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TOOLS OF GEOMETRY
G.GMD.B.4: ROTATIONS OF TWO-DIMENSIONAL OBJECTS

1 Which object is formed when right triangle \( RST \) shown below is rotated around leg \( RS \)?

1) a pyramid with a square base
2) an isosceles triangle
3) a right triangle
4) a cone

2 If the rectangle below is continuously rotated about side \( w \), which solid figure is formed?

1) pyramid
2) rectangular prism
3) cone
4) cylinder

3 Triangle \( ABC \), with vertices at \( A(0,0) \), \( B(3,5) \), and \( C(0,5) \), is graphed on the set of axes shown below.

Which figure is formed when \( \triangle ABC \) is rotated continuously about \( BC \)?

1)
2)
3)
4)
4 A student has a rectangular postcard that he folds in half lengthwise. Next, he rotates it continuously about the folded edge. Which three-dimensional object below is generated by this rotation?

1) \[ \text{ } \]
2) \[ \text{ } \]
3) \[ \text{ } \]
4) \[ \text{ } \]

5 If an equilateral triangle is continuously rotated around one of its medians, which 3-dimensional object is generated?
1) cone
2) pyramid
3) prism
4) sphere

6 In the diagram below, right triangle $ABC$ has legs whose lengths are 4 and 6.

![Right Triangle ABC]

What is the volume of the three-dimensional object formed by continuously rotating the right triangle around $AB$?
1) $32\pi$
2) $48\pi$
3) $96\pi$
4) $144\pi$

7 An isosceles right triangle whose legs measure 6 is continuously rotated about one of its legs to form a three-dimensional object. The three-dimensional object is a
1) cylinder with a diameter of 6
2) cylinder with a diameter of 12
3) cone with a diameter of 6
4) cone with a diameter of 12
8. A rectangle whose length and width are 10 and 6, respectively, is shown below. The rectangle is continuously rotated around a straight line to form an object whose volume is $150\pi$. Which line could the rectangle be rotated around?

1) a long side  
2) a short side  
3) the vertical line of symmetry  
4) the horizontal line of symmetry

9. Circle $O$ is centered at the origin. In the diagram below, a quarter of circle $O$ is graphed. Which three-dimensional figure is generated when the quarter circle is continuously rotated about the $y$-axis?

1) cone  
2) sphere  
3) cylinder  
4) hemisphere

10. Which figure can have the same cross section as a sphere?

1)  
2)  
3)  
4)  

11. The cross section of a regular pyramid contains the altitude of the pyramid. The shape of this cross section is a

1) circle  
2) square  
3) triangle  
4) rectangle
12 William is drawing pictures of cross sections of the right circular cone below.

Which drawing can not be a cross section of a cone?

1) 
2) 
3) 
4) 

13 A plane intersects a hexagonal prism. The plane is perpendicular to the base of the prism. Which two-dimensional figure is the cross section of the plane intersecting the prism?

1) triangle 
2) trapezoid 
3) hexagon 
4) rectangle 

14 A two-dimensional cross section is taken of a three-dimensional object. If this cross section is a triangle, what can not be the three-dimensional object?

1) cone 
2) cylinder 
3) pyramid 
4) rectangular prism 

15 A right hexagonal prism is shown below. A two-dimensional cross section that is perpendicular to the base is taken from the prism.

Which figure describes the two-dimensional cross section?

1) triangle 
2) rectangle 
3) pentagon 
4) hexagon 

16 A right cylinder is cut perpendicular to its base. The shape of the cross section is a

1) circle 
2) cylinder 
3) rectangle 
4) triangular prism
G.CO.D.12-13: CONSTRUCTIONS

17 Triangle $XYZ$ is shown below. Using a compass and straightedge, on the line below, construct and label $\triangle ABC$, such that $\triangle ABC \cong \triangle XYZ$. [Leave all construction marks.] Based on your construction, state the theorem that justifies why $\triangle ABC$ is congruent to $\triangle XYZ$.

18 Using a compass and straightedge, construct an altitude of triangle $ABC$ below. [Leave all construction marks.]

19 In the diagram below, radius $\overline{OA}$ is drawn in circle $O$. Using a compass and a straightedge, construct a line tangent to circle $O$ at point $A$. [Leave all construction marks.]
20 In the diagram of $\triangle ABC$ shown below, use a compass and straightedge to construct the median to $AB$. [Leave all construction marks.]

21 Using a compass and straightedge, construct and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a dilation with a scale factor of 2 and centered at $B$. [Leave all construction marks.] Describe the relationship between the lengths of $AC$ and $A'C'$.

22 Using a compass and straightedge, construct the line of reflection over which triangle $RST$ reflects onto triangle $R'S'T'$. [Leave all construction marks.]

23 Given: Trapezoid $JKLM$ with $JK \parallel ML$ Using a compass and straightedge, construct the altitude from vertex $J$ to $ML$. [Leave all construction marks.]
24 Using a compass and straightedge, construct the median to side $\overline{AC}$ in $\triangle ABC$ below. [Leave all construction marks.]

25 In the circle below, $\overline{AB}$ is a chord. Using a compass and straightedge, construct a diameter of the circle. [Leave all construction marks.]

26 Using a straightedge and compass, construct a square inscribed in circle $O$ below. [Leave all construction marks.]

Determine the measure of the arc intercepted by two adjacent sides of the constructed square. Explain your reasoning.
27 Use a compass and straightedge to construct an inscribed square in circle \( T \) shown below. [Leave all construction marks.]

29 Using a compass and straightedge, construct a regular hexagon inscribed in circle \( O \) below. Label it \( ABCDEF \). [Leave all construction marks.]

If chords \( FB \) and \( FC \) are drawn, which type of triangle, according to its angles, would \( \triangle FBC \) be? Explain your answer.

28 Construct an equilateral triangle inscribed in circle \( T \) shown below. [Leave all construction marks.]

30 Using a compass and straightedge, construct a regular hexagon inscribed in circle \( O \). [Leave all construction marks.]
31 The diagram below shows circle $O$ with diameter $AB$. Using a compass and straightedge, construct a square that is inscribed in circle $O$. [Leave all construction marks.]

32 What are the coordinates of the point on the directed line segment from $K(−5, −4)$ to $L(5, 1)$ that partitions the segment into a ratio of 3 to 2?
1) $(-3, -3)$
2) $(-1, -2)$
3) $\left(0, -\frac{3}{2}\right)$
4) $(1, -1)$

33 Point $Q$ is on $MN$ such that $MQ:QN = 2:3$. If $M$ has coordinates $(3, 5)$ and $N$ has coordinates $(8, -5)$, the coordinates of $Q$ are
1) $(5, 1)$
2) $(5, 0)$
3) $(6, -1)$
4) $(6, 0)$

34 The endpoints of $DEF$ are $D(1, 4)$ and $F(16, 14)$. Determine and state the coordinates of point $E$, if $DE:EF = 2:3$.

35 Line segment $RW$ has endpoints $R(-4, 5)$ and $W(6, 20)$. Point $P$ is on $RW$ such that $RP:PW$ is 2:3. What are the coordinates of point $P$?
1) $(2, 9)$
2) $(0, 11)$
3) $(2, 14)$
4) $(10, 2)$

36 The coordinates of the endpoints of $AB$ are $A(-6, -5)$ and $B(4, 0)$. Point $P$ is on $AB$. Determine and state the coordinates of point $P$, such that $AP:PB$ is 2:3. [The use of the set of axes below is optional.]
37 Point $P$ is on the directed line segment from point $X(-6,-2)$ to point $Y(6,7)$ and divides the segment in the ratio 1:5. What are the coordinates of point $P$?

1) $\left(4, \frac{1}{2}\right)$
2) $\left(-\frac{1}{2}, -4\right)$
3) $\left(-\frac{1}{2}, 0\right)$
4) $\left(-4, -\frac{1}{2}\right)$

38 Directed line segment $PT$ has endpoints whose coordinates are $P(-2,1)$ and $T(4,7)$. Determine the coordinates of point $J$ that divides the segment in the ratio 2 to 1. [The use of the set of axes below is optional.]

39 Point $P$ is on segment $AB$ such that $AP:PB$ is 4:5. If $A$ has coordinates $(4,2)$, and $B$ has coordinates $(22,2)$, determine and state the coordinates of $P$.

40 The coordinates of the endpoints of $AB$ are $A(-8,-2)$ and $B(16,6)$. Point $P$ is on $AB$. What are the coordinates of point $P$, such that $AP:PB$ is 3:5?

1) $(1,1)$
2) $(7,3)$
3) $(9.6, 3.6)$
4) $(6.4, 2.8)$

41 In the diagram below, $AC$ has endpoints with coordinates $A(-5,2)$ and $C(4,-10)$.

If $B$ is a point on $AC$ and $AB:BC = 1:2$, what are the coordinates of $B$?

1) $(-2, -2)$
2) $\left(-\frac{1}{2}, -4\right)$
3) $\left(0, -\frac{14}{3}\right)$
4) $(1, -6)$
42 Directed line segment $DE$ has endpoints $D(-4,-2)$ and $E(1,8)$. Point $F$ divides $DE$ such that $DF:FE$ is 2:3. What are the coordinates of $F$?
1) $(-3.0)$
2) $(-2,2)$
3) $(-1,4)$
4) $(2,4)$

43 The coordinates of the endpoints of directed line segment $ABC$ are $A(-8,7)$ and $C(7,-13)$. If $AB:BC = 3:2$, the coordinates of $B$ are
1) $(1,-5)$
2) $(-2,-1)$
3) $(-3,0)$
4) $(3,-6)$

G.CO.C.9: LINES & ANGLES

44 Steve drew line segments $ABCD$, $EFG$, $BF$, and $CF$ as shown in the diagram below. Scalene $\triangle BFC$ is formed.

Which statement will allow Steve to prove $ABCD \parallel EFG$?
1) $\angle CFG \cong \angle FCB$
2) $\angle ABF \cong \angle BFC$
3) $\angle EFB \cong \angle CFB$
4) $\angle CBF \cong \angle GFC$

45 In the diagram below, $EF$ intersects $AB$ and $CD$ at $G$ and $H$, respectively, and $GI$ is drawn such that $GH \cong IH$.

46 In the diagram below, $FE$ bisects $AC$ at $B$, and $GE$ bisects $BD$ at $C$.

Which statement is always true?
1) $AB \cong DC$
2) $FB \cong EB$
3) $BD$ bisects $GE$ at $C$.
4) $AC$ bisects $FE$ at $B$. 
47 In the diagram below, $DB$ and $AF$ intersect at point $C$, and $AD$ and $FBE$ are drawn.

If $AC = 6$, $DC = 4$, $FC = 15$, $m\angle D = 65^\circ$, and $m\angle CBE = 115^\circ$, what is the length of $CB$?
1) 10
2) 12
3) 17
4) 22.5

48 Segment $CD$ is the perpendicular bisector of $AB$ at $E$. Which pair of segments does not have to be congruent?
1) $AD, BD$
2) $AC, BC$
3) $AE, BE$
4) $DE, CE$

49 In the diagram below, lines $\ell, m, n,$ and $p$ intersect line $r$.

Which statement is true?
1) $\ell \parallel n$
2) $\ell \parallel p$
3) $m \parallel p$
4) $m \parallel n$

50 As shown in the diagram below, $ABC \parallel EFG$ and $BF \cong EF$.

If $m\angle CBF = 42.5^\circ$, then $m\angle EBF$ is
1) $42.5^\circ$
2) $68.75^\circ$
3) $95^\circ$
4) $137.5^\circ$
51 In the diagram below, $\overline{AB} \parallel \overline{DEF}$, $\overline{AE}$ and $\overline{BD}$ intersect at $C$, $\angle B = 43^\circ$, and $\angle CEF = 152^\circ$.

Which statement is true?
1) $\angle D = 28^\circ$
2) $\angle A = 43^\circ$
3) $\angle ACD = 71^\circ$
4) $\angle BCE = 109^\circ$

52 In the diagram below, $\overline{AEFB} \parallel \overline{CGD}$, and $\overline{GE}$ and $\overline{GF}$ are drawn.

If $\angle EFG = 32^\circ$ and $\angle AEG = 137^\circ$, what is $\angle EGF$?
1) $11^\circ$
2) $43^\circ$
3) $75^\circ$
4) $105^\circ$

53 Which equation represents a line that is perpendicular to the line represented by $2x - y = 7$?

1) $y = -\frac{1}{2}x + 6$
2) $y = \frac{1}{2}x + 6$
3) $y = -2x + 6$
4) $y = 2x + 6$

54 Given $\overline{MN}$ shown below, with $M(-6,1)$ and $N(3,-5)$, what is an equation of the line that passes through point $P(6,1)$ and is parallel to $\overline{MN}$?

1) $y = -\frac{2}{3}x + 5$
2) $y = \frac{2}{3}x - 3$
3) $y = \frac{3}{2}x + 7$
4) $y = \frac{3}{2}x - 8$
55. In the diagram below, \( \triangle ABC \) has vertices \( A(4,5) \), \( B(2,1) \), and \( C(7,3) \).

What is the slope of the altitude drawn from \( A \) to \( BC \)?

1) \( \frac{2}{5} \)
2) \( \frac{3}{2} \)
3) \( -\frac{1}{2} \)
4) \( -\frac{5}{2} \)

56. An equation of a line perpendicular to the line represented by the equation \( y = \frac{1}{2} x - 5 \) and passing through \( (6,-4) \) is

1) \( y = -\frac{1}{2} x + 4 \)
2) \( y = -\frac{1}{2} x - 1 \)
3) \( y = 2x + 14 \)
4) \( y = 2x - 16 \)

57. Line segment \( NY \) has endpoints \( N(-11,5) \) and \( Y(5,-7) \). What is the equation of the perpendicular bisector of \( NY \)?

1) \( y + 1 = \frac{4}{3} (x + 3) \)
2) \( y + 1 = -\frac{3}{4} (x + 3) \)
3) \( y - 6 = \frac{4}{3} (x - 8) \)
4) \( y - 6 = -\frac{3}{4} (x - 8) \)

58. Which equation represents the line that passes through the point \( (-2,2) \) and is parallel to \( y = \frac{1}{2} x + 8 \)?

1) \( y = \frac{1}{2} x \)
2) \( y = -2x - 3 \)
3) \( y = \frac{1}{2} x + 3 \)
4) \( y = -2x + 3 \)

59. What is an equation of a line that is perpendicular to the line whose equation is \( 2y = 3x - 10 \) and passes through \( (-6,1) \)?

1) \( y = \frac{2}{3} x - 5 \)
2) \( y = \frac{2}{3} x - 3 \)
3) \( y = \frac{2}{3} x + 1 \)
4) \( y = \frac{2}{3} x + 10 \)
60 What is an equation of the perpendicular bisector of the line segment shown in the diagram below?

1) \( y + 2x = 0 \)
2) \( y - 2x = 0 \)
3) \( 2y + x = 0 \)
4) \( 2y - x = 0 \)

61 What is an equation of a line which passes through \((6,9)\) and is perpendicular to the line whose equation is \(4x - 6y = 15\)?

1) \( y - 9 = \frac{3}{2} (x - 6) \)
2) \( y - 9 = \frac{2}{3} (x - 6) \)
3) \( y + 9 = \frac{3}{2} (x + 6) \)
4) \( y + 9 = \frac{2}{3} (x + 6) \)

62 What is an equation of the line that passes through the point \((6,8)\) and is perpendicular to a line with equation \(y = \frac{3}{2} x + 5\)?

1) \( y - 8 = \frac{3}{2} (x - 6) \)
2) \( y - 8 = -\frac{2}{3} (x - 6) \)
3) \( y + 8 = \frac{3}{2} (x + 6) \)
4) \( y + 8 = -\frac{2}{3} (x + 6) \)

63 Which equation represents a line that is perpendicular to the line represented by \(y = \frac{2}{3} x + 1\)?

1) \( 3x + 2y = 12 \)
2) \( 3x - 2y = 12 \)
3) \( y = \frac{3}{2} x + 2 \)
4) \( y = -\frac{2}{3} x + 4 \)

TRIANGLES
G.SRT.C.8: PYTHAGOREAN THEOREM, 30-60-90 TRIANGLES

64 Linda is designing a circular piece of stained glass with a diameter of 7 inches. She is going to sketch a square inside the circular region. To the nearest tenth of an inch, the largest possible length of a side of the square is

1) 3.5
2) 4.9
3) 5.0
4) 6.9
65 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television's screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

66 An equilateral triangle has sides of length 20. To the nearest tenth, what is the height of the equilateral triangle?
1) 10.0
2) 11.5
3) 17.3
4) 23.1

67 The diagram shows rectangle \( ABCD \), with diagonal \( BD \).

What is the perimeter of rectangle \( ABCD \), to the nearest tenth?
1) 28.4
2) 32.8
3) 48.0
4) 62.4

---

G.SRT.B.5: ISOSCELES TRIANGLE THEOREM

68 In isosceles \( \triangle MNP \), line segment \( NO \) bisects vertex \( \angle MNP \), as shown below. If \( MP = 16 \), find the length of \( MO \) and explain your answer.

69 In the diagram below of isosceles triangle \( ABC \), \( AB \cong CB \) and angle bisectors \( AD \), \( BF \), and \( CE \) are drawn and intersect at \( X \).

If \( \angle BAC = 50^\circ \), find \( \angle AXC \).
G.SRT.B.5: SIDE SPLITTER THEOREM

70 In the diagram of $\triangle ADC$ below, $EB \parallel DC$, $AE = 9$, $ED = 5$, and $AB = 9.2$.

What is the length of $AC$, to the nearest tenth?
1) 5.1
2) 5.2
3) 14.3
4) 14.4

71 In the diagram below, $\triangle ABC \sim \triangle ADE$.

Which measurements are justified by this similarity?
1) $AD = 3$, $AB = 6$, $AE = 4$, and $AC = 12$
2) $AD = 5$, $AB = 8$, $AE = 7$, and $AC = 10$
3) $AD = 3$, $AB = 9$, $AE = 5$, and $AC = 10$
4) $AD = 2$, $AB = 6$, $AE = 5$, and $AC = 15$

72 In the diagram of $\triangle ABC$, points $D$ and $E$ are on $AB$ and $CB$, respectively, such that $AC \parallel DE$.

If $AD = 24$, $DB = 12$, and $DE = 4$, what is the length of $AC$?
1) 8
2) 12
3) 16
4) 72

73 In $\triangle CED$ as shown below, points $A$ and $B$ are located on sides $CE$ and $ED$, respectively. Line segment $AB$ is drawn such that $AE = 3.75$, $AC = 5$, $EB = 4.5$, and $BD = 6$.

Explain why $AB$ is parallel to $CD$. 
74  Given $\triangle MRO$ shown below, with trapezoid $PTRO$, $MR = 9$, $MP = 2$, and $PO = 4$.

What is the length of $TR$?
1) 4.5
2) 5
3) 3
4) 6

75  In the diagram below, triangle $ACD$ has points $B$ and $E$ on sides $AC$ and $AD$, respectively, such that $BE \parallel CD$, $AB = 1$, $BC = 3.5$, and $AD = 18$.

What is the length of $AE$, to the nearest tenth?
1) 14.0
2) 5.1
3) 3.3
4) 4.0

76  In the diagram of $\triangle ABC$ below, $DE$ is parallel to $AB$, $CD = 15$, $AD = 9$, and $AB = 40$.

The length of $DE$ is
1) 15
2) 24
3) 25
4) 30

77  In the diagram below of $\triangle PQR$, $ST$ is drawn parallel to $PR$, $PS = 2$, $SQ = 5$, and $TR = 5$.

What is the length of $QR$?
1) 7
2) 2
3) $12 \frac{1}{2}$
4) $17 \frac{1}{2}$
78 In the diagram of \( \triangle ABC \) below, points \( D \) and \( E \) are on sides \( AB \) and \( CB \) respectively, such that \( DE \parallel AC \).

If \( EB \) is 3 more than \( DB \), \( AB = 14 \), and \( CB = 21 \), what is the length of \( AD \)?
1) 6
2) 8
3) 9
4) 12

79 In triangle \( ABC \), points \( D \) and \( E \) are on sides \( AB \) and \( BC \) respectively, such that \( DE \parallel AC \), and \( AD:DB = 3:5 \).

If \( DB = 6.3 \) and \( AC = 9.4 \), what is the length of \( DE \), to the nearest tenth?
1) 3.8
2) 5.6
3) 5.9
4) 15.7

G.CO.C.10: INTERIOR AND EXTERIOR ANGLES OF TRIANGLES

80 In the diagram below, \( m\angle BDC = 100^\circ \), \( m\angle A = 50^\circ \), and \( m\angle DBC = 30^\circ \).

Which statement is true?
1) \( \triangle ABD \) is obtuse.
2) \( \triangle ABC \) is isosceles.
3) \( m\angle ABD = 80^\circ \)
4) \( \triangle ABD \) is scalene.

81 In the diagram below, \( DE \) divides \( AB \) and \( AC \) proportionally, \( m\angle C = 26^\circ \), \( m\angle A = 82^\circ \), and \( DF \) bisects \( \angle BDE \).

The measure of angle \( DFB \) is
1) 36\(^\circ\)
2) 54\(^\circ\)
3) 72\(^\circ\)
4) 82\(^\circ\)
82 In the diagram below of triangle $MNO$, $\angle M$ and $\angle O$ are bisected by $MS$ and $OR$, respectively. Segments $MS$ and $OR$ intersect at $T$, and $m\angle N = 40^\circ$.

If $m\angle TMR = 28^\circ$, the measure of angle $OTS$ is
1) $40^\circ$
2) $50^\circ$
3) $60^\circ$
4) $70^\circ$

G.CO.C.10: EXTERIOR ANGLE THEOREM

83 Given $\triangle ABC$ with $m\angle B = 62^\circ$ and side $AC$ extended to $D$, as shown below.

Which value of $x$ makes $\overline{AB} \cong \overline{CB}$?
1) $59^\circ$
2) $62^\circ$
3) $118^\circ$
4) $121^\circ$

84 In $\triangle ABC$ shown below, side $AC$ is extended to point $D$ with $m\angle DAB = (180 - 3x)^\circ$, $m\angle B = (6x - 40)^\circ$, and $m\angle C = (x + 20)^\circ$.

What is $m\angle BAC$?
1) $20^\circ$
2) $40^\circ$
3) $60^\circ$
4) $80^\circ$

G.CO.C.10: MEDIANs, ALTITUDES AND BISECTORS

85 In $\triangle ABC$, $BD$ is the perpendicular bisector of $ADC$. Based upon this information, which statements below can be proven?
I. $BD$ is a median.
II. $BD$ bisects $\angle ABC$.
III. $\triangle ABC$ is isosceles.
1) I and II, only
2) I and III, only
3) II and III, only
4) I, II, and III
G.CO.C.10: MIDSEGMENTS

86 In the diagram below, \( \overline{DE}, \overline{DF}, \) and \( \overline{EF} \) are midsegments of \( \triangle ABC \).

The perimeter of quadrilateral \( ADEF \) is equivalent to
1) \( AB + BC + AC \)
2) \( \frac{1}{2} AB + \frac{1}{2} AC \)
3) \( 2AB + 2AC \)
4) \( AB + AC \)

87 In the diagram below of \( \triangle ABC \), \( D, E, \) and \( F \) are the midpoints of \( AB, BC, \) and \( CA \), respectively.

What is the ratio of the area of \( \triangle CFE \) to the area of \( \triangle CAB \)?
1) 1:1
2) 1:2
3) 1:3
4) 1:4

G.CO.C.10: CENTROID, ORTHOCENTER, INCENTER & CIRCUMCENTER

88 In triangle \( SRK \) below, medians \( \overline{SC}, \overline{KE}, \) and \( \overline{RL} \) intersect at \( M \).

Which statement must always be true?
1) \( 3(MC) = SC \)
2) \( MC = \frac{1}{3} (SM) \)
3) \( RM = 2MC \)
4) \( SM = KM \)

G.GPE.B.4: TRIANGLES IN THE COORDINATE PLANE

89 The coordinates of the vertices of \( \triangle RST \) are \( R(-2,-3), S(8,2), \) and \( T(4,5) \). Which type of triangle is \( \triangle RST \)?
1) right
2) acute
3) obtuse
4) equiangular
90 Triangle \(ABC\) has vertices with \(A(x, 3), B(-3, -1)\), and \(C(-1, -4)\). Determine and state a value of \(x\) that would make triangle \(ABC\) a right triangle. Justify why \(\triangle ABC\) is a right triangle. [The use of the set of axes below is optional.]

91 Triangle \(PQR\) has vertices \(P(-3, -1), Q(-1, 7)\), and \(R(3, 3)\), and points \(A\) and \(B\) are midpoints of \(\overline{PQ}\) and \(\overline{RQ}\), respectively. Use coordinate geometry to prove that \(\overline{AB}\) is parallel to \(\overline{PR}\) and is half the length of \(\overline{PR}\). [The use of the set of axes below is optional.]
92 Triangle $ABC$ has vertices with coordinates $A(-1,-1), B(4,0),$ and $C(0,4)$. Prove that $\triangle ABC$ is an isosceles triangle but not an equilateral triangle. [The use of the set of axes below is optional.]

93 The diagram below shows parallelogram $LMNO$ with diagonal $LN$, $\angle M = 118^\circ$, and $\angle LNO = 22^\circ$. Explain why $\angle NLO$ is 40 degrees.

94 In the diagram of parallelogram $FRED$ shown below, $ED$ is extended to $A$, and $AF$ is drawn such that $AF \cong DF$.

If $\angle R = 124^\circ$, what is $\angle AFD$?
1) $124^\circ$
2) $112^\circ$
3) $68^\circ$
4) $56^\circ$

95 In parallelogram $QRST$ shown below, diagonal $TR$ is drawn, $U$ and $V$ are points on $TS$ and $QR$, respectively, and $UV$ intersects $TR$ at $W$.

If $\angle S = 60^\circ$, $\angle SRT = 83^\circ$, and $\angle TWU = 35^\circ$, what is $\angle WVQ$?
1) $37^\circ$
2) $60^\circ$
3) $72^\circ$
4) $83^\circ$
96 In the diagram below, \(ABCD\) is a parallelogram, \(AB\) is extended through \(B\) to \(E\), and \(CE\) is drawn.

