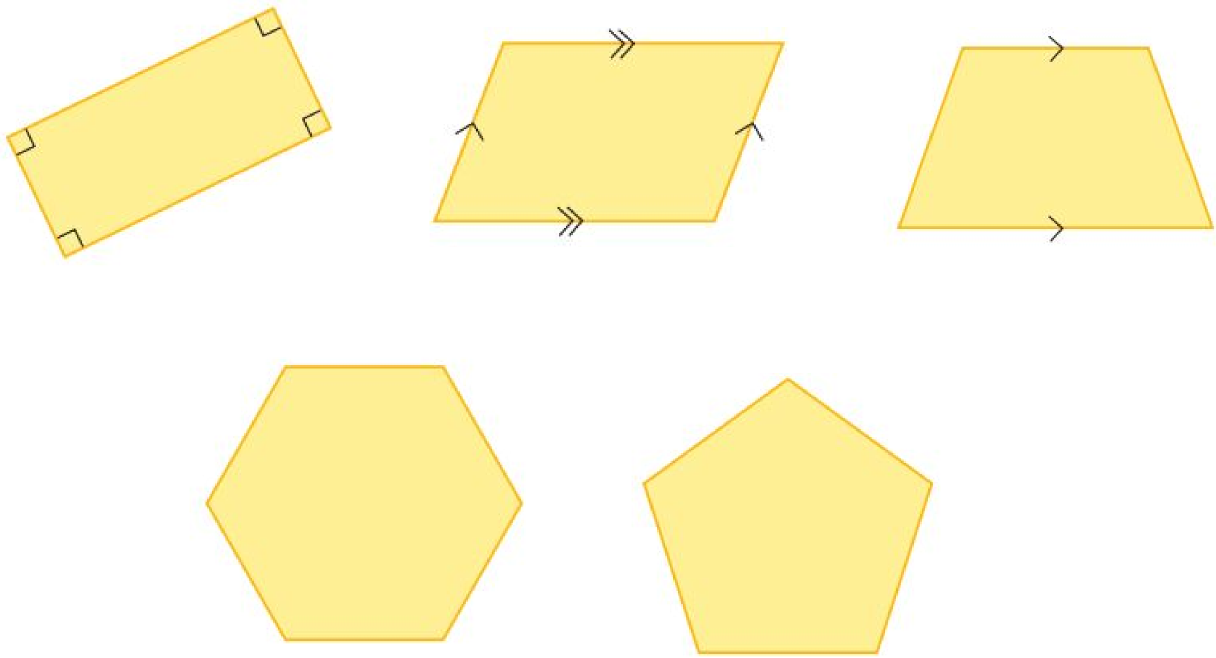
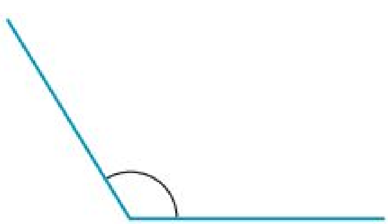
Unit 5: Properties of Figures

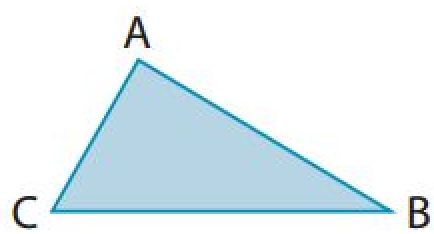
Warm up

1. Identify each of the figures below.



2. Measure each of the angles below.





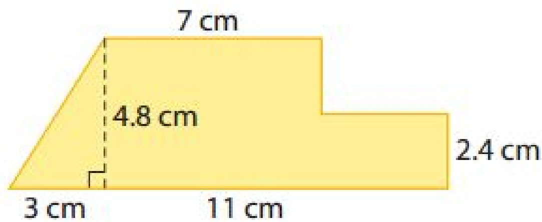
3. Draw each of the angles given below.
   a. 55°

   b. 155°

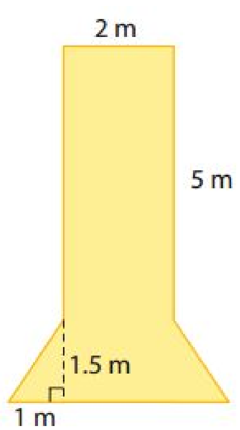
4. Determine the area of each figure, use lines to break complex shapes into rectangles or triangles.

   a.

   b.



   c.

