



# Geometry

## Workbook

First Edition

Grade 7

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# Unit 1: Geometry



*"The laws of nature are but the mathematical thoughts of God"*

Euclid



Unit 1

**C** H A P T E R

**1**

**Chapter 1: Foundation for  
Geometry**



## Lesson 1: Understand Points, Lines, and Planes

### WHAT WILL YOU LEARN?

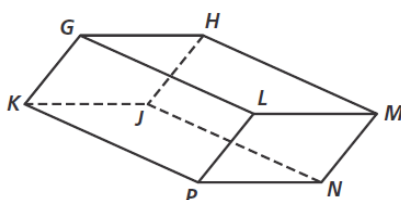
Define and represent basic geometric terms.

### FOCUS ON APPLICATION

Architects use representations of points, lines, and planes to create models of buildings. Interwoven segments were used to model the beams of Beijing's Stadium for 2008 Olympics.

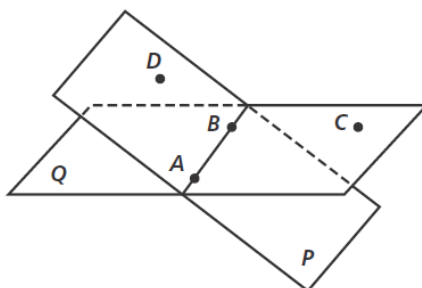


**Exercises 1 – 5:** Use the diagram below to answer the questions



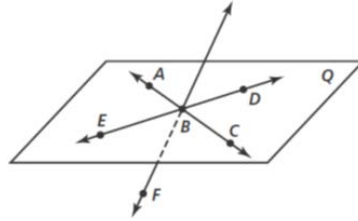
- 1) Name four coplanar points.
- 2) Name three straight lines.
- 3) Name two planes.
- 4) Name two lines whose intersection is point P.
- 5) Name two planes whose intersection is line PL.

**Exercises 6 – 9:** Use the diagram below to answer each question.



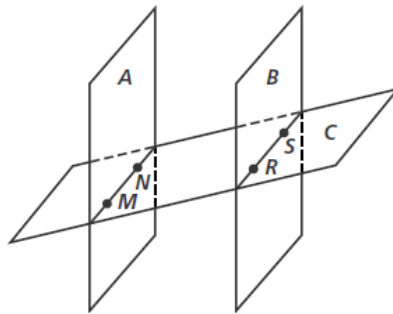
- 6) Name two planes.
- 7) Are the points A, B, C and D coplanar.
- 8) Are the points A, B and D collinear.
- 9) What is the intersection of the two planes P and Q?

**Exercises 10 – 18:** Use the diagram below to answer each question.



- |                                                                   |                                                   |
|-------------------------------------------------------------------|---------------------------------------------------|
| 10) Name four coplanar points.                                    | 11) Name three straight lines.                    |
| 12) Name two planes.                                              | 13) Name Two straight lines.                      |
| 14) What is the intersection of the two straight lines AC and ED? | 15) Are the points A, C and F collinear?          |
| 16) Are the points F, B, D and C coplanar?                        | 17) Name two lines whose intersection is point B. |
| 18) What is the intersection of plane Q and line BF?              |                                                   |

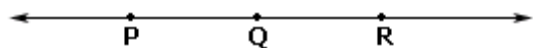
**Exercises 19 – 23:** Use the diagram below to answer each question.



- |                                                 |                                                 |
|-------------------------------------------------|-------------------------------------------------|
| 19) Name four coplanar points.                  | 20) Name two straight lines                     |
| 21) Name two planes.                            | 22) What is the intersection of planes A and C? |
| 23) What is the intersection of planes B and C? |                                                 |

**Exercise 24:** Which of the following statements best describes the points P, Q, R?

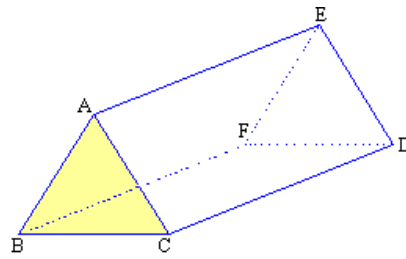
- I. The points P, Q, R are collinear.
- II. The points P, Q, R are non-collinear.
- III. The points P, Q, R are on plane R.



- |                   |             |
|-------------------|-------------|
| A. I only         | B. II only  |
| C. I, II, and III | D. III only |



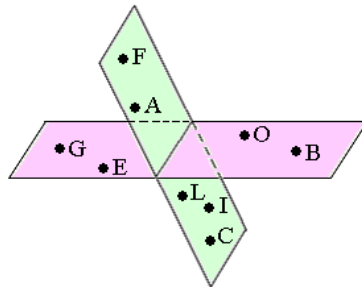
**Exercise 25:** What is the intersection of AEFB and CDEA?



- A.  $\overline{CD}$
- B.  $\overline{FE}$
- C.  $\overline{AE}$
- D.  $\overline{ED}$

**Exercise 26:** Choose the correct statement/statements.

- I. Points F, A, L, I, C, G, E, O, B are coplanar.
- II. Points G, E, O, B are collinear.
- III. O, A, and B are coplanar.
- IV. Points F, A, L, I, C are coplanar.



- A. I only
- B. III and IV only
- C. I and II only
- D. IV only

**Exercises 27-30:** Determine the total number of lines that can be drawn through the given number of distinct points on a plane.

27) 3 points

28) 6 points

29) 8 points

30) Derive the formula for the total number of lines that can be drawn through  $n$  points.

**Exercises 31 - 32:** Each street in a particular town intersects every existing street exactly one time. Only two streets pass through each intersection



**2 streets**



**3 streets**



**4 streets**

31) A traffic light is needed at each intersection. How many traffic lights are needed if there are 5 streets in the town? 6 streets?

32) Describe a pattern you can use to find the number of additional traffic lights that are needed each time a street is added to the town.

**Exercise 33:** Plot the following points in the same coordinate plane then determine the total number of lines that can be drawn through the given the number of distinct points on a plane.

$(-5, 1), (-3, -3), (-1, -2), (0, 3), (-3, 3), (-5, 1)$

## Lesson 2: Measuring and Constructing Segments

### WHAT WILL YOU LEARN?

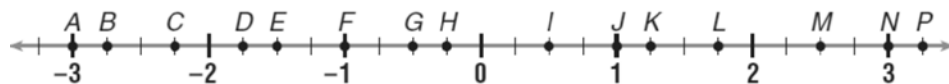
Find the length of a segment using a number line or specific measurements.

### FOCUS ON APPLICATION

You can measure a segment to calculate the distance between two locations. Maps of a race are used to show the distance between stations on the course.



**Exercises 1 - 11:** Use the number line to find each measure.



- |        |        |
|--------|--------|
| 1) AI  | 2) FK  |
| 3) AP  | 4) CK  |
| 5) HM  | 6) JK  |
| 7) IN  | 8) GH  |
| 9) AN  | 10) MN |
| 11) HL |        |

**Exercises 12 - 18:** Use the number line to find each measure.



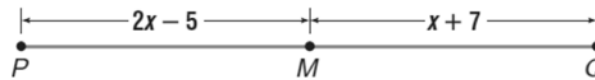
- |        |        |
|--------|--------|
| 12) BG | 13) AF |
| 14) DE | 15) DF |
| 16) CD | 17) AE |
| 18) AG |        |

**Exercises 19 - 20:** Three segment measures are given. The three points named are collinear. Determine which point is between the other two.

19)  $TM = 21, MH = 37, TH = 16$

20)  $XZ = 36, YZ = 17, XY = 19$

**Exercises 21 - 23:** In the figure below,  $M$  is the midpoint of  $\overline{PQ}$ .

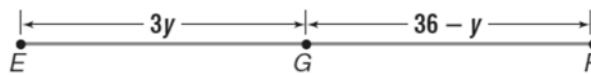


21) Find the value of  $x$ .

22) Find the length of  $PM$ .

23) Find the length of  $PQ$ .

**Exercises 24 - 26:** In the figure below,  $G$  is the midpoint of  $\overline{EF}$ .

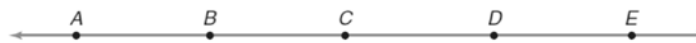


24) Find the value of  $y$ .

25) Find the length of  $EG$  and  $GF$ .

26) Find the length of  $EF$ .

**Exercises 27 - 29:** If  $AB = 5, BD = 14, CE = 19$ , and  $AE = 35$ , find:



27)  $BC$

28)  $CD$

29)  $DE$

**Exercise 30:** At the beginning of a drive on Sheikh Zayed Road that goes due west, Mohammad noticed that he was 7 miles east of a run-down shack. If the midpoint of his drive was 5 miles west of the run-down shack, how far did Mohammad have to travel?

**Exercise 31:** If Mariam is 18 kilometers west of Sanjay, Omar is 27 kilometers east of Hana, and Mariam is 13 kilometers west of Omar, how many miles is Sanjay from Hana?

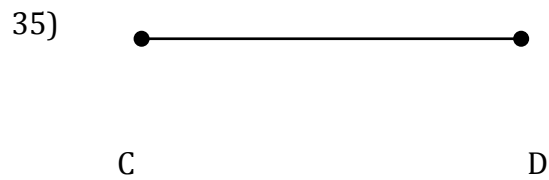
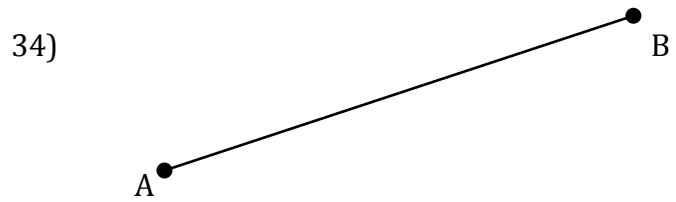
**Exercises 32 - 33:** In the year 2003, a remote-controlled model of an airplane became the first ever to fly nonstop across the Atlantic Ocean. The map below shows the position of the airplane at three different locations during its flight.



32) What is the total distance traveled by the model airplane?

33) The plane's flight lasted nearly 38 hrs. What is the approximate average speed of the model airplane in miles per hour?

**Exercise 34-35:** Construct the midpoint of the following segments.



## Lesson 3: Measuring and Constructing Angles

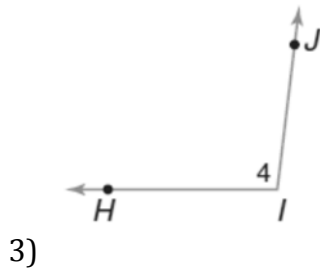
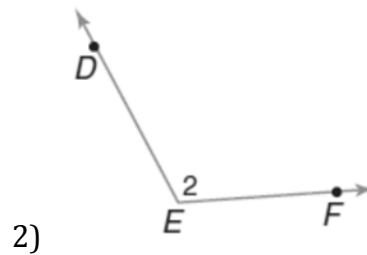
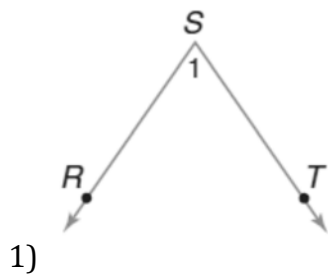
### WHAT WILL YOU LEARN?

Classify angles according to their measure in degrees.

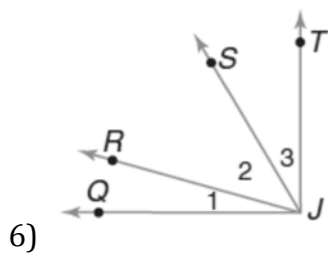
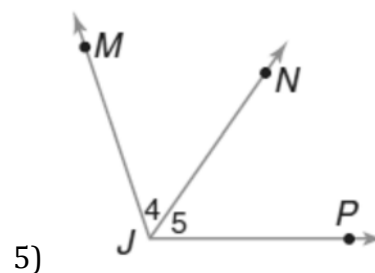
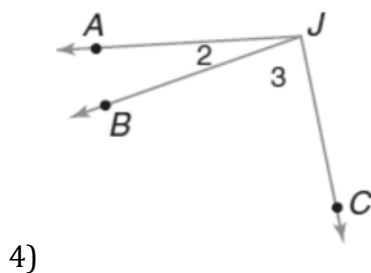
### FOCUS ON APPLICATION

Bicycle manufacturers use angles when designing bicycles.

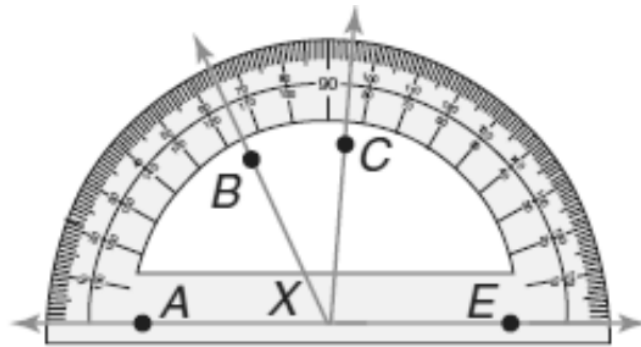
**Exercises 1 - 3:** Name each angle in four ways. Then identify its vertex and its sides.