If \(CE \cong BE\) and \(m\angle D = 112^\circ\), what is \(m\angle E\)?

1) 44°
2) 56°
3) 68°
4) 112°

G.CO.C.11: PARALLELOGRAMS

98 Quadrilateral \(ABCD\) has diagonals \(AC\) and \(BD\). Which information is not sufficient to prove \(ABCD\) is a parallelogram?

1) \(AC\) and \(BD\) bisect each other.
2) \(AB \cong CD\) and \(BC \cong AD\)
3) \(AB \cong CD\) and \(AB \parallel CD\)
4) \(AB \cong CD\) and \(BC \parallel AD\)

99 Quadrilateral \(ABCD\) with diagonals \(AC\) and \(BD\) is shown in the diagram below.

Which information is not enough to prove \(ABCD\) is a parallelogram?

1) \(AB \cong CD\) and \(AB \parallel DC\)
2) \(AB \cong CD\) and \(BC \cong DA\)
3) \(AB \cong CD\) and \(BC \parallel AD\)
4) \(AB \parallel DC\) and \(BC \parallel AD\)

100 Quadrilateral \(MATH\) has both pairs of opposite sides congruent and parallel. Which statement about quadrilateral \(MATH\) is always true?

1) \(MT \cong AH\)
2) \(MT \perp AH\)
3) \(\angle MHT \cong \angle ATH\)
4) \(\angle MAT \cong \angle MHT\)
101 In quadrilateral \( \text{BLUE} \) shown below, \( \overline{BE} \cong \overline{UL} \).

Which information would be sufficient to prove quadrilateral \( \text{BLUE} \) is a parallelogram?
1) \( \overline{BL} \parallel \overline{EU} \)
2) \( \overline{LU} \parallel \overline{BE} \)
3) \( \overline{BE} \cong \overline{BL} \)
4) \( \overline{LU} \cong \overline{EU} \)

102 Parallelogram \( \text{HAND} \) is drawn below with diagonals \( \overline{HN} \) and \( \overline{AD} \) intersecting at \( S \).

Which statement is always true?
1) \( \overline{AN} = \frac{1}{2} \overline{AD} \)
2) \( \overline{AS} = \frac{1}{2} \overline{AD} \)
3) \( \angle \text{AHS} \cong \angle \text{ANS} \)
4) \( \angle \text{HDS} \cong \angle \text{NDS} \)

103 In parallelogram \( \text{ABCD} \) shown below, the bisectors of \( \angle \text{ABC} \) and \( \angle \text{DCB} \) meet at \( E \), a point on \( \overline{AD} \).

If \( m \angle A = 68^\circ \), determine and state \( m \angle \text{BEC} \).

104 A parallelogram must be a rectangle when its
1) diagonals are perpendicular
2) diagonals are congruent
3) opposite sides are parallel
4) opposite sides are congruent

105 In parallelogram \( \text{ABCD} \), diagonals \( \overline{AC} \) and \( \overline{BD} \) intersect at \( E \). Which statement does not prove parallelogram \( \text{ABCD} \) is a rhombus?
1) \( \overline{AC} \cong \overline{DB} \)
2) \( \overline{AB} \cong \overline{BC} \)
3) \( \overline{AC} \perp \overline{DB} \)
4) \( \overline{AC} \) bisects \( \angle \text{DCB} \)

106 A parallelogram is always a rectangle if
1) the diagonals are congruent
2) the diagonals bisect each other
3) the diagonals intersect at right angles
4) the opposite angles are congruent
107 In the diagram below, if $\triangle ABE \cong \triangle CDF$ and $AEFC$ is drawn, then it could be proven that quadrilateral $ABCD$ is a

1) square  
2) rhombus  
3) rectangle  
4) parallelogram

108 In the diagram of rhombus $PQRS$ below, the diagonals $PR$ and $QS$ intersect at point $T$, $PR = 16$, and $QS = 30$. Determine and state the perimeter of $PQRS$.

110 Which set of statements would describe a parallelogram that can always be classified as a rhombus?

I. Diagonals are perpendicular bisectors of each other.
II. Diagonals bisect the angles from which they are drawn.
III. Diagonals form four congruent isosceles right triangles.

1) I and II  
2) I and III  
3) II and III  
4) I, II, and III

111 A parallelogram must be a rhombus if its diagonals

1) are congruent  
2) bisect each other  
3) do not bisect its angles  
4) are perpendicular to each other

112 The diagram below shows parallelogram $ABCD$ with diagonals $AC$ and $BD$ intersecting at $E$.

109 If $ABCD$ is a parallelogram, which statement would prove that $ABCD$ is a rhombus?

1) $\angle ABC \cong \angle CDA$  
2) $AC \cong BD$  
3) $AC \perp BD$  
4) $AB \perp CD$  

What additional information is sufficient to prove that parallelogram $ABCD$ is also a rhombus?

1) $BD$ bisects $AC$.  
2) $AB$ is parallel to $CD$.  
3) $AC$ is congruent to $BD$.  
4) $AC$ is perpendicular to $BD$.  

26
G.GPE.B.4: QUADRILATERALS IN THE COORDINATE PLANE

113 In rhombus \( MATH \), the coordinates of the endpoints of the diagonal \( MT \) are \( M(0, -1) \) and \( T(4, 6) \). Write an equation of the line that contains diagonal \( AH \). [Use of the set of axes below is optional.] Using the given information, explain how you know that your line contains diagonal \( AH \).

114 The diagonals of rhombus \( TEAM \) intersect at \( P(2, 1) \). If the equation of the line that contains diagonal \( TA \) is \( y = -x + 3 \), what is the equation of a line that contains diagonal \( EM \)?

1) \( y = x - 1 \)
2) \( y = x - 3 \)
3) \( y = x - 1 \)
4) \( y = -x - 3 \)

115 A quadrilateral has vertices with coordinates \((-3, 1), (0, 3), (5, 2), \) and \((-1, -2) \). Which type of quadrilateral is this?

1) rhombus
2) rectangle
3) square
4) trapezoid

116 In the coordinate plane, the vertices of \( \triangle RST \) are \( R(6, -1), S(1, -4), \) and \( T(-5, 6) \). Prove that \( \triangle RST \) is a right triangle. State the coordinates of point \( P \) such that quadrilateral \( RSTP \) is a rectangle. Prove that your quadrilateral \( RSTP \) is a rectangle. [The use of the set of axes below is optional.]
117 Parallelogram $ABCD$ has coordinates $A(0,7)$ and $C(2,1)$. Which statement would prove that $ABCD$ is a rhombus?

1) The midpoint of $AC$ is (1,4).
2) The length of $BD$ is $\sqrt{40}$.
3) The slope of $BD$ is $\frac{1}{3}$.
4) The slope of $AB$ is $\frac{1}{3}$.

118 In square $GEOM$, the coordinates of $G$ are $(2,-2)$ and the coordinates of $O$ are $(-4,2)$. Determine and state the coordinates of vertices $E$ and $M$. [The use of the set of axes below is optional.]

119 Quadrilateral $PQRS$ has vertices $P(-2,3)$, $Q(3,8)$, $R(4,1)$, and $S(-1,-4)$. Prove that $PQRS$ is a rhombus. Prove that $PQRS$ is not a square. [The use of the set of axes below is optional.]
120 In the coordinate plane, the vertices of triangle PAT are $P(-1, -6)$, $A(-4, 5)$, and $T(5, -2)$. Prove that $\triangle PAT$ is an isosceles triangle. [The use of the set of axes below is optional.] State the coordinates of $R$ so that quadrilateral PART is a parallelogram. Prove that quadrilateral PART is a parallelogram.

121 The vertices of quadrilateral MATH have coordinates $M(-4, 2)$, $A(-1, -3)$, $T(9, 3)$, and $H(6, 8)$. Prove that quadrilateral MATH is a parallelogram. Prove that quadrilateral MATH is a rectangle. [The use of the set of axes below is optional.]

G.GPE.B.7: POLYGONS IN THE COORDINATE PLANE

122 The endpoints of one side of a regular pentagon are $(-1, 4)$ and $(2, 3)$. What is the perimeter of the pentagon?

1) $\sqrt{10}$
2) $5\sqrt{10}$
3) $5\sqrt{2}$
4) $25\sqrt{2}$
123 Triangle \(RST\) is graphed on the set of axes below.

![Diagram of triangle RST]

How many square units are in the area of \(\triangle RST\)?
1) \(9\sqrt{3} + 15\)
2) \(9\sqrt{5} + 15\)
3) 45
4) 90

124 The coordinates of vertices \(A\) and \(B\) of \(\triangle ABC\) are \(A(3,4)\) and \(B(3,12)\). If the area of \(\triangle ABC\) is 24 square units, what could be the coordinates of point \(C\)?
1) \((3,6)\)
2) \((8,-3)\)
3) \((-3,8)\)
4) \((6,3)\)

125 The vertices of square \(RSTV\) have coordinates \(R(-1,5)\), \(S(-3,1)\), \(T(-7,3)\), and \(V(-5,7)\). What is the perimeter of \(RSTV\)?
1) \(\sqrt{20}\)
2) \(\sqrt{40}\)
3) \(4\sqrt{20}\)
4) \(4\sqrt{40}\)

126 Triangle \(DAN\) is graphed on the set of axes below. The vertices of \(\triangle DAN\) have coordinates \(D(-6,-1)\), \(A(6,3)\), and \(N(-3,10)\).

![Diagram of triangle DAN]

What is the area of \(\triangle DAN\)?
1) 60
2) 120
3) \(20\sqrt{13}\)
4) \(40\sqrt{13}\)

127 Rhombus \(STAR\) has vertices \(S(-1,2)\), \(T(2,3)\), \(A(3,0)\), and \(R(0,-1)\). What is the perimeter of rhombus \(STAR\)?
1) \(\sqrt{34}\)
2) \(4\sqrt{34}\)
3) \(\sqrt{10}\)
4) \(4\sqrt{10}\)
128 On the set of axes below, the vertices of $\triangle PQR$ have coordinates $P(-6,7)$, $Q(2,1)$, and $R(-1,-3)$.

What is the area of $\triangle PQR$?
1) 10
2) 20
3) 25
4) 50

129 In circle $O$ shown below, diameter $AC$ is perpendicular to $CD$ at point $C$, and chords $AB$, $BC$, $AE$, and $CE$ are drawn.

Which statement is not always true?
1) $\angle ABC \cong \angle BCD$
2) $\angle ABC \cong \angle ACD$
3) $\angle BAC \cong \angle DCB$
4) $\angle CBA \cong \angle AEC$

CONICS
G.C.A.2: CHORDS, SECANTS AND TANGENTS

130 In the diagram of circle $A$ shown below, chords $CD$ and $EF$ intersect at $G$, and chords $CE$ and $FD$ are drawn.

Which statement is not always true?
1) $CG \cong FG$
2) $\angle CEG \cong \angle FDG$
3) $\frac{CE}{FD} = \frac{EG}{DG}$
4) $\triangle CEG \sim \triangle FDG$

131 In the diagram shown below, $AC$ is tangent to circle $O$ at $A$ and to circle $P$ at $C$, $OP$ intersects $AC$ at $B$, $OA = 4$, $AB = 5$, and $PC = 10$.

What is the length of $BC$?
1) 6.4
2) 8
3) 12.5
4) 16
132 In the diagram below, $\overline{DC}$, $\overline{AC}$, $\overline{DOB}$, $\overline{CB}$, and $\overline{AB}$ are chords of circle $O$, $\overline{FDE}$ is tangent at point $D$, and radius $\overline{AO}$ is drawn. Sam decides to apply this theorem to the diagram: “An angle inscribed in a semi-circle is a right angle.”

Which angle is Sam referring to?
1) $\angle AOB$
2) $\angle BAC$
3) $\angle DCB$
4) $\angle FDB$

133 In the diagram below of circle $O$ with diameter $\overline{BC}$ and radius $\overline{OA}$, chord $\overline{DC}$ is parallel to chord $\overline{BA}$.

If $\angle BCD = 30^\circ$, determine and state $\angle AOB$.

134 In the diagram below of circle $O$, $\overline{OB}$ and $\overline{OC}$ are radii, and chords $\overline{AB}$, $\overline{BC}$, and $\overline{AC}$ are drawn.

Which statement must always be true?
1) $\angle BAC \cong \angle BOC$
2) $m\angle BAC = \frac{1}{2} m\angle BOC$
3) $\triangle BAC$ and $\triangle BOC$ are isosceles.
4) The area of $\triangle BAC$ is twice the area of $\triangle BOC$.

135 In the diagram below, $\overline{BC}$ is the diameter of circle $A$.

Point $D$, which is unique from points $B$ and $C$, is plotted on circle $A$. Which statement must always be true?
1) $\triangle BCD$ is a right triangle.
2) $\triangle BCD$ is an isosceles triangle.
3) $\triangle BAD$ and $\triangle CBD$ are similar triangles.
4) $\triangle BAD$ and $\triangle CAD$ are congruent triangles.
136 Lines $AE$ and $BD$ are tangent to circles $O$ and $P$ at $A$, $E$, $B$, and $D$, as shown in the diagram below. If $AC:CE = 5:3$, and $BD = 56$, determine and state the length of $CD$.

137 In circle $O$, secants $ADB$ and $AEC$ are drawn from external point $A$ such that points $D$, $B$, $E$, and $C$ are on circle $O$. If $AD = 8$, $AE = 6$, and $EC$ is 12 more than $BD$, the length of $BD$ is

1) 6  
2) 22  
3) 36  
4) 48

138 In the diagram below, tangent $DA$ and secant $DBC$ are drawn to circle $O$ from external point $D$, such that $AC \cong BC$.

If $mBC = 152^\circ$, determine and state $m\angle D$.

139 In the diagram below, $m\angle ABC = 268^\circ$.

What is the number of degrees in the measure of $\angle ABC$?

1) 134°  
2) 92°  
3) 68°  
4) 46°

140 In the diagram below of circle $O$, chord $DF$ bisects chord $BC$ at $E$.

If $BC = 12$ and $FE$ is 5 more than $DE$, then $FE$ is

1) 13  
2) 9  
3) 6  
4) 4
141 In the diagram below of circle $O$, chord $CD$ is parallel to diameter $AOB$ and $m\overline{CD} = 130$.

What is $m\overline{AC}$?
1) 25  
2) 50  
3) 65  
4) 115

142 In the diagram shown below, $PA$ is tangent to circle $T$ at $A$, and secant $PBC$ is drawn where point $B$ is on circle $T$.

If $PB = 3$ and $BC = 15$, what is the length of $PA$?
1) $3\sqrt{5}$  
2) $3\sqrt{6}$  
3) 3  
4) 9

143 In circle $M$ below, diameter $\overline{AC}$, chords $\overline{AB}$ and $\overline{BC}$, and radius $\overline{MB}$ are drawn.

Which statement is not true?
1) $\triangle ABC$ is a right triangle.  
2) $\triangle ABM$ is isosceles.  
3) $m\overline{BC} = m\angle BMC$  
4) $m\overline{AB} = \frac{1}{2} m\angle ACB$

144 In the diagram below of circle $O$, chords $\overline{AB}$ and $\overline{CD}$ intersect at $E$.

If $m\overline{AC} = 72^\circ$ and $m\angle AEC = 58^\circ$, how many degrees are in $m\angle DB$?
1) 108°  
2) 65°  
3) 44°  
4) 14°
145. In the diagram below, secants $RST$ and $RQP$, drawn from point $R$, intersect circle $O$ at $S$, $T$, $Q$, and $P$.

If $RS = 6$, $ST = 4$, and $RP = 15$, what is the length of $RQ$?

146. In the figure shown below, quadrilateral $TAEQ$ is circumscribed around circle $D$. The midpoint of $TA$ is $R$, and $HO \cong PE$.

If $AP = 10$ and $EO = 12$, what is the perimeter of quadrilateral $TAEQ$?

1) 56
2) 64
3) 72
4) 76

147. In circle $A$ below, chord $BC$ and diameter $DAE$ intersect at $F$.

If $\widehat{CD} = 46^\circ$ and $\widehat{DB} = 102^\circ$, what is $\angle CFE$?

G.C.A.3: INSCRIBED QUADRILATERALS

148. In the diagram below, quadrilateral $ABCD$ is inscribed in circle $P$.

What is $m\angle ADC$?
1) $70^\circ$
2) $72^\circ$
3) $108^\circ$
4) $110^\circ$
149 Quadrilateral $ABCD$ is inscribed in circle $O$, as shown below.

If $\angle A = 80^\circ$, $\angle B = 75^\circ$, $\angle C = (y + 30)^\circ$, and $\angle D = (x - 10)^\circ$, which statement is true?

1) $x = 85$ and $y = 50$
2) $x = 90$ and $y = 45$
3) $x = 110$ and $y = 75$
4) $x = 115$ and $y = 70$

G.GPE.A.1: EQUATIONS OF CIRCLES

150 The equation of a circle is $x^2 + y^2 + 6y = 7$. What are the coordinates of the center and the length of the radius of the circle?
1) center (0,3) and radius 4
2) center (0,−3) and radius 4
3) center (0,3) and radius 16
4) center (0,−3) and radius 16

151 If $x^2 + 4x + y^2 - 6y - 12 = 0$ is the equation of a circle, the length of the radius is
1) 25
2) 16
3) 5
4) 4

152 What are the coordinates of the center and length of the radius of the circle whose equation is $x^2 + 6x + y^2 - 4y = 23$?
1) (3,−2) and 36
2) (3,−2) and 6
3) (−3,2) and 36
4) (−3,2) and 6

153 Kevin’s work for deriving the equation of a circle is shown below.

$x^2 + 4x = -(y^2 - 20)$

STEP 1 $x^2 + 4x = -y^2 + 20$
STEP 2 $x^2 + 4x + 4 = -y^2 + 20 - 4$
STEP 3 $(x + 2)^2 = -y^2 + 20 - 4$
STEP 4 $(x + 2)^2 + y^2 = 16$

In which step did he make an error in his work?
1) Step 1
2) Step 2
3) Step 3
4) Step 4

154 What are the coordinates of the center and the length of the radius of the circle represented by the equation $x^2 + y^2 - 4x + 8y + 11 = 0$?
1) center (2,−4) and radius 3
2) center (−2,4) and radius 3
3) center (2,−4) and radius 9
4) center (−2,4) and radius 9

155 Determine and state the coordinates of the center and the length of the radius of a circle whose equation is $x^2 + y^2 - 6x = 56 - 8y$. 
156 The equation of a circle is \( x^2 + y^2 - 6y + 1 = 0 \). What are the coordinates of the center and the length of the radius of this circle?

1) center (0, 3) and radius \( = 2\sqrt{2} \)
2) center (0, -3) and radius \( = 2\sqrt{2} \)
3) center (0, 6) and radius \( = \sqrt{35} \)
4) center (0, -6) and radius \( = \sqrt{35} \)

157 The graph below shows \( AB \), which is a chord of circle \( O \). The coordinates of the endpoints of \( AB \) are \( A(3, 3) \) and \( B(3, -7) \). The distance from the midpoint of \( AB \) to the center of circle \( O \) is 2 units.

158 The equation of a circle is \( x^2 + y^2 - 12y + 20 = 0 \). What are the coordinates of the center and the length of the radius of the circle?

1) center (0, 6) and radius 4
2) center (0, -6) and radius 4
3) center (0, 6) and radius 16
4) center (0, -6) and radius 16

159 The equation of a circle is \( x^2 + y^2 - 6x + 2y = 6 \). What are the coordinates of the center and the length of the radius of the circle?

1) center (-3, 1) and radius 4
2) center (3, -1) and radius 4
3) center (-3, 1) and radius 16
4) center (3, -1) and radius 16

160 What is an equation of circle \( O \) shown in the graph below?

\[
\begin{align*}
1) & \quad x^2 + 10x + y^2 + 4y = -13 \\
2) & \quad x^2 - 10x + y^2 - 4y = -13 \\
3) & \quad x^2 + 10x + y^2 + 4y = -25 \\
4) & \quad x^2 - 10x + y^2 - 4y = -25
\end{align*}
\]
161 An equation of circle \( O \) is \( x^2 + y^2 + 4x - 8y = -16 \). The statement that best describes circle \( O \) is the 
1) center is (2, -4) and is tangent to the \( x \)-axis 
2) center is (2, -4) and is tangent to the \( y \)-axis 
3) center is (-2, 4) and is tangent to the \( x \)-axis 
4) center is (-2, 4) and is tangent to the \( y \)-axis

G.GPE.B.4: CIRCLES IN THE COORDINATE PLANE

162 The center of circle \( Q \) has coordinates (3, -2). If circle \( Q \) passes through \( R(7, 1) \), what is the length of its diameter? 
1) 50 
2) 25 
3) 10 
4) 5

163 A circle whose center is the origin passes through the point (-5, 12). Which point also lies on this circle? 
1) (10, 3) 
2) (-12, 13) 
3) (11, 2\sqrt{12}) 
4) (-8, 5\sqrt{21})

164 A circle has a center at (1, -2) and radius of 4. Does the point (3, 4, 1.2) lie on the circle? Justify your answer.

MEASURING IN THE PLANE AND SPACE

G.MG.A.3: AREA OF POLYGONS, SURFACE AREA AND LATERAL AREA

165 A farmer has 64 feet of fence to enclose a rectangular vegetable garden. Which dimensions would result in the biggest area for this garden? 
1) the length and the width are equal 
2) the length is 2 more than the width 
3) the length is 4 more than the width 
4) the length is 6 more than the width

166 Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.
167 A gallon of paint will cover approximately 450 square feet. An artist wants to paint all the outside surfaces of a cube measuring 12 feet on each edge. What is the least number of gallons of paint he must buy to paint the cube?
1) 1  
2) 2  
3) 3  
4) 4

G.GMD.A.1: CIRCUMFERENCE

168 A circle with a radius of 5 was divided into 24 congruent sectors. The sectors were then rearranged, as shown in the diagram below.

To the nearest integer, the value of x is
1) 31  
2) 16  
3) 12  
4) 10

G.C.B.5: ARC LENGTH

170 In the diagram below, the circle shown has radius 10. Angle B intercepts an arc with a length of $2\pi$.

What is the measure of angle B, in radians?
1) $10 + 2\pi$  
2) $20\pi$  
3) $\frac{\pi}{5}$  
4) $\frac{5}{\pi}$

171 In the diagram below, Circle 1 has radius 4, while Circle 2 has radius 6.5. Angle A intercepts an arc of length $\pi$, and angle B intercepts an arc of length $\frac{13\pi}{8}$.

Dominic thinks that angles A and B have the same radian measure. State whether Dominic is correct or not. Explain why.
172 In the diagram below, two concentric circles with center O, and radii \( OC, OD, OGE, \) and \( ODF \) are drawn.

If \( OC = 4 \) and \( OE = 6 \), which relationship between the length of arc \( EF \) and the length of arc \( CD \) is always true?
1) The length of arc \( EF \) is 2 units longer than the length of arc \( CD \).
2) The length of arc \( EF \) is 4 units longer than the length of arc \( CD \).
3) The length of arc \( EF \) is 1.5 times the length of arc \( CD \).
4) The length of arc \( EF \) is 2.0 times the length of arc \( CD \).

173 The diagram below shows circle \( O \) with radii \( OA \) and \( OB \). The measure of angle \( AOB \) is 120°, and the length of a radius is 6 inches.

Which expression represents the length of arc \( AB \), in inches?
1) \( \frac{120}{360} (6\pi) \)
2) \( 120(6) \)
3) \( \frac{1}{3} (36\pi) \)
4) \( \frac{1}{3} (12\pi) \)

G.C.B.5: SECTORS

174 In the diagram below of circle \( O \), diameter \( \overline{AB} \) and radii \( OC \) and \( OD \) are drawn. The length of \( AB \) is 12 and the measure of \( \angle COD \) is 20 degrees.

If \( \overline{AC} \cong \overline{BD} \), find the area of sector \( BOD \) in terms of \( \pi \).
175 In the diagram below of circle $O$, the area of the shaded sector $AOC$ is $12\pi$ in$^2$ and the length of $OA$ is 6 inches. Determine and state $m\angle AOC$.

176 Triangle $FGH$ is inscribed in circle $O$, the length of radius $OH$ is 6, and $FH \cong OG$.

What is the area of the sector formed by angle $FOH$?
1) $2\pi$
2) $\frac{3}{2}\pi$
3) $6\pi$
4) $24\pi$

177 Determine and state, in terms of $\pi$, the area of a sector that intercepts a $40^\circ$ arc of a circle with a radius of 4.5.

178 In the diagram below of circle $O$, the area of the shaded sector $LOM$ is $2\pi$ cm$^2$.

If the length of $NL$ is 6 cm, what is $m\angle N$?
1) $10^\circ$
2) $20^\circ$
3) $40^\circ$
4) $80^\circ$

179 What is the area of a sector of a circle with a radius of 8 inches and formed by a central angle that measures $60^\circ$?
1) $\frac{8\pi}{3}$
2) $\frac{16\pi}{3}$
3) $\frac{32\pi}{3}$
4) $\frac{64\pi}{3}$
180 In circle $O$, diameter $AB$, chord $BC$, and radius $OC$ are drawn, and the measure of arc $BC$ is $108^\circ$.

Some students wrote these formulas to find the area of sector $COB$:
- Amy: $\frac{3}{10} \cdot \pi \cdot (BC)^2$
- Beth: $\frac{108}{360} \cdot \pi \cdot (OC)^2$
- Carl: $\frac{3}{10} \cdot \pi \cdot \left(\frac{1}{2} AB\right)^2$
- Dex: $\frac{108}{360} \cdot \pi \cdot \left(\frac{1}{2} AB\right)^2$

Which students wrote correct formulas?
1) Amy and Dex
2) Beth and Carl
3) Carl and Amy
4) Dex and Beth

181 In a circle with a diameter of 32, the area of a sector is $\frac{512 \pi}{3}$. The measure of the angle of the sector, in radians, is
1) $\frac{\pi}{3}$
2) $\frac{4\pi}{3}$
3) $\frac{16\pi}{3}$
4) $\frac{64\pi}{3}$

182 In the diagram below of circle $O$, $GO = 8$ and $m\angle GOJ = 60^\circ$.

What is the area, in terms of $\pi$, of the shaded region?
1) $\frac{4\pi}{3}$
2) $\frac{20\pi}{3}$
3) $\frac{32\pi}{3}$
4) $\frac{160\pi}{3}$

183 In the diagram below, the circle has a radius of 25 inches. The area of the unshaded sector is $500\pi$ in$^2$.

Determine and state the degree measure of angle $Q$, the central angle of the shaded sector.
184 A circle with a diameter of 10 cm and a central angle of 30° is drawn below.