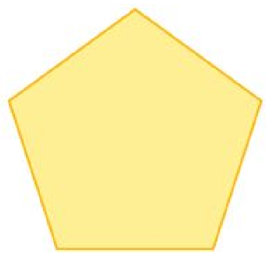


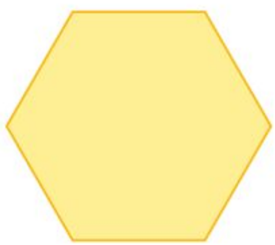
Section 5.1 - Angle Properties of Polygons

The angle properties of a **regular polygon** can be determined by the number of triangles in the shape.

- the number of triangles in a shape is determined by drawing as many **diagonals** as possible without any of them crossing.

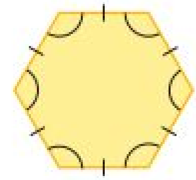
Draw diagonals on the shapes below and write the number of triangles in each.





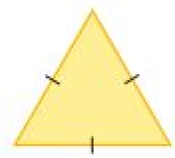
regular polygon

- a closed figure with three or more straight sides and equal side and angle measurements



equilateral triangle

- a triangle with equal side lengths



diagonal

- a line segment connecting two non-adjacent vertices in a polygon

Complete the table below.

Figure	Number of Sides	Number of Triangles	Sum of Interior Angles	Measure of Each Interior Angle
Equilateral triangle	3	1	180°	
Square				
Regular pentagon				
Regular hexagon				

In any **regular polygon**, the **sum of the interior angles** will always be: $S = 180(n-2)$

And the measure of **each interior angle** will always be: $M = \frac{180(n-2)}{n}$

- **n is the number of sides in the shape.**

For example, consider a **hexagon** (n = 6)

$$S = 180(6-2)$$
$$S = 180(4)$$
$$S = 720$$

The sum of the angles in a hexagon is 720°

For each of the shapes listed use the equations above to determine the the sum of the internal angles and the measure of each angle.

1. Rectangle

2. Regular Pentagon

3. Regular Octagon

4. A 10-sided Regular Polygon

5. A 25-sided Regular Polygon

Tesselation

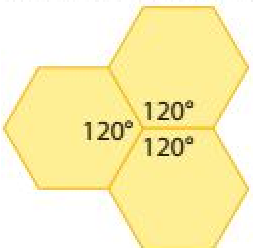
To form a tessellation, the corners of the objects involved must be able to be combined to **add up to 360°**.

tessellate

- to cover an area using the repetition of geometric shapes, with no overlaps and no gaps

Example:

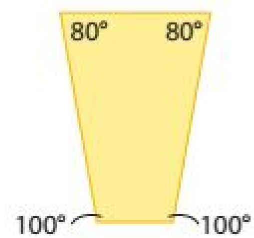
Measure the interior angles where the vertices of the hexagons meet.



Each of the interior angles is 120°. The sum of the three angles is 360°. Therefore, a regular hexagon can be used to tile the floor.

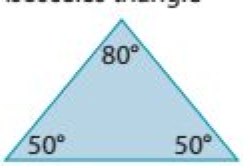
> When the interior angles where the vertices meet total exactly 360°, it means the polygon can tessellate an area.

The angles in these objects do not have to all be equal. The shape shown can form a tessellation by alternating the orientation to allow for two 80° corners and two 100° corners, totaling 360°.

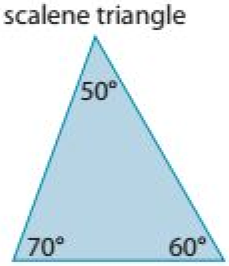


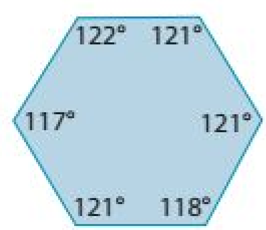
Can each of the shapes below be used in a tessellation? **Explain by showing your work.**

isosceles triangle

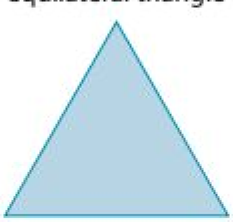


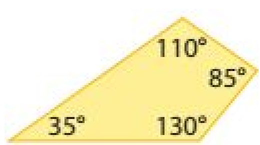
scalene triangle





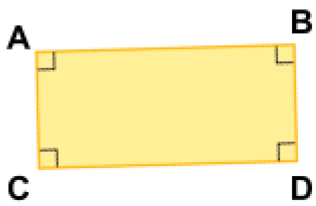
equilateral triangle





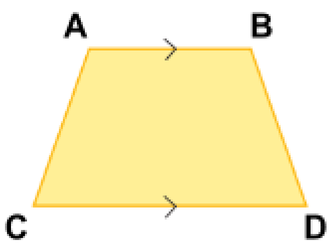
Section 5.2 - Side Lengths and Diagonal Properties of Polygons

Measure the length of **each of the diagonals** in the shapes below.