**Exercises 4 - 6:** Name all angles having J as their vertex.



**Exercises 7 - 11:** Find the measures of:



7)  $\angle BXE$

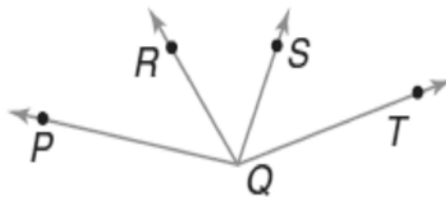
8)  $\angle CXE$

9)  $\angle AXB$

10)  $\angle AXC$

11)  $\angle BXC$

**Exercises 12 - 14:** Given that  $m\angle SQT = x+10$ ,  $\angle PQS = 4x+40$ , and  $\angle PQT = 10x-120$ , find the measures of:

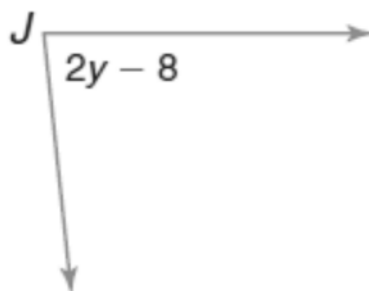


12)  $\angle SQT$

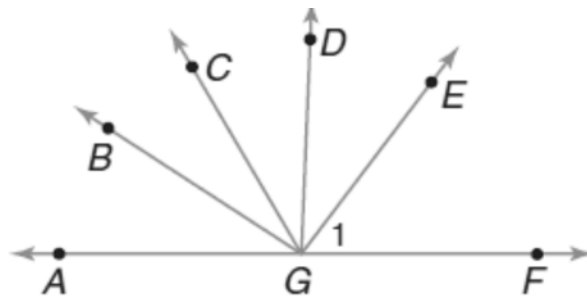
13)  $\angle PQS$

14)  $\angle PQT$

**Exercise 15:** The measure of  $\angle J$  is 84. Solve for  $y$ .



**Exercises 16 - 18:** Refer to the figure to answer the following questions:

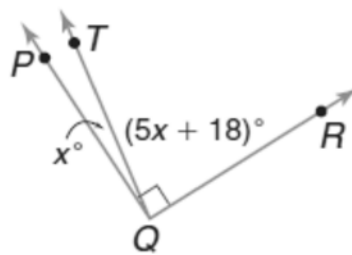


16) If  $m\angle AGB = 40$  and  $m\angle BGC = 24$ , find  $m\angle AGC$ .

17) If  $m\angle BGD = 52$  and  $m\angle BGC = 24$ , find  $m\angle CGD$ .

18) If  $GE$  bisects  $\angle CGF$  and  $m\angle CGF = 116$ , find  $m\angle 1$ .

**Exercises 19 - 21:** If  $m\angle PQT = x$ ,  $m\angle TQR = 5x + 18$ , and  $m\angle PQR = 90$ , find:

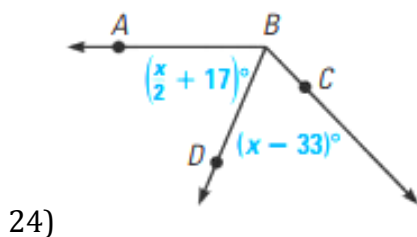
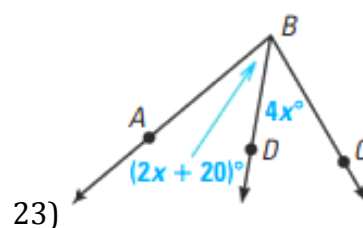
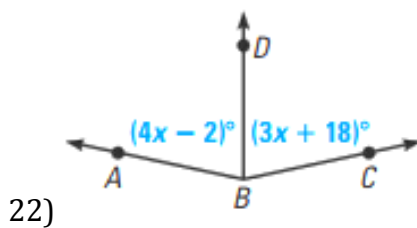


19) value of  $x$

20)  $m\angle PQT$

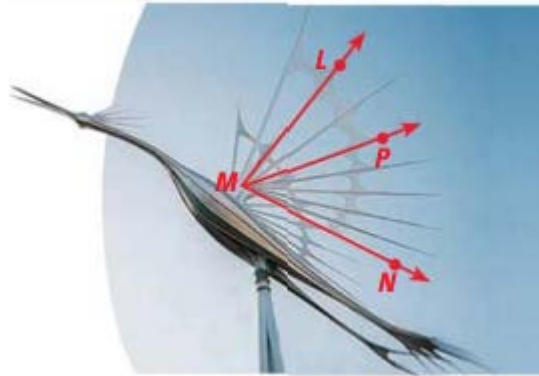
21)  $m\angle TQR$

**Exercises 22-24:** In each diagram,  $BD$  bisects  $\angle ABC$ . Find  $m\angle ABC$ .

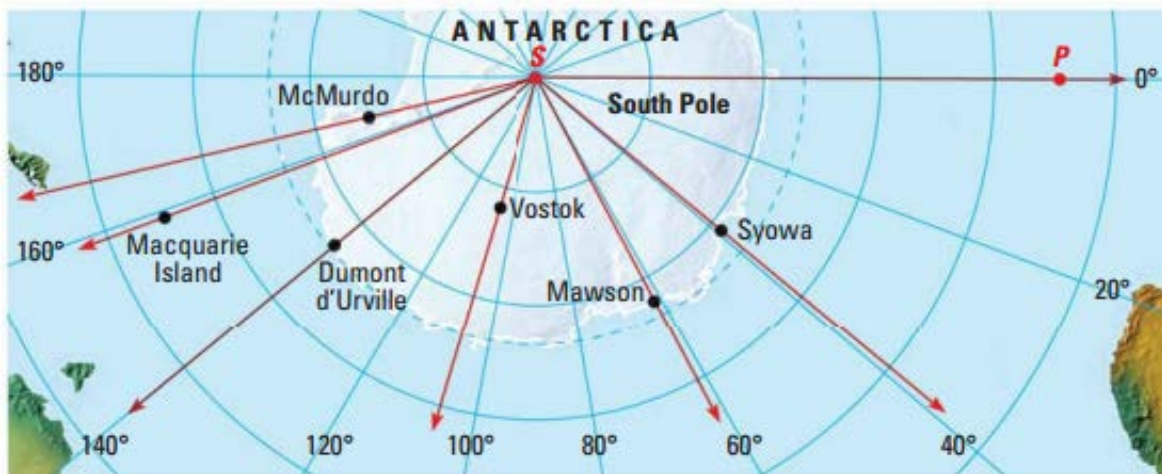




**Exercise 25:** In the sculpture shown in the picture below, if the measure of  $\angle LMN$  is  $79^\circ$  and the measure of  $\angle PMN$  is  $47^\circ$ , find the measure of  $\angle LMP$ .



**Exercises 26-31:** For the selected location on the map, find the approximate measure of  $\angle PSL$ , where P is on the Prime Meridian ( $0^\circ$  longitude), S is the South Pole, and L is the location of the indicated research station.



26) Macquarie Island

27) Dumont d'Urville

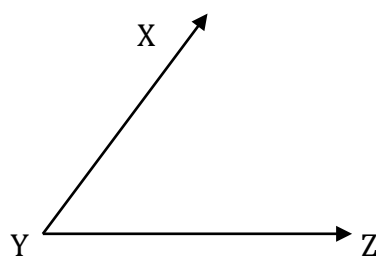
28) MacMurdo

29) Mawson

30) Syowa

31) Vostok

**Exercise 32:** Construct the angle bisector of  $\angle XYZ$



## Lesson 4: Adjacent Angles and Pairs of Angles

### WHAT WILL YOU LEARN?

Define adjacent angles, complementary angles and supplementary angles and use their properties in problem solving.

### FOCUS ON APPLICATION

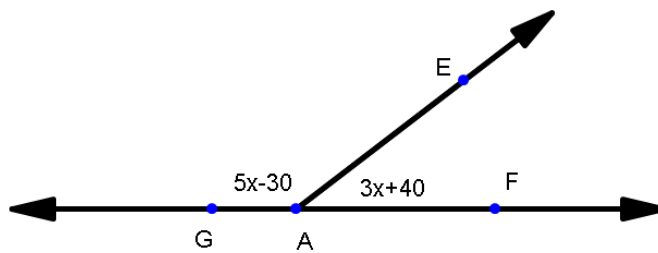
Scientists use properties of angle pairs to design fiber-optic cables.

A fibre-optic cable is a strand of glass as thin as a human hair. Data can be transmitted over long distances by bouncing light off the inner walls of the cable.

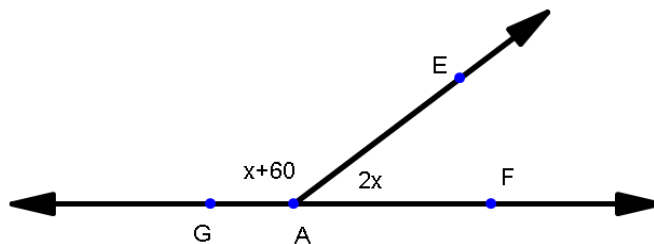


**Exercises 1 - 2:** Given that  $\angle GAE$  and  $\angle EAF$  are supplementary, find the value of  $x$  and the measure of each angle

1)

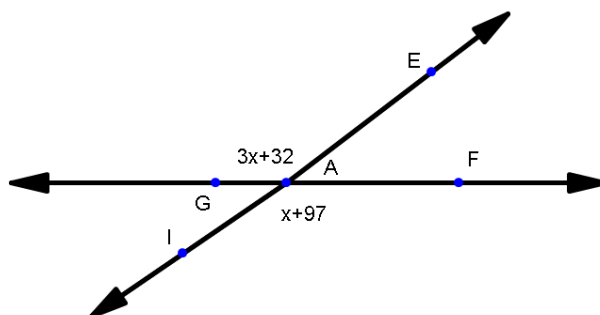


2)

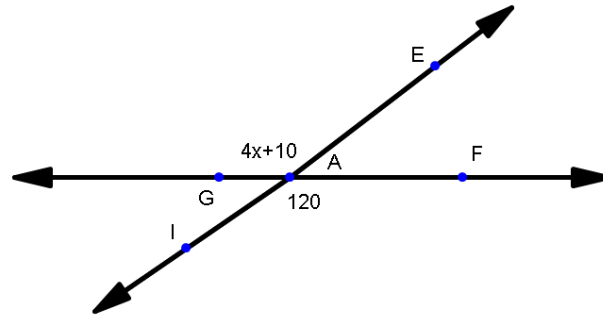


**Exercises 3 - 4:** Find the value of  $x$  and the measure of each angle.

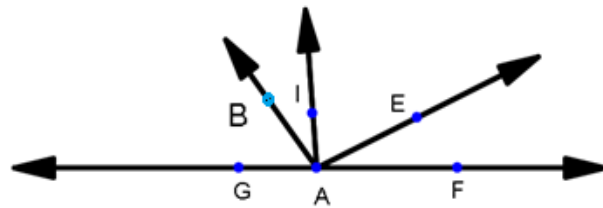
3)



4)

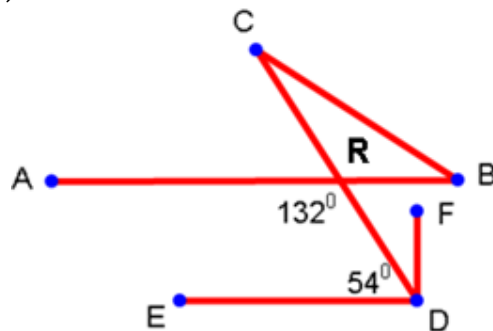


**Exercises 5 - 8:** Given the diagram below.



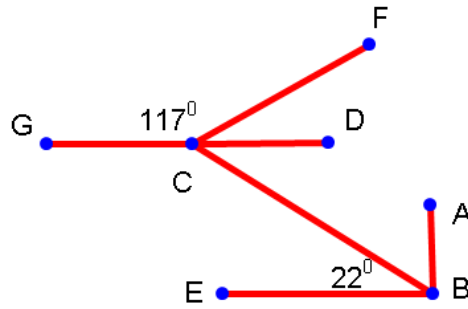
- 5) If  $m\angle FAE = 40^\circ$  and  $\angle FAE$  is the complement of  $\angle IAE$ , find  $m\angle IAE$  and  $m\angle GAE$ .
- 6)  $m\angle FAB = 137^\circ$ , find  $m\angle GAB$ .
- 7) If  $m\angle FAB = 163^\circ$  and  $m\angle FAI = 100^\circ$  find  $m\angle IAB$ .
- 8) If  $m\angle BAI = 38^\circ$  and  $\angle IAE$  is the complement of  $\angle IAB$ , find  $m\angle IAE$ .

**Exercises 9 - 12:** Given that  $m\angle ARD = 132^\circ$ ,  $m\angle RDE = 54^\circ$  and  $\angle FDR$  is the complement of  $\angle RDE$ , find:



- |                   |                   |
|-------------------|-------------------|
| 9) $m\angle FDR$  | 10) $m\angle CRB$ |
| 11) $m\angle CRA$ | 12) $m\angle CRA$ |

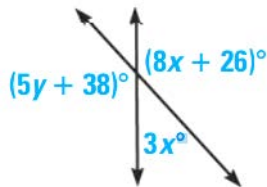
**Exercises 13 - 14:** Given that  $m\angle GCF = 117^\circ$ ,  $m\angle EBC = 22^\circ$  and  $\angle ABC$  is the complement of  $\angle CBE$ , find:



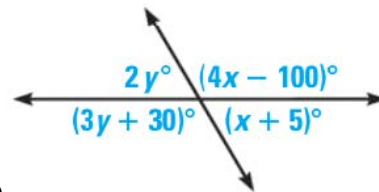
13)  $m\angle FCD$

14)  $m\angle ABC$

**Exercises 15-16:** Find the values of  $x$  and  $y$ .



15)



16)

**Exercises 17-18:** Identify whether the statement is always, sometimes, or never true. Explain your answer.

17) The complement of an acute angle is an acute angle.

18) The supplement of an acute angle is an obtuse angle.

**Exercise 19:** The length of a shadow varies as the sun rises. In the figure below, the length of  $\overline{CB}$  is the length of the shadow of Ibrahim. The end of his shadow is the vertex of  $\angle ABC$ , which is formed by the ground and the sun's rays. Explain how the shadow and angle change as the sun rises.

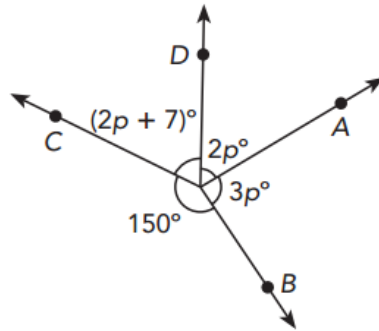


**Exercise 20:** The sum of the measures of two complementary angles exceeds the difference of their measures by  $86^\circ$ . What is the measure of each angle? Explain how you found the angle measures.

**Exercise 21:** The measure of the supplement of an angle is 30 more than twice the measure of the angle. Find the measure of the angles.

**Exercise 22:** If the measures of two complementary angles are in the ratio of 1:14, what is the degree measure of the smallest angle?