What is the area, to the nearest tenth of a square centimeter, of the sector formed by the 30° angle?
1) 5.2  
2) 6.5  
3) 13.1  
4) 26.2

185 Two stacks of 23 quarters each are shown below. One stack forms a cylinder but the other stack does not form a cylinder.

Use Cavelieri’s principle to explain why the volumes of these two stacks of quarters are equal.

186 Sue believes that the two cylinders shown in the diagram below have equal volumes.

Is Sue correct? Explain why.

187 The diagram below shows two figures. Figure A is a right triangular prism and figure B is an oblique triangular prism. The base of figure A has a height of 5 and a length of 8 and the height of prism A is 14. The base of figure B has a height of 8 and a length of 5 and the height of prism B is 14.

Use Cavalieri's Principle to explain why the volumes of these two triangular prisms are equal.
188 The Great Pyramid of Giza was constructed as a regular pyramid with a square base. It was built with an approximate volume of 2,592,276 cubic meters and a height of 146.5 meters. What was the length of one side of its base, to the nearest meter?
1) 73
2) 77
3) 133
4) 230

189 A fish tank in the shape of a rectangular prism has dimensions of 14 inches, 16 inches, and 10 inches. The tank contains 1680 cubic inches of water. What percent of the fish tank is empty?
1) 10
2) 25
3) 50
4) 75

190 As shown in the diagram below, a regular pyramid has a square base whose side measures 6 inches.

If the altitude of the pyramid measures 12 inches, its volume, in cubic inches, is
1) 72
2) 144
3) 288
4) 432

191 The diameter of a basketball is approximately 9.5 inches and the diameter of a tennis ball is approximately 2.5 inches. The volume of the basketball is about how many times greater than the volume of the tennis ball?
1) 3591
2) 65
3) 55
4) 4

192 A company is creating an object from a wooden cube with an edge length of 8.5 cm. A right circular cone with a diameter of 8 cm and an altitude of 8 cm will be cut out of the cube. Which expression represents the volume of the remaining wood?
1) $(8.5)^3 - \pi (4)^2 (8)$
2) $(8.5)^3 - \pi (4)^2 (8)$
3) $(8.5)^3 - \frac{1}{3} \pi (8)^2 (8)$
4) $(8.5)^3 - \frac{1}{3} \pi (4)^2 (8)$

193 Tennis balls are sold in cylindrical cans with the balls stacked one on top of the other. A tennis ball has a diameter of 6.7 cm. To the nearest cubic centimeter, what is the minimum volume of the can that holds a stack of 4 tennis balls?
1) 236
2) 282
3) 564
4) 945
194 A barrel of fuel oil is a right circular cylinder where the inside measurements of the barrel are a diameter of 22.5 inches and a height of 33.5 inches. There are 231 cubic inches in a liquid gallon. Determine and state, to the nearest tenth, the gallons of fuel that are in a barrel of fuel oil.

195 A water glass can be modeled by a truncated right cone (a cone which is cut parallel to its base) as shown below.

The diameter of the top of the glass is 3 inches, the diameter at the bottom of the glass is 2 inches, and the height of the glass is 5 inches. The base with a diameter of 2 inches must be parallel to the base with a diameter of 3 inches in order to find the height of the cone. Explain why. Determine and state, in inches, the height of the larger cone. Determine and state, to the nearest tenth of a cubic inch, the volume of the water glass.

196 When volleyballs are purchased, they are not fully inflated. A partially inflated volleyball can be modeled by a sphere whose volume is approximately 180 in³. After being fully inflated, its volume is approximately 294 in³. To the nearest tenth of an inch, how much does the radius increase when the volleyball is fully inflated?

197 A solid metal prism has a rectangular base with sides of 4 inches and 6 inches, and a height of 4 inches. A hole in the shape of a cylinder, with a radius of 1 inch, is drilled through the entire length of the rectangular prism.

What is the approximate volume of the remaining solid, in cubic inches?
1) 19
2) 77
3) 93
4) 96

198 A water cup in the shape of a cone has a height of 4 inches and a maximum diameter of 3 inches. What is the volume of the water in the cup, to the nearest tenth of a cubic inch, when the cup is filled to half its height?
1) 1.2
2) 3.5
3) 4.7
4) 14.1
199 A candle maker uses a mold to make candles like the one shown below.

The height of the candle is 13 cm and the circumference of the candle at its widest measure is 31.416 cm. Use modeling to approximate how much wax, to the nearest cubic centimeter, is needed to make this candle. Justify your answer.

200 The pyramid shown below has a square base, a height of 7, and a volume of 84.

What is the length of the side of the base?
1) 6  
2) 12  
3) 18  
4) 36

201 A fabricator is hired to make a 27-foot-long solid metal railing for the stairs at the local library. The railing is modeled by the diagram below. The railing is 2.5 inches high and 2.5 inches wide and is comprised of a rectangular prism and a half-cylinder.

How much metal, to the nearest cubic inch, will the railing contain?
1) 151  
2) 795  
3) 1808  
4) 2025

202 A gas station has a cylindrical fueling tank that holds the gasoline for its pumps, as modeled below. The tank holds a maximum of 20,000 gallons of gasoline and has a length of 34.5 feet.

A metal pole is used to measure how much gas is in the tank. To the nearest tenth of a foot, how long does the pole need to be in order to reach the bottom of the tank and still extend one foot outside the tank? Justify your answer. [1 ft³=7.48 gallons]
203 A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot? Find the volume of the inside of the pool to the nearest cubic foot. A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft³ = 7.48 gallons]

204 An ice cream waffle cone can be modeled by a right circular cone with a base diameter of 6.6 centimeters and a volume of $54.45\pi$ cubic centimeters. What is the number of centimeters in the height of the waffle cone?

1) $3\frac{3}{4}$
2) 5
3) 15
4) $24\frac{3}{4}$

205 Randy's basketball is in the shape of a sphere with a maximum circumference of 29.5 inches. Determine and state the volume of the basketball, to the nearest cubic inch.

206 A regular pyramid has a square base. The perimeter of the base is 36 inches and the height of the pyramid is 15 inches. What is the volume of the pyramid in cubic inches?

1) 180
2) 405
3) 540
4) 1215

207 The base of a pyramid is a rectangle with a width of 4.6 cm and a length of 9 cm. What is the height, in centimeters, of the pyramid if its volume is 82.8 cm³?

1) 6
2) 2
3) 9
4) 18
208 A storage tank is in the shape of a cylinder with a hemisphere on the top. The highest point on the inside of the storage tank is 13 meters above the floor of the storage tank, and the diameter inside the cylinder is 8 meters. Determine and state, to the nearest cubic meter, the total volume inside the storage tank.

209 Ian needs to replace two concrete sections in his sidewalk, as modeled below. Each section is 36 inches by 36 inches and 4 inches deep. He can mix his own concrete for $3.25 per cubic foot. How much money will it cost Ian to replace the two concrete sections?

210 The greenhouse pictured below can be modeled as a rectangular prism with a half-cylinder on top. The rectangular prism is 20 feet wide, 12 feet high, and 45 feet long. The half-cylinder has a diameter of 20 feet. To the nearest cubic foot, what is the volume of the greenhouse?

- 1) 17,869
- 2) 24,937
- 3) 39,074
- 4) 67,349

211 A child's tent can be modeled as a pyramid with a square base whose sides measure 60 inches and whose height measures 84 inches. What is the volume of the tent, to the nearest cubic foot?

- 1) 35
- 2) 58
- 3) 82
- 4) 175
G.MG.A.2: DENSITY

212 Trees that are cut down and stripped of their branches for timber are approximately cylindrical. A timber company specializes in a certain type of tree that has a typical diameter of 50 cm and a typical height of about 10 meters. The density of the wood is 380 kilograms per cubic meter, and the wood can be sold by mass at a rate of $4.75 per kilogram. Determine and state the minimum number of whole trees that must be sold to raise at least $50,000.

213 A shipping container is in the shape of a right rectangular prism with a length of 12 feet, a width of 8.5 feet, and a height of 4 feet. The container is completely filled with contents that weigh, on average, 0.25 pound per cubic foot. What is the weight, in pounds, of the contents in the container?
   1) 1,632
   2) 408
   3) 102
   4) 92

214 A hemispherical tank is filled with water and has a diameter of 10 feet. If water weighs 62.4 pounds per cubic foot, what is the total weight of the water in a full tank, to the nearest pound?
   1) 16,336
   2) 32,673
   3) 130,690
   4) 261,381

215 A contractor needs to purchase 500 bricks. The dimensions of each brick are 5.1 cm by 10.2 cm by 20.3 cm, and the density of each brick is 1920 kg/m³. The maximum capacity of the contractor’s trailer is 900 kg. Can the trailer hold the weight of 500 bricks? Justify your answer.

216 The water tower in the picture below is modeled by the two-dimensional figure beside it. The water tower is composed of a hemisphere, a cylinder, and a cone. Let $C$ be the center of the hemisphere and let $D$ be the center of the base of the cone.

If $AC = 8.5$ feet, $BF = 25$ feet, and $\angle EFD = 47^\circ$, determine and state, to the nearest cubic foot, the volume of the water tower. The water tower was constructed to hold a maximum of 400,000 pounds of water. If water weighs 62.4 pounds per cubic foot, can the water tower be filled to 85% of its volume and not exceed the weight limit? Justify your answer.
217 A wooden cube has an edge length of 6 centimeters and a mass of 137.8 grams. Determine the density of the cube, to the nearest thousandth. State which type of wood the cube is made of, using the density table below.

<table>
<thead>
<tr>
<th>Type of Wood</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine</td>
<td>0.373</td>
</tr>
<tr>
<td>Hemlock</td>
<td>0.431</td>
</tr>
<tr>
<td>Elm</td>
<td>0.554</td>
</tr>
<tr>
<td>Birch</td>
<td>0.601</td>
</tr>
<tr>
<td>Ash</td>
<td>0.638</td>
</tr>
<tr>
<td>Maple</td>
<td>0.676</td>
</tr>
<tr>
<td>Oak</td>
<td>0.711</td>
</tr>
</tbody>
</table>

218 Walter wants to make 100 candles in the shape of a cone for his new candle business. The mold shown below will be used to make the candles. Each mold will have a height of 8 inches and a diameter of 3 inches. To the nearest cubic inch, what will be the total volume of 100 candles?

Walter goes to a hobby store to buy the wax for his candles. The wax costs $0.10 per ounce. If the weight of the wax is 0.52 ounce per cubic inch, how much will it cost Walter to buy the wax for 100 candles? If Walter spent a total of $37.83 for the molds and charges $1.95 for each candle, what is Walter's profit after selling 100 candles?

219 Molly wishes to make a lawn ornament in the form of a solid sphere. The clay being used to make the sphere weighs .075 pound per cubic inch. If the sphere's radius is 4 inches, what is the weight of the sphere, to the nearest pound?

1) 34  
2) 20  
3) 15  
4) 4

220 Seawater contains approximately 1.2 ounces of salt per liter on average. How many gallons of seawater, to the nearest tenth of a gallon, would contain 1 pound of salt?

1) 3.3  
2) 3.5  
3) 4.7  
4) 13.3
221  A machinist creates a solid steel part for a wind turbine engine. The part has a volume of 1015 cubic centimeters. Steel can be purchased for $0.29 per kilogram, and has a density of 7.95 g/cm³. If the machinist makes 500 of these parts, what is the cost of the steel, to the nearest dollar?

222  Shae has recently begun kickboxing and purchased training equipment as modeled in the diagram below. The total weight of the bag, pole, and unfilled base is 270 pounds. The cylindrical base is 18 inches tall with a diameter of 20 inches. The dry sand used to fill the base weighs 95.46 lbs per cubic foot. To the nearest pound, determine and state the total weight of the training equipment if the base is filled to 85% of its capacity.

To the nearest pound, determine and state the total weight of the training equipment if the base is filled to 85% of its capacity.

223  A hemispherical water tank has an inside diameter of 10 feet. If water has a density of 62.4 pounds per cubic foot, what is the weight of the water in a full tank, to the nearest pound?

1) 16,336
2) 32,673
3) 130,690
4) 261,381

224  The density of the American white oak tree is 752 kilograms per cubic meter. If the trunk of an American white oak tree has a circumference of 4.5 meters and the height of the trunk is 8 meters, what is the approximate number of kilograms of the trunk?

1) 13
2) 9694
3) 13,536
4) 30,456

225  During an experiment, the same type of bacteria is grown in two petri dishes. Petri dish A has a diameter of 51 mm and has approximately 40,000 bacteria after 1 hour. Petri dish B has a diameter of 75 mm and has approximately 72,000 bacteria after 1 hour.

Determine and state which petri dish has the greater population density of bacteria at the end of the first hour.
226 The 2010 U.S. Census populations and population densities are shown in the table below.

<table>
<thead>
<tr>
<th>State</th>
<th>Population Density (people/mi²)</th>
<th>Population in 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida</td>
<td>350.6</td>
<td>18,801,310</td>
</tr>
<tr>
<td>Illinois</td>
<td>231.1</td>
<td>12,830,632</td>
</tr>
<tr>
<td>New York</td>
<td>411.2</td>
<td>19,378,102</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>283.9</td>
<td>12,702,379</td>
</tr>
</tbody>
</table>

Based on the table above, which list has the states' areas, in square miles, in order from largest to smallest?

1) Illinois, Florida, New York, Pennsylvania
2) New York, Florida, Illinois, Pennsylvania

227 A snow cone consists of a paper cone completely filled with shaved ice and topped with a hemisphere of shaved ice, as shown in the diagram below. The inside diameter of both the cone and the hemisphere is 8.3 centimeters. The height of the cone is 10.2 centimeters. The desired density of the shaved ice is 0.697 g/cm³, and the cost, per kilogram, of ice is $3.83. Determine and state the cost of the ice needed to make 50 snow cones.

228 New streetlights will be installed along a section of the highway. The posts for the streetlights will be 7.5 m tall and made of aluminum. The city can choose to buy the posts shaped like cylinders or the posts shaped like rectangular prisms. The cylindrical posts have a hollow core, with aluminum 2.5 cm thick, and an outer diameter of 53.4 cm. The rectangular-prism posts have a hollow core, with aluminum 2.5 cm thick, and a square base that measures 40 cm on each side. The density of aluminum is 2.7 g/cm³, and the cost of aluminum is $0.38 per kilogram. If all posts must be the same shape, which post design will cost the town less? How much money will be saved per streetlight post with the less expensive design?

229 A bakery sells hollow chocolate spheres. The larger diameter of each sphere is 4 cm. The thickness of the chocolate of each sphere is 0.5 cm. Determine and state, to the nearest tenth of a cubic centimeter, the amount of chocolate in each hollow sphere. The bakery packages 8 of them into a box. If the density of the chocolate is 1.308 g/cm³, determine and state, to the nearest gram, the total mass of the chocolate in the box.
230 In the diagram below, \( CD \) is the image of \( AB \) after a dilation of scale factor \( k \) with center \( E \).

Which ratio is equal to the scale factor \( k \) of the dilation?

1) \( \frac{EC}{EA} \)
2) \( \frac{BA}{EA} \)
3) \( \frac{EA}{BA} \)
4) \( \frac{EA}{EC} \)

231 The line \( 3y = -2x + 8 \) is transformed by a dilation centered at the origin. Which linear equation could be its image?

1) \( 2x + 3y = 5 \)
2) \( 2x - 3y = 5 \)
3) \( 3x + 2y = 5 \)
4) \( 3x - 2y = 5 \)

232 The equation of line \( h \) is \( 2x + y = 1 \). Line \( m \) is the image of line \( h \) after a dilation of scale factor 4 with respect to the origin. What is the equation of the line \( m \)?

1) \( y = -2x + 1 \)
2) \( y = -2x + 4 \)
3) \( y = 2x + 4 \)
4) \( y = 2x + 1 \)

233 The line \( y = 2x - 4 \) is dilated by a scale factor of \( \frac{3}{2} \) and centered at the origin. Which equation represents the image of the line after the dilation?

1) \( y = 2x - 4 \)
2) \( y = 2x - 6 \)
3) \( y = 3x - 4 \)
4) \( y = 3x - 6 \)

234 Line \( y = 3x - 1 \) is transformed by a dilation with a scale factor of 2 and centered at \((3,8)\). The line's image is

1) \( y = 3x - 8 \)
2) \( y = 3x - 4 \)
3) \( y = 3x - 2 \)
4) \( y = 3x - 1 \)

235 A line that passes through the points whose coordinates are \((1,1)\) and \((5,7)\) is dilated by a scale factor of 3 and centered at the origin. The image of the line

1) is perpendicular to the original line
2) is parallel to the original line
3) passes through the origin
4) is the original line
236 On the graph below, point \(A(3,4)\) and \(BC\) with coordinates \(B(4,3)\) and \(C(2,1)\) are graphed. What are the coordinates of \(B'\) and \(C'\) after \(BC\) undergoes a dilation centered at point \(A\) with a scale factor of 2?
1) \(B'(5,2)\) and \(C'(1,-2)\)
2) \(B'(6,1)\) and \(C'(0,-1)\)
3) \(B'(5,0)\) and \(C'(1,-2)\)
4) \(B'(5,2)\) and \(C'(3,0)\)

238 Line \(n\) is represented by the equation \(3x + 4y = 20\). Determine and state the equation of line \(p\), the image of line \(n\), after a dilation of scale factor \(\frac{1}{3}\) centered at the point \((4,2)\). [The use of the set of axes below is optional.] Explain your answer.

237 A line segment is dilated by a scale factor of 2 centered at a point not on the line segment. Which statement regarding the relationship between the given line segment and its image is true?
1) The line segments are perpendicular, and the image is one-half of the length of the given line segment.
2) The line segments are perpendicular, and the image is twice the length of the given line segment.
3) The line segments are parallel, and the image is twice the length of the given line segment.
4) The line segments are parallel, and the image is one-half of the length of the given line segment.

239 Line \(\ell\) is mapped onto line \(m\) by a dilation centered at the origin with a scale factor of 2. The equation of line \(\ell\) is \(3x - y = 4\). Determine and state an equation for line \(m\).

240 A three-inch line segment is dilated by a scale factor of 6 and centered at its midpoint. What is the length of its image?
1) 9 inches
2) 2 inches
3) 15 inches
4) 18 inches
241 The coordinates of the endpoints of $AB$ are $A(2,3)$ and $B(5,-1)$. Determine the length of $A'B'$, the image of $AB$, after a dilation of $\frac{1}{2}$ centered at the origin. [The use of the set of axes below is optional.]

242 Line segment $A'B'$, whose endpoints are $(4,-2)$ and $(16,14)$, is the image of $AB$ after a dilation of $\frac{1}{2}$ centered at the origin. What is the length of $AB$?

1) 5
2) 10
3) 20
4) 40

243 The line represented by the equation $4y = 3x + 7$ is transformed by a dilation centered at the origin. Which linear equation could represent its image?

1) $3x - 4y = 9$
2) $3x + 4y = 9$
3) $4x - 3y = 9$
4) $4x + 3y = 9$

244 The line whose equation is $3x - 5y = 4$ is dilated by a scale factor of $\frac{5}{3}$ centered at the origin. Which statement is correct?

1) The image of the line has the same slope as the pre-image but a different $y$-intercept.
2) The image of the line has the same $y$-intercept as the pre-image but a different slope.
3) The image of the line has the same slope and the same $y$-intercept as the pre-image.
4) The image of the line has a different slope and a different $y$-intercept from the pre-image.

245 Line $MN$ is dilated by a scale factor of 2 centered at the point $(0,6)$. If $MN$ is represented by $y = -3x + 6$, which equation can represent $M'N'$, the image of $MN$?

1) $y = -3x + 12$
2) $y = -3x + 6$
3) $y = -6x + 12$
4) $y = -6x + 6$
246 Aliyah says that when the line $4x + 3y = 24$ is dilated by a scale factor of 2 centered at the point (3,4), the equation of the dilated line is $y = -\frac{4}{3}x + 16$. Is Aliyah correct? Explain why.

[The use of the set of axes below is optional.]

G.CO.A.5: ROTATIONS

247 The grid below shows $\triangle ABC$ and $\triangle DEF$.

Let $\triangle A'B'C'$ be the image of $\triangle ABC$ after a rotation about point $A$. Determine and state the location of $B'$ if the location of point $C'$ is $(8,-3)$. Explain your answer. Is $\triangle DEF$ congruent to $\triangle A'B'C'$? Explain your answer.
248 Which point shown in the graph below is the image of point \( P \) after a counterclockwise rotation of 90° about the origin?

1) \( A \)
2) \( B \)
3) \( C \)
4) \( D \)

G.CO.A.5: REFLECTIONS

249 Triangle \( ABC \) is graphed on the set of axes below. Graph and label \( \Delta A' B' C' \), the image of \( \Delta ABC \) after a reflection over the line \( x = 1 \).

G.SRT.A.2: DILATIONS

250 The image of \( \Delta ABC \) after a dilation of scale factor \( k \) centered at point \( A \) is \( \Delta ADE \), as shown in the diagram below.

Which statement is always true?
1) \( 2AB = AD \)
2) \( AD \perp DE \)
3) \( AC = CE \)
4) \( BC \parallel DE \)

251 A triangle is dilated by a scale factor of 3 with the center of dilation at the origin. Which statement is true?
1) The area of the image is nine times the area of the original triangle.
2) The perimeter of the image is nine times the perimeter of the original triangle.
3) The slope of any side of the image is three times the slope of the corresponding side of the original triangle.
4) The measure of each angle in the image is three times the measure of the corresponding angle of the original triangle.
252 If \( \triangle ABC \) is dilated by a scale factor of 3, which statement is true of the image \( \triangle A'B'C' \)?

1) \( 3A'B' = AB \)
2) \( B'C' = 3BC \)
3) \( m\angle A' = 3(m\angle A) \)
4) \( 3(m\angle C') = m\angle C \)

253 In the diagram below, \( \triangle ABE \) is the image of \( \triangle ACD \) after a dilation centered at the origin. The coordinates of the vertices are \( A(0,0) \), \( B(3,0) \), \( C(4.5,0) \), \( D(0,6) \), and \( E(0,4) \).

The ratio of the lengths of \( BE \) to \( CD \) is

1) \( \frac{2}{3} \)
2) \( \frac{3}{2} \)
3) \( \frac{3}{4} \)
4) \( \frac{4}{3} \)

254 Triangle \( QRS \) is graphed on the set of axes below.

On the same set of axes, graph and label \( \triangle Q'R'S' \), the image of \( \triangle QRS \) after a dilation with a scale factor of \( \frac{3}{2} \) centered at the origin. Use slopes to explain why \( Q'R' \parallel QR \).

255 Rectangle \( A'B'C'D' \) is the image of rectangle \( ABCD \) after a dilation centered at point \( A \) by a scale factor of \( \frac{2}{3} \). Which statement is correct?

1) Rectangle \( A'B'C'D' \) has a perimeter that is \( \frac{2}{3} \) the perimeter of rectangle \( ABCD \).
2) Rectangle \( A'B'C'D' \) has a perimeter that is \( \frac{3}{2} \) the perimeter of rectangle \( ABCD \).
3) Rectangle \( A'B'C'D' \) has an area that is \( \frac{2}{3} \) the area of rectangle \( ABCD \).
4) Rectangle \( A'B'C'D' \) has an area that is \( \frac{3}{2} \) the area of rectangle \( ABCD \).
256 Triangle $ABC$ and triangle $ADE$ are graphed on the set of axes below.

Describe a transformation that maps triangle $ABC$ onto triangle $ADE$. Explain why this transformation makes triangle $ADE$ similar to triangle $ABC$.

257 Triangle $RJM$ has an area of 6 and a perimeter of 12. If the triangle is dilated by a scale factor of 3 centered at the origin, what are the area and perimeter of its image, triangle $R'J'M'$?
1) area of 9 and perimeter of 15
2) area of 18 and perimeter of 36
3) area of 54 and perimeter of 36
4) area of 54 and perimeter of 108

258 Given square $RSTV$, where $RS = 9$ cm. If square $RSTV$ is dilated by a scale factor of 3 about a given center, what is the perimeter, in centimeters, of the image of $RSTV$ after the dilation?
1) 12
2) 27
3) 36
4) 108

259 Triangle $ABC$ and point $D(1,2)$ are graphed on the set of axes below.

Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$, after a dilation of scale factor 2 centered at point $D$. 
260 A regular pentagon is shown in the diagram below.

If the pentagon is rotated clockwise around its center, the minimum number of degrees it must be rotated to carry the pentagon onto itself is
1) 54°
2) 72°
3) 108°
4) 360°

261 Which regular polygon has a minimum rotation of 45° to carry the polygon onto itself?
1) octagon
2) decagon
3) hexagon
4) pentagon

262 A regular hexagon is rotated in a counterclockwise direction about its center. Determine and state the minimum number of degrees in the rotation such that the hexagon will coincide with itself.

263 Which rotation about its center will carry a regular decagon onto itself?
1) 54°
2) 162°
3) 198°
4) 252°

264 In the diagram below, a square is graphed in the coordinate plane.

A reflection over which line does not carry the square onto itself?
1) $x = 5$
2) $y = 2$
3) $y = x$
4) $x + y = 4$

265 The regular polygon below is rotated about its center.

Which angle of rotation will carry the figure onto itself?
1) 60°
2) 108°
3) 216°
4) 540°
266 Which figure always has exactly four lines of reflection that map the figure onto itself?
1) square  
2) rectangle  
3) regular octagon  
4) equilateral triangle

267 As shown in the graph below, the quadrilateral is a rectangle.

Which transformation would not map the rectangle onto itself?
1) a reflection over the $x$-axis  
2) a reflection over the line $x = 4$  
3) a rotation of $180^\circ$ about the origin  
4) a rotation of $180^\circ$ about the point $(4,0)$

268 A regular decagon is rotated $n$ degrees about its center, carrying the decagon onto itself. The value of $n$ could be
1) $10^\circ$  
2) $150^\circ$  
3) $225^\circ$  
4) $252^\circ$

269 Which transformation would not carry a square onto itself?
1) a reflection over one of its diagonals  
2) a $90^\circ$ rotation clockwise about its center  
3) a $180^\circ$ rotation about one of its vertices  
4) a reflection over the perpendicular bisector of one side

270 In the diagram below, rectangle $ABCD$ has vertices whose coordinates are $A(7,1)$, $B(9,3)$, $C(3,9)$, and $D(1,7)$.