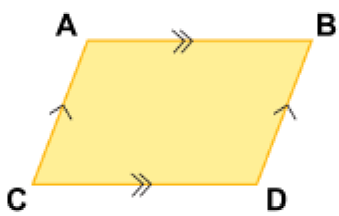
AD =

CB =



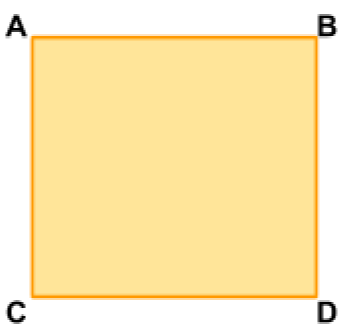
AD =

CB =



AD =

CB =



AD =

CB =

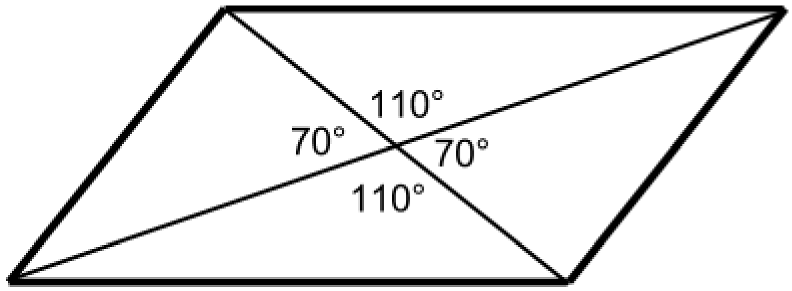
What do you notice about the lengths of the diagonals for most of the quadrilaterals?

Which one didn't fit the pattern?

Angle Properties

In any regular polygon, the **sum** of the angles made by the diagonals must equal **360°** and angles opposite one another **must be the same!**

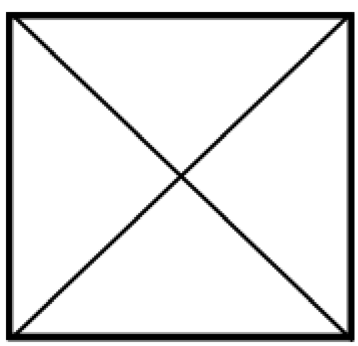
Ex.

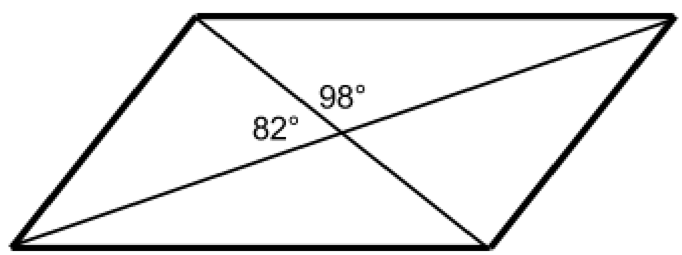


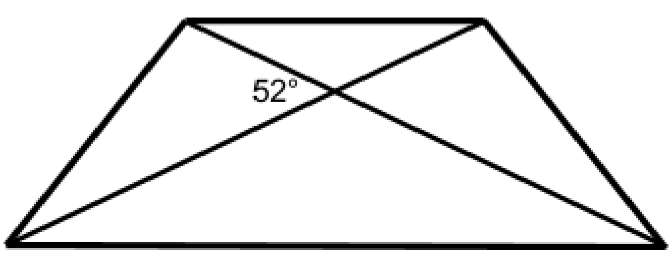
$110 + 110 + 70 + 70 = 360°$

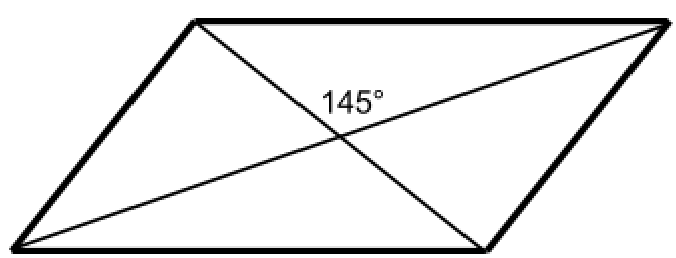
For a square, each of these angles is 90°.