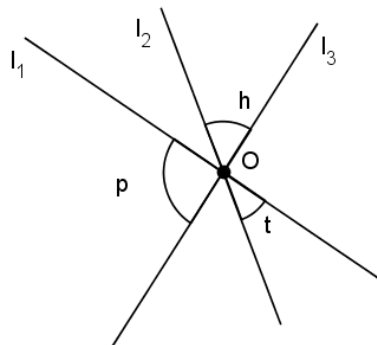
**Exercise 23:** Find the value of  $p$ . (Note: The sum of all the angles at a point is  $360^\circ$ )



**Exercise 24:** In the above figure, lines  $l_1$ ,  $l_2$  and  $l_3$  intersect at point O.

If  $\angle p = 100^\circ$  and  $\angle h = 30^\circ$  what is the measure of  $\angle t$ ?

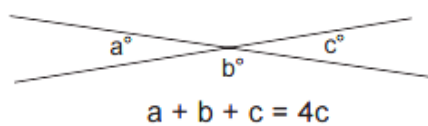
(SAT PROBLEM)



Note: Figure not drawn to scale

- A.  $30^\circ$
- B.  $50^\circ$
- C.  $80^\circ$
- D.  $100^\circ$
- E.  $150^\circ$

**Exercise 25:** In the given figure,  $a + b + c = 4c$ . What is the value of  $c$ ? (SAT PROBLEM)



## Lesson 5: Lines Relationships

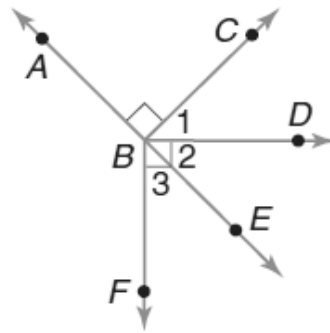
### WHAT WILL YOU LEARN?

Determine the relation between a pair of lines.

### FOCUS ON APPLICATION

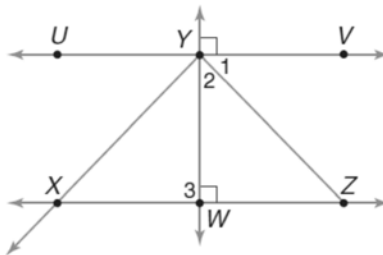
Card architects use playing cards to build structures that contains parallel and perpendicular planes.

**Exercises 1 – 5:** Refer to the given diagram to answer each question:



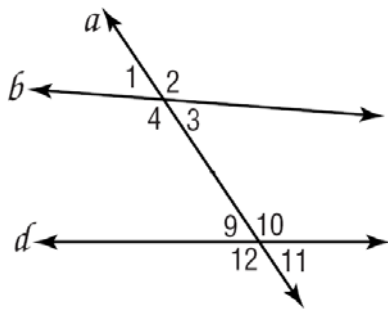
- 1) What is the relation between lines  $\overline{AB}$  and  $\overline{CB}$ ?
- 2) What is the relation between lines  $\overline{DB}$  and  $\overline{FB}$ ?
- 3) What is  $m\angle ABC$ ?
- 4) What is  $m\angle FBD$ ?
- 5) If  $\overline{BE}$  is the bisector of  $\angle FBD$ , find  $m\angle 1$  and  $m\angle 2$

**Exercises 6 – 11:** In the figure,  $\overline{UV} \perp \overline{YW}$

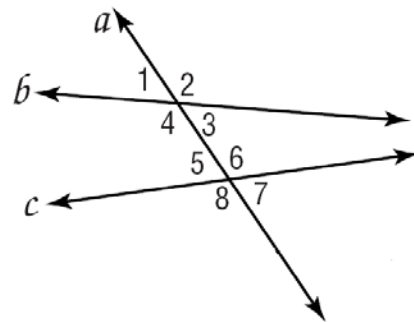


- 6) If  $m\angle 2 = 46^\circ$ , find  $m\angle 1$
- 7) If  $m\angle 1 = 55^\circ$ , find  $m\angle 2$
- 8) Find  $m\angle VYW + m\angle ZWY$
- 9) Is  $\overline{UV} \perp \overline{YZ}$ ?
- 10) Find  $m\angle UYX + m\angle XYW$
- 11) Name two pairs of adjacent right angles.

**Exercises 12 - 13:** Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior* angles.

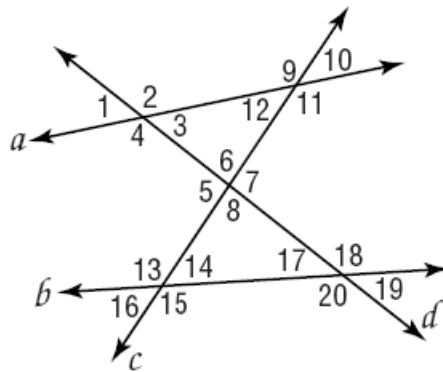


12)



13)

**Exercises 14 - 17:** Name the transversal that forms each pair of angles. Then identify the special name for the angle pair.



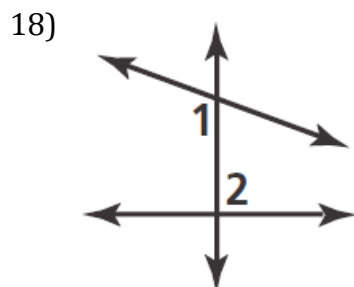
14)  $\angle 2$  and  $\angle 12$

15)  $\angle 6$  and  $\angle 18$

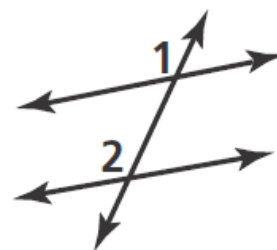
16)  $\angle 13$  and  $\angle 19$

17)  $\angle 11$  and  $\angle 7$

**Exercises 18 - 19:** Classify each pair of angles as *alternate interior angles*, *same-side interior angles*, or *corresponding angles*.

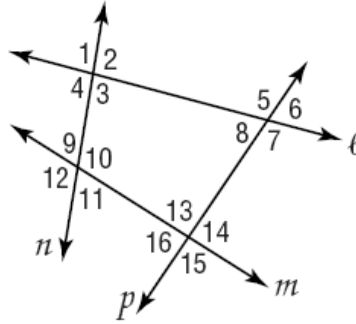


18)



19)

**Exercises 20 - 28:** Identify each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior* angles.



20)  $\angle 9$  and  $\angle 13$

21)  $\angle 6$  and  $\angle 16$

22)  $\angle 3$  and  $\angle 10$

23)  $\angle 8$  and  $\angle 14$

24)  $\angle 9$  and  $\angle 3$

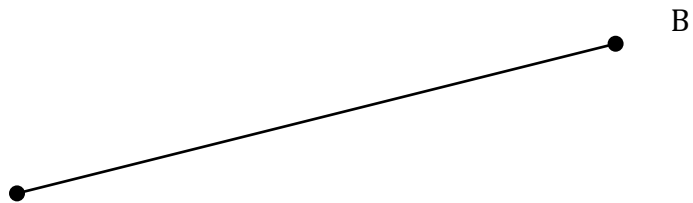
25)  $\angle 6$  and  $\angle 14$

26)  $\angle 4$  and  $\angle 9$

27)  $\angle 7$  and  $\angle 13$

28)  $\angle 1$  and  $\angle 9$

**Exercise 29:** Construct the perpendicular bisector of  $\overline{AB}$





## Lesson 6: Angles Formed by Parallel Lines and Transversal

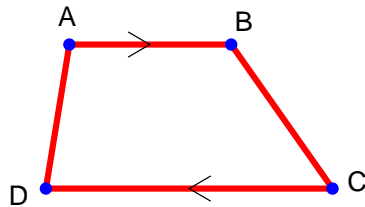
### WHAT WILL YOU LEARN?

Define alternate angles, corresponding angles and same sided interior angles and use their properties in problem solving.

### FOCUS ON APPLICATION

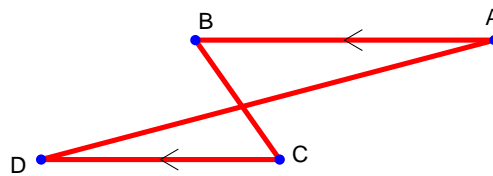
Piano makers use parallel strings for the higher notes. The longer strings used to produce lower notes can be viewed as transversals.

**Exercises 1 – 4:** Given that  $\overline{AB} \parallel \overline{CD}$ ,



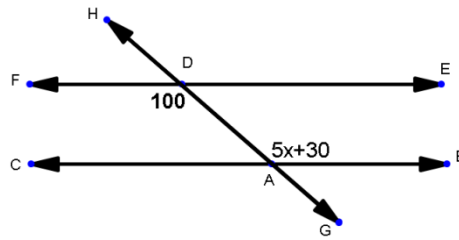
- |                                                                                               |                                                                                                |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 1) If $m\angle ADC = 97^\circ$ , find $m\angle DAB$                                           | 2) If $m\angle ABC = 121^\circ$ , find $m\angle BCD$                                           |
| 3) If $m\angle ADC = (4x + 20)^\circ$ and $m\angle DAB = (x - 15)^\circ$ , find $m\angle DAB$ | 4) If $m\angle ABC = (7x + 24)^\circ$ and $m\angle DCB = (2x - 13)^\circ$ , find $m\angle BCD$ |

**Exercises 5 – 8:** Given that  $\overline{AB} \parallel \overline{CD}$ ,



- |                                                                                               |                                                                                             |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 5) If $m\angle ADC = 25^\circ$ , find $m\angle DAB$                                           | 6) If $m\angle ABC = 65^\circ$ , find $m\angle BCD$                                         |
| 7) If $m\angle ADC = (4x - 20)^\circ$ and $m\angle DAB = (x + 15)^\circ$ , find $m\angle DAB$ | 8) $m\angle ABC = (7x - 24)^\circ$ and $m\angle DCB = (2x - 13)^\circ$ , find $m\angle BCD$ |

**Exercises 9 - 11:** Given that  $\overline{FE} \parallel \overline{BC}$ , find:

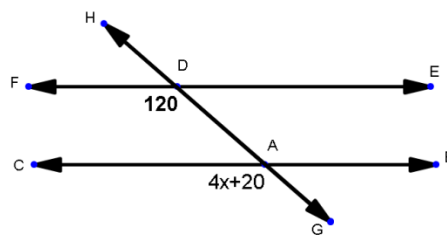


9) the value of x

10)  $m\angle DAB$

11)  $m\angle EDA$

**Exercises 12 - 14:** Given that  $\overline{FE} \parallel \overline{BC}$ , find:

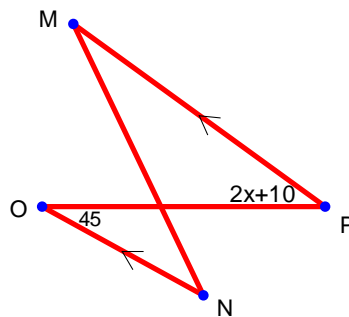


12) the value of x

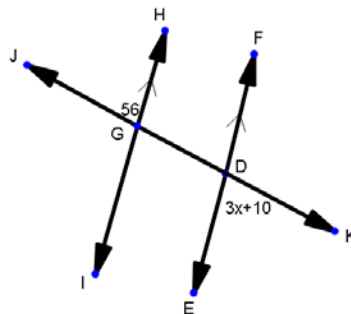
13)  $m\angle DAB$

14)  $m\angle DAC$

**Exercise 15:** Given that  $\overline{ON} \parallel \overline{MP}$ , and  $m\angle NOP = 45^\circ$ , find  $m\angle OPM$



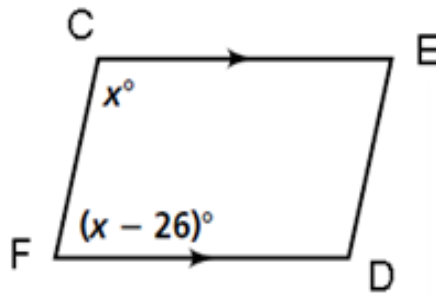
**Exercises 16 - 17:** Given that  $(HI) \parallel (FE)$ , find:



16) value of x

17)  $m\angle FDK$

**Exercises 18 - 20:** Given that  $\overline{CE} \parallel \overline{FD}$ , find:

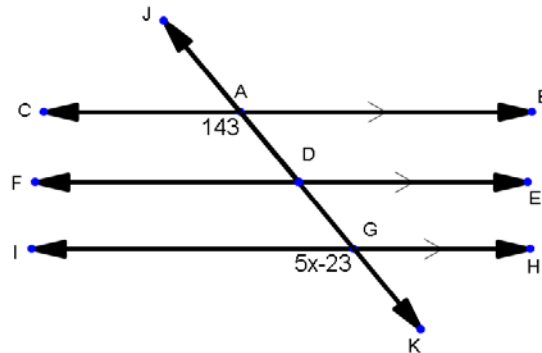


18) the value of  $x$ .