Which transformation will not carry the rectangle onto itself?
1) a reflection over the line $y = x$  
2) a reflection over the line $y = -x + 10$  
3) a rotation of $180^\circ$ about the point $(6,6)$  
4) a rotation of $180^\circ$ about the point $(5,5)$
274 Identify which sequence of transformations could map pentagon $ABCD$ onto pentagon $A'B'C'D'E'$, as shown below.

1) dilation followed by a rotation
2) translation followed by a rotation
3) line reflection followed by a translation
4) line reflection followed by a line reflection
275 A sequence of transformations maps rectangle \(ABCD\) onto rectangle \(A'B'C'D'\), as shown in the diagram below.

Which sequence of transformations maps \(ABCD\) onto \(A'B'C'D'\) and then maps \(A'B'C'D'\) onto \(A''B''C''D''\)?

1) a reflection followed by a rotation  
2) a reflection followed by a translation  
3) a translation followed by a rotation  
4) a translation followed by a reflection

276 Triangle \(ABC\) and triangle \(DEF\) are graphed on the set of axes below.

Which sequence of transformations maps triangle \(ABC\) onto triangle \(DEF\)?

1) a reflection over the \(x\)-axis followed by a reflection over the \(y\)-axis  
2) a 180° rotation about the origin followed by a reflection over the line \(y = x\)  
3) a 90° clockwise rotation about the origin followed by a reflection over the \(y\)-axis  
4) a translation 8 units to the right and 1 unit up followed by a 90° counterclockwise rotation about the origin
277 Describe a sequence of transformations that will map $\triangle ABC$ onto $\triangle DEF$ as shown below.

278 In the diagram below, $\triangle ABC$ has coordinates $A(1, 1), B(4, 1)$, and $C(4, 5)$. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after the translation five units to the right and two units up followed by the reflection over the line $y = 0$.

279 In the diagram below, $\triangle ABC \cong \triangle DEF$.

Which sequence of transformations maps $\triangle ABC$ onto $\triangle DEF$?
1) a reflection over the $x$-axis followed by a translation
2) a reflection over the $y$-axis followed by a translation
3) a rotation of $180^\circ$ about the origin followed by a translation
4) a counterclockwise rotation of $90^\circ$ about the origin followed by a translation
280 Quadrilateral \(MATH\) and its image \(M"A"T"H"\) are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral \(MATH\) onto quadrilateral \(M"A"T"H"\).

281 Quadrilaterals \(BIKE\) and \(GOLF\) are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral \(BIKE\) onto quadrilateral \(GOLF\).

282 Trapezoids \(ABCD\) and \(A"B"C"D"\) are graphed on the set of axes below.

Describe a sequence of transformations that maps trapezoid \(ABCD\) onto trapezoid \(A"B"C"D"\).

283 In the diagram below, triangles \(XYZ\) and \(UVZ\) are drawn such that \(\angle X \cong \angle U\) and \(\angle XZY \cong \angle UZV\).

Describe a sequence of similarity transformations that shows \(\triangle XYZ\) is similar to \(\triangle UVZ\).
284 In the diagram below, \( \triangle DEF \) is the image of \( \triangle ABC \) after a clockwise rotation of 180\(^\circ\) and a dilation where \( AB = 3 \), \( BC = 5.5 \), \( AC = 4.5 \), \( DE = 6 \), \( FD = 9 \), and \( EF = 11 \).

Which relationship must always be true?

1) \( \frac{\angle A}{\angle D} = \frac{1}{2} \)

2) \( \frac{\angle C}{\angle F} = \frac{2}{1} \)

3) \( \frac{\angle A}{\angle C} = \frac{\angle F}{\angle D} \)

4) \( \frac{\angle B}{\angle E} = \frac{\angle C}{\angle F} \)

285 Triangle \( A'B'C' \) is the image of \( \triangle ABC \) after a dilation followed by a translation. Which statement(s) would always be true with respect to this sequence of transformations?

I. \( \triangle ABC \cong \triangle A'B'C' \)

II. \( \triangle ABC \sim \triangle A'B'C' \)

III. \( AB \parallel A'B' \)

IV. \( AA' = BB' \)

1) II, only

2) I and II

3) II and III

4) II, III, and IV

286 Which sequence of transformations will map \( \triangle ABC \) onto \( \triangle A'B'C' \)?

1) reflection and translation

2) rotation and reflection

3) translation and dilation

4) dilation and rotation
287 Given: $\triangle AEC$, $\triangle DEF$, and $FE \perp CE$

What is a correct sequence of similarity transformations that shows $\triangle AEC \sim \triangle DEF$?

1) a rotation of 180 degrees about point $E$ followed by a horizontal translation
2) a counterclockwise rotation of 90 degrees about point $E$ followed by a horizontal translation
3) a rotation of 180 degrees about point $E$ followed by a dilation with a scale factor of 2 centered at point $E$
4) a counterclockwise rotation of 90 degrees about point $E$ followed by a dilation with a scale factor of 2 centered at point $E$

288 In the diagram below, $\triangle ADE$ is the image of $\triangle ABC$ after a reflection over the line $AC$ followed by a dilation of scale factor $\frac{AC}{AE}$ centered at point $A$.

Which statement must be true?

1) $m\angle BAC \cong m\angle AED$
2) $m\angle ABC \cong m\angle ADE$
3) $m\angle DAE \cong \frac{1}{2} m\angle BAC$
4) $m\angle ACB \cong \frac{1}{2} m\angle DAB$
289 In regular hexagon $ABCDEF$ shown below, $AD$, $BE$, and $CF$ all intersect at $G$.

When $\triangle ABG$ is reflected over $BG$ and then rotated $180^\circ$ about point $G$, $\triangle ABG$ is mapped onto

1) $\triangle FEG$
2) $\triangle AFG$
3) $\triangle CBG$
4) $\triangle DEG$

290 Triangle $MNP$ is the image of triangle $JKL$ after a $120^\circ$ counterclockwise rotation about point $Q$. If the measure of angle $L$ is $47^\circ$ and the measure of angle $N$ is $57^\circ$, determine the measure of angle $M$. Explain how you arrived at your answer.

291 After a counterclockwise rotation about point $X$, scalene triangle $ABC$ maps onto $\triangle RST$, as shown in the diagram below.

Which statement must be true?
1) $\angle A \cong \angle R$
2) $\angle A \cong \angle S$
3) $\overline{CB} \cong \overline{TR}$
4) $\overline{CA} \cong \overline{TS}$

292 The image of $\triangle ABC$ after a rotation of $90^\circ$ clockwise about the origin is $\triangle DEF$, as shown below.

Which statement is true?
1) $\overline{BC} \cong \overline{DE}$
2) $\overline{AB} \cong \overline{DF}$
3) $\angle C \cong \angle E$
4) $\angle A \cong \angle D$
293 Quadrilateral \(ABCD\) is graphed on the set of axes below.

When \(ABCD\) is rotated 90° in a counterclockwise direction about the origin, its image is quadrilateral \(A'B'C'D'\). Is distance preserved under this rotation, and which coordinates are correct for the given vertex?

1) no and \(C'(1,2)\)
2) no and \(D'(2,4)\)
3) yes and \(A'(6,2)\)
4) yes and \(B'(-3,4)\)

296 In the diagram below, a sequence of rigid motions maps \(ABCD\) onto \(JKLM\).

If \( \angle A = 82^\circ \), \( \angle B = 104^\circ \), and \( \angle L = 121^\circ \), the measure of \(\angle M\) is

1) 53°
2) 82°
3) 104°
4) 121°

G.CO.A.2: IDENTIFYING TRANSFORMATIONS

294 Triangle \(A'B'C'\) is the image of triangle \(ABC\) after a translation of 2 units to the right and 3 units up. Is triangle \(ABC\) congruent to triangle \(A'B'C'\)? Explain why.

295 If \(\triangle ABC\) is mapped onto \(\triangle DEF\) after a line reflection and \(\triangle DEF\) is mapped onto \(\triangle XYZ\) after a translation, the relationship between \(\triangle ABC\) and \(\triangle XYZ\) is that they are always

1) congruent and similar
2) congruent but not similar
3) similar but not congruent
4) neither similar nor congruent
298 If $\triangle A'B'C'$ is the image of $\triangle ABC$, under which transformation will the triangles not be congruent?
1) reflection over the x-axis
2) translation to the left 5 and down 4
3) dilation centered at the origin with scale factor 2
4) rotation of $270^\circ$ counterclockwise about the origin

299 In the diagram below, which single transformation was used to map triangle $A$ onto triangle $B$?

![Diagram of triangles](image)

1) line reflection
2) rotation
3) dilation
4) translation

300 Which transformation would not always produce an image that would be congruent to the original figure?
1) translation
2) dilation
3) rotation
4) reflection

301 Which transformation of $\overline{OA}$ would result in an image parallel to $\overline{OA}$?

![Diagram of line segment](image)

1) a translation of two units down
2) a reflection over the x-axis
3) a reflection over the y-axis
4) a clockwise rotation of $90^\circ$ about the origin

302 On the set of axes below, rectangle $ABCD$ can be proven congruent to rectangle $KLMN$ using which transformation?

![Diagram of rectangles](image)

1) rotation
2) translation
3) reflection over the x-axis
4) reflection over the y-axis
303 Under which transformation would $\Delta A'B'C'$, the image of $\Delta ABC$, not be congruent to $\Delta ABC$?
1) reflection over the $y$-axis
2) rotation of $90^\circ$ clockwise about the origin
3) translation of 3 units right and 2 units down
4) dilation with a scale factor of 2 centered at the origin

304 Triangle $ABC$ has vertices at $A(-5,2)$, $B(-4,7)$, and $C(-2,7)$, and triangle $DEF$ has vertices at $D(3,2)$, $E(2,7)$, and $F(0,7)$. Graph and label $\Delta ABC$ and $\Delta DEF$ on the set of axes below. Determine and state the single transformation where $\Delta DEF$ is the image of $\Delta ABC$. Use your transformation to explain why $\Delta ABC \cong \Delta DEF$.

305 The image of $\Delta DEF$ is $\Delta D'E'F'$. Under which transformation will the triangles not be congruent?
1) a reflection through the origin
2) a reflection over the line $y = x$
3) a dilation with a scale factor of 1 centered at $(2,3)$
4) a dilation with a scale factor of $\frac{3}{2}$ centered at the origin

306 The graph below shows two congruent triangles, $ABC$ and $A'B'C'$.

Which rigid motion would map $\Delta ABC$ onto $\Delta A'B'C'$?
1) a rotation of 90 degrees counterclockwise about the origin
2) a translation of three units to the left and three units up
3) a rotation of 180 degrees about the origin
4) a reflection over the line $y = x$
307 In the diagram below, line \( m \) is parallel to line \( n \). Figure 2 is the image of Figure 1 after a reflection over line \( m \). Figure 3 is the image of Figure 2 after a reflection over line \( n \).

Which single transformation would carry Figure 1 onto Figure 3?
1) a dilation
2) a rotation
3) a reflection
4) a translation

G.CO.A.2: ANALYTICAL REPRESENTATIONS OF TRANSFORMATIONS

308 Which transformation would result in the perimeter of a triangle being different from the perimeter of its image?
1) \((x,y) \rightarrow (y,x)\)
2) \((x,y) \rightarrow (x,-y)\)
3) \((x,y) \rightarrow (4x,4y)\)
4) \((x,y) \rightarrow (x+2,y-5)\)

G.SRT.B.5: SIMILARITY

309 The vertices of \( \triangle PQR \) have coordinates \( P(2,3), Q(3,8) \), and \( R(7,3) \). Under which transformation of \( \triangle PQR \) are distance and angle measure preserved?
1) \((x,y) \rightarrow (2x,3y)\)
2) \((x,y) \rightarrow (x+2,3y)\)
3) \((x,y) \rightarrow (2x,y+3)\)
4) \((x,y) \rightarrow (x+2,y+3)\)

310 Triangles \( ABC \) and \( DEF \) are drawn below.

If \( AB = 9 \), \( BC = 15 \), \( DE = 6 \), \( EF = 10 \), and \( \angle B \cong \angle E \), which statement is true?
1) \( \angle CAB \cong \angle DEF \)
2) \( \frac{AB}{CB} = \frac{FE}{DE} \)
3) \( \triangle ABC \sim \triangle DEF \)
4) \( \frac{AB}{DE} = \frac{FE}{CB} \)

311 A flagpole casts a shadow 16.60 meters long. Tim stands at a distance of 12.45 meters from the base of the flagpole, such that the end of Tim's shadow meets the end of the flagpole's shadow. If Tim is 1.65 meters tall, determine and state the height of the flagpole to the nearest tenth of a meter.
312 As shown in the diagram below, $\overline{AB}$ and $\overline{CD}$ intersect at $E$, and $\overline{AC} \parallel \overline{BD}$.

![Diagram](image1)

Given $\triangle AEC \sim \triangle BED$, which equation is true?

1) $\frac{CE}{DE} = \frac{EB}{EA}$

2) $\frac{AE}{BE} = \frac{AC}{BD}$

3) $\frac{EC}{AE} = \frac{BE}{ED}$

4) $\frac{ED}{EC} = \frac{AC}{BD}$

313 To find the distance across a pond from point $B$ to point $C$, a surveyor drew the diagram below. The measurements he made are indicated on his diagram.

![Diagram](image2)

Use the surveyor's information to determine and state the distance from point $B$ to point $C$, to the nearest yard.

314 In the diagram below, $\triangle ABC \sim \triangle DEC$.

![Diagram](image3)

If $AC = 12$, $DC = 7$, $DE = 5$, and the perimeter of $\triangle ABC$ is 30, what is the perimeter of $\triangle DEC$?

1) 12.5

2) 14.0

3) 14.8

4) 17.5

315 Triangles $RST$ and $XYZ$ are drawn below. If $RS = 6$, $ST = 14$, $XY = 9$, $YZ = 21$, and $\angle S \cong \angle Y$, is $\triangle RST$ similar to $\triangle XYZ$? Justify your answer.

![Diagram](image4)

316 The ratio of similarity of $\triangle BOY$ to $\triangle GRL$ is 1:2. If $BO = x + 3$ and $GR = 3x - 1$, then the length of $GR$ is

1) 5

2) 7

3) 10

4) 20
317 In the diagram below, $\triangle ABC \sim \triangle DEF$.

If $AB = 6$ and $AC = 8$, which statement will justify similarity by SAS?

1) $DE = 9$, $DF = 12$, and $\angle A \cong \angle D$
2) $DE = 8$, $DF = 10$, and $\angle A \cong \angle D$
3) $DE = 36$, $DF = 64$, and $\angle C \cong \angle F$
4) $DE = 15$, $DF = 20$, and $\angle C \cong \angle F$

318 In the diagram below, the line of sight from the park ranger station, $P$, to the lifeguard chair, $L$, on the beach of a lake is perpendicular to the path joining the campground, $C$, and the first aid station, $F$. The campground is 0.25 mile from the lifeguard chair. The straight paths from both the campground and first aid station to the park ranger station are perpendicular.

If the path from the park ranger station to the campground is 0.55 mile, determine and state, to the nearest hundredth of a mile, the distance between the park ranger station and the lifeguard chair. Gerald believes the distance from the first aid station to the campground is at least 1.5 miles. Is Gerald correct? Justify your answer.

319 In the diagram below, $CD$ is the altitude drawn to the hypotenuse $AB$ of right triangle $ABC$.

Which lengths would not produce an altitude that measures $6\sqrt{2}$?

1) $AD = 2$ and $DB = 36$
2) $AD = 3$ and $AB = 24$
3) $AD = 6$ and $DB = 12$
4) $AD = 8$ and $AB = 17$

320 In $\triangle SCU$ shown below, points $T$ and $O$ are on $SU$ and $CU$, respectively. Segment $OT$ is drawn so that $\angle C \cong \angle OTU$.

If $TU = 4$, $OU = 5$, and $OC = 7$, what is the length of $ST$?

1) 5.6
2) 8.75
3) 11
4) 15
321 Using the information given below, which set of triangles can not be proven similar?

1) 

2) 

3) 

4) 

322 In right triangle $ABC$ shown below, altitude $CD$ is drawn to hypotenuse $AB$. Explain why $\triangle ABC \sim \triangle ACD$.

323 In $\triangle RST$ shown below, altitude $SU$ is drawn to $RT$ at $U$.

If $SU = h$, $UT = 12$, and $RT = 42$, which value of $h$ will make $\triangle RST$ a right triangle with $\angle RST$ as a right angle?

1) $6\sqrt{3}$
2) $6\sqrt{10}$
3) $6\sqrt{14}$
4) $6\sqrt{35}$

324 In the diagram of right triangle $ABC$, $CD$ intersects hypotenuse $AB$ at $D$.

If $AD = 4$ and $DB = 6$, which length of $AC$ makes $CD \perp AB$?

1) $2\sqrt{6}$
2) $2\sqrt{10}$
3) $2\sqrt{15}$
4) $4\sqrt{2}$
325 In triangle \( CHR \), \( O \) is on \( HR \), and \( D \) is on \( CR \) so that \( \angle H \cong \angle RDO \).

If \( RD = 4 \), \( RO = 6 \), and \( OH = 4 \), what is the length of \( CD \)?
1) \( 2 \frac{2}{3} \)
2) \( 6 \frac{2}{3} \)
3) 11
4) 15

326 In the diagram below, \( AC = 7.2 \) and \( CE = 2.4 \).

Which statement is not sufficient to prove \( \triangle ABC \sim \triangle EDC \)?
1) \( AB \parallel ED \)
2) \( DE = 2.7 \) and \( AB = 8.1 \)
3) \( CD = 3.6 \) and \( BC = 10.8 \)
4) \( DE = 3.0 \), \( AB = 9.0 \), \( CD = 2.9 \), and \( BC = 8.7 \)

327 In the diagram below, \( AD \) intersects \( BE \) at \( C \), and \( AB \parallel DE \).

If \( CD = 6.6 \) cm, \( DE = 3.4 \) cm, \( CE = 4.2 \) cm, and \( BC = 5.25 \) cm, what is the length of \( AC \), to the nearest hundredth of a centimeter?
1) 2.70
2) 3.34
3) 5.28
4) 8.25

328 Kirstie is testing values that would make triangle \( KLM \) a right triangle when \( LN \) is an altitude, and \( KM = 16 \), as shown below.

Which lengths would make triangle \( KLM \) a right triangle?
1) \( LM = 13 \) and \( KN = 6 \)
2) \( LM = 12 \) and \( NM = 9 \)
3) \( KL = 11 \) and \( KN = 7 \)
4) \( LN = 8 \) and \( NM = 10 \)
329  In the diagram below, $\overline{XS}$ and $\overline{YR}$ intersect at $Z$. Segments $XY$ and $RS$ are drawn perpendicular to $\overline{YR}$ to form triangles $XYZ$ and $SRZ$.

Which statement is always true?
1) $(XY)(SR) = (XZ)(RZ)$
2) $\triangle XYZ \cong \triangle SRZ$
3) $XS \cong YR$
4) $\frac{XY}{SR} = \frac{YZ}{RZ}$

330  In the diagram below of $\triangle ABC$, $\angle ABC$ is a right angle, $AC = 12$, $AD = 8$, and altitude $\overline{BD}$ is drawn.

What is the length of $\overline{CB}$?
1) 3.2
2) 4.8
3) 16.2
4) 19.2

331  In the diagram below, $\overline{AF}$, and $\overline{DB}$ intersect at $C$, and $\overline{AD}$ and $\overline{FBE}$ are drawn such that $m\angle D = 65^\circ$, $m\angle CBE = 115^\circ$, $DC = 7.2$, $AC = 9.6$, and $FC = 21.6$.

What is the length of $\overline{CB}$?
1) 3.2
2) 4.8
3) 16.2
4) 19.2

332  Line segment $CD$ is the altitude drawn to hypotenuse $\overline{EF}$ in right triangle $ECF$. If $EC = 10$ and $EF = 24$, then, to the nearest tenth, $ED$ is
1) $4.2$
2) $5.4$
3) $15.5$
4) $21.8$
333 In the diagram below of right triangle $AED$, $BC \parallel DE$.

Which statement is always true?

1) $\frac{AC}{BC} = \frac{DE}{AE}$
2) $\frac{AB}{AD} = \frac{BC}{DE}$
3) $\frac{AC}{CE} = \frac{BC}{DE}$
4) $\frac{DE}{BC} = \frac{DB}{AB}$

334 In the diagram below of right triangle $ABC$, altitude $BD$ is drawn to hypotenuse $AC$.

If $BD = 4$, $AD = x - 6$, and $CD = x$, what is the length of $CD$?

1) 5
2) 2
3) 8
4) 11

335 In the model below, a support wire for a telephone pole is attached to the pole and anchored to a stake in the ground 15 feet from the base of the telephone pole. Jamal places a 6-foot wooden pole under the support wire parallel to the telephone pole, such that one end of the pole is on the ground and the top of the pole is touching the support wire. He measures the distance between the bottom of the pole and the stake in the ground.

Jamal says he can approximate how high the support wire attaches to the telephone pole by using similar triangles. Explain why the triangles are similar.
336 In the accompanying diagram of right triangle $ABC$, altitude $BD$ is drawn to hypotenuse $AC$.

Which statement must always be true?

1) $\frac{AD}{AB} = \frac{BC}{AC}$

2) $\frac{AD}{AB} = \frac{AB}{AC}$

3) $\frac{BD}{BC} = \frac{AB}{AD}$

4) $\frac{AB}{BC} = \frac{BD}{AC}$

---

337 In the diagram below, $\triangle ERM \sim \triangle JTM$.

Which statement is always true?

1) $\cos J = \frac{RM}{RE}$

2) $\cos R = \frac{JM}{JT}$

3) $\tan T = \frac{RM}{EM}$

4) $\tan E = \frac{TM}{JM}$
338 In the diagram of right triangle $ADE$ below, $BC \parallel DE$.

Which ratio is always equivalent to the sine of $\angle A$?

1) $\frac{AD}{DE}$
2) $\frac{AE}{AD}$
3) $\frac{BC}{AB}$
4) $\frac{AB}{AC}$

G.SRT.C.7: COFUNCTIONS

339 In scalene triangle $ABC$ shown in the diagram below, $m\angle C = 90^\circ$.

Which equation is always true?

1) $\sin A = \sin B$
2) $\cos A = \cos B$
3) $\cos A = \sin C$
4) $\sin A = \cos B$

340 In $\triangle ABC$, where $\angle C$ is a right angle, $\cos A = \frac{\sqrt{21}}{5}$. What is $\sin B$?

1) $\frac{\sqrt{21}}{5}$
2) $\frac{\sqrt{21}}{2}$
3) $\frac{2}{5}$
4) $\frac{5}{\sqrt{21}}$

341 Explain why $\cos(x) = \sin(90^\circ - x)$ for $x$ such that $0 < x < 90^\circ$.

342 In right triangle $ABC$ with the right angle at $C$, $\sin A = 2x + 0.1$ and $\cos B = 4x - 0.7$. Determine and state the value of $x$. Explain your answer.

343 Which expression is always equivalent to $\sin x$ when $0^\circ < x < 90^\circ$?

1) $\cos(90^\circ - x)$
2) $\cos(45^\circ - x)$
3) $\cos(2x)$
4) $\cos x$

344 In $\triangle ABC$, the complement of $\angle B$ is $\angle A$. Which statement is always true?

1) $\tan \angle A = \tan \angle B$
2) $\sin \angle A = \sin \angle B$
3) $\cos \angle A = \tan \angle B$
4) $\sin \angle A = \cos \angle B$
345 Find the value of $R$ that will make the equation $\sin 73^\circ = \cos R$ true when $0^\circ < R < 90^\circ$. Explain your answer.

346 When instructed to find the length of $\overline{HJ}$ in right triangle $HJG$, Alex wrote the equation $\sin 28^\circ = \frac{HJ}{20}$ while Marlene wrote $\cos 62^\circ = \frac{HJ}{20}$. Are both students’ equations correct? Explain why.

347 In right triangle $ABC$, $m\angle C = 90^\circ$. If $\cos B = \frac{5}{13}$, which function also equals $\frac{5}{13}$?
1) $\tan A$
2) $\tan B$
3) $\sin A$
4) $\sin B$

348 In a right triangle, $\sin(40 - x)^\circ = \cos(3x)^\circ$. What is the value of $x$?
1) 10
2) 15
3) 20
4) 25

349 Given: Right triangle $ABC$ with right angle at $C$. If $\sin A$ increases, does $\cos B$ increase or decrease? Explain why.

350 In a right triangle, the acute angles have the relationship $\sin(2x + 4) = \cos(46)$. What is the value of $x$?
1) 20
2) 21
3) 24
4) 25

351 If $\sin(2x + 7)^\circ = \cos(4x - 7)^\circ$, what is the value of $x$?
1) 7
2) 15
3) 21
4) 30
G.SRT.C.8: USING TRIGONOMETRY TO FIND A SIDE

352 As shown below, a canoe is approaching a lighthouse on the coastline of a lake. The front of the canoe is 1.5 feet above the water and an observer in the lighthouse is 112 feet above the water.

At 5:00, the observer in the lighthouse measured the angle of depression to the front of the canoe to be 6°. Five minutes later, the observer measured and saw the angle of depression to the front of the canoe had increased by 49°. Determine and state, to the nearest foot per minute, the average speed at which the canoe traveled toward the lighthouse.

353 As shown in the diagram below, the angle of elevation from a point on the ground to the top of the tree is 34°.

If the point is 20 feet from the base of the tree, what is the height of the tree, to the nearest tenth of a foot?