Determine the **missing angles** in each and **check that the angles add to 360°**:

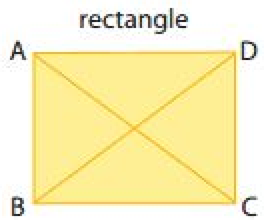








Use what you discovered on the previous two pages to determine the missing values:



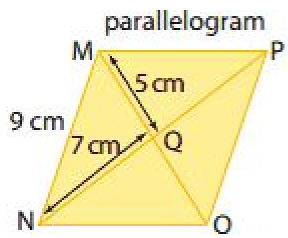
AB = 3 in. AD = 4 in.
AC = 5 in. BC = ■ in.
CD = ■ in. BD = ■ in.

a) BC: __________

CD: __________

BD: __________

b)



QO = ■ cm MO = ■ cm
PO = ■ cm PQ = ■ cm

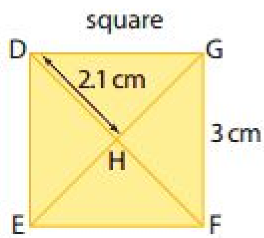
QO: __________

MO: __________

PO: __________

PQ: __________

c)



DG = ■ cm HF = ■ cm
GE = ■ cm ∠GHF = ■°

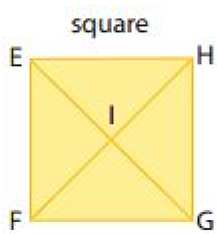
DG: __________

HF: __________

GE: __________

∠GHF: __________

d)



EF = 6.5 cm FG = ■ cm
EG = 9.2 cm FH = ■ cm
∠GFE = ■° ∠EIH = ■°

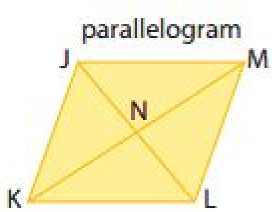
FG: __________

FH: __________

∠GFE: __________

∠EIH: __________

e)



JM = 6 ft KL = ■ ft
∠JNM = 100° ∠KNL = ■°
∠JNK = ■° ∠LNM = ■°

KL: __________

∠KNL: __________

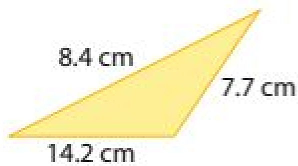
∠JNK : __________

∠LNM : __________

Triangle Properties

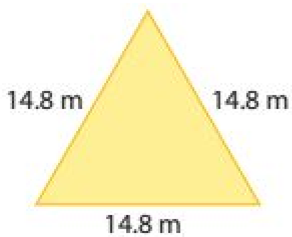
For any given triangle, a side length must always be opposite it's corresponding angle. This means the longest side is opposite the largest angle, the smallest side is opposite the smallest angle, etc.

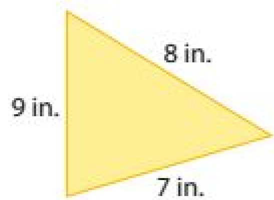
Ex.

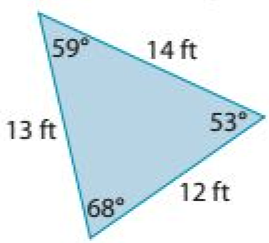


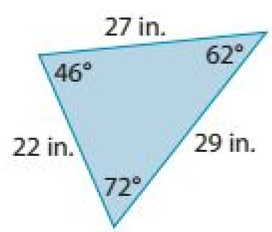
This triangle cannot be correct because the largest angle is opposite 8.4 cm, which is not the longest side!

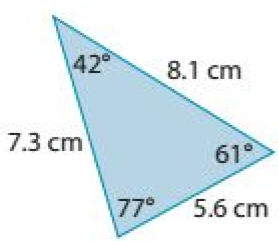
Are the triangles below labelled properly? **If not, explain what is wrong.**