19)  $m\angle ECF$

20)  $m\angle CFD$

**Exercises 21 - 25:** Given that  $\overline{FE} \parallel \overline{BC} \parallel \overline{IH}$ , find:



21) the value of  $x$

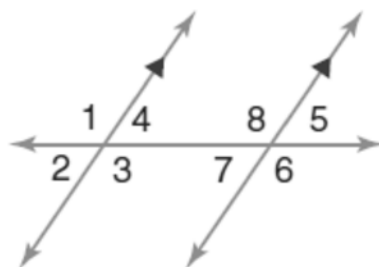
22)  $m\angle ADE$

23)  $m\angle AGH$

24)  $m\angle JAC$

25)  $m\angle HGK$

**Exercises 26 - 29:** If  $m\angle 1 = 124^\circ$ , find the measure of each angle.



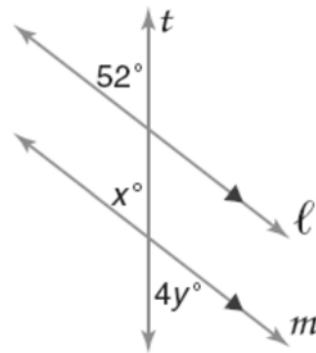
26)  $m\angle 3$

27)  $m\angle 4$

28)  $m\angle 6$

29)  $m\angle 8$

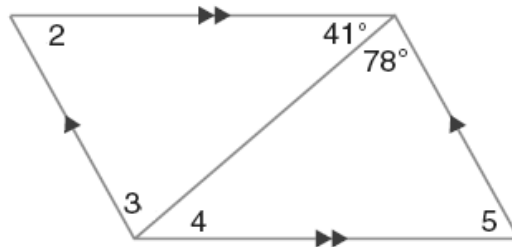
**Exercises 30 - 31:** Given the diagram, find:



30) the value of  $x$

31) the value of  $y$

**Exercises 32 - 35:** Find the measure of each numbered angle.



32)  $m\angle 3$

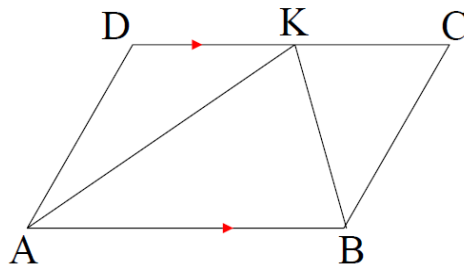
33)  $m\angle 4$

34)  $m\angle 2$

35)  $m\angle 5$

**Exercises 36 - 38:** Given:  $m\angle D = 116$

$\overline{AK}$  bisects  $\angle DAB$   
 $\overline{DC} \parallel \overline{AB}$ ,



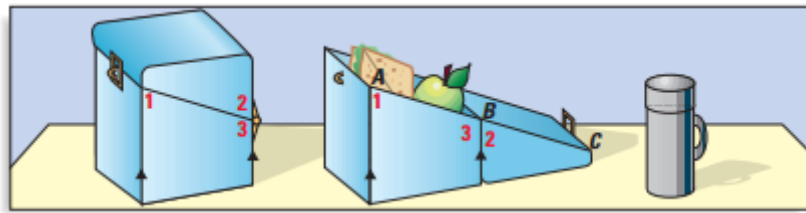
find the measure of:

36)  $\angle DAB$

37)  $\angle KAB$

38)  $\angle DKA$

**Exercises 39 - 41:** Hesham is designing a lunch box similar to the figure below.



If the measure of  $\angle 1 = 70^\circ$ , find the following:

39)  $m\angle 2$

40)  $m\angle 3$

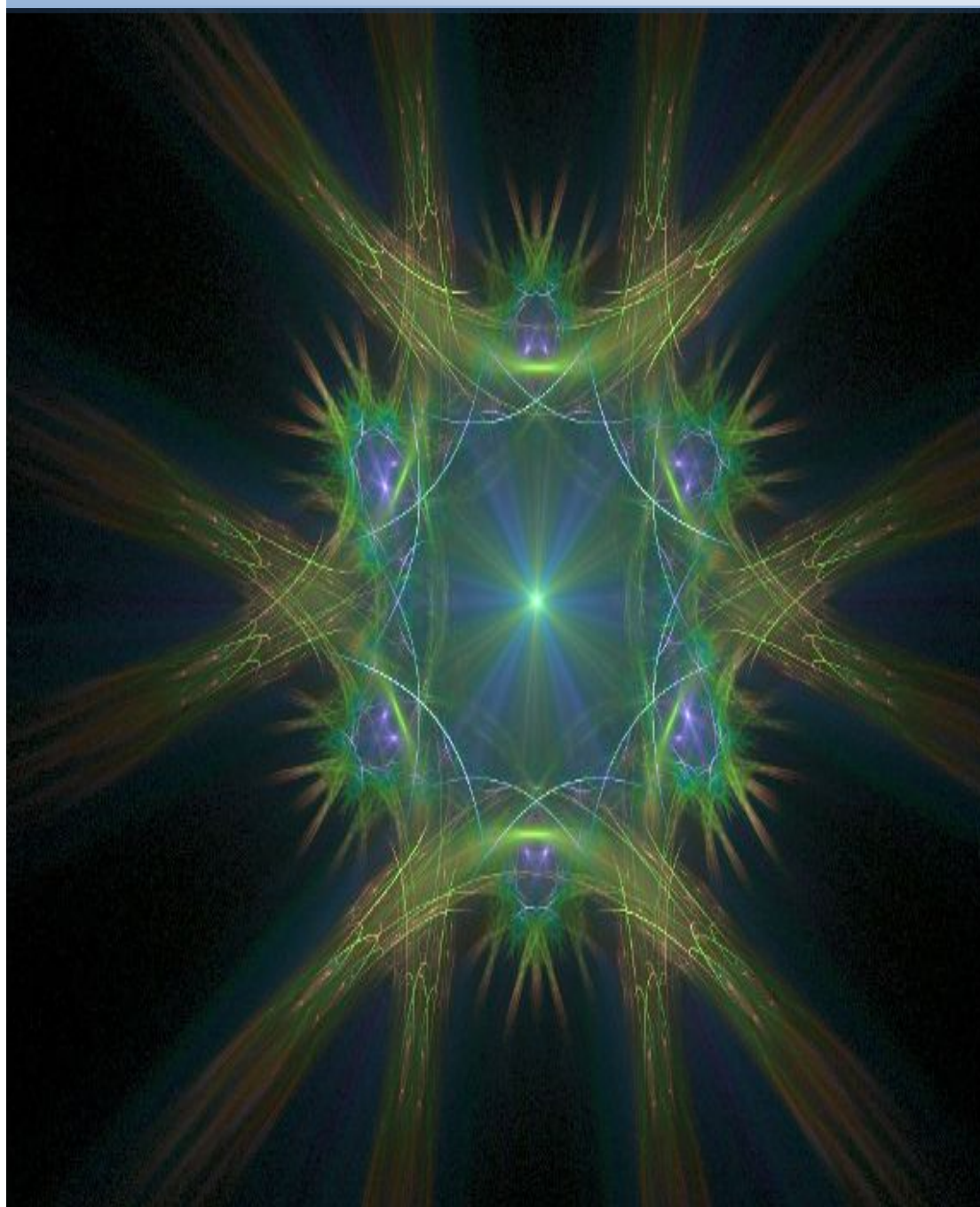
41) Explain why  $\angle ABC$  is a straight angle.

Unit 1

**C** HAPTER

**2**

## Chapter 2: Plane Figures



## Lesson 1: Classify Polygons

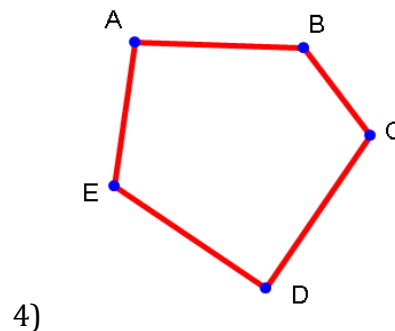
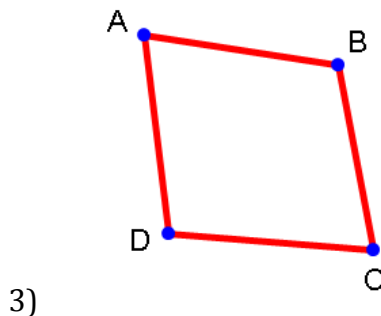
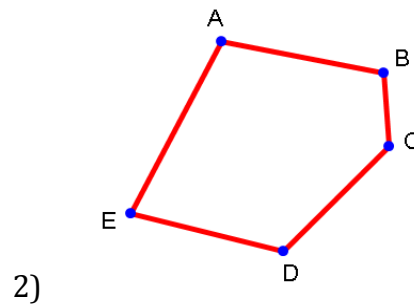
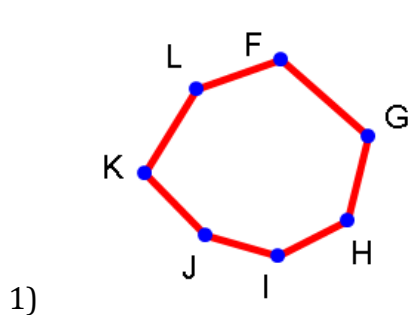
### WHAT WILL YOU LEARN?

Classify polygons according to their number of sides. Differentiate between regular and irregular or concave or convex polygons.

### FOCUS ON APPLICATION

The cross section of a brilliant-cut diamond is a *pentagon*. The most beautiful and valuable diamonds have precisely cut angles that maximize the amount of light they reflect.

**Exercises 1 - 4:** Classify and name the polygons according to the number of sides.



**Exercise 5:** The measures of the sides of a polygon in terms of  $x$  are given:

$$5x-3, 2x+1, 3x-1, 4x+2$$

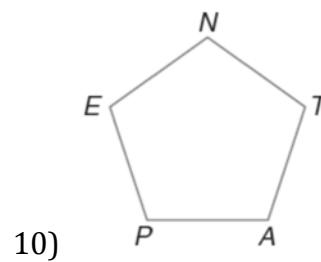
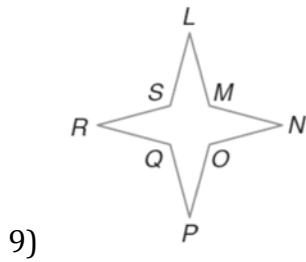
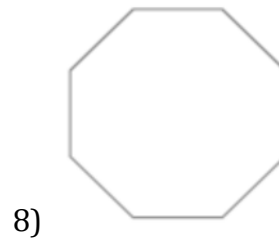
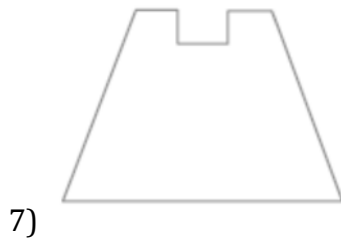
Find the value of  $x$  and the measure of each side if the perimeter is 56.

**Exercise 6:** The measures of the sides of a polygon in terms of  $x$  are given:

$$x-1, 2x+5, 3x-2, 5x-4, x+7$$

Find the value of  $x$  and the measure of each side if the perimeter is 85.

**Exercises 7 - 10:** Classify each polygon as *convex* or *concave* and specify the number of sides.

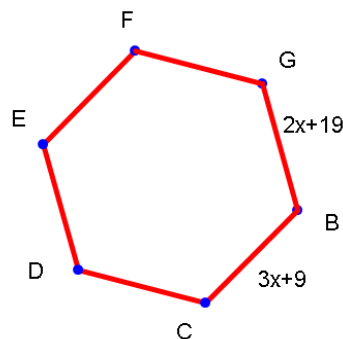


**Exercise 11:** The measures of the sides of a polygon in terms of  $x$  are given:

$$x-1, 5x+2, 7x-1, 2x-4, x+7$$

Find the value of  $x$  and the measure of each side if the perimeter is 82.

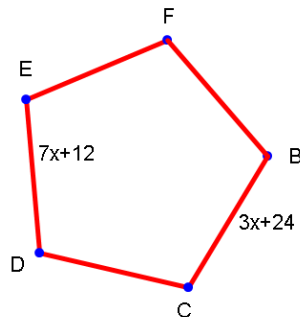
**Exercises 12 - 13:** Given the regular polygon BCDEFG, find:



12) the value of  $x$

13)  $CB$

**Exercises 14 - 15:** Given the regular polygon BCDEF, find:

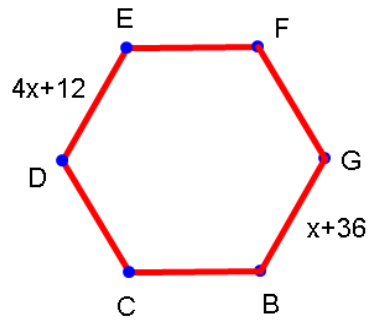


14) the value of  $x$

15)  $CB$



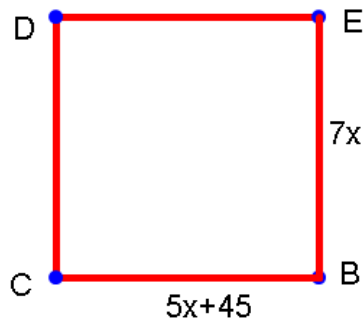
**Exercises 16 - 17:** Given the regular polygon BCDEFG, find:



16) the value of  $x$

17)  $\angle C$

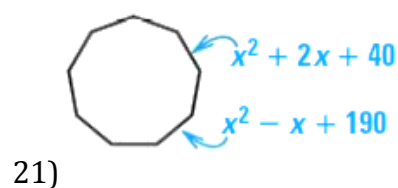
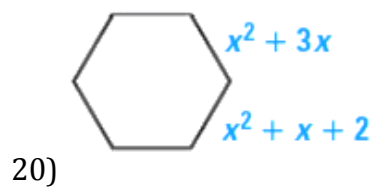
**Exercises 18 - 19:** Given the regular polygon BCDE, find



18) the value of  $x$

19)  $\angle C$

**Exercises 20-21:** The figures below are regular polygons. The two expressions given represent the side lengths. Find  $x$ .



**Exercise 22:** Two vertices of a regular quadrilateral are  $A(0, 4)$  and  $B(0, 24)$ . Which of the following could be the other two vertices?

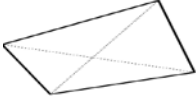
A.  $C(4, 4)$  and  $D(4, 24)$

B.  $C(24, 4)$  and  $D(24, 24)$

C.  $C(8, 24)$  and  $D(8, 4)$

D.  $C(0, 8)$  and  $D(0, 28)$

**Exercises 23 - 25:** A segment that joins two nonconsecutive vertices of a polygon is called a diagonal. For example, a quadrilateral has two diagonals, as shown below.

Type of Polygon	Diagram	Number of Sides	Number of Diagonals
Quadrilateral		4	2
Pentagon			
Hexagon			
Heptagon			

23) Complete the table. Do you see any pattern? Describe it.

24) How many diagonals does an octagon have? Decagon? Justify your answer.

25) The expression  $\frac{n(n-3)}{2}$  can be used to find the number of diagonals in an  $n$ -gon. Find the number of diagonals in a 100-gon.

## Lesson 2: Interior and Exterior Angles of Polygons

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### WHAT WILL YOU LEARN?

You'll learn to find measures of interior and exterior angles of polygons.