1) 29.7
2) 16.6
3) 13.5
4) 11.2

354 As shown in the diagram below, a ship is heading directly toward a lighthouse whose beacon is 125 feet above sea level. At the first sighting, point A, the angle of elevation from the ship to the light was 7°. A short time later, at point D, the angle of elevation was 16°.

To the nearest foot, determine and state how far the ship traveled from point A to point D.
355 The map below shows the three tallest mountain peaks in New York State: Mount Marcy, Algonquin Peak, and Mount Haystack. Mount Haystack, the shortest peak, is 4960 feet tall. Surveyors have determined the horizontal distance between Mount Haystack and Mount Marcy is 6336 feet and the horizontal distance between Mount Marcy and Algonquin Peak is 20,493 feet.

The angle of depression from the peak of Mount Marcy to the peak of Mount Haystack is 3.47 degrees. The angle of elevation from the peak of Algonquin Peak to the peak of Mount Marcy is 0.64 degrees. What are the heights, to the nearest foot, of Mount Marcy and Algonquin Peak? Justify your answer.

356 A carpenter leans an extension ladder against a house to reach the bottom of a window 30 feet above the ground. As shown in the diagram below, the ladder makes a 70° angle with the ground. To the nearest foot, determine and state the length of the ladder.

357 Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.

Determine and state, to the nearest tenth of a meter, the height of the flagpole.
358 A 20-foot support post leans against a wall, making a 70° angle with the ground. To the nearest tenth of a foot, how far up the wall will the support post reach?

1) 6.8
2) 6.9
3) 18.7
4) 18.8

359 In the diagram below, a window of a house is 15 feet above the ground. A ladder is placed against the house with its base at an angle of 75° with the ground. Determine and state the length of the ladder to the nearest tenth of a foot.

361 The diagram below shows two similar triangles.

If \( \tan \theta = \frac{3}{7} \), what is the value of \( x \), to the nearest tenth?

1) 1.2
2) 5.6
3) 7.6
4) 8.8

360 A ladder 20 feet long leans against a building, forming an angle of 71° with the level ground. To the nearest foot, how high up the wall of the building does the ladder touch the building?

1) 15
2) 16
3) 18
4) 19

362 Given the right triangle in the diagram below, what is the value of \( x \), to the nearest foot?

1) 11
2) 17
3) 18
4) 22
363 A man was parasailing above a lake at an angle of elevation of 32° from a boat, as modeled in the diagram below.

If 129.5 meters of cable connected the boat to the parasail, approximately how many meters above the lake was the man?
1) 68.6
2) 80.9
3) 109.8
4) 244.4

364 Freda, who is training to use a radar system, detects an airplane flying at a constant speed and heading in a straight line to pass directly over her location. She sees the airplane at an angle of elevation of 15° and notes that it is maintaining a constant altitude of 6250 feet. One minute later, she sees the airplane at an angle of elevation of 52°. How far has the airplane traveled, to the nearest foot? Determine and state the speed of the airplane, to the nearest mile per hour.

365 In right triangle ABC, m∠A = 32°, m∠B = 90°, and AE = 6.2 cm. What is the length of BC, to the nearest tenth of a centimeter?
1) 3.3
2) 3.9
3) 5.3
4) 11.7

366 As shown in the diagram below, an island (I) is due north of a marina (M). A boat house (H) is 4.5 miles due west of the marina. From the boat house, the island is located at an angle of 54° from the marina.

Determine and state, to the nearest tenth of a mile, the distance from the boat house (H) to the island (I). Determine and state, to the nearest tenth of a mile, the distance from the island (I) to the marina (M).
367 The map of a campground is shown below. Campsite $C$, first aid station $F$, and supply station $S$ lie along a straight path. The path from the supply station to the tower, $T$, is perpendicular to the path from the supply station to the campsite. The length of path $FS$ is 400 feet. The angle formed by path $TF$ and path $FS$ is $72^\circ$. The angle formed by path $TC$ and path $CS$ is $55^\circ$.

Determine and state, to the nearest foot, the distance from the campsite to the tower.

368 Yolanda is making a springboard to use for gymnastics. She has 8-inch-tall springs and wants to form a $16.5^\circ$ angle with the base, as modeled in the diagram below.

To the nearest tenth of an inch, what will be the length of the springboard, $x$?

1) 2.3 
2) 8.3 
3) 27.0 
4) 28.2

369 A homeowner is building three steps leading to a deck, as modeled by the diagram below. All three step rises, $HA$, $FG$, and $DE$, are congruent, and all three step runs, $HG$, $FE$, and $DC$, are congruent. Each step rise is perpendicular to the step run it joins. The measure of $\angle CAB = 36^\circ$ and $\angle CBA = 90^\circ$.

If each step run is parallel to $AB$ and has a length of 10 inches, determine and state the length of each step rise, to the nearest tenth of an inch. Determine and state the length of $AC$, to the nearest inch.
G.SRT.C.8: USING TRIGONOMETRY TO FIND AN ANGLE

370 A man who is 5 feet 9 inches tall casts a shadow of 8 feet 6 inches. Assuming that the man is standing perpendicular to the ground, what is the angle of elevation from the end of the shadow to the top of the man’s head, to the nearest tenth of a degree?
1) 34.1
2) 34.5
3) 42.6
4) 55.9

371 The diagram below shows a ramp connecting the ground to a loading platform 4.5 feet above the ground. The ramp measures 11.75 feet from the ground to the top of the loading platform.

Determine and state, to the nearest degree, the angle of elevation formed by the ramp and the ground.

372 A ladder leans against a building. The top of the ladder touches the building 10 feet above the ground. The foot of the ladder is 4 feet from the building. Find, to the nearest degree, the angle that the ladder makes with the level ground.

373 In the diagram of right triangle ABC shown below, \(AB = 14\) and \(AC = 9\).

What is the measure of \(\angle A\), to the nearest degree?
1) 33
2) 40
3) 50
4) 57

374 As modeled below, a movie is projected onto a large outdoor screen. The bottom of the 60-foot-tall screen is 12 feet off the ground. The projector sits on the ground at a horizontal distance of 75 feet from the screen.

Determine and state, to the nearest tenth of a degree, the measure of \(\theta\), the projection angle.
375 In the diagram of $\triangle RST$ below, $m\angle T = 90^\circ$, $RS = 65$, and $ST = 60$.

What is the measure of $\angle S$, to the nearest degree?

1) 23°
2) 43°
3) 47°
4) 67°

376 To build a handicapped-access ramp, the building code states that for every 1 inch of vertical rise in height, the ramp must extend out 12 inches horizontally, as shown in the diagram below.

What is the angle of inclination, $x$, of this ramp, to the nearest hundredth of a degree?

1) 4.76
2) 4.78
3) 85.22
4) 85.24

377 Bob places an 18-foot ladder 6 feet from the base of his house and leans it up against the side of his house. Find, to the nearest degree, the measure of the angle the bottom of the ladder makes with the ground.

378 In right triangle $ABC$, hypotenuse $AB$ has a length of 26 cm, and side $BC$ has a length of 17.6 cm. What is the measure of angle $B$, to the nearest degree?

1) 48°
2) 47°
3) 43°
4) 34°

379 In the diagram below of $\triangle HAR$ and $\triangle NTY$, angles $H$ and $N$ are right angles, and $\triangle HAR \sim \triangle NTY$.

If $AR = 13$ and $HR = 12$, what is the measure of angle $Y$, to the nearest degree?

1) 23°
2) 25°
3) 65°
4) 67°
LOGIC
G.CO.B.7-8, G.SRT.B.5: TRIANGLE CONGRUENCY

380 Given: \( D \) is the image of \( A \) after a reflection over \( CH \).

\( CH \) is the perpendicular bisector of \( BCE \)
\( \triangle ABC \) and \( \triangle DEC \) are drawn
Prove: \( \triangle ABC \cong \triangle DEC \)

381 Given right triangles \( \triangle ABC \) and \( \triangle DEF \) where \( \angle C \) and \( \angle F \) are right angles, \( AC \cong DF \) and \( CB \cong FE \).
Describe a precise sequence of rigid motions which would show \( \triangle ABC \cong \triangle DEF \).

382 After a reflection over a line, \( \triangle A'B'C' \) is the image of \( \triangle ABC \). Explain why triangle \( ABC \) is congruent to triangle \( A'B'C' \).

383 Which statement is sufficient evidence that \( \triangle DEF \) is congruent to \( \triangle ABC \)?

1) \( AB = DE \) and \( BC = EF \)
2) \( \angle D \cong \angle A, \angle B \cong \angle E, \angle C \cong \angle F \)
3) There is a sequence of rigid motions that maps \( AB \) onto \( DE \), \( BC \) onto \( EF \), and \( AC \) onto \( DF \).
4) There is a sequence of rigid motions that maps point \( A \) onto point \( D \), \( AB \) onto \( DE \), and \( \angle B \) onto \( \angle E \).

384 In the diagram below, \( \triangle ABC \) and \( \triangle XYZ \) are graphed.

Use the properties of rigid motions to explain why \( \triangle ABC \cong \triangle XYZ \).
385 In the diagram below, $AC \cong DF$ and points $A$, $C$, $D$, and $F$ are collinear on line $l$.

Let $\triangle D'EF$ be the image of $\triangle DEF$ after a translation along $l$, such that point $D$ is mapped onto point $A$. Determine and state the location of $F'$. Explain your answer.

386 As graphed on the set of axes below, $\triangle A'B'C'$ is the image of $\triangle ABC$ after a sequence of transformations.

Is $\triangle A'B'C'$ congruent to $\triangle ABC$? Use the properties of rigid motion to explain your answer.

387 In the two distinct acute triangles $ABC$ and $DEF$, $\angle B \cong \angle E$. Triangles $ABC$ and $DEF$ are congruent when there is a sequence of rigid motions that maps
1) $\angle A$ onto $\angle D$, and $\angle C$ onto $\angle F$
2) $AC$ onto $DF$, and $BC$ onto $EF$
3) $\angle C$ onto $\angle F$, and $BC$ onto $EF$
4) point $A$ onto point $D$, and $AB$ onto $DE$

388 In the diagram below of $\triangle ABC$ and $\triangle XYZ$, a sequence of rigid motions maps $\angle A$ onto $\angle X$, $\angle C$ onto $\angle Z$, and $AC$ onto $XZ$.

Determine and state whether $\overline{BC} \cong \overline{YZ}$. Explain why.
389 In the graph below, \( \triangle ABC \) has coordinates \( A(-9,2), B(-6,-6), \) and \( C(-3,-2) \), and \( \triangle RST \) has coordinates \( R(-2,9), S(5,6), \) and \( T(2,3) \).

Is \( \triangle ABC \) congruent to \( \triangle RST \)? Use the properties of rigid motions to explain your reasoning.

390 In the diagram of \( \triangle LAC \) and \( \triangle DNC \) below, \( \overline{LA} \cong \overline{DN}, \overline{CA} \cong \overline{CN}, \) and \( \angle DAC \perp \angle LCN \).

\[ \begin{align*} 
\text{a)} & \quad \text{Prove that } \triangle LAC \cong \triangle DNC. \\
\text{b)} & \quad \text{Describe a sequence of rigid motions that will map } \triangle LAC \text{ onto } \triangle DNC. 
\end{align*} \]

391 Given \( \triangle ABC \cong \triangle DEF \), which statement is not always true?

1) \( \overline{BC} \cong \overline{DF} \)
2) \( m\angle A = m\angle D \)
3) area of \( \triangle ABC = \) area of \( \triangle DEF \)
4) perimeter of \( \triangle ABC = \) perimeter of \( \triangle DEF \)

392 Skye says that the two triangles below are congruent. Margaret says that the two triangles are similar.

Are Skye and Margaret both correct? Explain why.

G.CO.C.10, G.SRT.B.5: TRIANGLE PROOFS

393 Given: \( \triangle XYZ, \overline{XY} \cong \overline{ZY}, \) and \( \overline{YW} \) bisects \( \angle XYZ \)

Prove that \( \angle YWZ \) is a right angle.
Given the theorem, “The sum of the measures of the interior angles of a triangle is $180^\circ$,” complete the proof for this theorem.

Given: $\triangle ABC$
Prove: $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $\triangle ABC$</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point $C$, draw $\overline{DCE}$ parallel to $\overline{AB}$.</td>
<td>(2)</td>
</tr>
<tr>
<td>(3) $m\angle 1 = m\angle ACD$, $m\angle 3 = m\angle BCE$</td>
<td>(3)</td>
</tr>
<tr>
<td>(4) $m\angle ACD + m\angle 2 + m\angle BCE = 180^\circ$</td>
<td>(4)</td>
</tr>
<tr>
<td>(5) $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$</td>
<td>(5)</td>
</tr>
</tbody>
</table>
395 Prove the sum of the exterior angles of a triangle is 360°.

396 Line segment $EA$ is the perpendicular bisector of $ZT$, and $ZE$ and $TE$ are drawn.

Which conclusion can not be proven?
1) $EA$ bisects angle $ZET$.
2) Triangle $EZT$ is equilateral.
3) $EA$ is a median of triangle $EZT$.
4) Angle $Z$ is congruent to angle $T$.

397 Two right triangles must be congruent if
1) an acute angle in each triangle is congruent
2) the lengths of the hypotenuses are equal
3) the corresponding legs are congruent
4) the areas are equal

398 Given: $\triangle ABE$ and $\triangle CBD$ shown in the diagram below with $DB \cong BE$

Which statement is needed to prove $\triangle ABE \cong \triangle CBD$ using only $SAS \cong SAS$?
1) $\angle CDB \cong \angle AEB$
2) $\angle AFD \cong \angle EFC$
3) $AD \cong CE$
4) $AE \cong CD$

399 Kelly is completing a proof based on the figure below.

She was given that $\angle A \cong \angle EDF$, and has already proven $AB \cong DE$. Which pair of corresponding parts and triangle congruency method would not prove $\triangle ABC \cong \triangle DEF$?
1) $AC \cong DF$ and $SAS$
2) $BC \cong EF$ and $SAS$
3) $\angle C \cong \angle F$ and $AAS$
4) $\angle CBA \cong \angle FED$ and $ASA$
400 Given: $\overline{RS}$ and $\overline{TV}$ bisect each other at point $X$
$\overline{TR}$ and $\overline{SV}$ are drawn

Prove: $\overline{TR} \parallel \overline{SV}$

401 In the diagram below, $\overline{AKS}$, $\overline{NKC}$, $\overline{AN}$, and $\overline{SC}$ are drawn such that $\overline{AN} \cong \overline{SC}$.

Which additional statement is sufficient to prove $\triangle KAN \cong \triangle KSC$ by AAS?
1) $AS$ and $NC$ bisect each other.
2) $K$ is the midpoint of $NC$.
3) $\overline{AS} \perp \overline{CN}$
4) $\overline{AN} \parallel \overline{SC}$

Fill in the missing statement and reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 $\triangle ABC$, $\triangle AEC$, $\triangle BDE$ with $\angle ABE \cong \angle CBE$, and $\angle ADE \cong \angle CDE$</td>
<td>1 Given</td>
</tr>
<tr>
<td>2 $BD \cong BD$</td>
<td>2</td>
</tr>
<tr>
<td>3 $\angle BDA$ and $\angle ADE$ are supplementary. $\angle BDC$ and $\angle CDE$ are supplementary.</td>
<td>3 Linear pairs of angles are supplementary.</td>
</tr>
<tr>
<td>4</td>
<td>4 Supplements of congruent angles are congruent.</td>
</tr>
<tr>
<td>5 $\triangle ABD \cong \triangle CBD$</td>
<td>5 ASA</td>
</tr>
<tr>
<td>6 $AD \cong CD$, $AB \cong CB$</td>
<td>6</td>
</tr>
<tr>
<td>7 $\overline{BDE}$ is the perpendicular bisector of $\overline{AC}$.</td>
<td>7</td>
</tr>
</tbody>
</table>

402 Given: $\triangle ABC$, $\triangle AEC$, $\triangle BDE$ with $\angle ABE \cong \angle CBE$, and $\angle ADE \cong \angle CDE$

Prove: $\overline{BDE}$ is the perpendicular bisector of $\overline{AC}$
In parallelogram $ABCD$ shown below, diagonals $AC$ and $BD$ intersect at $E$.

Prove: $\angle ACD \cong \angle CAB$

Given: Quadrilateral $ABCD$ with diagonals $AC$ and $BD$ that bisect each other, and $\angle 1 \cong \angle 2$

Prove: $\triangle ACD$ is an isosceles triangle and $\triangle AEB$ is a right triangle

Given: Parallelogram $ABCD$, $BF \perp AFD$, and $DE \perp BEC$

Prove: $BEDF$ is a rectangle

Given: Quadrilateral $ABCD$ is a parallelogram with diagonals $AC$ and $BD$ intersecting at $E$

Prove: $\triangle AED \cong \triangle CEB$

Describe a single rigid motion that maps $\triangle AED$ onto $\triangle CEB$. 
407  In quadrilateral $ABCD$, $AB \cong CD$, $AB \parallel CD$, and $BF$ and $DE$ are perpendicular to diagonal $AC$ at points $F$ and $E$.

Prove: $AE \cong CF$

408  In the diagram of parallelogram $ABCD$ below, $BE \perp CED$, $DF \perp BFC$, $CE \cong CF$.

Prove $ABCD$ is a rhombus.

409  Given: Parallelogram $ANDR$ with $AW$ and $DE$ bisecting $NWD$ and $REA$ at points $W$ and $E$, respectively

Prove that $\triangle ANW \cong \triangle DRE$. Prove that quadrilateral $AWDE$ is a parallelogram.

410  Isosceles trapezoid $ABCD$ has bases $DC$ and $AB$ with nonparallel legs $AD$ and $BC$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE \cong \angle DCE$, $AE \perp DE$, and $BE \perp CE$.

Prove $\triangle ADE \cong \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.
Given: Parallelogram \(ABCD\) with diagonal \(AC\) drawn

Prove: \(\triangle ABC \cong \triangle CDA\)

**G.SRT.B.5: CIRCLE PROOFS**

412 In the diagram below, secant \(ACD\) and tangent \(AB\) are drawn from external point \(A\) to circle \(O\).

![Diagram showing a circle with secant and tangent](image)

Prove the theorem: If a secant and a tangent are drawn to a circle from an external point, the product of the lengths of the secant segment and its external segment equals the length of the tangent segment squared. \((AC \cdot AD = AB^2)\)

Given: Circle \(O\), chords \(AB\) and \(CD\) intersect at \(E\)

Theorem: If two chords intersect in a circle, the product of the lengths of the segments of one chord is equal to the product of the lengths of the segments of the other chord. Prove this theorem by proving \(AE \cdot EB = CE \cdot ED\).

413 Given: Circle \(O\), chords \(AB\) and \(CD\) intersect at \(E\)

![Diagram showing a circle with intersecting chords](image)

414 In the diagram below of circle \(O\), tangent \(EC\) is drawn to diameter \(AC\). Chord \(BC\) is parallel to secant \(ADE\), and chord \(AB\) is drawn.

![Diagram showing a circle with tangent and parallel chord](image)

Prove: \(\frac{BC}{CA} = \frac{AB}{EC}\)
415 In the diagram below, \( \angle GRS \cong \angle ART \), \( GR = 36 \), \( SR = 45 \), \( AR = 15 \), and \( RT = 18 \).

Which triangle similarity statement is correct?
1) \( \triangle GRS \sim \triangle ART \) by AA.
2) \( \triangle GRS \sim \triangle ART \) by SAS.
3) \( \triangle GRS \sim \triangle ART \) by SSS.
4) \( \triangle GRS \) is not similar to \( \triangle ART \).

416 Given: Parallelogram \( ABCD \), \( EFG \), and diagonal \( DFB \)

Prove: \( \triangle DEF \sim \triangle BGF \)

417 In the diagram below, \( \triangle A'B'C' \) is the image of \( \triangle ABC \) after a transformation.

Describe the transformation that was performed. Explain why \( \triangle A'B'C' \sim \triangle ABC \).

418 In the diagram below, \( GI \) is parallel to \( NT \), and \( IN \) intersects \( GT \) at \( A \).

Prove: \( \triangle GI'A' \sim \triangle TNA \)
419 In the diagram below, $AB \parallel DFC$, $EDA \parallel CBG$, and $EFB$ and $AG$ are drawn.

Which statement is always true?
1) $\triangle DEF \cong \triangle CBF$
2) $\triangle BAG \cong \triangle BAE$
3) $\triangle BAG \sim \triangle AEB$
4) $\triangle DEF \sim \triangle AEB$

420 As shown in the diagram below, circle $A$ has a radius of 3 and circle $B$ has a radius of 5.

Use transformations to explain why circles $A$ and $B$ are similar.
Geometry Regents Exam Questions by State Standard: Topic
Answer Section

1 ANS: 4 PTS: 2 REF: 061501geo NAT: G.GMD.B.4
TOP: Rotations of Two-Dimensional Objects

2 ANS: 4 PTS: 2 REF: 081503geo NAT: G.GMD.B.4
TOP: Rotations of Two-Dimensional Objects

3 ANS: 3 PTS: 2 REF: 061816geo NAT: G.GMD.B.4
TOP: Rotations of Two-Dimensional Objects

4 ANS: 3 PTS: 2 REF: 061601geo NAT: G.GMD.B.4
TOP: Rotations of Two-Dimensional Objects

5 ANS: 1 PTS: 2 REF: 081603geo NAT: G.GMD.B.4
TOP: Rotations of Two-Dimensional Objects

6 ANS: 1
\[ V = \frac{1}{3} \pi (4)^2 (6) = 32\pi \]
PTS: 2 REF: 061718geo NAT: G.GMD.B.4 TOP: Rotations of Two-Dimensional Objects

7 ANS: 4 PTS: 2 REF: 081803geo NAT: G.GMD.B.4
TOP: Rotations of Two-Dimensional Objects

8 ANS: 3
\[ v = \pi r^2 h \]
(1) \( 6^2 \cdot 10 = 360 \)
(2) \( 10^2 \cdot 6 = 600 \)
(3) \( 5^2 \cdot 6 = 150 \)
(4) \( 3^2 \cdot 10 = 900 \)
PTS: 2 REF: 081713geo NAT: G.GMD.B.4 TOP: Rotations of Two-Dimensional Objects

9 ANS: 4 PTS: 2 REF: 011810geo NAT: G.GMD.B.4
TOP: Rotations of Two-Dimensional Objects

10 ANS: 2 PTS: 2 REF: 061506geo NAT: G.GMD.B.4
TOP: Cross-Sections of Three-Dimensional Objects

11 ANS: 3 PTS: 2 REF: 081613geo NAT: G.GMD.B.4
TOP: Cross-Sections of Three-Dimensional Objects

12 ANS: 1 PTS: 2 REF: 011601geo NAT: G.GMD.B.4
TOP: Cross-Sections of Three-Dimensional Objects

13 ANS: 4 PTS: 2 REF: 011723geo NAT: G.GMD.B.4
TOP: Cross-Sections of Three-Dimensional Objects

14 ANS: 2 PTS: 2 REF: 081701geo NAT: G.GMD.B.4
TOP: Cross-Sections of Three-Dimensional Objects

15 ANS: 2 PTS: 2 REF: 011805geo NAT: G.GMD.B.4
TOP: Cross-Sections of Three-Dimensional Objects

16 ANS: 3 PTS: 2 REF: 081805geo NAT: G.GMD.B.4
TOP: Cross-Sections of Three-Dimensional Objects
17 ANS:

\[ \triangle ABC \cong \triangle DEF \]

PTS: 4 REF: 011634geo NAT: G.CO.D.12 TOP: Constructions
KEY: congruent and similar figures

18 ANS:

PTS: 2 REF: fall1409geo NAT: G.CO.D.12 TOP: Constructions
KEY: parallel and perpendicular lines

19 ANS:

PTS: 2 REF: 061631geo NAT: G.CO.D.12 TOP: Constructions
KEY: parallel and perpendicular lines
20 ANS:

PTS: 2 REF: 081628geo NAT: G.CO.D.12 TOP: Constructions
KEY: line bisector

21 ANS:

The length of $\overline{A'C'}$ is twice $\overline{AC}$.

PTS: 4 REF: 081632geo NAT: G.CO.D.12 TOP: Constructions
KEY: congruent and similar figures

22 ANS:

PTS: 2 REF: 011725geo NAT: G.CO.D.12 TOP: Constructions
KEY: line bisector
23 ANS:

[Diagram of parallel and perpendicular lines]

PTS: 2  REF: 061725geo  NAT: G.CO.D.12  TOP: Constructions
KEY: parallel and perpendicular lines

24 ANS:

[Diagram of line bisector]

PTS: 2  REF: 061829geo  NAT: G.CO.D.12  TOP: Constructions
KEY: line bisector

25 ANS:

[Diagram of parallel and perpendicular lines]

PTS: 2  REF: 081825geo  NAT: G.CO.D.12  TOP: Constructions
KEY: parallel and perpendicular lines
Since the square is inscribed, each vertex of the square is on the circle and the diagonals of the square are diameters of the circle. Therefore, each angle of the square is an inscribed angle in the circle that intercepts the circle at the endpoints of the diameters. Each angle of the square, which is an inscribed angle, measures 90 degrees. Therefore, the measure of the arc intercepted by two adjacent sides of the square is 180 degrees because it is twice the measure of its inscribed angle.

PTS: 4 REF: fall1412geo NAT: G.CO.D.13 TOP: Constructions

Since the square is inscribed, each vertex of the square is on the circle and the diagonals of the square are diameters of the circle. Therefore, each angle of the square is an inscribed angle in the circle that intercepts the circle at the endpoints of the diameters. Each angle of the square, which is an inscribed angle, measures 90 degrees. Therefore, the measure of the arc intercepted by two adjacent sides of the square is 180 degrees because it is twice the measure of its inscribed angle.

PTS: 2 REF: 061525geo NAT: G.CO.D.13 TOP: Constructions

Since the square is inscribed, each vertex of the square is on the circle and the diagonals of the square are diameters of the circle. Therefore, each angle of the square is an inscribed angle in the circle that intercepts the circle at the endpoints of the diameters. Each angle of the square, which is an inscribed angle, measures 90 degrees. Therefore, the measure of the arc intercepted by two adjacent sides of the square is 180 degrees because it is twice the measure of its inscribed angle.