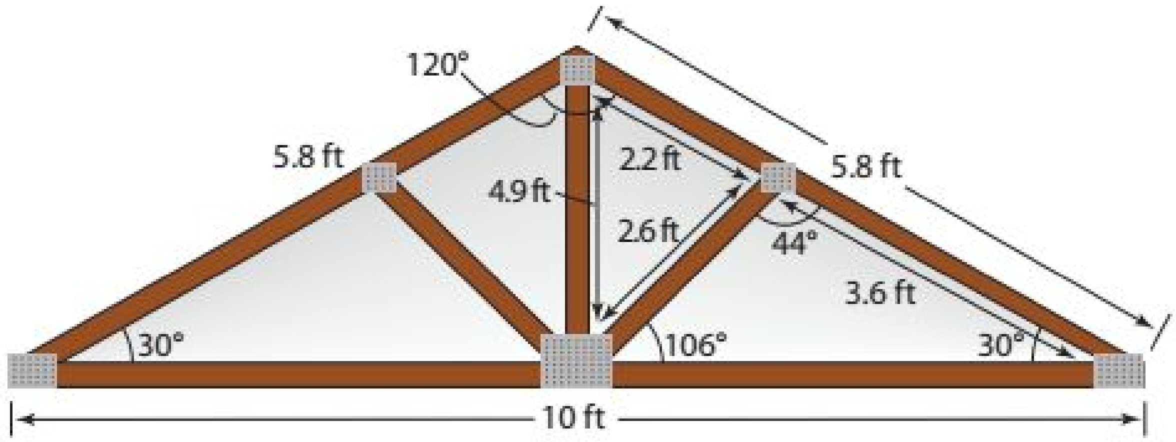








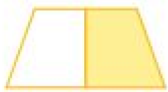
The following plans are drawn for a roof truss. Will they work? **Explain.**



Section 5.3 - Symmetry

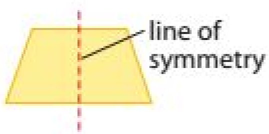
line symmetry

- a type of symmetry in which an image or object can be divided into two identical halves by a line of symmetry



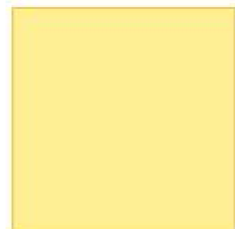
line of symmetry

- a line that divides a figure into two identical halves
- sometimes called a line of reflection or axis of symmetry



For each shape below, **draw** all possible lines of symmetry:

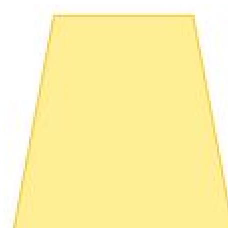
Square:



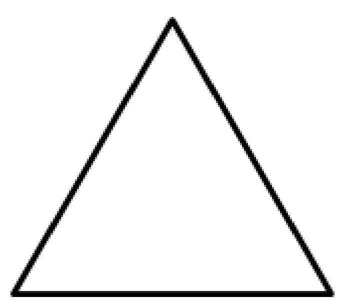
Rectangle:

Parallelogram:

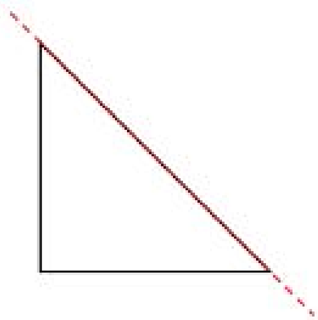
Trapezoid:

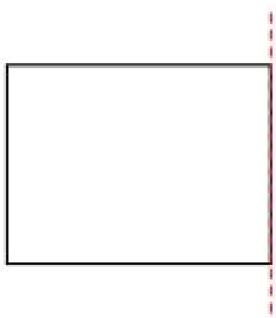


Equilateral Triangle:

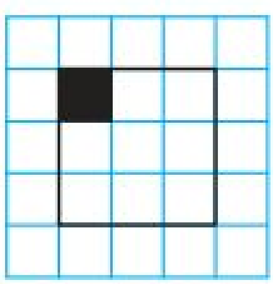


Each diagram shows half of a symmetric quadrilateral. **Sketch** the missing half.

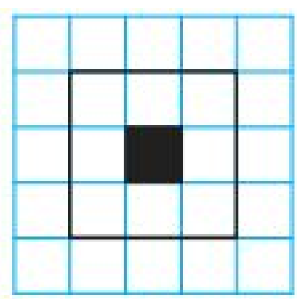




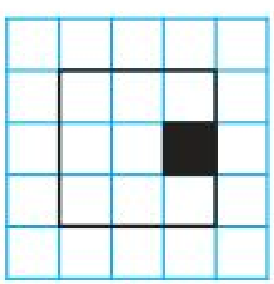
On each grid, shade in squares so that each **large square** has the number of lines of symmetry indicated. **Draw** in the lines of symmetry.



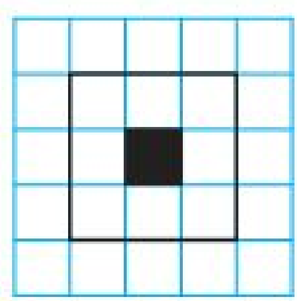
1 line of symmetry



4 lines of symmetry



2 lines of symmetry



0 lines of symmetry