### FOCUS ON APPLICATION

**Landscaping:** Landscapers use angle measures of polygons in constructing garden borders.

**Exercises 1 – 3:** Find the sum of the interior angles of each convex polygon.

- 1) Quadrilateral
- 2) Decagon
- 3) 14-gon

**Exercises 4 – 6:** Find the measure of each interior angles of each convex polygon.

- 4) Quadrilateral
- 5) Decagon
- 6) 14-gon

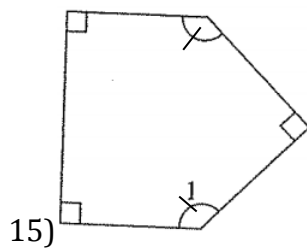
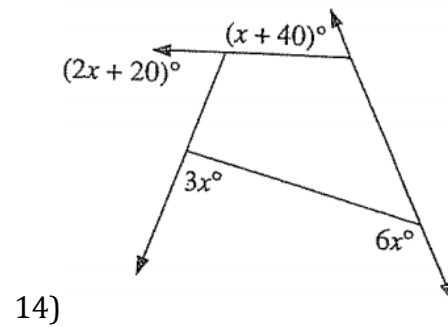
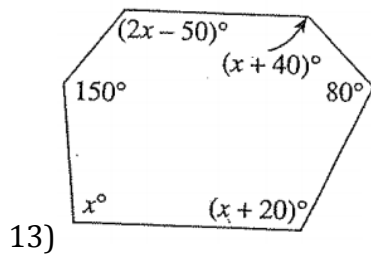
**Exercises 7 – 9:** Find the sum of the exterior angles of each convex polygon.

- 7) Quadrilateral
- 8) Decagon
- 9) 14-gon

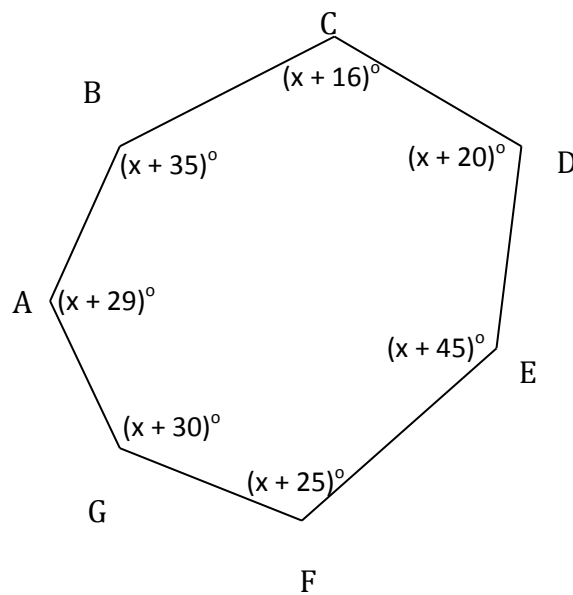
**Exercises 10 – 12:** Find the measure of each exterior angles of each convex polygon.

- 10) Quadrilateral
- 11) Decagon
- 12) 14-gon

**Exercises 13-15:** Find the measures of the unknowns.



**Exercise 16:** Find the measures of each interior angle of the given convex polygon. Name the figure.



**Exercise 17:** If the measure of an interior angle of a regular polygon is  $171^\circ$ , what type of polygon is it?

**Exercise 18:** If the measure of each exterior angle of a regular polygon is one thirds the measure of each interior angle, how many sides does the polygon have?

**Exercise 19:** The measures of the six interior angles of a convex octagon are equal, If each of the two remaining angles is 20 degrees more than one of the six angles, what is the measure of each angle?

## Lesson 3: Congruence

### WHAT WILL YOU LEARN?

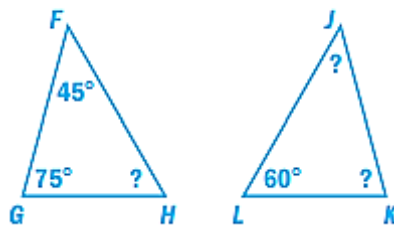
Determine if two shapes are congruent or not

### FOCUS ON APPLICATION

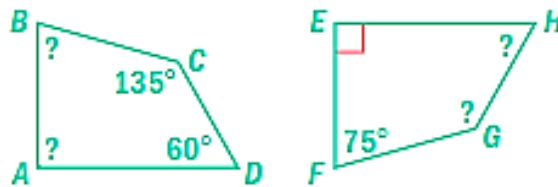
Machinists used triangles to construct a model of the Atomic Model in Brussel

**Exercise 1:** Name the corresponding sides and the corresponding angles of the congruent polygons. Then find the unknown measures.

$$\triangle FGH \cong \triangle JKL$$

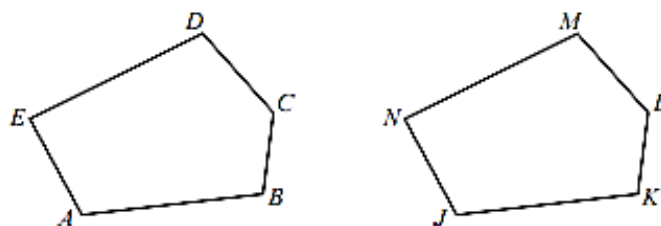


**Exercises 2 - 4:** Given that  $ABCD \cong EFGH$ .

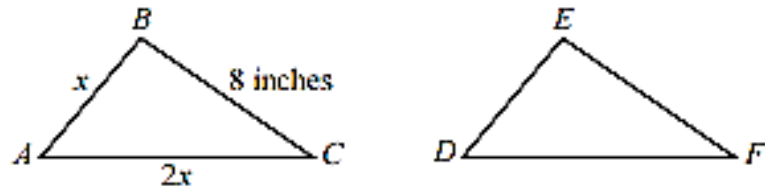


- 2) Name the corresponding sides
- 3) Name the corresponding angles
- 4) Find the unknown angle measure

**Exercise 5:** Given that  $ABCDE \cong JKLMN$ , identify the corresponding sides and angles.

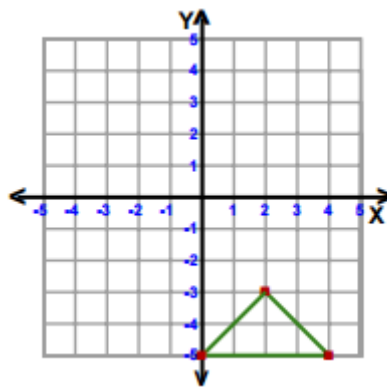


**Exercise 6:**  $\triangle ABC$  and  $\triangle DEF$  are congruent.

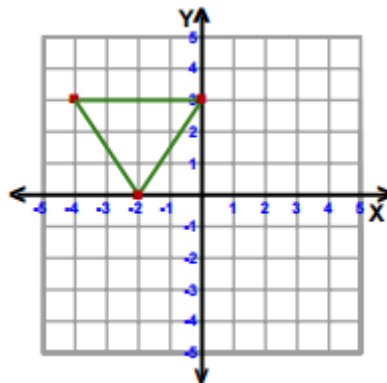


If the perimeter of  $\triangle ABC$  is 23 centimeters, what is the length of side  $\overline{DF}$ ?

**Exercise 7:** If the triangle below is shifted 5 units upward, what are the coordinates of the new triangle? Are the two triangles congruent? Explain your answer.



**Exercise 8:** If the triangle below is reflected or flipped over the x-axis, what are the coordinates of the new triangle? Are the two triangles congruent? Explain your answer.



## Lesson 4: Classify Triangles

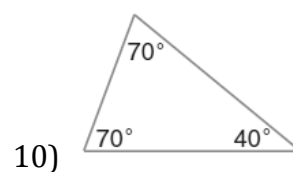
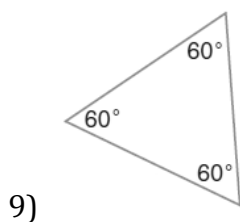
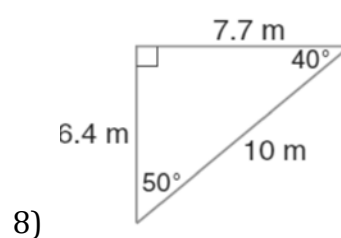
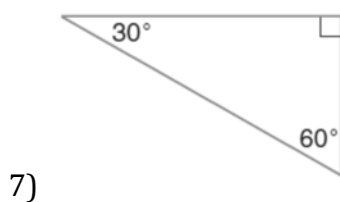
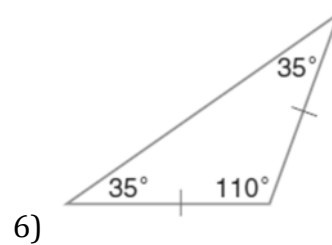
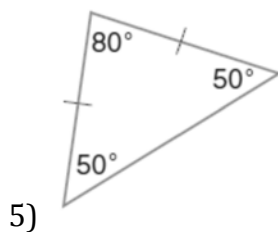
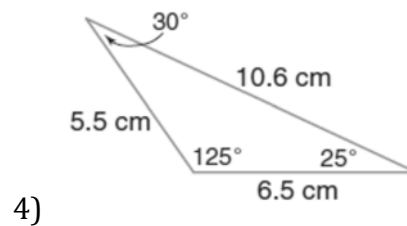
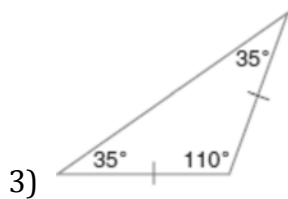
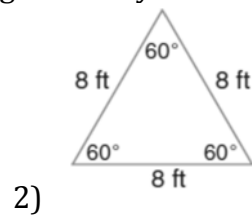
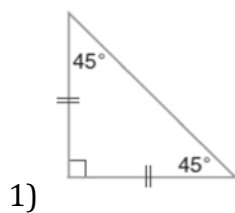
### WHAT WILL YOU LEARN?

Classify triangles according to sides or angles.

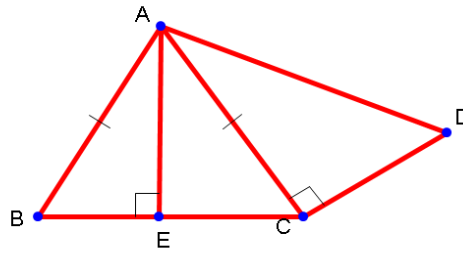
### FOCUS ON APPLICATION

Manufacturers use properties of triangles to calculate the amount of materials needed to make triangular objects.

**Exercises 1- 10:** Classify each triangle by its angles and by its sides.



**Exercises 11 - 14:** Given the diagram below:



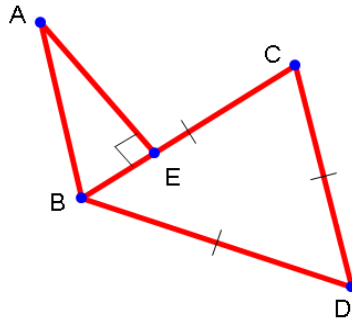
11) Deduce the given from the figure.

12) Classify  $\triangle ABE$

13) Classify  $\triangle ACD$

14) Classify  $\triangle ABC$

**Exercises 15 - 17:** Given the diagram below:

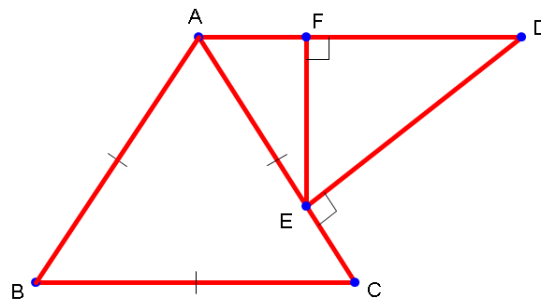


15) Deduce the given from the figure.

16) Classify  $\triangle ABE$

17) Classify  $\triangle BCD$

**Exercises 18 - 21:** Given the diagram below:



18) Deduce the given from the figure.

19) Classify  $\triangle ABC$

20) Classify  $\triangle EFD$ .

21) Classify  $\triangle AED$

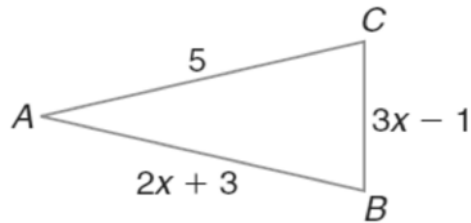


**Exercises 22 - 23:** Classify the triangle.

22) The sides of a triangle are 10 cm, 8 cm, and 10 cm.

23) The angles of a triangle are  $44^\circ$ ,  $110^\circ$ , and  $26^\circ$ .

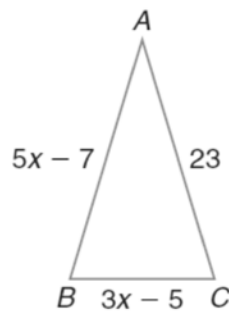
**Exercises 24 - 25:**  $\triangle ABC$  is an isosceles triangle with base  $BC$ . Find



24) AB

25) BC

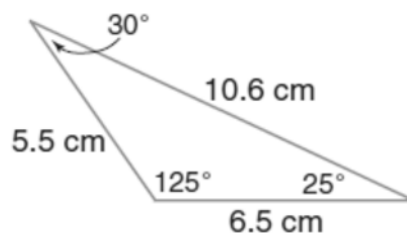
**Exercises 26 - 27:**  $\triangle ABC$  is an isosceles triangle with base  $BC$ . Find :



26) AB

27) BC

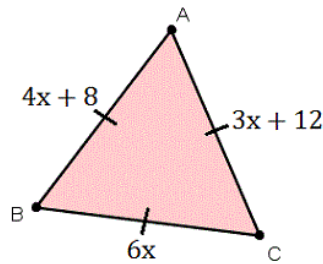
**Exercise 28:** Classify the triangle by its angles and by its sides.



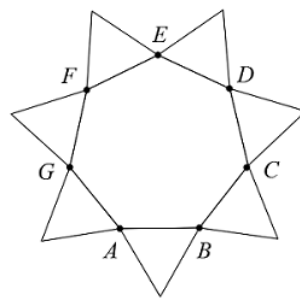
**Exercise 29:**  $\triangle DEF$  is an equilateral triangle in which  $ED = x + 5$  and  $DF = 3x - 3$ . Find the measure of each side.