PTS: 2 REF: 081526geo NAT: G.CO.D.13 TOP: Constructions
Right triangle because $\angle CBF$ is inscribed in a semi-circle.

PTS: 4  REF: 011733geo  NAT: G.CO.D.13  TOP: Constructions

PTS: 2  REF: 081728geo  NAT: G.CO.D.13  TOP: Constructions

PTS: 2  REF: 011826geo  NAT: G.CO.D.13  TOP: Constructions
32 ANS: 4
\[-5 + \frac{3}{5}(5 - 5) - 4 + \frac{3}{5}(1 - 4)\]
\[-5 + \frac{3}{5}(10) \quad -4 + \frac{3}{5}(5)\]
\[-5 + 6 \quad -4 + 3\]
1 \quad -1

PTS: 2 REF: spr1401geo NAT: G.GPE.B.6 TOP: Directed Line Segments

33 ANS: 1
\[3 + \frac{2}{5}(8 - 3) = 3 + \frac{2}{5}(5) = 3 + 2 = 5 \quad 5 + \frac{2}{5}(-5 - 5) = 5 + \frac{2}{5}(-10) = 5 - 4 = 1\]

PTS: 2 REF: 011720geo NAT: G.GPE.B.6 TOP: Directed Line Segments

34 ANS:
\[\frac{2}{5} \cdot (16 - 1) = 6 \quad \frac{2}{5} \cdot (14 - 4) = 4 \quad (1 + 6, 4 + 4) = (7, 8)\]

PTS: 2 REF: 081531geo NAT: G.GPE.B.6 TOP: Directed Line Segments

35 ANS: 2
\[-4 + \frac{2}{5}(6 - 4) = -4 + \frac{2}{5}(10) = -4 + 4 = 0 \quad 5 + \frac{2}{5}(20 - 5) = 5 + \frac{2}{5}(15) = 5 + 6 = 11\]

PTS: 2 REF: 061715geo NAT: G.GPE.B.6 TOP: Directed Line Segments

36 ANS:
\[-6 + \frac{2}{5}(4 - 6) \quad -5 + \frac{2}{5}(0 - 5) \quad (-2, -3)\]
\[-6 + \frac{2}{5}(10) \quad -5 + \frac{2}{5}(5)\]
\[-6 + 4 \quad -5 + 2\]
\[-2 \quad -3\]

PTS: 2 REF: 061527geo NAT: G.GPE.B.6 TOP: Directed Line Segments

37 ANS: 4
\[x = -6 + \frac{1}{6}(6 - 6) = -6 + 2 = 4 \quad y = -2 + \frac{1}{6}(7 - 2) = -2 + \frac{9}{6} = \frac{1}{2}\]

PTS: 2 REF: 081618geo NAT: G.GPE.B.6 TOP: Directed Line Segments
38 ANS:

\[
x = \frac{2}{3} (4 - 2) = 4 \quad -2 + 4 = 2 \quad J(2, 5)
\]

\[
y = \frac{2}{3} (7 - 1) = 4 \quad 1 + 4 = 5
\]

PTS: 2 REF: 011627geo NAT: G.GPE.B.6 TOP: Directed Line Segments

39 ANS:

\[
4 + \frac{4}{9} (22 - 4) \quad 2 + \frac{4}{9} (2 - 2) \quad (12, 2)
\]

\[
4 + \frac{4}{9} (18) \quad 2 + \frac{4}{9} (0)
\]

\[
4 + 8 \quad 2 + 0
\]

\[
12 \quad 2
\]

PTS: 2 REF: 061626geo NAT: G.GPE.B.6 TOP: Directed Line Segments

40 ANS: 1

\[-8 + \frac{3}{8} (16 - 8) = -8 + \frac{3}{8} (24) = -8 + 9 = 1 \quad -2 + \frac{3}{8} (6 - 2) = -2 + \frac{3}{8} (8) = -2 + 3 = 1\]

PTS: 2 REF: 081717geo NAT: G.GPE.B.6 TOP: Directed Line Segments

41 ANS: 1

\[-5 + \frac{1}{3} (4 - 5) = -5 + 3 = -2 \quad y = 2 + \frac{1}{3} (-10 - 2) = 2 - 4 = -2\]

PTS: 2 REF: 011806geo NAT: G.GPE.B.6 TOP: Directed Line Segments

42 ANS: 2

\[-4 + \frac{2}{5} (1 - 4) = -4 + \frac{2}{5} (5) = -4 + 2 = -2 \quad -2 + \frac{2}{5} (8 - 2) = -2 + \frac{2}{5} (10) = -2 + 4 = 2\]

PTS: 2 REF: 061814geo NAT: G.GPE.B.6 TOP: Directed Line Segments

43 ANS: 1

\[-8 + \frac{3}{5} (7 - 8) = -8 + 9 = 1 \quad 7 + \frac{3}{5} (-13 - 7) = 7 - 12 = -5\]

PTS: 2 REF: 081815geo NAT: G.GPE.B.6 TOP: Directed Line Segments
44 ANS: 1
Alternate interior angles

PTS: 2 REF: 061517geo NAT: G.CO.C.9 TOP: Lines and Angles

45 ANS:
Since linear angles are supplementary, \( m \angle GHI = 65^\circ \). Since \( \overline{GH} \cong \overline{HI} \), \( m \angle GHI = 50^\circ \) \((180 - (65 + 65))\). Since \( \angle EGB \cong \angle GHI \), the corresponding angles formed by the transversal and lines are congruent and \( AB \parallel CD \).

PTS: 4 REF: 061532geo NAT: G.CO.C.9 TOP: Lines and Angles

46 ANS: 1

PTS: 2 REF: 011606geo NAT: G.CO.C.9
TOP: Lines and Angles

47 ANS: 1
\[ \frac{f}{4} = \frac{15}{6} \]
\[ f = 10 \]

PTS: 2 REF: 061617geo NAT: G.CO.C.9 TOP: Lines and Angles

48 ANS: 4

PTS: 2 REF: 081611geo NAT: G.CO.C.9
TOP: Lines and Angles

49 ANS: 2

PTS: 2 REF: 081601geo NAT: G.CO.C.9
TOP: Lines and Angles

50 ANS: 2

51 ANS: 3

PTS: 2 REF: 061802geo NAT: G.CO.C.9
TOP: Lines and Angles

52 ANS: 4

PTS: 2 REF: 081801geo NAT: G.CO.C.9
TOP: Lines and Angles

53 ANS: 1
\[ m = -\frac{4}{B} = \frac{-2}{-1} = 2 \]
\[ m_{\perp} = -\frac{1}{2} \]

PTS: 2 REF: 061509geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: identify perpendicular lines
54 ANS: 1
\[ m = -\frac{2}{3} \quad 1 = \left( -\frac{2}{3} \right) 6 + b \]
\[ 1 = -4 + b \]
\[ 5 = b \]

PTS: 2 REF: 081510geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: write equation of parallel line

55 ANS: 4
The slope of $BC$ is $\frac{2}{5}$. Altitude is perpendicular, so its slope is $-\frac{5}{2}$.

PTS: 2 REF: 061614geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: find slope of perpendicular line

56 ANS: 4
\[ m = -\frac{1}{2} \quad -4 = 2(6) + b \]
\[ m_\perp = 2 \quad -4 = 12 + b \]
\[ -16 = b \]

PTS: 2 REF: 011602geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: write equation of perpendicular line

57 ANS: 1
\[ m = \left( \frac{-11 + 5}{2}, \frac{5 + -7}{2} \right) = (-3,-1) \]
\[ m = \frac{5 - -7}{-11 - 5} = \frac{12}{-16} = -\frac{3}{4} \]
\[ m_\perp = \frac{4}{3} \]

PTS: 2 REF: 061612geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: perpendicular bisector

58 ANS: 3
\[ y = mx + b \]
\[ 2 = \frac{1}{2} (-2) + b \]
\[ 3 = b \]

PTS: 2 REF: 011701geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: write equation of parallel line

59 ANS: 2
\[ m = \frac{3}{2} \quad 1 = -\frac{2}{3} (-6) + b \]
\[ m_\perp = -\frac{2}{3} \quad 1 = 4 + b \]
\[ -3 = b \]

PTS: 2 REF: 061719geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: write equation of perpendicular line
The segment’s midpoint is the origin and slope is $-2$. The slope of a perpendicular line is \( \frac{1}{2} \).  

\[
y = \frac{1}{2}x + 0
\]

\[
2y = x
\]

\[
2y - x = 0
\]


\[
m = \frac{-4}{-6} = \frac{2}{3}
\]

\[m_\perp = -\frac{3}{2}\]

PTS: 2  REF: 011820geo  NAT: G.GPE.B.5  TOP: Parallel and Perpendicular Lines  KEY: write equation of perpendicular line

\[
m = \frac{3}{2}
\]

\[m_\perp = -\frac{2}{3}\]

PTS: 2  REF: 061812geo  NAT: G.GPE.B.5  TOP: Parallel and Perpendicular Lines  KEY: write equation of perpendicular line

The slope of $3x + 2y = 12$ is $-\frac{3}{2}$, which is the opposite reciprocal of $\frac{2}{3}$.

PTS: 2  REF: 081811geo  NAT: G.GPE.B.5  TOP: Parallel and Perpendicular Lines  KEY: identify perpendicular lines

\[
s^2 + s^2 = 7^2
\]

\[2s^2 = 49
\]

\[s^2 = 24.5
\]

\[s \approx 4.9
\]

PTS: 2  REF: 081511geo  NAT: G.SRT.C.8  TOP: Pythagorean Theorem

\[
\frac{16}{9} = \frac{x}{20.6} \quad D = \sqrt{36.6^2 + 20.6^2} \approx 42
\]

\[x \approx 36.6
\]

PTS: 4  REF: 011632geo  NAT: G.SRT.C.8  TOP: Pythagorean Theorem  KEY: without graphics
66 ANS: \( \sqrt{20^2 - 10^2} \approx 17.3 \)

PTS: 2 REF: 081608geo NAT: G.SRT.C.8 TOP: Pythagorean Theorem

KEY: without graphics

67 ANS: \( 2 \)

\[ 6 + 6\sqrt{3} + 6 + 6\sqrt{3} \approx 32.8 \]

PTS: 2 REF: 011709geo NAT: G.SRT.C.8 TOP: 30-60-90 Triangles

68 ANS:
\( \triangle MNO \) is congruent to \( \triangle PNO \) by SAS. Since \( \triangle MNO \cong \triangle PNO \), then \( MO \cong PO \) by CPCTC. So \( NO \) must divide \( MP \) in half, and \( MO = 8 \).

PTS: 2 REF: fall1405geo NAT: G.SRT.B.5 TOP: Isosceles Triangle Theorem

69 ANS:
\( 180 - 2(25) = 130 \)

PTS: 2 REF: 011730geo NAT: G.SRT.B.5 TOP: Isosceles Triangle Theorem

70 ANS: \( 3 \)

\[ \frac{9}{5} = \frac{9.2}{x} \]

\[ 5.1 + 9.2 = 14.3 \]

\[ 9x = 46 \]

\[ x \approx 5.1 \]

PTS: 2 REF: 061511geo NAT: G.SRT.B.5 TOP: Side Splitter Theorem

71 ANS: \( 4 \)

\[ \frac{2}{6} = \frac{5}{15} \]

PTS: 2 REF: 081517geo NAT: G.SRT.B.5 TOP: Side Splitter Theorem

72 ANS: \( 2 \)

\[ \frac{12}{4} = \frac{36}{x} \]

\[ 12x = 144 \]

\[ x = 12 \]

PTS: 2 REF: 061621geo NAT: G.SRT.B.5 TOP: Side Splitter Theorem

73 ANS:
\[ \frac{3.75}{5} = \frac{4.5}{6} \]

\( AB \) is parallel to \( CD \) because \( AB \) divides the sides proportionately.

\[ 39.375 = 39.375 \]

PTS: 2 REF: 061627geo NAT: G.SRT.B.5 TOP: Side Splitter Theorem
74 ANS: 4
\[ \frac{2}{4} = \frac{9-x}{x} \]
36 - 4x = 2x
x = 6

PTS: 2  REF: 061705geo  NAT: G.SRT.B.5  TOP: Side Splitter Theorem

75 ANS: 4
\[ \frac{1}{3.5} = \frac{x}{18-x} \]
3.5x = 18 - x
4.5x = 18
x = 4

PTS: 2  REF: 081707geo  NAT: G.SRT.B.5  TOP: Side Splitter Theorem

76 ANS: 3
\[ \frac{24+15}{40} = \frac{x}{x} \]
24x = 600
x = 25

PTS: 2  REF: 011813geo  NAT: G.SRT.B.5  TOP: Side Splitter Theorem

77 ANS: 4
\[ \frac{5}{7} = \frac{x}{x+5} \]
12 \( \frac{1}{2} \) + 5 = 17 \( \frac{1}{2} \)
5x + 25 = 7x
2x = 25
x = 12 \( \frac{1}{2} \)

PTS: 2  REF: 061821geo  NAT: G.SRT.B.5  TOP: Side Splitter Theorem

78 ANS: 2
\[ \frac{x}{x+3} = \frac{14}{21} \]
14 - 6 = 8
21x = 14x + 42
7x = 42
x = 6

PTS: 2  REF: 081812geo  NAT: G.SRT.B.5  TOP: Side Splitter Theorem
\[
\frac{x}{6.3} = \frac{3}{5} \quad \frac{y}{9.4} = \frac{6.3}{6.3 + 3.78}
\]

\[x = 3.78 \quad y \approx 5.9\]

PTS: 2  
REF: 081816geo  
NAT: G.SRT.B.5  
TOP: Side Splitter Theorem

\[\angle B = 180 - (82 + 26) = 72; \quad \angle DEC = 180 - 26 = 154; \quad \angle EDB = 360 - (154 + 26 + 72) = 108; \quad \angle BDF = \frac{108}{2} = 54; \quad \angle DFB = 180 - (54 + 72) = 54\]

PTS: 2  
REF: 081604geo  
NAT: G.CO.C.10  
TOP: Interior and Exterior Angles of Triangles

\[6x - 40 + x + 20 = 180 - 3x \quad m\angle BAC = 180 - (80 + 40) = 60\]

\[10x = 200\]

\[x = 20\]

PTS: 2  
REF: 011809geo  
NAT: G.CO.C.10  
TOP: Exterior Angle Theorem

\[\angle BAC = \angle ABD = 59^\circ \quad \angle ABC = 62^\circ\]

PTS: 4  
REF: 081711geo  
NAT: G.CO.C.10  
TOP: Exterior Angle Theorem

\[\triangle ABC\]

PTS: 2  
REF: 081822geo  
NAT: G.CO.C.10  
TOP: Medians, Altitudes and Bisectors
86 ANS: 4 PTS: 2 REF: 011704geo NAT: G.CO.C.10
TOP: Midsegments
87 ANS: 4 PTS: 2 REF: 081716geo NAT: G.CO.C.10
TOP: Midsegments
88 ANS: 1
$M$ is a centroid, and cuts each median $2:1$.

PTS: 2 REF: 061818geo NAT: G.CO.C.10
TOP: Centroid, Orthocenter, Incenter and Circumcenter
89 ANS: 1
$m_{RT} = \frac{5 - (-3)}{4 - 2} = \frac{8}{6} = \frac{4}{3} \quad m_{SR} = \frac{5 - 2}{4 - 8} = \frac{3}{-4} = -\frac{3}{4}$ Slopes are opposite reciprocals, so lines form a right angle.

PTS: 2 REF: 011618geo NAT: G.GPE.B.4 TOP: Triangles in the Coordinate Plane
90 ANS:
The slopes of perpendicular lines are opposite reciprocals. Since the lines are perpendicular, they form right angles and a right triangle. $m_{BC} = -\frac{3}{2} \quad -1 = \frac{2}{3}(-3) + b$ or $-4 = \frac{2}{3}(-1) + b$
$$m_{\perp} = \frac{2}{3} \quad -1 = -2 + b \quad 1 = b$$
$$3 = \frac{2}{3}x + 1 \quad \frac{-10}{3} = b$$
$$2 = \frac{2}{3}x \quad 3 = \frac{2}{3}x - \frac{10}{3}$$
$$3 = x \quad 9 = 2x - 10$$
$$19 = 2x \quad 9.5 = x$$

PTS: 4 REF: 081533geo NAT: G.GPE.B.4 TOP: Triangles in the Coordinate Plane
Because $\overline{AB} \cong \overline{AC}$, $\triangle ABC$ has two congruent sides and is isosceles. Because $\overline{AB} \cong \overline{BC}$ is not true, $\triangle ABC$ has sides that are not congruent and $\triangle ABC$ is not equilateral.

Opposite angles in a parallelogram are congruent, so $m\angle O = 118^\circ$. The interior angles of a triangle equal $180^\circ$. $180 - (118 + 22) = 40.$
95 ANS: 3


96 ANS: 1

\[ 180 - (68 \times 2) \]

PTS: 2  REF: 081624geo  NAT: G.CO.C.11  TOP: Interior and Exterior Angles of Polygons

97 ANS: 4


99 ANS: 3

(3) Could be a trapezoid.

PTS: 2  REF: 081607geo  NAT: G.CO.C.11  TOP: Parallelograms

100 ANS: 4  PTS: 2  REF: 081813geo  NAT: G.CO.C.11  TOP: Parallelograms


102 ANS: 2  PTS: 2  REF: 011802geo  NAT: G.CO.C.11  TOP: Parallelograms

103 ANS:

PTS: 2  REF: 081826geo  NAT: G.CO.C.11  TOP: Parallelograms

104 ANS: 2  PTS: 2  REF: 081501geo  NAT: G.CO.C.11  TOP: Special Quadrilaterals

105 ANS: 1

1) opposite sides; 2) adjacent sides; 3) perpendicular diagonals; 4) diagonal bisects angle

PTS: 2  REF: 061609geo  NAT: G.CO.C.11  TOP: Special Quadrilaterals
106 ANS: 1 PTS: 2 REF: 011716geo NAT: G.CO.C.11
TOP: Special Quadrilaterals
107 ANS: 4 PTS: 2 REF: 011705geo NAT: G.CO.C.11
TOP: Special Quadrilaterals
108 ANS:
The four small triangles are 8-15-17 triangles. \(4 \times 17 = 68\)

PTS: 2 REF: 081726geo NAT: G.CO.C.11 TOP: Special Quadrilaterals
109 ANS: 3
In (1) and (2), \(ABCD\) could be a rectangle with non-congruent sides. (4) is not possible

PTS: 2 REF: 081714geo NAT: G.CO.C.11 TOP: Special Quadrilaterals
110 ANS: 4 PTS: 2 REF: 061711geo NAT: G.CO.C.11
TOP: Special Quadrilaterals
111 ANS: 4 PTS: 2 REF: 011819geo NAT: G.CO.C.11
TOP: Special Quadrilaterals
112 ANS: 4 PTS: 2 REF: 061813geo NAT: G.CO.C.11
TOP: Special Quadrilaterals
113 ANS:
\[M\left(\frac{4+0}{2}, \frac{6-1}{2}\right) = M\left(\frac{2}{2}, \frac{5}{2}\right)\]
\[m = \frac{6-1}{4-0} = \frac{7}{4}, \quad m_\perp = -\frac{4}{7}\]
\[y - 2.5 = -\frac{4}{7}(x - 2)\]
The diagonals, \(MT\) and \(AH\), of rhombus \(MATH\) are perpendicular bisectors of each other.

PTS: 4 REF: fall1411geo NAT: G.GPE.B.4 TOP: Quadrilaterals in the Coordinate Plane
KEY: grids
114 ANS: 1
\[m_{TA} = -1, \quad y = mx + b\]
\[m_{EM} = 1, \quad 1 = 1(2) + b\]
\[-1 = b\]

PTS: 2 REF: 081614geo NAT: G.GPE.B.4 TOP: Quadrilaterals in the Coordinate Plane
KEY: general
115 ANS: 4
\[-2 - 1 \overline{-1 - 3} = -\frac{3}{2}, \quad 3 - 2 \overline{0 - 5} = -\frac{1}{3}, \quad 3 - 1 \overline{0 - 3} = -\frac{2}{3}, \quad 2 - 2 \overline{5 - 1} = 4 \overline{6}\]

PTS: 2 REF: 081522geo NAT: G.GPE.B.4 TOP: Quadrilaterals in the Coordinate Plane
KEY: general
Since the slopes of \( \overline{TS} \) and \( \overline{SR} \) are opposite reciprocals, they are perpendicular and form a right angle. \( \triangle RST \) is a right triangle because \( \angle S \) is a right angle. \( P(0,9) \)

\[
m_{\overline{RP}} = -\frac{10}{6} = -\frac{5}{3} \quad \text{and} \quad m_{\overline{PT}} = \frac{3}{5}
\]

Since the slopes of all four adjacent sides (\( \overline{TS}, \overline{SR}, \overline{RP}, \overline{PT} \)) are opposite reciprocals, they are perpendicular and form right angles. Quadrilateral \( RSTP \) is a rectangle because it has four right angles.

\[
\frac{7-1}{0-2} = \frac{6}{-2} = -3 \quad \text{The diagonals of a rhombus are perpendicular.}
\]
ANS:  
\[PQ = \sqrt{(8 - 3)^2 + (3 - 2)^2} = \sqrt{50} \quad QR = \sqrt{(1 - 8)^2 + (4 - 3)^2} = \sqrt{50} \quad RS = \sqrt{(-4 - 1)^2 + (-1 - 4)^2} = \sqrt{50}\]

\[PS = \sqrt{(-4 - 3)^2 + (-1 - 2)^2} = \sqrt{50}\]

\[PQRS\] is a rhombus because all sides are congruent. \(m_{\overline{PQ}} = \frac{8 - 3}{3 - 2} = \frac{5}{1} = 1\)

\[m_{\overline{QR}} = \frac{1 - 8}{4 - 3} = -7\]

Because the slopes of adjacent sides are not opposite reciprocals, they are not perpendicular and do not form a right angle. Therefore \(PQRS\) is not a square.

\[\triangle PAT\] is an isosceles triangle because sides \(\overline{AP}\) and \(\overline{AT}\) are congruent (\(\sqrt{3^2 + 11^2} = \sqrt{7^2 + 9^2} = \sqrt{130}\)).

\(R(2, 9)\). Quadrilateral \(PART\) is a parallelogram because the opposite sides are parallel since they have equal slopes.

\((m_{\overline{AR}} = \frac{4}{6} = \frac{2}{3}; \quad m_{\overline{PT}} = \frac{4}{6} = \frac{2}{3}; \quad m_{\overline{PA}} = -\frac{11}{3}; \quad m_{\overline{RT}} = -\frac{11}{3})\)
121 ANS:

\[ m_{\text{MH}} = \frac{6}{10} = \frac{3}{5}, \quad m_{\text{AT}} = \frac{6}{10} = \frac{3}{5}, \quad m_{\text{MA}} = -\frac{5}{3}, \quad m_{\text{HT}} = -\frac{5}{3}; \quad \text{MH} \parallel \text{AT} \quad \text{and} \quad \text{MA} \parallel \text{HT}. \]

\[ MATH \] is a parallelogram since both sides of opposite sides are parallel. \( m_{\text{MA}} = -\frac{5}{3}, \quad m_{\text{AT}} = \frac{3}{5}. \) Since the slopes are negative reciprocals, \( MA \perp AT \) and \( \angle A \) is a right angle. \( MATH \) is a rectangle because it is a parallelogram with a right angle.

PTS: 6 REF: 081835geo NAT: G.GPE.B.4 TOP: Quadrilaterals in the Coordinate Plane

KEY: grids

122 ANS: 2

\[
\sqrt{(-1-2)^2 + (4-3)^2} = \sqrt{10}
\]

PTS: 2 REF: 011615geo NAT: G.GPE.B.7 TOP: Polygons in the Coordinate Plane

123 ANS: 3

\[
\sqrt{45} = 3\sqrt{5} \quad a = \frac{1}{2} \left( 3 \sqrt{5} \right) \left( 6 \sqrt{5} \right) = \frac{1}{2} (18)(5) = 45
\]

\[
\sqrt{180} = 6\sqrt{5}
\]

PTS: 2 REF: 061622geo NAT: G.GPE.B.7 TOP: Polygons in the Coordinate Plane

124 ANS: 3

\[ A = \frac{1}{2} ab \quad 3 - 6 = -3 = x \]

\[ 24 = \frac{1}{2} a(8) \quad \frac{4 + 12}{2} = 8 = y \]

\[ a = 6 \]

PTS: 2 REF: 081615geo NAT: G.GPE.B.7 TOP: Polygons in the Coordinate Plane
125 \[ 4\sqrt{(-1-3)^2 + (5-1)^2} = 4\sqrt{20} \]

PTS: 2 \hspace{1cm} \text{REF: 081703geo} \hspace{1cm} \text{NAT: G.GPE.B.7} \hspace{1cm} \text{TOP: Polygons in the Coordinate Plane}

126 \[ (12 \cdot 11) - \left( \frac{1}{2} (12 \cdot 4) + \frac{1}{2} (7 \cdot 9) + \frac{1}{2} (11 \cdot 3) \right) = 60 \]

PTS: 2 \hspace{1cm} \text{REF: 061815geo} \hspace{1cm} \text{NAT: G.GPE.B.7} \hspace{1cm} \text{TOP: Polygons in the Coordinate Plane}

127 \[ 4\sqrt{(-1-2)^2 + (2-3)^2} = 4\sqrt{10} \]

PTS: 2 \hspace{1cm} \text{REF: 081808geo} \hspace{1cm} \text{NAT: G.GPE.B.7} \hspace{1cm} \text{TOP: Polygons in the Coordinate Plane}

128 \[ 3 \hspace{1cm} \text{PTS: 2} \hspace{1cm} \text{REF: 061702geo} \hspace{1cm} \text{NAT: G.GPE.B.7} \]

129 \[ 1 \hspace{1cm} \text{PTS: 2} \hspace{1cm} \text{REF: 061520geo} \hspace{1cm} \text{NAT: G.C.A.2} \]

130 \[ 1 \hspace{1cm} \text{PTS: 2} \hspace{1cm} \text{REF: 061508geo} \hspace{1cm} \text{NAT: G.C.A.2} \]

131 \[ \frac{5 \cdot 10}{4} = \frac{50}{4} = 12.5 \]

PTS: 2 \hspace{1cm} \text{REF: 081512geo} \hspace{1cm} \text{NAT: G.C.A.2} \hspace{1cm} \text{TOP: Chords, Secants and Tangents} \hspace{1cm} \text{KEY: common tangents}

132 \[ 3 \hspace{1cm} \text{PTS: 2} \hspace{1cm} \text{REF: 011621geo} \hspace{1cm} \text{NAT: G.C.A.2} \]

133 \[ 2 \hspace{1cm} \text{PTS: 2} \hspace{1cm} \text{REF: 061610geo} \hspace{1cm} \text{NAT: G.C.A.2} \]

134 \[ 2 \hspace{1cm} \text{PTS: 2} \hspace{1cm} \text{REF: 061610geo} \hspace{1cm} \text{NAT: G.C.A.2} \]
135 ANS: 1
The other statements are true only if $\overline{AD}\perp\overline{BC}$.

