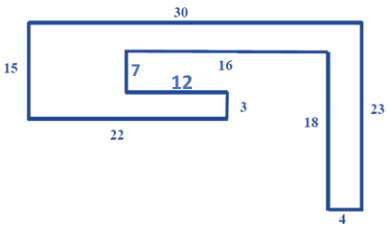
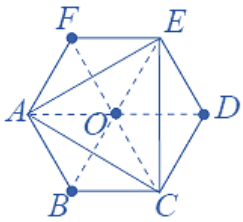
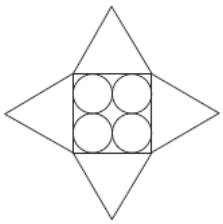
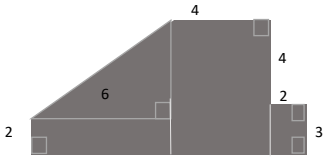
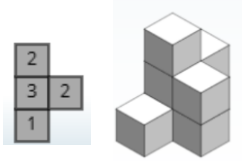
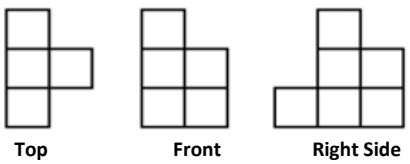
Teacher: _____ **Parent's email:** _____

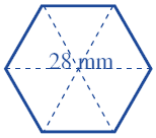
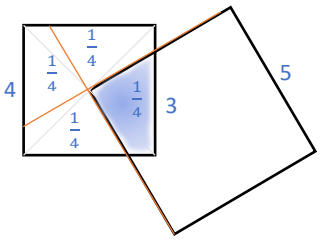
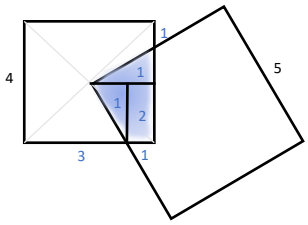
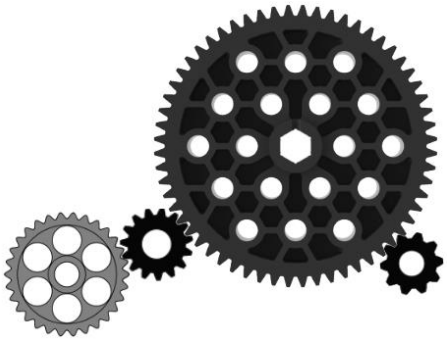
Fun Shapes

Welcome to Math Challenge #12. In this challenge, we will explore 2-dimensional shapes such as circles, squares, rectangles, and hexagons. In geometry, there are regular and irregular shapes, which are also called regular and irregular polygons. A regular polygon has all its sides equal and all its angles equal in measure. Examples of regular polygons are squares, equilateral triangles, regular pentagons, etc. An irregular polygon does not have all its sides equal and not all the angles are equal in measure. Examples of irregular polygons are right triangles, scalene triangles, rectangles and rhombi (when they are not a square), parallelograms irregular hexagons, etc.

Kinder & First Grade: solve <u>at least</u> 3 problems.
Second & Third Grade: solve <u>at least</u> 7 problems.
Fourth Grade and above: solve <u>at least</u> 12 problems.

		Answer
1.	The smiley face is inside how many circles?  	*3*
2.	When you have 2 identically-shaped cookies that you share equally with a friend, each of you will get 1 cookie. a. If you have 6 small cookies (identical in shape and size) to share equally with another friend, each of you will get ___ cookies.  b. If you have one giant cookie to share with your mom equally, you will get ___ of a cookie. 	*a. 3 [cookies]* *b. Half or ½*
3.	How many of the following pictures have equal part of black and white area? 	*3*
4.	A square was originally made out of 25 small squares. Some of the small squares are missing. How many small squares are missing? There are 14 squares, so the number of missing squares is 25 – 14 = 11 	*11 [squares]*

5.	Only the first 4 can be made without overlapping the pieces. 	*4*
6.	▲ = 6 ● = 2 ■ = 7 ■ + ■ = **14**	*14*
7.	Single rectangle: 5 Double rectangles: 4 Triple rectangle: 1 Total = 5+4+1 = **10** 	*10*
8.	 23-18 = 5 15-5-3 = 7 30-(16+4) = 10 22-10 = 12 P = 15+30+23+4+18+16+7+12+3+22 = **150**	*150*
9.	 We can label vertices A, B, C, D, E and F. Since the hexagon is regular, it can be divided into 6 equilateral triangles as shown. Therefore, quadrilateral OABC is a rhombus, and its diagonal AC is a line of symmetry. So, if vertex B is folded onto O, the fold will be along AC. Similarly, if D and F are folded onto O, the fold will be along CE and EA respectively. The figure that is formed will be a triangle, and since all three of the rhombuses (OABC, OCDE, and OEFA) are made out of two congruent equilateral triangles, the lengths of their diagonals AC, CE, and EA will be equal. Therefore, the shape of ACE that is formed is an **equilateral triangle**.	*Equilateral triangle*
10.	The radius of each of the circles is 5 cm and hence the diameter of each is 10 cm. The length of the side of the square is equal to the sum of the diameters of two circles and is equal to 20 cm. The length of each side of the equilateral triangle is equal to the length of the side of the square. Hence the perimeter of the star, which is made up of eight sides of congruent equilateral triangles, is 8 × 20 cm = **160 cm.** 	*160 [cm]*
11.	Split it into smaller shapes you can find the area as the sum of the areas of the smaller parts. 2×3 + 4×(4+3) + 2×6+1/2×6×(7-2) = 6 + 28 + 12 + 15 = **61 cm^2** 	*61 [sq cm or cm^2]*
12.	Each small square has a side of 5 inches. The perimeter of the rectangle is 2×(4+3)×5 = **70 inches.**	*70 inches*
13.	Build it with the cubes you probably have, or think about the right side, which has 6 cubes already, then, looking from the top and front, you have another two cubes. Thus, there will be **8 cubes.**  	*8*

14.		A regular hexagon can be subdivided into 6 equilateral triangles. The long diagonal consists of exactly 2 of these side lengths, and the perimeter consists of 6 of these side lengths, which is 3 times as much. The perimeter of the hexagon must be 3 × 28 = **84** mm.	*84 [mm]*
15.	Original square is 16×16 = 256 in^2. Then fold it in half once we get the area of 128 in^2. Then another fold will get 64 in^2; then 32 in^2; and finally, **16 in^2.**		*16 [sq in or in^2]*
16.	An octagon with whole number side lengths could have perimeter 80, 88, or 96. A hexagon with whole number side lengths could have perimeter 84, 90, 96. So, 96 must be the perimeter of both if their perimeters are equal. A square with perimeter 96 would have side lengths of 96÷4 = 24, and an area of 24^2 = **576**.		*576 [cm^2]*
17.	 Notice that the square with a side of 4 can be divided into 4 identical shapes. The area of shaded region is ¼ of 4^2 = **4 unit^2.** If one side of the overlapping region is equal to 3, then the left-out part is 1. And split into the smaller parts. The areas will be 1 for the right triangles and 2 for the rectangle. 1 + 1 + 2 = **4 unit^2** 		*4 [unit^2]*
18.	The number of teeth in gear ratio from left to right is 30 : 15 : 60 : 10. When the left gear rotates once, the second one will rotate twice. The large gear will rotate halfway (30 teeth), while the smallest one (last) will make 3 full turns 30/10 = **3**.		*3 [revolutions]*

Solution is available on March 29, 2024
www.mathinaction.org