**Exercise 30:** Sketch and label an isosceles triangle in which the vertex is  $X$  and the base is  $YZ = 4$  cm.

**Exercise 31:** Determine the lengths of the sides of the equilateral triangle below.

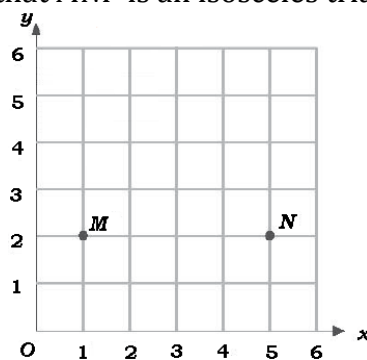


**Exercise 32:** In the figure below, ABCDEFG is a regular heptagon. To each of its sides is attached an equilateral triangle. If the perimeter of ABCDEFG is 84, what is the perimeter of the star-shaped figure? (SAT PROBLEM)



- A. 84
- B. 96
- C. 144
- D. 168
- E. 216

**Exercise 33:** Two points  $M$  and  $N$  are shown in the figure above. Mohammad is looking for the point  $P$  such that  $MNP$  is an isosceles triangle. (TIMSS, 2007)



Which of these points could be point  $P$ ?

- A. (3,5)
- B. (3,2)
- C. (1,5)
- D. (5,1)

## Lesson 5: Angles Relationships in Triangle

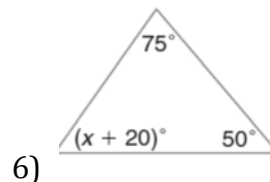
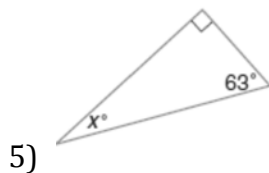
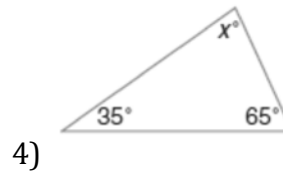
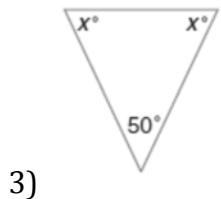
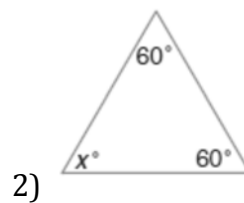
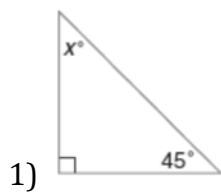
### WHAT WILL YOU LEARN?

Find the measure of an angle in a triangle using the triangle angle sum theorem.

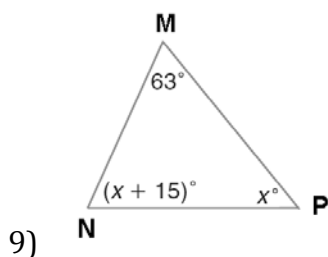
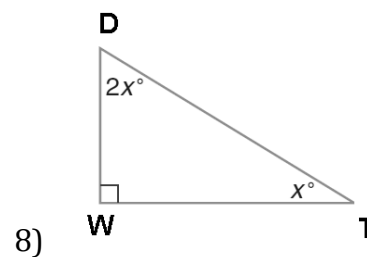
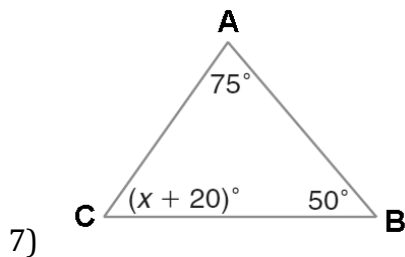
### FOCUS ON APPLICATION

Surveyors use triangles to make measurements and create boundaries.

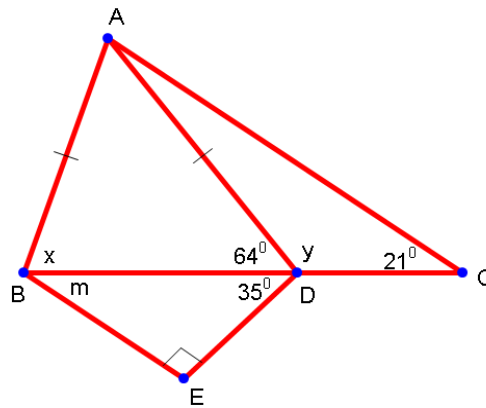
**Exercises 1 - 6:** Find the value of the variable.



**Exercises 7 - 9:** Find the value of the variable and the measure of each angle.



**Exercises 10 - 15:** Given the diagram below, find:



10) value of  $x$

11) value of  $m$

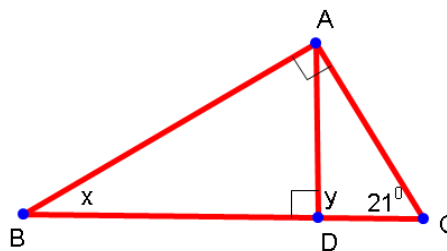
12) value of  $y$

13)  $m\angle BAD$

14)  $m\angle DAC$

15)  $m\angle ABE$

**Exercises 16 - 19:** Given the diagram below, find:



16) value of  $y$

17) value of  $x$

18)  $m\angle BAD$

19)  $m\angle DAC$

**Exercises 20 - 23:** Find the measure of each angle.

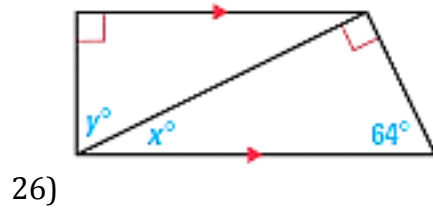
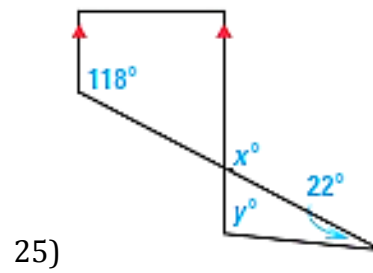
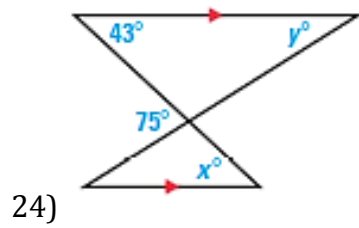
20) The measures of the angles of a triangle are  $2x$ ,  $3x$ , and  $4x$ .

21) The measures of the angles of a triangle are  $x + 5$ ,  $3x - 14$ , and  $x + 11$ .

22) The measure of one acute angle in a right triangle is half the measure of the other acute angle.

23) The measure of one acute angle of a right triangle is 25.

**Exercises 24-26:** Find the values of  $x$  and  $y$ .

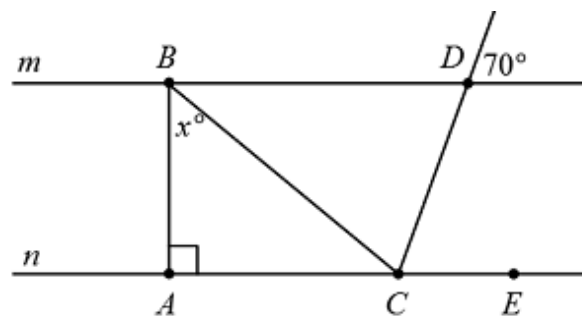


**Exercises 27-28:**  $\triangle ABC$  is isosceles. If  $AB = x$  and  $BC = 2x - 4$ , find:

27) Two possible values of  $x$  if the perimeter is 32 inches.

28) Number of possible values of  $x$  if the perimeter is 12 centimeters.

**Exercise 29:** In the figure below,  $m \parallel n$  and  $\overline{CD}$  bisects  $\angle BCE$ . Which of the following is the value of  $x$ ? (SAT PROBLEM)

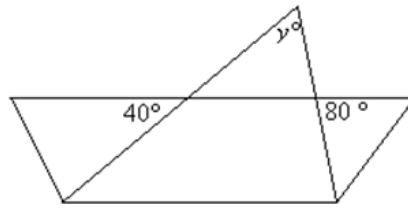


- A. 30
- C. 50
- E. 70

- B. 40
- D. 60

**Exercise 30:** In the figure below, what is the value of  $y$  ?

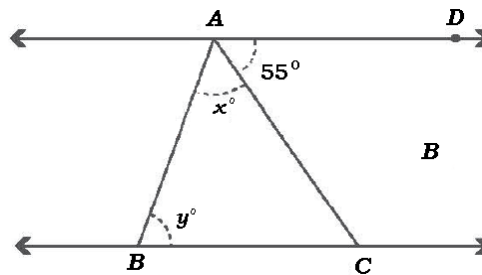
(SAT PROBLEM)



- A. 40
- B. 50
- C. 60
- D. 100
- E. 120

**Exercise 31:** In this figure, line  $l$  is parallel to line  $m$ . The measure of angle  $DAC$  is  $55^\circ$ .

(TIMSS, 2007)



What is the value of  $x + y$  ?

- A. 55
- B. 110
- C. 125
- D. 135

## Lesson 6: Quadrilaterals

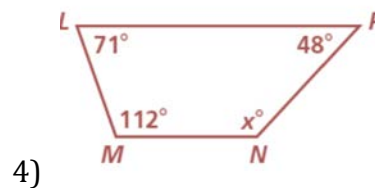
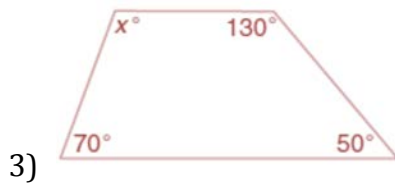
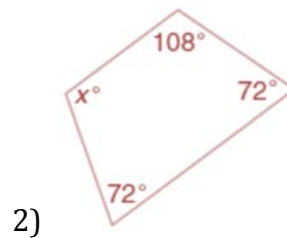
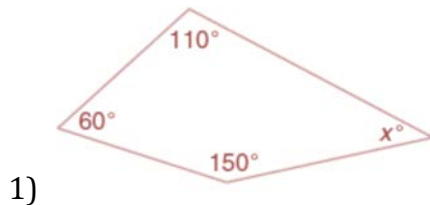
**WHAT WILL YOU LEARN?**

Classify a quadrilateral according to the relationship between the opposite sides or opposite angles.

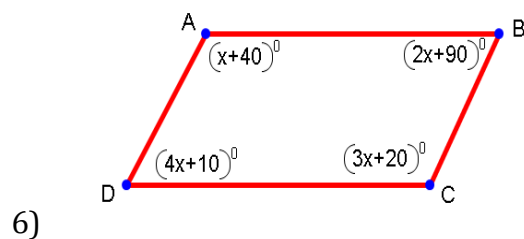
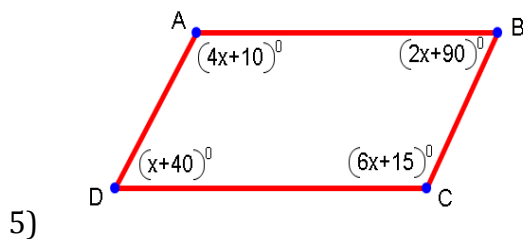
**FOCUS ON APPLICATION**

Race car designers can use a parallelogram-shaped linkage to keep the wheels of the car vertical on uneven surface.

**Exercises 1 - 4:** Find the value of each variable.



**Exercises 5 - 6:** Find the value of each variable.



**Exercise 7:** Each of the two larger angles of a rhombus is 6 less than twice the two smaller angles. Find the measure of the two larger angles.

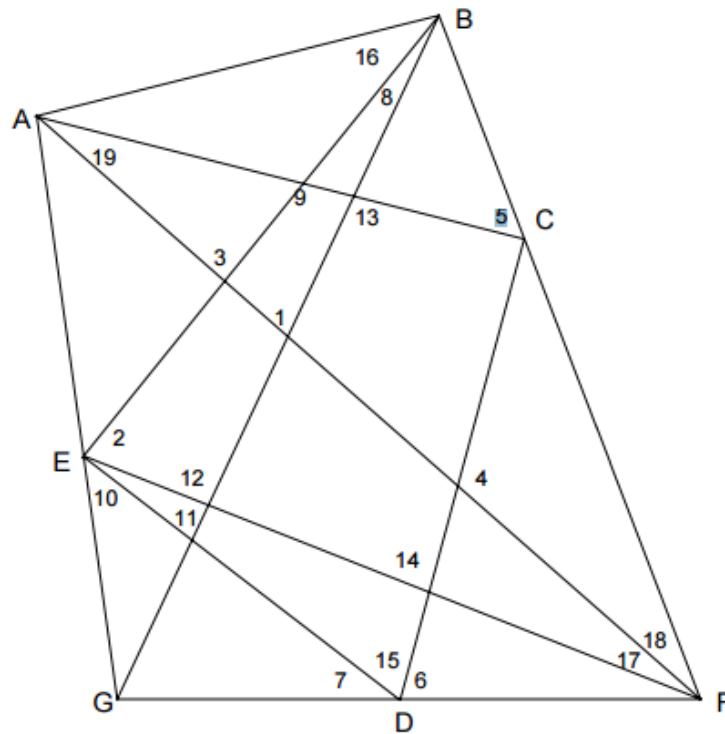
**Exercise 8:** The smaller two angles of a parallelogram have equal measures, and the larger two angles measure five more than six times each smaller angle. Find the measure of each angle.