PTS: 2 REF: 081623geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents

KEY: inscribed

136 ANS: 
$\frac{3}{8} \cdot 56 = 21$

PTS: 2 REF: 081625geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents

KEY: common tangents

137 ANS: 2
$8(x + 8) = 6(x + 18)$
$8x + 64 = 6x + 108$
$2x = 44$
$x = 22$

PTS: 2 REF: 011715geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents

KEY: secants drawn from common point, length

138 ANS: 
$\frac{152 - 56}{2} = 48$

PTS: 2 REF: 011728geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents

KEY: secant and tangent drawn from common point, angle

139 ANS: 4
$\frac{1}{2} (360 - 268) = 46$

PTS: 2 REF: 061704geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents

KEY: inscribed

140 ANS: 2
$6 \cdot 6 = x(x - 5)$
$36 = x^2 - 5x$
$0 = x^2 - 5x - 36$
$0 = (x - 9)(x + 4)$
$x = 9$

PTS: 2 REF: 061708geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents

KEY: intersecting chords, length
141 ANS: 1
Parallel chords intercept congruent arcs. \( \frac{180 - 130}{2} = 25 \)

PTS: 2 REF: 081704geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents
KEY: parallel lines

142 ANS: 2
\[ x^2 = 3 \cdot 18 \]
\[ x = \sqrt{3 \cdot 3 \cdot 6} \]
\[ x = 3\sqrt{6} \]

PTS: 2 REF: 081712geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents
KEY: secant and tangent drawn from common point, length

143 ANS: 4
PTS: 2 REF: 011816geo NAT: G.C.A.2
TOP: Chords, Secants and Tangents
KEY: inscribed

144 ANS: 3
\[ \frac{x + 72}{2} = 58 \]
\[ x + 72 = 116 \]
\[ x = 44 \]

PTS: 2 REF: 061817geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents
KEY: intersecting chords, angle

145 ANS:
\[ 10 \cdot 6 = 15x \]
\[ x = 4 \]

PTS: 2 REF: 061828geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents
KEY: secants drawn from common point, length

146 ANS: 2

PTS: 2 REF: 081814geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents
KEY: tangents drawn from common point, length
147 ANS:
\[
\frac{134 + 102}{2} = 118
\]

PTS: 2  REF: 081827geo  NAT: G.C.A.2  TOP: Chords, Secants and Tangents
KEY: intersecting chords, angle

148 ANS: 3  PTS: 2  REF: 081515geo  NAT: G.C.A.3
TOP: Inscribed Quadrilaterals

149 ANS: 4
Opposite angles of an inscribed quadrilateral are supplementary.

PTS: 2  REF: 011821geo  NAT: G.C.A.3  TOP: Inscribed Quadrilaterals

150 ANS: 2
\[
x^2 + y^2 + 6y + 9 = 7 + 9
\]
\[
x^2 + (y + 3)^2 = 16
\]

PTS: 2  REF: 061514geo  NAT: G.GPE.A.1  TOP: Equations of Circles
KEY: completing the square

151 ANS: 3
\[
x^2 + 4x + 4 + y^2 - 6y + 9 = 12 + 4 + 9
\]
\[
(x + 2)^2 + (y - 3)^2 = 25
\]

PTS: 2  REF: 081509geo  NAT: G.GPE.A.1  TOP: Equations of Circles
KEY: completing the square

152 ANS: 4
\[
x^2 + 6x + 9 + y^2 - 4y + 4 = 23 + 9 + 4
\]
\[
(x + 3)^2 + (y - 2)^2 = 36
\]

PTS: 2  REF: 011617geo  NAT: G.GPE.A.1  TOP: Equations of Circles
KEY: completing the square

153 ANS: 2  PTS: 2  REF: 061603geo  NAT: G.GPE.A.1
TOP: Equations of Circles  KEY: find center and radius | completing the square
154 ANS: 1
\[ x^2 - 4x + 4 + y^2 + 8y + 16 = -11 + 4 + 16 \]
\[ (x - 2)^2 + (y + 4)^2 = 9 \]

PTS: 2 REF: 081616geo NAT: G.GPE.A.1 TOP: Equations of Circles
KEY: completing the square

155 ANS:
\[ x^2 - 6x + 9 + y^2 + 8y + 16 = 56 + 9 + 16 \]
\[ (x - 3)^2 + (y + 4)^2 = 81 \]

PTS: 2 REF: 081731geo NAT: G.GPE.A.1 TOP: Equations of Circles
KEY: completing the square

156 ANS: 1
\[ x^2 + y^2 - 6y + 9 = -1 + 9 \]
\[ x^2 + (y - 3)^2 = 8 \]

PTS: 2 REF: 011718geo NAT: G.GPE.A.1 TOP: Equations of Circles
KEY: completing the square

157 ANS: 1
Since the midpoint of \( AB \) is \((3, -2)\), the center must be either \((5, -2)\) or \((1, -2)\).
\[ r = \sqrt{2^2 + 5^2} = \sqrt{29} \]

PTS: 2 REF: 061623geo NAT: G.GPE.A.1 TOP: Equations of Circles
KEY: other

158 ANS: 1
\[ x^2 + y^2 - 12y + 36 = -20 + 36 \]
\[ x^2 + (y - 6)^2 = 16 \]

PTS: 2 REF: 061712geo NAT: G.GPE.A.1 TOP: Equations of Circles
KEY: completing the square
159  ANS: 2
\[ x^2 + y^2 - 6x + 2y = 6 \]
\[ x^2 - 6x + 9 + y^2 + 2y + 1 = 6 + 9 + 1 \]
\[ (x - 3)^2 + (y + 1)^2 = 16 \]

PTS: 2  REF: 011812geo  NAT: G.GPE.A.1  TOP: Equations of Circles
KEY: completing the square

160  ANS: 2
\[ (x - 5)^2 + (y - 2)^2 = 16 \]
\[ x^2 - 10x + 25 + y^2 - 4y + 4 = 16 \]
\[ x^2 - 10x + y^2 - 4y = -13 \]

PTS: 2  REF: 061820geo  NAT: G.GPE.A.1  TOP: Equations of Circles
KEY: write equation, given graph

161  ANS: 4
\[ x^2 + 4x + 4 + y^2 - 8y + 16 = -16 + 4 + 16 \]
\[ (x + 2)^2 + (y - 4)^2 = 4 \]

PTS: 2  REF: 081821geo  NAT: G.GPE.A.1  TOP: Equations of Circles
KEY: completing the square

162  ANS: 3
\[ r = \sqrt{(7 - 3)^2 + (1 - 2)^2} = \sqrt{16 + 9} = 5 \]

PTS: 2  REF: 061503geo  NAT: G.GPE.B.4  TOP: Circles in the Coordinate Plane

163  ANS: 3
\[ \sqrt{(-5)^2 + 12^2} = \sqrt{169} \quad \sqrt{11^2 + (2\sqrt{12})^2} = \sqrt{121 + 48} = \sqrt{169} \]

PTS: 2  REF: 011722geo  NAT: G.GPE.B.4  TOP: Circles in the Coordinate Plane

164  ANS:
Yes.
\[ (x - 1)^2 + (y + 2)^2 = 4^2 \]
\[ (3.4 - 1)^2 + (1.2 + 2)^2 = 16 \]
\[ 5.76 + 10.24 = 16 \]
\[ 16 = 16 \]

PTS: 2  REF: 081630geo  NAT: G.GPE.B.4  TOP: Circles in the Coordinate Plane
\[
\frac{64}{4} = 16 \quad 16^2 = 256 \quad 2w + 2(w + 2) = 64 \quad 15 \times 17 = 255 \quad 2w + 2(w + 4) = 64 \quad 14 \times 18 = 252 \quad 2w + 2(w + 6) = 64
\]
\[
w = 15 \quad w = 14 \quad w = 13
\]

\[
13 \times 19 = 247
\]

PTS: 2  
REF: 011708geo  
NAT: G.MG.A.3  
TOP: Area of Polygons

166 ANS:  
\[
x^2 + x^2 = 58^2 \quad A = (\sqrt{1682} + 8)^2 \approx 2402.2
\]
\[
2x^2 = 3364
\]
\[
x = \sqrt{1682}
\]

PTS: 4  
REF: 081734geo  
NAT: G.MG.A.3  
TOP: Area of Polygons

167 ANS:  
\[
SA = 6 \cdot 12^2 = 864
\]
\[
\frac{864}{450} = 1.92
\]

PTS: 2  
REF: 061519geo  
NAT: G.MG.A.3  
TOP: Surface Area

168 ANS:  
\[
x \text{ is } \frac{1}{2} \text{ the circumference. } \frac{C}{2} = \frac{10\pi}{2} \approx 16
\]

PTS: 2  
REF: 061523geo  
NAT: G.GMD.A.1  
TOP: Circumference

169 ANS:  
\[
\frac{1000}{20\pi} \approx 15.9
\]

PTS: 2  
REF: 011623geo  
NAT: G.GMD.A.1  
TOP: Circumference

170 ANS:  
\[
\theta \cdot r = \frac{2\pi}{10} = \frac{\pi}{5}
\]

PTS: 2  
REF: fall1404geo  
NAT: G.C.B.5  
TOP: Arc Length  
KEY: angle

171 ANS:  
\[
s = \theta \cdot r \quad s = \theta \cdot r \quad \text{Yes, both angles are equal.}
\]
\[
\pi = A \cdot 4 \quad \frac{13\pi}{8} = B \cdot 6.5
\]
\[
\frac{\pi}{4} = A \quad \frac{\pi}{4} = B
\]

PTS: 2  
REF: 061629geo  
NAT: G.C.B.5  
TOP: Arc Length  
KEY: arc length
172 ANS: 3
\[ \frac{s_L}{s_S} = \frac{6\theta}{4\theta} = 1.5 \]

KEY: arc length

173 ANS: 4
\[ C = 12\pi \frac{120}{360} (12\pi) = \frac{1}{3} (12\pi) \]

PTS: 2 REF: 061822geo NAT: G.C.B.5 TOP: Arc Length
KEY: arc length

174 ANS:
\[ \left( \frac{180 - 20}{2} \right) \frac{\pi (6)^2}{360} = \frac{80}{360} \times 36\pi = 8\pi \]


175 ANS:
\[ A = 6^2 \pi = 36\pi \quad 36\pi \cdot \frac{x}{360} = 12\pi \]
\[ x = 360 \cdot \frac{12}{36} \]
\[ x = 120 \]

PTS: 2 REF: 061529geo NAT: G.C.B.5 TOP: Sectors

176 ANS: 3
\[ \frac{60}{360} \cdot 6^2 \pi = 6\pi \]

PTS: 2 REF: 081518geo NAT: G.C.B.5 TOP: Sectors

177 ANS:
\[ \frac{40}{360} \cdot \pi (4.5)^2 = 2.25\pi \]

PTS: 2 REF: 061726geo NAT: G.C.B.5 TOP: Sectors

178 ANS: 3
\[ \frac{x}{360} \cdot 3^2 \pi = 2\pi \quad 180 - 80 = 100 \]
\[ x = 80 \frac{180 - 100}{2} = 40 \]

PTS: 2 REF: 011612geo NAT: G.C.B.5 TOP: Sectors
\[ \frac{60}{360} \cdot 8^2 \pi = \frac{1}{6} \cdot 64\pi = \frac{32\pi}{3} \]

PTS: 2  REF: 061624geo  NAT: G.C.B.5  TOP: Sectors

180  ANS: 2  PTS: 2  REF: 081619geo  NAT: G.C.B.5

TOP: Sectors

181  ANS: 2
\[ \frac{512\pi}{3} \cdot \frac{3}{2} = \frac{4\pi}{3} \]

PTS: 2  REF: 081723geo  NAT: G.C.B.5  TOP: Sectors

182  ANS: 4
\[ \frac{300}{360} \cdot 8^2 \pi = \frac{160\pi}{3} \]

PTS: 2  REF: 011721geo  NAT: G.C.B.5  TOP: Sectors

183  ANS:
\[ \frac{Q}{360} \left( \pi \left( \frac{25^2}{2} \right) \right) = \left( \pi \left( \frac{25^2}{2} \right) \right) - 500\pi \]
\[ Q = \frac{125\pi(360)}{625\pi} \]
\[ Q = 72 \]

PTS: 2  REF: 011828geo  NAT: G.C.B.5  TOP: Sectors

184  ANS: 2
\[ \frac{30}{360} (5)^2 (\pi) \approx 6.5 \]

PTS: 2  REF: 081818geo  NAT: G.C.B.5  TOP: Sectors

185  ANS:
Each quarter in both stacks has the same base area. Therefore, each corresponding cross-section of the stacks will have the same area. Since the two stacks of quarters have the same height of 23 quarters, the two volumes must be the same.

PTS: 2  REF: spr1405geo  NAT: G.GMD.A.1  TOP: Volume

186  ANS:
Yes. The bases of the cylinders have the same area and the cylinders have the same height.

PTS: 2  REF: 081725geo  NAT: G.GMD.A.1  TOP: Volume
Each triangular prism has the same base area. Therefore, each corresponding cross-section of the prisms will have the same area. Since the two prisms have the same height of 14, the two volumes must be the same.

\[ 2592276 = \frac{1}{3} \cdot s^2 \cdot 146.5 \]

\[ 230 \approx s \]

\[ V = \frac{1}{3} \cdot 6^2 \cdot 12 = 144 \]

\[ \frac{4}{3} \pi \left( \frac{9.5}{2} \right)^3 \approx 55 \]

\[ \frac{4}{3} \pi \left( \frac{2.5}{2} \right)^3 \]

\[ V = \pi \left( \frac{6.7}{2} \right)^2 (4 \cdot 6.7) \approx 945 \]
194 ANS:
\[
\frac{\pi \cdot 11.25^2 \cdot 33.5}{231} \approx 57.7
\]

PTS: 4 REF: 061632geo NAT: G.GMD.A.3 TOP: Volume
KEY: cylinders

195 ANS:
Similar triangles are required to model and solve a proportion.
\[
\frac{x + 5}{1.5} = \frac{x}{1} \quad \frac{1}{3} \pi (1.5)^2 (15) - \frac{1}{3} \pi (1)^2 (10) \approx 24.9
\]
\[
x + 5 = 1.5x
\]
\[
5 = 0.5x
\]
\[
10 = x
\]
\[
10 + 5 = 15
\]

PTS: 6 REF: 061636geo NAT: G.GMD.A.3 TOP: Volume
KEY: cones

196 ANS:
\[
\frac{3 V_f}{4 \pi} - \frac{3 V_p}{4 \pi} = \frac{3(294)}{4 \pi} - \frac{3(180)}{4 \pi} \approx 0.6
\]

PTS: 2 REF: 061728geo NAT: G.GMD.A.3 TOP: Volume
KEY: spheres

197 ANS: 2
\[
4 \times 4 \times 6 - \pi (1)^2 (6) \approx 77
\]

PTS: 2 REF: 011711geo NAT: G.GMD.A.3 TOP: Volume
KEY: compositions

198 ANS: 1
\[
V = \frac{1}{3} \pi \left( \frac{1.5}{2} \right)^2 \left( \frac{4}{2} \right) \approx 1.2
\]

PTS: 2 REF: 011724geo NAT: G.GMD.A.3 TOP: Volume
KEY: cones

199 ANS:
\[
C = 2 \pi r \quad V = \frac{1}{3} \pi \cdot 5^2 \cdot 13 \approx 340
\]
\[
31.416 = 2 \pi r
\]
\[
5 \approx r
\]

PTS: 4 REF: 011734geo NAT: G.GMD.A.3 TOP: Volume
KEY: cones
200 ANS: 1
84 = \frac{1}{3} \cdot s^2 \cdot 7
6 = s

PTS: 2 REF: 061716geo NAT: G.GMD.A.3 TOP: Volume
KEY: pyramids

201 ANS: 3
2.5 \times 1.25 \times (27 \times 12) + \frac{1}{2} \pi (1.25)^2 (27 \times 12) \approx 1808

PTS: 2 REF: 061723geo NAT: G.GMD.A.3 TOP: Volume
KEY: compositions

202 ANS:
20000 \text{ g} \left( \frac{1 \text{ ft}^3}{7.48 \text{ g}} \right) = 2673.8 \text{ ft}^3 
2673.8 = \pi r^2 (34.5) 
9.9 + 1 = 10.9
\quad r \approx 4.967
\quad d \approx 9.9

PTS: 4 REF: 061734geo NAT: G.GMD.A.3 TOP: Volume
KEY: cylinders

203 ANS:
tan 16.5 = \frac{x}{13.5} 
9 \times 16 \times 4.5 = 648 
3752 - (35 \times 16 \times 5) = 3472
\quad x \approx 4
\quad 13.5 \times 16 \times 4.5 = 972 
3472 \times 7.48 \approx 25971
\quad 4 + 4.5 = 8.5 
\frac{1}{2} \times 13.5 \times 16 \times 4 = 432 
\frac{25971}{10.5} \approx 2473.4
\quad \frac{12.5 \times 16 \times 8.5}{3752} \approx 41

PTS: 6 REF: 081736geo NAT: G.GMD.A.3 TOP: Volume
KEY: compositions

204 ANS: 3
V = \frac{1}{3} \pi r^2 h

54.45 \pi = \frac{1}{3} \pi (3.3)^2 h
\quad h = 15

PTS: 2 REF: 011807geo NAT: G.GMD.A.3 TOP: Volume
KEY: cones
205 ANS:

\[29.5 = 2\pi r \quad V = \frac{4}{3}\pi \left(\frac{29.5}{2\pi}\right)^3 \approx 434\]

\[r = \frac{29.5}{2\pi}\]

PTS: 2 REF: 061831geo NAT: G.GMD.A.3 TOP: Volume
KEY: spheres

206 ANS: 2

\[V = \frac{1}{3}\left(\frac{36}{4}\right)^2 \cdot 15 = 405\]

PTS: 2 REF: 011822geo NAT: G.GMD.A.3 TOP: Volume
KEY: pyramids

207 ANS: 1

\[82.8 = \frac{1}{3}(4.6)(9)h\]

\[h = 6\]

PTS: 2 REF: 061810geo NAT: G.GMD.A.3 TOP: Volume
KEY: pyramids

208 ANS:

\[V = (\pi)(4^3)(9) + \left(\frac{1}{2}\right)\left(\frac{4}{3}\right)(\pi)(4^3) \approx 586\]

PTS: 4 REF: 011833geo NAT: G.GMD.A.3 TOP: Volume
KEY: compositions

209 ANS:

\[2\left(\frac{36}{12} \times \frac{36}{12} \times \frac{4}{12}\right) \times 3.25 = 19.50\]

PTS: 2 REF: 081831geo NAT: G.GMD.A.3 TOP: Volume
KEY: prisms

210 ANS: 1

\[20 \cdot 12 \cdot 45 + \frac{1}{2} \pi(10)^2(45) \approx 17869\]

PTS: 2 REF: 061807geo NAT: G.GMD.A.3 TOP: Volume
KEY: compositions

211 ANS: 2

\[V = \frac{1}{3}\left(\frac{60}{12}\right)^2\left(\frac{84}{12}\right) \approx 58\]

PTS: 2 REF: 081819geo NAT: G.GMD.A.3 TOP: Volume
KEY: pyramids
212 ANS:
\[ r = 25 \text{ cm} \left( \frac{1 \text{ m}}{100 \text{ cm}} \right) = 0.25 \text{ m} \quad V = \pi (0.25 \text{ m})^2 (10 \text{ m}) = 0.625 \pi \text{ m}^3 \quad W = 0.625 \pi \text{ m}^3 \left( \frac{380 \text{ K}}{1 \text{ m}^3} \right) \approx 746.1 \text{ K} \]
\[ n = \frac{\$50,000}{\left( \frac{\$4.75}{\text{K}} \right) (746.1 \text{ K})} = 14.1 \quad 15 \text{ trees} \]

PTS: 4 \quad REF: spr1412geo \quad NAT: G.MG.A.2 \quad TOP: Density

213 ANS: 3
\[ V = 12 \cdot 8.5 \cdot 4 = 408 \]
\[ W = 408 \cdot 0.25 = 102 \]

PTS: 2 \quad REF: 061507geo \quad NAT: G.MG.A.2 \quad TOP: Density

214 ANS: 1
\[ V = \frac{\frac{4}{3} \pi \left( \frac{10}{2} \right)^3}{2} \approx 261.8 \cdot 62.4 = 16,336 \]

PTS: 2 \quad REF: 081516geo \quad NAT: G.MG.A.2 \quad TOP: Density

215 ANS:
No, the weight of the bricks is greater than 900 kg. 500 \times (5.1 \text{ cm} \times 10.2 \text{ cm} \times 20.3 \text{ cm}) = 528,003 \text{ cm}^3.
\[ 528,003 \text{ cm}^3 \times \frac{1 \text{ m}^3}{100 \text{ cm}^3} = 0.528003 \text{ m}^3. \quad 1920 \text{ kg/m}^3 \times 0.528003 \text{ m}^3 \approx 1013 \text{ kg}. \]

PTS: 2 \quad REF: fall1406geo \quad NAT: G.MG.A.2 \quad TOP: Density

216 ANS:
\[ \tan 47^\circ = \frac{x}{8.5} \quad \text{Cone: } V = \frac{1}{3} \pi (8.5)^2 (9.115) \approx 689.6 \quad \text{Cylinder: } V = \pi (8.5)^2 (25) \approx 5674.5 \quad \text{Hemisphere: } \]
\[ x \approx 9.115 \]
\[ V = \frac{1}{2} \left( \frac{4}{3} \pi (8.5)^3 \right) \approx 1286.3 \quad 689.6 + 5674.5 + 1286.3 \approx 7650 \quad \text{No, because } 7650 \cdot 62.4 = 477,360 \]
\[ 477,360 \cdot 0.85 = 405,756, \text{ which is greater than } 400,000. \]

PTS: 6 \quad REF: 061535geo \quad NAT: G.MG.A.2 \quad TOP: Density

217 ANS:
\[ \frac{137.8}{6^3} \approx 0.638 \quad \text{Ash} \]

PTS: 2 \quad REF: 081525geo \quad NAT: G.MG.A.2 \quad TOP: Density
218 ANS: 
\[ V = \frac{1}{3} \pi \left( \frac{3}{2} \right)^2 \cdot 8 \approx 18.85 \cdot 100 = 1885 \ 1885 \cdot 0.52 \cdot 0.10 = 98.02 \ 1.95(100) - (37.83 + 98.02) = 59.15 \]

PTS: 6  REF: 081536geo  NAT: G.MG.A.2  TOP: Density

219 ANS: 2
\[ \frac{4}{3} \pi \cdot 4^3 + 0.075 \approx 20 \]

PTS: 2  REF: 011619geo  NAT: G.MG.A.2  TOP: Density

220 ANS: 2
\[ \frac{11}{1.2 \text{ oz}} \left( \frac{16 \text{ oz}}{1 \text{ lb}} \right) = \frac{13.31}{\text{ lb}} \left( \frac{1 \text{ g}}{3.7851 \text{ lb}} \right) \approx \frac{3.5 \text{ g}}{1 \text{ lb}} \]

PTS: 2  REF: 061618geo  NAT: G.MG.A.2  TOP: Density

221 ANS:
\[
500 \times 1015 \text{ cc} \times \frac{0.29 \text{ kg}}{1000 \text{ g}} \times \frac{7.95 \text{ g}}{\text{ cc}} \times \frac{1 \text{ kg}}{1000 \text{ g}} = \$1170
\]

PTS: 2  REF: 011829geo  NAT: G.MG.A.2  TOP: Density

222 ANS:
\[ V = \pi (10)^2 (18) = 1800 \pi \text{ in}^3 \ 1800 \pi \text{ in}^3 \left( \frac{1 \text{ ft}^3}{12^3 \text{ in}^3} \right) = \frac{25}{24} \pi \text{ ft}^3 \ \frac{25}{24} \pi (95.46)(0.85) \approx 266 \ 266 + 270 = 536 \]

PTS: 4  REF: 061834geo  NAT: G.MG.A.2  TOP: Density

223 ANS: 1
\[ \frac{1}{2} \left( \frac{4}{3} \pi \right) \cdot 5^3 \cdot 62.4 \approx 16,336 \]

PTS: 2  REF: 061620geo  NAT: G.MG.A.2  TOP: Density

224 ANS: 2
\[ C = \pi d \ V = \pi \left( \frac{2.25}{\pi} \right)^2 \cdot 8 \approx 12.8916 \ W = 12.8916 \cdot 752 \approx 9694 \]
\[ 4.5 = \pi d \]
\[ \frac{4.5}{\pi} = d \]
\[ \frac{2.25}{\pi} = r \]

PTS: 2  REF: 081617geo  NAT: G.MG.A.2  TOP: Density
225 ANS: 
\[
\frac{40000}{\pi \left( \frac{51}{2} \right)^2} \approx 19.6 \quad \frac{72000}{\pi \left( \frac{75}{2} \right)^2} \approx 16.3 \quad \text{Dish A}
\]

PTS: 2  REF: 011630geo  NAT: G.MG.A.2  TOP: Density

226 ANS: 1
Illinois: \[ \frac{12830632}{231.1} \approx 55520 \] Florida: \[ \frac{18801310}{350.6} \approx 53626 \] New York: \[ \frac{19378102}{411.2} \approx 47126 \] Pennsylvania: \[
\frac{12702379}{283.9} \approx 44742
\]

PTS: 2  REF: 081720geo  NAT: G.MG.A.2  TOP: Density

227 ANS:
\[
V = \frac{1}{3} \pi \left( \frac{8.3}{2} \right)^2 (10.2) + \frac{1}{2} \cdot \frac{4}{3} \pi \left( \frac{8.3}{2} \right)^3 \approx 183.961 + 149.693 \approx 333.65 \text{ cm}^3 \quad 333.65 \times 50 = 16682.7 \text{ cm}^3
\]
\[
16682.7 \times 0.697 = 11627.8 \text{ g} \quad 11.6278 \times 3.83 = \$44.53
\]

PTS: 6  REF: 081636geo  NAT: G.MG.A.2  TOP: Density

228 ANS:
C: \[ V = \pi (26.7)^2 (750) - \pi (24.2)^2 (750) = 95,437.5 \pi \]
\[ 95,437.5 \pi \text{ cm}^3 \left\{ \begin{array}{c} 2.7 \text{ g} \\ 1000 \text{ g} \end{array} \right\} \left\{ \begin{array}{c} 0.38 \\ \text{kg} \end{array} \right\} = \$307.62 \]

P: \[ V = 40^2 (750) - 35^2 (750) = 281,250 \quad \$307.62 - 288.56 = \$19.06 \]
\[ 281,250 \text{ cm}^3 \left\{ \begin{array}{c} 2.7 \text{ g} \\ 1000 \text{ g} \end{array} \right\} \left\{ \begin{array}{c} 0.38 \\ \text{kg} \end{array} \right\} = \$288.56 \]

PTS: 6  REF: 011736geo  NAT: G.MG.A.2  TOP: Density

229 ANS:
\[
\frac{4 \pi}{3} (2^3 - 1.5^3) \approx 19.4 \quad 19.4 \cdot 1.308 \cdot 8 \approx 203
\]

PTS: 4  REF: 081834geo  NAT: G.MG.A.2  TOP: Density
230 ANS: 1
TOP: Line Dilations

231 ANS: 1
The line $3y = -2x + 8$ does not pass through the center of dilation, so the dilated line will be distinct from
$3y = -2x + 8$. Since a dilation preserves parallelism, the line $3y = -2x + 8$ and its image $2x + 3y = 5$ are parallel,
with slopes of $\frac{-2}{3}$.

