1. a) How many equilateral triangles can you construct by joining the points in this isometric grid?

b) How many parallelograms?

c) How many trapezoids?

In each case, how do you know you have found all possibilities?
2. Given the square grid shown, draw quadrilaterals having segment AB as one of the sides. All four vertices of the quadrilateral must be grid points.

   a) How many parallelograms are possible?

   b) How many rectangles are possible?

   c) How many rhombuses are possible?

   d) How many squares are possible?

   In each case, be prepared to make an argument that there are no more.
3. A pentomino is made by five connected squares that touch only on a complete side. There are 12 non-congruent pentominos.

- Draw all 12 pentominos on a sheet of centimeter graph paper.
- Label the pentominos that have reflection symmetry and draw all lines of symmetry.
- Label the pentominos that have rotation symmetry and give the smallest angle of rotational symmetry.
4. Use 3 pentomino shapes to form a 3 x 5 rectangle. Use 5 pentomino shapes to form a 5 x 5 square. Use all of the pentominos to make a 6 x 10 rectangle.
5. Use your protractor to measure angles E, D, C, and F with dots on their vertices in the following semicircle. Make a conjecture based on your findings.

What are some differences between a conjecture and a proof?
6. Find the measures of $\angle 1$, $\angle 2$, $\angle 3$ and $\angle 4$ if lines $l$, $m$, and $n$ are parallel. Is this picture drawn to scale?
7. Saima is attempting a tessellation with regular pentagons. She ends up with gaps as shown in this figure. What kind of quadrilateral is made by a gap? What are the angle measurements of that quadrilateral? Be prepared to justify your answer without using a protractor.
8. Find the measure of the following angles drawn on isometric grids without using your protractor. What are the properties of the isometric grid that allow you to make your conclusions?
9. Sometimes one must deal with very small angles. What angle does the hour hand sweep out in one second of time.
10. When it is exactly twelve o'clock, the angle between the hour hand and the minute hand is 0 degrees? Because the minute hand passes the hour hand once every hour there will be eleven more times when the hands coincide. When? Please note that the hands are NOT coincident at 1:05 because at that time the hour hand has already passed the 1:00 mark.
11. A square and a regular pentagon are shown. Find the measure of the indicated angle. Is the sketch drawn to scale? That is, can you find the answer by measuring?
12. A regular 9-gon is shown. Is the triangle ACE obtuse, acute, or right? Find the measure of the indicated angle. Is the sketch drawn to scale? Can you find the answer by measuring?
13. Find the measure of angles $a$ and $b$. Show your work. Is the drawing a scale drawing?
14. Calculate the measure of the indicated angles. Is the diagram drawn to scale?

Given that \( \angle F = \angle H \)

Find the measure of these angles.

\( \angle DCA \)

\( \angle ECD \)

\( \angle F \)

\( \angle BKF \)
15. In the five-pointed star, what are the measures at the angles at points A, B, C, D, and E? Assume that the pentagon in the center is a regular pentagon.
16. A ninth grade student drew this figure to investigate the sum of the angles in a convex 7-gon. He said that, because there are seven triangles in the picture, the sum of its vertex angles equal to 7 times $180^\circ = 1260^\circ$. Where has this student gone wrong? Working from his picture show how to find the correct answer.
17. If one circle represents the set of rectangles and the other circle represents the set of parallelograms, which of the diagrams best represents the relationship between rectangles and parallelograms?

a) If one circle represents the set of rhombuses and the other circle represents the set of rectangles, which of the diagrams best represents the relationship between rhombuses and rectangles?

b) Find a different relationship to illustrate the remaining diagram.
18. Find the measures of all angles of this regular nonagon when the diagonals from one vertex are included in the diagram.
19. These conversations were overheard in the classroom, in stores, and in other places where people discuss mathematics. Comment on the reasoning expressed or implied.

a) Gail draws a horizontal line through a parallelogram and says, “If I cut along this line, the two pieces fit on top of each other. So my line must be a line of symmetry!”

b) Fred chose the floor tiling pattern shown below using squares and octagons. After studying it for a few minutes, he decided that each angle of the octagon measures 135°, even it is not a regular octagon.
20. A saw blade is made by cutting 17 congruent right triangles out of a regular 17-gon as shown below. If the angle $M$ is the right angle, what is the measure of the angle made by the sharp points of the blade? The line segment $MN$ is coincident with a radius of the 17-gon.
21. Identify the types of symmetry present in the following patterns.

Create a pattern in this square that has symmetry through a vertical line but no other symmetries.
22. Determine the isometry that maps the shape on the left onto the shape on the right. All but one can be done with one simple isometry (rotation, translation or reflection). Which one? In each case be ready to demonstrate the transformation using tracing paper. Include the center of rotation, line of reflection, arrow of translation as needed.