**Exercise 9:** A cosmetic sponge is in the shape of an isosceles trapezoid. An isosceles trapezoid is a trapezoid whose base angles are congruent. The top angles measure 15 less than twice the measure of the bottom angles. Find the measure of each angle

**Exercise 10:** Find the missing angles.

Given:

- |                        |                                     |
|------------------------|-------------------------------------|
| $m\angle EAB=95^\circ$ | $m\angle ABC=104^\circ$             |
| $m\angle BED=80^\circ$ | $\overline{AC} \perp \overline{CD}$ |
| $m\angle 1=83^\circ$   | $m\angle 2=62^\circ$                |
| $m\angle 3=101^\circ$  | $m\angle 4=104^\circ$               |
| $m\angle 5=46^\circ$   | $m\angle 6=70^\circ$                |
| $m\angle 7=35^\circ$   |                                     |



**Exercise 11:** The vertices of a quadrilateral are shown below. Plot these points on a coordinate plane and connect them to form the figure. That type of a quadrilateral is formed? Justify your answer.

$$(-1, 2), (7, 2), (10, -7), (-10, -7)$$



## Lesson 7: Coordinate Plane

**WHAT WILL YOU LEARN?**

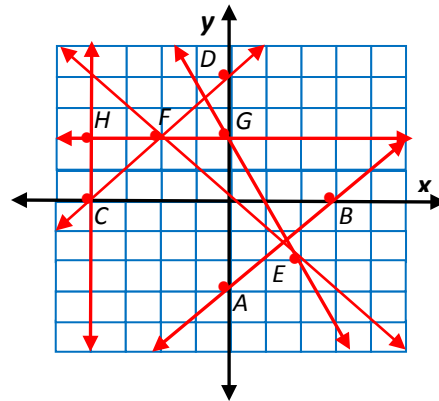
Understand the different properties of the coordinate system, plot points and find the slope of linear equations

**FOCUS ON APPLICATION**

In computer graphics, a coordinate system is used to create images, from simple geometric figures to realistic figures.

**Exercises 1 – 6:** Determine if the slope of each line is positive, negative, 0, or undefined. Then find the slope of each line.

- 1) AB
- 2) EG
- 3) HG
- 4) CH
- 5) Which lines are parallel?
- 6) Which lines are perpendicular?



**Exercises 7 – 8:** Graph the quadrilaterals with the given vertices. Give all of the names that apply to each quadrilateral.

- 7) A (2, 1), B (1, 3), C (-5, 0), and D (-4,-2)
- 8) P (1, 1), Q (2, 4), R (5, 6) and S (4, 3)

**Exercises 9 – 10:** Draw the line through the given points and find its slope.

- 9) A (3, -6), B (5, 9)
- 10) G (4, -10), H ( $\frac{1}{2}$ , -10)

**Exercise 11:** Show that quadrilateral A(1,2), B(2,5),C(5,7) and D(4,4) is a parallelogram by using slopes.

**Exercise 12:** Show that A(1,1), B(4,4), C(6,2) are the vertices of a right triangle using slopes.

**Exercise 13:** Show that A(2, -1), B(1, 3), C(6, 5), and D(7, 1) are the vertices of a parallelogram.

**Exercise 14:** Quadrilateral DEFG has vertices at  $D(3,4)$ ,  $E(8,6)$ ,  $F(9,9)$  and  $G(4,7)$ . Prove that DEFG is a parallelogram using slopes.

**Exercise 15:** The vertices of are  $A(-3,1)$ ,  $B(-2,-1)$ , and  $C(2,1)$ . Show that is a right triangle.



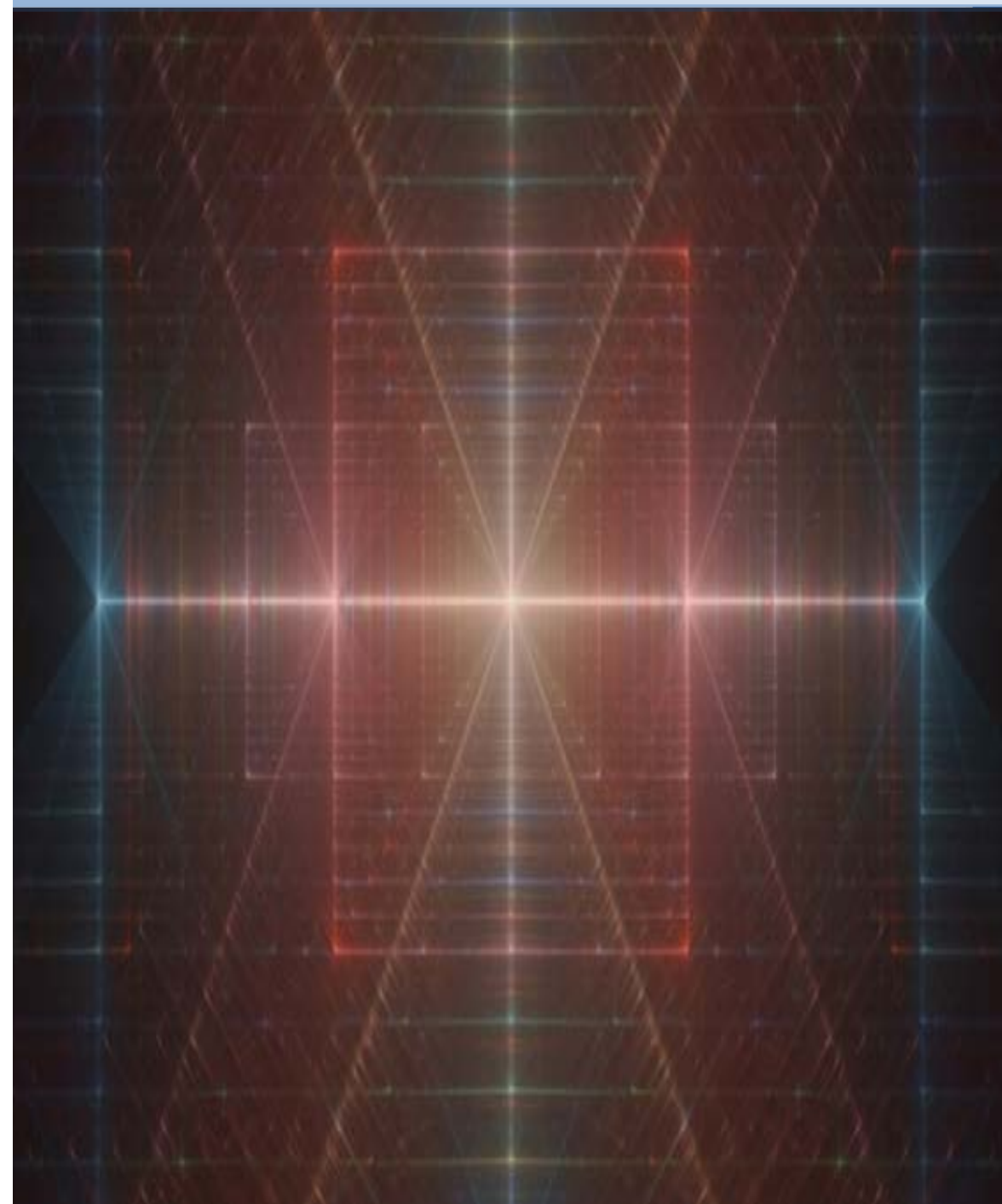
# Unit 2: Area, Perimeter and Volume



Unit 2

# CHAPTER 3

## Chapter 3: Perimeter, Area and Volume



# Lesson 1: Area of Parallelograms, Triangles and Trapezoids

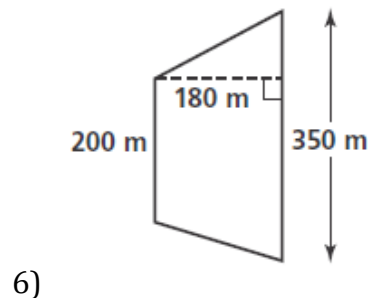
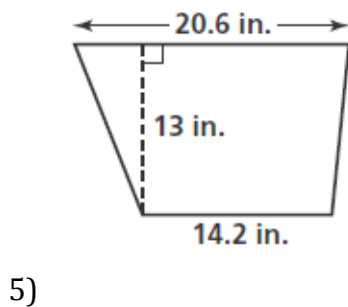
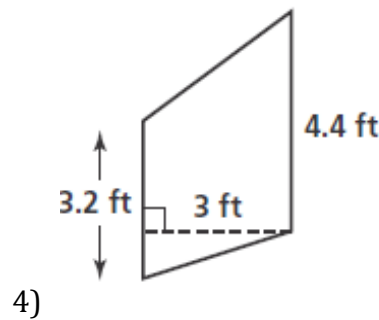
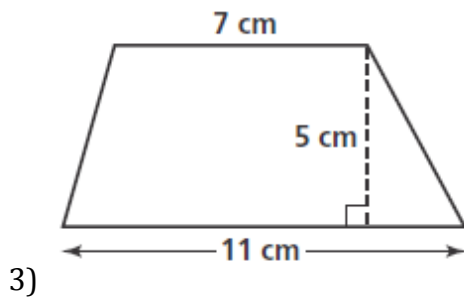
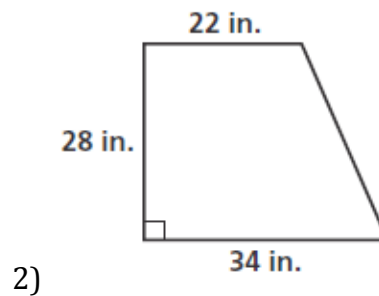
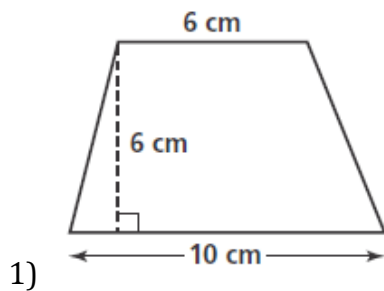
## WHAT WILL YOU LEARN?

Find the area of a parallelogram or a trapezoid

## FOCUS ON APPLICATION:

The area of a classroom whose shape is like a parallelogram can be solved using  $A = bh$ .

**Exercises 1 - 6:** Find the area of each trapezoid.



**Exercises 7 - 9:** Find the area of each parallelogram with the given base and height.

7) base: 3 cm; height: 1.5 cm

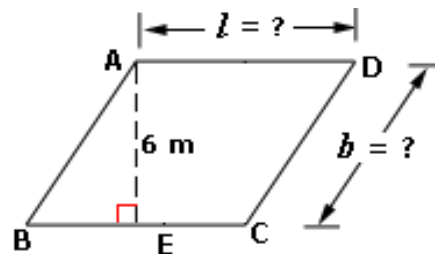
8) base: 60 in.; height: 22 in.

9) base: 2 m; height: 120 m

**Exercise 10:** A trapezoid has its bases as 11 in. and 8 in. and a height of 9 in. Calculate its area.

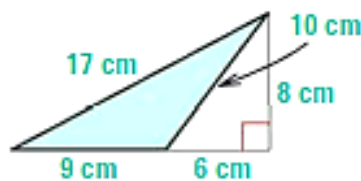
**Exercise 11:** Aisha bought a piece of fabric in the shape of a parallelogram. Its height is 12 yards and its base is 18 yards. She cuts the fabric into four equal parallelograms by cutting the base and the height in half. Find the area of each new parallelogram.

**Exercise 12:** The area of the parallelogram ABCD is  $42 \text{ m}^2$  and its perimeter is 28 m. What are the dimensions of the parallelogram?



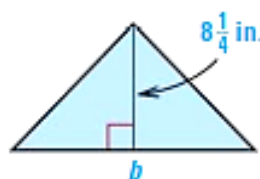
**Exercise 13:** What happens to the area of the parallelogram, if the base is increased by 2 times and the height is halved?

**Exercise 14:** Find the area and the perimeter of the shaded figure.



**Exercise 15:** Use the information about the figure to find the indicated measure.

Area =  $66 \text{ in.}^2$   
Find the base  $b$ .





**Exercise 16:** The vertices of 8 polygons are shown below. Do the following:

- Plot the points in one coordinate plane. For every set of ordered pairs, connect the points in order as they are listed.
- Color each shaped formed as indicated. Identify each type of polygon.
- Find the area of each shape taking each box in the grid as 1 unit. Break each shape into rectangles and triangles or use a formula to find each area.

The vertices are as follows:

1<sup>st</sup> polygon-Gray Color:  $(-7, 4), (-8, 5), (-8, 6), (-7, 7), (-5, 7), (-5, 5), (-7, 4)$

2<sup>nd</sup> polygon-Orange Color:  $(-2, -7), (-1, -4), (3, -1), (6, -7), (-2, -7)$

3<sup>rd</sup> polygon-Green Color:  $(4, 3), (3, 3), (2, 2), (2, 1), (3, 0), (4, 0), (5, 1), (5, 2), (4, 3)$

4<sup>th</sup> polygon-Brown Color:  $(0, -10), (0, -8), (7, -10), (0, -10)$

5<sup>th</sup> Polygon-Purple Color:  $(-8, -5), (-8, -8), (-5, -8), (-5, -5), (-8, -5)$

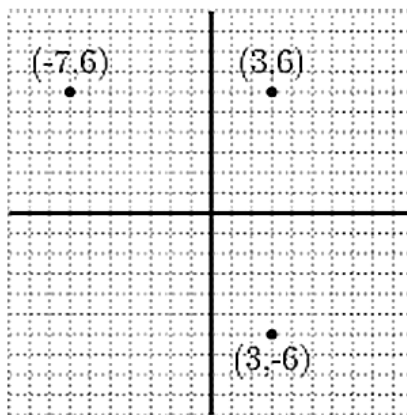
6<sup>th</sup> Polygon-Pink Color:  $(9, -1), (6, 1), (6, -3), (9, -1)$

7<sup>th</sup> Polygon-Blue Color:  $(-6, -4), (-6, 1), (-9, 1), (-9, -4), (-6, -4)$

8<sup>th</sup> Polygon-Yellow Color:  $(-5, 1), (-3, -3), (-1, -2), (0, 3), (-3, 3), (-5, 1)$

**Exercises 17 – 19:** If the points on the coordinate plane below are the three vertices of a rectangle,

- What are the coordinates of the fourth vertex? How do you know?
- What are the length and the width of the rectangle?
- What are the area and perimeter of the rectangle?



## Lesson 2: Circumference and Area of a Circle

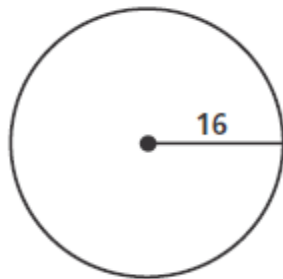
**WHAT WILL YOU LEARN?**

Find the area of the circumference of a circle.

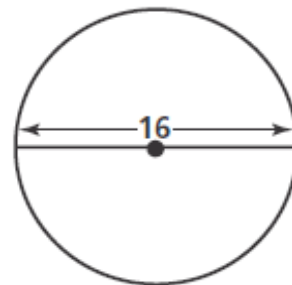
**FOCUS ON APPLICATION:**

Bicycle wheels and car wheels are real life application of circles and their properties

**Exercises 1 - 6:** Find the circumference and the area of each circle in terms of  $\pi$ .



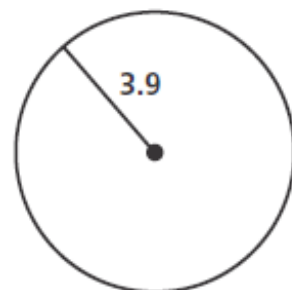
1)



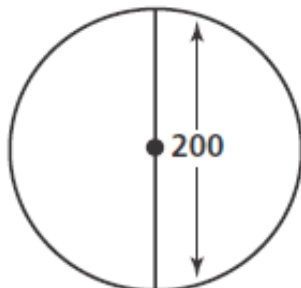
2)



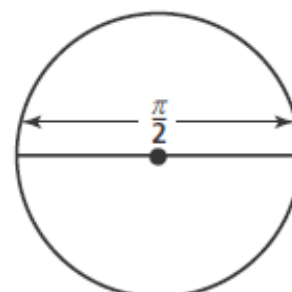
3)



4)



5)



6)

**Exercises 7 – 10:** Find the radius and the diameter of each circle.

7) Circumference = 69.1 yd

8) Circumference = 25.1 ft

9) Area = 78.5 ft<sup>2</sup>

10) Area = 314.2 in<sup>2</sup>

**Exercises 11 – 12:** Answer each question.

11) Find the area of a circle whose diameter is 122 ft.

12) Find the radius and the diameter of a circle with circumference of 23m.

**Exercise 13:** The diameter of the Earth is 7,926.41 miles. If you wish to walk around the equator, what would be the distance you would have to walk?



**Exercise 14:** The diameter of the wheel of Kumar's bicycle is 21 inches. What is its circumference and area in terms of  $\pi$ .

**Exercise 15:** Mr. Nasser has three silos in his farm. The largest among the three has a diameter of 24 ft. The radius of the smallest silo is  $\frac{1}{3}$  as large as the diameter of the largest. The middle-sized silo, however, has a radius that is 2 ft. greater than the radius of the smallest silo. Find the circumference of each silo in his farm.



**Exercises 16 - 18:** A bicycle tire has a spot of wet paint on it. The diameter of the tire is 92 cm. Every time the wheel turns, the paint marks the ground.

16) Describe the pattern that the paint makes on the ground as the bicycle moves.

17) How far will the bicycle have traveled between 2 consecutive paint marks on the ground?

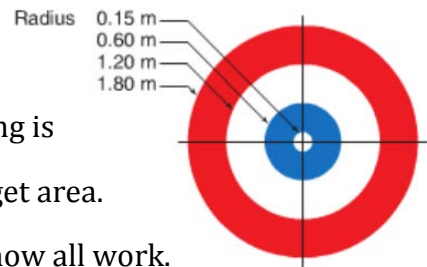
18) Suppose the paint continues to mark the ground. How many times will the paint mark the ground when the bicycle travels 1 km? Show your work.

**Exercises 19 - 20:** In curling, the target area is a bull's eye with 4 concentric circles. (Concentric circles have the same center.)

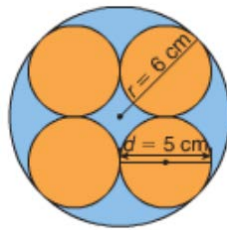
19) Find the area of the smallest circle.

20) If a smaller circle overlaps a larger circle, a ring is formed. Find the area of each ring on the target area.

Give your answers to 4 decimal places, and show all work.



**Exercises 21 - 23:** A circle containing 4 adjacent circles has a radius 6 centimeters. The diameter of each small circle is 5 centimeters. Each small circle touches two other small circles and the large circle.

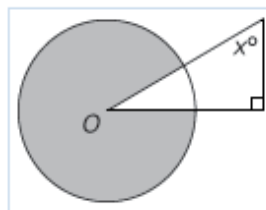


21) What is the area of the large circle?

22) What is the area of each small circle?

23) What is the area of the blue region?

**Exercise 24:** The circle shown below has center  $O$  and a radius of length 5. If the area of the shaded region is  $20\pi$ , what is the value of  $x$ ? (Note that a circle contains a total of  $360^\circ$  of arc.) (SAT PROBLEM)



Note: Figure not drawn to scale.

A. 18

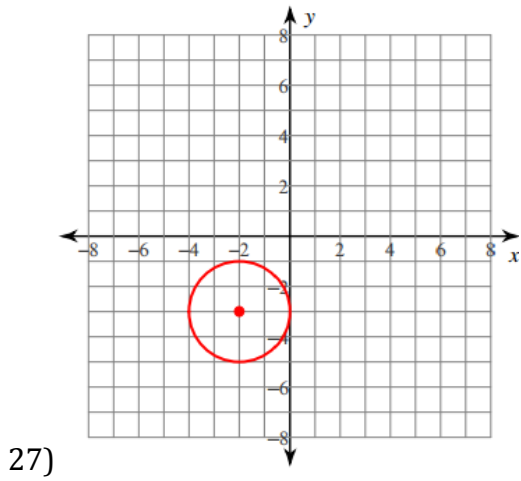
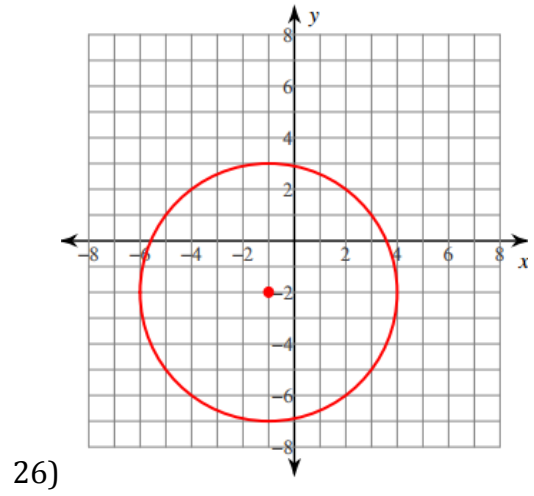
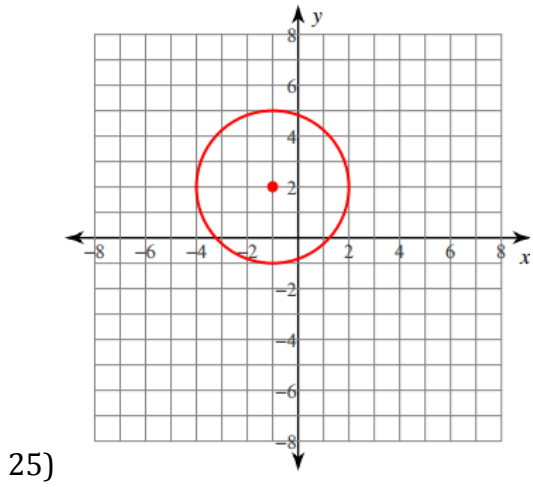
B. 36

C. 45

D. 54

E. 72

**Exercises 25 – 27:** Find the radius, diameter and area of the following circles in each coordinate plane.



## Lesson 3: Scale Drawing

### WHAT WILL YOU LEARN?

You'll learn how to use ratio and proportion in the enlargement and reduction of figures in scale drawing.

### FOCUS ON APPLICATION

One can determine the actual size of a building or area in a map using scale drawing.

**Exercises 1 – 3:** Use the drawing and an inch ruler to answer the following questions.



1 cm : 5 ft

- 1) What is the actual length and width of the rose bed?
- 2) What is the actual perimeter of the green perennial bed?
- 3) The area of the tulip bed is what percent of the area of the rose bed?

**Exercises 4 – 8:** If the scale factor is 1:12, find the missing dimension.

Item	Model	Actual
4) <b>Mattress</b>	Length: 6.25 inches	Length: ____ inches
5) <b>Corvette</b>	Length: _____ inches	Length: 15 feet
6) <b>Water Tower</b>	Depth: 32 centimeters	Depth: ____ meters
7) <b>Wingspan</b>	Width: 5.4 feet	Width: ____ yards
8) <b>Football helmet</b>	Diameter: _____ mm	Diameter: 21 centimeters

**Exercise 9:** Mark made a treasure map with his friends.



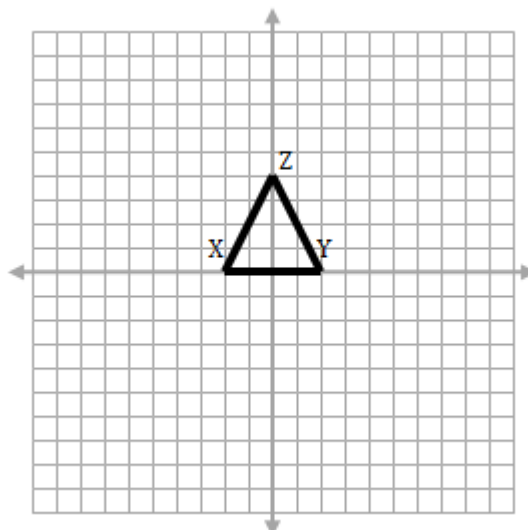
The treasure in the map is 25 centimeters away from his location. What is the distance between him and the treasure if each 1 cm. on the treasure map is equivalent to 5 meters?

**Exercise 10:** Abdulla constructed a wooden square box. All the sides of the box are 6 centimeters. If his friends want to increase the length of all the sides by 1.6 centimeters, find the perimeter and area of the new box.

**Exercise 11:** Fatema decided to redecorate her house. The figure below shows a scale drawing of her house. If every 6 centimeters on the scale drawing corresponds to 12 feet, what are the actual dimensions of Fatema's house?

**Exercise 12:** Rashed is a salesman working in cities within North Carolina and South Carolina. On his map, these two cities are 50 cm apart. The map indicates that the scale is 2 cm : 4 km. How far apart are the two cities?

**Exercise 13:** Triangle XYZ is shown in the figure below. Draw another triangle on a separate coordinate plane that is thrice as large as the one given. Make sure that your new image is in quadrant III. What are the coordinates of the new image?



**Exercises 14 - 16:** On a map, the movie house is located at  $(-4,-4)$ , the town hall is located at  $(2, 9)$ , and the train station is located at  $(2,-4)$ . Represent the locations as points on a coordinate grid with a unit of 1 km.

- 14) What is the distance from the movie house to the train station? The distance from the train station to the town hall? How do you know?
- 15) What shape does connecting the three locations form?
- 16) The town mayor is planning on constructing a public plaza in this area. What is the area of the planned plaza?



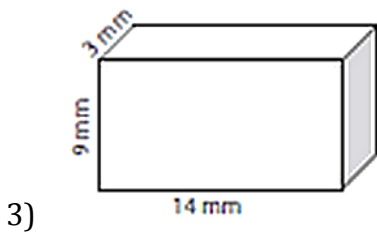
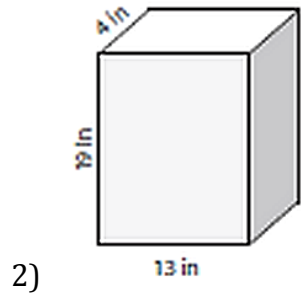
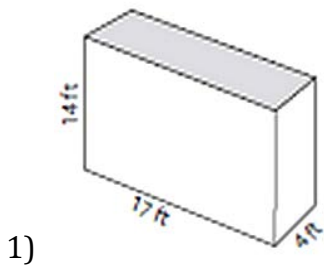
## Lesson 4: Volume and Surface Area of Cubes and Right Rectangular Prism

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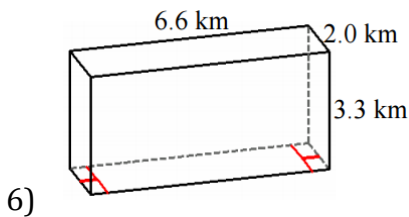
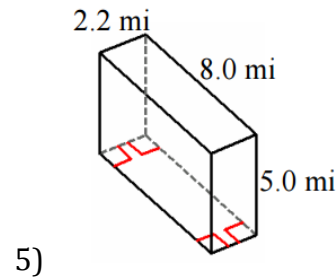
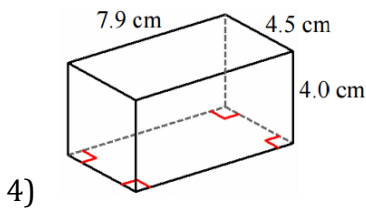
**WHAT WILL YOU LEARN?**  
 Find the volume and surface area of cubes and rectangular prisms.

**FOCUS ON APPLICATION**  
 One can determine the capacity of a rectangular aquarium using the concept of volume.

**Exercises 1 – 3:** Find the total surface area of the following rectangular prisms.



**Exercises 4 - 6:** Find the volume of the following rectangular prisms.



**Exercise 7:** The volume of a rectangular aquarium is 2,880 square inches. If the length of the aquarium is 2 feet, and the width is 10 inches, what is the height?

**Exercise 8:** Salam's new backyard pool is in the shape of a right rectangular prism whose length and width are 24.4 meters and 20 meters, respectively. Salam needed 858.88 cubic meters to fill the swimming pool  $\frac{4}{5}$  of the way to the top. How deep is the swimming pool?

**Exercises 9 - 10:** Prakash's pool has a length, width and height of 8 meters, 6 meters and 1.5 meters, respectively. The water resistant paint required for the pool costs 6 dollars every square meter.

9) How much will it cost to paint the interior surfaces of his pool?

10) How many liters of water will be needed to fill it?

**Exercise 11:** Company ABC is trying to keep boxes in a storage room with a length, width and height of 5 meters, 3 meters and 2 meters, respectively. How many boxes can fit in this room if each box is 10 cm long, 6 cm wide and 4 cm high?

**Exercise 12:** Khalid is painting his room with a length of 18 feet, width of 14 feet and a height of 8 feet. What is the area of the four walls that he wants to paint?

**Exercise 13:** If the lateral area of the figure below is 54 square inches, what is the length?