232 ANS: 2
The given line $h$, $2x + y = 1$, does not pass through the center of dilation, the origin, because the $y$-intercept is at
$(0, 1)$. The slope of the dilated line, $m$, will remain the same as the slope of line $h$, -2. All points on line $h$, such as
$(0, 1)$, the $y$-intercept, are dilated by a scale factor of 4; therefore, the $y$-intercept of the dilated line is $(0, 4)$ because
the center of dilation is the origin, resulting in the dilated line represented by the equation $y = -2x + 4$.

233 ANS: 2
The line $y = 2x - 4$ does not pass through the center of dilation, so the dilated line will be distinct from $y = 2x - 4$.
Since a dilation preserves parallelism, the line $y = 2x - 4$ and its image will be parallel, with slopes of 2. To
obtain the $y$-intercept of the dilated line, the scale factor of the dilation, $\frac{3}{2}$, can be applied to the $y$-intercept,
$(0, -4)$. Therefore, $\left(0 \cdot \frac{3}{2}, -4 \cdot \frac{3}{2}\right) \rightarrow (0, -6)$. So the equation of the dilated line is $y = 2x - 6$.

234 ANS: 4
The line $y = 3x - 1$ passes through the center of dilation, so the dilated line is not distinct.

235 ANS: 2
TOP: Line Dilations

236 ANS: 1

237 ANS: 3
238 ANS:

\[ y = \frac{2}{3} x + 2 \]

The line is on the center of dilation, so the line does not change. \( p: 3x + 4y = 20 \)

PTS: 2  REF: 061731geo  NAT: G.SRT.A.1  TOP: Line Dilations

239 ANS:

\[
\ell: y = 3x - 4 \\
m: y = 3x - 8
\]

PTS: 2  REF: 011631geo  NAT: G.SRT.A.1  TOP: Line Dilations

240 ANS: 4

\[ 3 \times 6 = 18 \]

PTS: 2  REF: 061602geo  NAT: G.SRT.A.1  TOP: Line Dilations

241 ANS:

\[
\sqrt{(2.5 - 1)^2 + (-.5 - 1.5)^2} = \sqrt{2.25 + 4} = 2.5
\]

PTS: 2  REF: 081729geo  NAT: G.SRT.A.1  TOP: Line Dilations

242 ANS: 4

\[
\sqrt{(32 - 8)^2 + (28 - (-4))^2} = \sqrt{576 + 1024} = \sqrt{1600} = 40
\]

PTS: 2  REF: 081621geo  NAT: G.SRT.A.1  TOP: Line Dilations

243 ANS: 1

Since a dilation preserves parallelism, the line \( 4y = 3x + 7 \) and its image \( 3x - 4y = 9 \) are parallel, with slopes of \( \frac{3}{4} \).

PTS: 2  REF: 081710geo  NAT: G.SRT.A.1  TOP: Line Dilations

244 ANS: 1  PTS: 2  REF: 011814geo  NAT: G.SRT.A.1  TOP: Line Dilations

245 ANS: 2

The line \( y = -3x + 6 \) passes through the center of dilation, so the dilated line is not distinct.

PTS: 2  REF: 061824geo  NAT: G.SRT.A.1  TOP: Line Dilations
ANS:
No, The line $4x + 3y = 24$ passes through the center of dilation, so the dilated line is not distinct.

$4x + 3y = 24$

$3y = -4x + 24$

$y = \frac{-4}{3}x + 8$

PTS: 2

ANS:
$ABC$ – point of reflection $\rightarrow (-y, x)$ + point of reflection
$\triangle DEF \cong \triangle A'B'C'$ because $\triangle DEF$ is a reflection of $A(2, -3) - (2, -3) = (0, 0) \rightarrow (0, 0) + (2, -3) = A'(2, -3)$

$B(6, -8) - (2, -3) = (4, -5) \rightarrow (5, 4) + (2, -3) = B'(7, 1)$

$C(2, -9) - (2, -3) = (0, -6) \rightarrow (6, 0) + (2, -3) = C'(8, -3)$

$\triangle A'B'C'$ and reflections preserve distance.

PTS: 4

ANS: 1

PTS: 2

KEY: grids

ANS:

PTS: 2

KEY: grids

ANS: 1

3\^2 = 9

PTS: 2

KEY: grids

ANS: 1

$4\div 6 = \frac{3}{4.5} = \frac{2}{3}$

PTS: 2

KEY: grids

ANS: 1

$\frac{4}{6} = \frac{3}{4.5} = \frac{2}{3}$

PTS: 2
A dilation preserves slope, so the slopes of $\overline{QR}$ and $\overline{Q'R'}$ are equal. Because the slopes are equal, $\overline{Q'R'} \parallel \overline{QR}$.

255 ANS: 1

PTS: 4

Ref: 011732geo

Nat: G.SRT.A.2

Top: Dilations

Key: grids

A dilation of 3 centered at $A$. A dilation preserves angle measure, so the triangles are similar.

256 ANS: 3

$6 \cdot 3^2 = 54 \quad 12 \cdot 3 = 36$

PTS: 2

Ref: 011811geo

Nat: G.SRT.A.2

Top: Dilations

257 ANS: 4

$9 \cdot 3 = 27, 27 \cdot 4 = 108$

PTS: 2

Ref: 081823geo

Nat: G.SRT.A.2

Top: Dilations

258 ANS: 2

Segments drawn from the center of the regular pentagon bisect each angle of the pentagon, and create five isosceles triangles as shown in the diagram below. Since each exterior angle equals the angles formed by the segments drawn from the center of the regular pentagon, the minimum degrees necessary to carry a regular polygon onto itself are equal to the measure of an exterior angle of the regular polygon.

PTS: 2

Ref: spr1402geo

Nat: G.CO.A.3

Top: Mapping a Polygon onto Itself
261 ANS: 1
\(\frac{360^\circ}{45^\circ} = 8\)

PTS: 2 REF: 061510geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

262 ANS: \(\frac{360}{6} = 60\)

PTS: 2 REF: 081627geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

263 ANS: 4
\(\frac{360^\circ}{10} = 36^\circ \) 252° is a multiple of 36°

PTS: 2 REF: 011717geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

264 ANS: 1 PTS: 2 REF: 081505geo NAT: G.CO.A.3
TOP: Mapping a Polygon onto Itself

265 ANS: 3
\(\frac{360^\circ}{5} = 72^\circ \) 216° is a multiple of 72°

PTS: 2 REF: 061819geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

266 ANS: 1 PTS: 2 REF: 081706geo NAT: G.CO.A.3
TOP: Mapping a Polygon onto Itself

267 ANS: 3
The x-axis and line \(x = 4\) are lines of symmetry and \((4,0)\) is a point of symmetry.

PTS: 2 REF: 081706geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

268 ANS: 4
\(\frac{360^\circ}{10} = 36^\circ \) 252° is a multiple of 36°

PTS: 2 REF: 011722geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

269 ANS: 3 PTS: 2 REF: 011815geo NAT: G.CO.A.3
TOP: Mapping a Polygon onto Itself

270 ANS: 3 PTS: 2 REF: 081817geo NAT: G.CO.A.3
TOP: Mapping a Polygon onto Itself

TOP: Compositions of Transformations

272 ANS:
Rotate \(\triangle ABC\) clockwise about point \(C\) until \(\overline{DF} \parallel \overline{AC}\). Translate \(\triangle ABC\) along \(\overline{CF}\) so that \(C\) maps onto \(F\).

PTS: 2 REF: 061730geo NAT: G.CO.A.5 TOP: Compositions of Transformations KEY: identify
273 ANS: 
\[ T_{0,-2} \circ r_{y-axis} \]

PTS: 2  
REF: 011726geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: identify

274 ANS: 3  
PTS: 2  
REF: 011710geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: identify

275 ANS: 1  
PTS: 2  
REF: 081507geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: identify

276 ANS: 1  
PTS: 2  
REF: 011608geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: identify

277 ANS: 
\[ T_{6,0} \circ r_{x-axis} \]

PTS: 2  
REF: 061625geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: identify

278 ANS: 
![Diagram](image)

PTS: 2  
REF: 081626geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: grids

279 ANS: 2  
PTS: 2  
REF: 061701geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: identify

280 ANS: 
\[ R_{180^{\circ}} \text{ about } \left( \frac{1}{2}, \frac{1}{2} \right) \]

PTS: 2  
REF: 081727geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: identify

281 ANS:  
Reflection across the y-axis, then translation up 5.

PTS: 2  
REF: 061827geo  
NAT: G.CO.A.5  
TOP: Compositions of Transformations  
KEY: identify
rotation 180° about the origin, translation 2 units down; rotation 180° about B, translation 6 units down and 6 units left; or reflection over x-axis, translation 2 units down, reflection over y-axis

ANS:

Triangle $X'Y'Z'$ is the image of $\triangle XYZ$ after a rotation about point $Z$ such that $\overline{ZX}$ coincides with $\overline{ZU}$. Since rotations preserve angle measure, $\overline{ZY}$ coincides with $\overline{ZV}$, and corresponding angles $X$ and $Y$, after the rotation, remain congruent, so $\overline{XY} \parallel \overline{UV}$. Then, dilate $\triangle X'YZ$ by a scale factor of $\frac{\overline{ZU}}{\overline{ZX}}$ with its center at point $Z$. Since dilations preserve parallelism, $\overline{XY}$ maps onto $\overline{UV}$. Therefore, $\triangle XYZ \sim \triangle UYZ$.

NYSED accepts either (1) or (3) as a correct answer. Statement III is not true if $A$, $B$, $A'$ and $B'$ are collinear.

$M = 180 - (47 + 57) = 76$ Rotations do not change angle measurements.

The measures of the angles of a triangle remain the same after all rotations because rotations are rigid motions which preserve angle measure.

ANS: 4

The measures of the angles of a triangle remain the same after all rotations because rotations are rigid motions which preserve angle measure.
Yes, as translations do not change angle measurements.

Distance and angle measure are preserved after a reflection and translation.

$360 - (82 + 104 + 121) = 53$

Reflections are rigid motions that preserve distance, so $\triangle ABC \cong \triangle DEF$. 

$\text{rx} = -1$
308 ANS: 3  PTS: 2  REF: 011605geo  NAT: G.CO.A.2
TOP: Analytical Representations of Transformations  KEY: basic

TOP: Analytical Representations of Transformations  KEY: basic

310 ANS: 3
\[ \frac{AB}{BC} = \frac{DE}{EF} \]
\[ \frac{9}{15} = \frac{6}{10} \]
\[ 90 = 90 \]

PTS: 2  REF: 061515geo  NAT: G.SRT.B.5  TOP: Similarity  KEY: basic

311 ANS:
\[
\begin{align*}
\frac{1.65}{4.15} &= \frac{x}{16.6} \\
4.15x &= 27.39 \\
x &= 6.6
\end{align*}
\]

PTS: 2  REF: 061531geo  NAT: G.SRT.B.5  TOP: Similarity  KEY: basic

312 ANS: 2  PTS: 2  REF: 081519geo  NAT: G.SRT.B.5
TOP: Similarity  KEY: basic

313 ANS:
\[ \frac{120}{230} = \frac{x}{315} \]
\[ x = 164 \]

PTS: 2  REF: 081527geo  NAT: G.SRT.B.5  TOP: Similarity  KEY: basic

314 ANS: 4
\[ \frac{7}{12} \cdot 30 = 17.5 \]

PTS: 2  REF: 061521geo  NAT: G.SRT.B.5  TOP: Similarity  KEY: perimeter and area
315 ANS: \[
\frac{6}{14} = \frac{9}{21} \quad \text{SAS}
\]
\[126 = 126\]

PTS: 2 \quad \text{REF: 081529geo} \quad \text{NAT: G.SRT.B.5} \quad \text{TOP: Similarity}

KEY: basic

316 ANS: 4
\[
\frac{1}{2} = \frac{x + 3}{3x - 1}
\]
\[GR = 3(7) - 1 = 20\]
\[3x - 1 = 2x + 6\]
\[x = 7\]

PTS: 2 \quad \text{REF: 011620geo} \quad \text{NAT: G.SRT.B.5} \quad \text{TOP: Similarity}

KEY: basic

317 ANS: 1
\[
\frac{6}{8} = \frac{9}{12}
\]

PTS: 2 \quad \text{REF: 011613geo} \quad \text{NAT: G.SRT.B.5} \quad \text{TOP: Similarity}

KEY: basic

318 ANS:
\[
x = \sqrt{.55^2 -.25^2} \geq 0.49 \quad \text{No, } .49^2 = .25 \quad .9604 + .25 < 1.5
\]
\[.9604 = y\]

PTS: 4 \quad \text{REF: 061534geo} \quad \text{NAT: G.SRT.B.5} \quad \text{TOP: Similarity}

KEY: leg

319 ANS: 2
\[
\sqrt{3 \cdot 21} = \sqrt{63} = 3\sqrt{7}
\]

PTS: 2 \quad \text{REF: 011622geo} \quad \text{NAT: G.SRT.B.5} \quad \text{TOP: Similarity}

KEY: altitude

320 ANS: 3
\[
\frac{12}{4} = \frac{x}{5} \quad 15 - 4 = 11
\]
\[x = 15\]

PTS: 2 \quad \text{REF: 011624geo} \quad \text{NAT: G.SRT.B.5} \quad \text{TOP: Similarity}

KEY: basic

321 ANS: 3
\[
1) \frac{12}{9} = \frac{4}{3} \quad 2) \text{AA} \quad 3) \frac{32}{16} \neq \frac{8}{2} \quad 4) \text{SAS}
\]

PTS: 2 \quad \text{REF: 061605geo} \quad \text{NAT: G.SRT.B.5} \quad \text{TOP: Similarity}

KEY: basic
If an altitude is drawn to the hypotenuse of a triangle, it divides the triangle into two right triangles similar to each other and the original triangle.

\[ h^2 = 30 \cdot 12 \]
\[ h^2 = 360 \]
\[ h = 6\sqrt{10} \]

\[ x^2 = 4 \cdot 10 \]
\[ x = \sqrt{40} \]
\[ x = 2\sqrt{10} \]

\[ \frac{x}{10} = \frac{6}{4} \]
\[ CD = 15 - 4 = 11 \]
\[ x = 15 \]

(1) AA; (3) SAS; (4) SSS. NYSED has stated that all students should be awarded credit regardless of their answer to this question.

\[ \frac{6.6}{x} = \frac{4.2}{5.25} \]
\[ 4.2x = 34.65 \]
\[ x = 8.25 \]
328  ANS: 2
   $12^2 = 9 \cdot 16$
   $144 = 144$

   PTS: 2  REF: 081718geo  NAT: G.SRT.B.5  TOP: Similarity
   KEY: leg

329  ANS: 4
   PTS: 2  REF: 011817geo  NAT: G.SRT.B.5
   TOP: Similarity
   KEY: basic

330  ANS: 2
   $x^2 = 12(12 - 8)$
   $x^2 = 48$
   $x = 4\sqrt{3}$

   PTS: 2  REF: 011823geo  NAT: G.SRT.B.5  TOP: Similarity
   KEY: leg

331  ANS: 3
\[ \triangle CFB \sim \triangle CAD \]
\[ \frac{CB}{CF} = \frac{CD}{CA} \]
\[ \frac{x}{21.6} = \frac{7.2}{9.6} \]
\[ x = 16.2 \]

   PTS: 2  REF: 061804geo  NAT: G.SRT.B.5  TOP: Similarity
   KEY: basic

332  ANS: 1
   $24x = 10^2$
   $24x = 100$
   $x \approx 4.2$

   PTS: 2  REF: 061823geo  NAT: G.SRT.B.5  TOP: Similarity
   KEY: leg

333  ANS: 2
\[ \triangle ACB \sim \triangle AED \]

   PTS: 2  REF: 061811geo  NAT: G.SRT.B.5  TOP: Similarity
   KEY: basic
\[ x(x - 6) = 4^2 \]
\[ x^2 - 6x - 16 = 0 \]
\[ (x - 8)(x + 2) = 0 \]
\[ x = 8 \]

\[ \Delta ABC \sim \Delta AED \] by AA. \( \angle DAE \cong \angle CAB \) because they are the same \( \angle \).
\[ \angle DEA \cong \angle CBA \] because they are both right \( \angle \)s.

\[ \overline{AB} = 10 \text{ since } \triangle ABC \text{ is a 6-8-10 triangle. } \]
\[ 6^2 = 10x \]
\[ 3.6 = x \]

The acute angles in a right triangle are always complementary. The sine of any acute angle is equal to the cosine of its complement.
342 ANS:
4x − .07 = 2x + .01 \ SinA is the ratio of the opposite side and the hypotenuse while \ cos B is the ratio of the adjacent
2x = 0.8
x = 0.4
side and the hypotenuse. The side opposite angle \(A\) is the same side as the side adjacent to angle \(B\). Therefore, \(\sin A = \cos B\).

PTS: 2  REF: fall1407geo  NAT: G.SRT.C.7  TOP: Cofunctions

343 ANS: 1
344 ANS: 4
345 ANS:
73 + R = 90 Equal cofunctions are complementary.

\[ R = 17 \]

PTS: 2  REF: 061628geo  NAT: G.SRT.C.7  TOP: Cofunctions

346 ANS:
Yes, because 28º and 62º angles are complementary. The sine of an angle equals the cosine of its complement.

PTS: 2  REF: 011727geo  NAT: G.SRT.C.7  TOP: Cofunctions

347 ANS: 3
348 ANS: 4
40 − x + 3x = 90
2x = 50
x = 25

PTS: 2  REF: 081721geo  NAT: G.SRT.C.7  TOP: Cofunctions

349 ANS:
\(\cos B\) increases because \(\angle A\) and \(\angle B\) are complementary and \(\sin A = \cos B\).

PTS: 2  REF: 011827geo  NAT: G.SRT.C.7  TOP: Cofunctions

350 ANS: 1
2x + 4 + 46 = 90
2x = 40
x = 20

PTS: 2  REF: 061808geo  NAT: G.SRT.C.7  TOP: Cofunctions
351  ANS:  2  
\[2x + 7 + 4x - 7 = 90\]  
\[6x = 90\]  
\[x = 15\]  

PTS: 2  REF: 081824geo  NAT: G.SRT.C.7  TOP: Cofunctions

352  ANS:  
x represents the distance between the lighthouse and the canoe at 5:00; \(y\) represents the distance between the lighthouse and the canoe at 5:05.  
\[\tan 6 = \frac{112 - 1.5}{x}\]  
\[\tan(49 + 6) = \frac{112 - 1.5}{y}\]  
\[\frac{1051.3 - 77.4}{5} \approx 195\]  
\[x \approx 1051.3\]  
\[y \approx 77.4\]  

PTS: 4  REF: spr1409geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

353  ANS: 3  
\[\tan 34 = \frac{T}{20}\]  
\[T \approx 13.5\]  

PTS: 2  REF: 061505geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

354  ANS:  
\[\tan 7 = \frac{125}{x}\]  
\[\tan 16 = \frac{125}{y}\]  
\[1018 - 436 \approx 582\]  
\[x \approx 1018\]  
\[y \approx 436\]  

PTS: 4  REF: 081532geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

355  ANS:  
\[\tan 3.47 = \frac{M}{6336}\]  
\[M \approx 384\]  
\[4960 + 384 = 5344\]  
\[A \approx 229\]  
\[5344 - 229 = 5115\]  

PTS: 6  REF: fall1413geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

KEY: advanced
356 ANS:
\[ \sin 70 = \frac{30}{L} \]
\[ L \approx 32 \]

PTS: 2 REF: 011629geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side
KEY: graphics

357 ANS:
\[ \tan 52.8 = \frac{h}{x} \]
\[ x \tan 52.8 = x \tan 34.9 + 8 \tan 34.9 \quad \tan 52.8 \approx \frac{h}{9} \quad 11.86 + 1.7 \approx 13.6 \]
\[ h = x \tan 52.8 \]
\[ x \tan 52.8 - x \tan 34.9 = 8 \tan 34.9 \]
\[ x \approx 11.86 \]
\[ x \tan 34.9 = \frac{h}{x + 8} \]
\[ h = (x + 8) \tan 34.9 \]
\[ x = \frac{8 \tan 34.9}{\tan 52.8 - \tan 34.9} \]
\[ x \approx 9 \]

PTS: 6 REF: 011636geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side
KEY: advanced

358 ANS: 4
\[ \sin 70 = \frac{x}{20} \]
\[ x \approx 18.8 \]

PTS: 2 REF: 061611geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side
KEY: without graphics

359 ANS:
\[ \sin 75 = \frac{15}{x} \]
\[ x = \frac{15}{\sin 75} \]
\[ x \approx 15.5 \]

PTS: 2 REF: 081631geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side
KEY: graphics

360 ANS: 4
\[ \sin 71 = \frac{x}{20} \]
\[ x = 20 \sin 71 \approx 19 \]

PTS: 2 REF: 061721geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side
KEY: without graphics
\[ \tan \theta = \frac{2.4}{x} \]
\[ \frac{3}{7} = \frac{2.4}{x} \]
\[ x = 5.6 \]

PTS: 2  
REF: 011707geo  
NAT: G.SRT.C.8  
TOP: Using Trigonometry to Find a Side

362
ANS: 3
\[ \cos 40 = \frac{14}{x} \]
\[ x \approx 18 \]

PTS: 2  
REF: 011712geo  
NAT: G.SRT.C.8  
TOP: Using Trigonometry to Find a Side

363
ANS: 1
\[ \sin 32 = \frac{O}{129.5} \]
\[ O \approx 68.6 \]

PTS: 2  
REF: 011804geo  
NAT: G.SRT.C.8  
TOP: Using Trigonometry to Find a Side

364
ANS:
\[ \tan 15 = \frac{6250}{x} \]
\[ \tan 52 = \frac{6250}{y} \]
\[ 23325.3 - 4883 = 18442 \frac{18442 \text{ ft}}{1 \text{ min}} \left( \frac{1 \text{ mi}}{5280 \text{ ft}} \right) \left( \frac{60 \text{ min}}{1 \text{ h}} \right) \approx 210 \]
\[ x \approx 23325.3 \]
\[ y \approx 4883 \]

PTS: 6  
KEY: advanced  
REF: 061736geo  
NAT: G.SRT.C.8  
TOP: Using Trigonometry to Find a Side

365
ANS: 1
\[ \sin 32 = \frac{x}{6.2} \]
\[ x \approx 3.3 \]

PTS: 2  
REF: 081719geo  
NAT: G.SRT.C.8  
TOP: Using Trigonometry to Find a Side

366
ANS:
\[ \cos 54 = \frac{4.5}{m} \]
\[ \tan 54 = \frac{h}{4.5} \]
\[ m \approx 7.7 \]
\[ h \approx 6.2 \]

PTS: 4  
REF: 011834geo  
NAT: G.SRT.C.8  
TOP: Using Trigonometry to Find a Side
\[ \tan 72 = \frac{x}{400} \quad \sin 55 = \frac{400 \tan 72}{y} \]
\[ x = 400 \tan 72 \quad y = \frac{400 \tan 72}{\sin 55} \approx 1503 \]

ANS: 4  
REF: 061833geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

\[ \sin 16.5 = \frac{8}{x} \]
\[ x \approx 28.2 \]

ANS: 4  
REF: 081806ai  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

\[ \tan 36 = \frac{x}{10} \quad \cos 36 = \frac{10}{y} \quad 12.3607 \times 3 \approx 37 \]
\[ x \approx 7.3 \quad y \approx 12.3607 \]

ANS: 4  
REF: 081833geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

\[ \text{The man's height, 69 inches, is opposite to the angle of elevation, and the shadow length, 102 inches, is adjacent to the angle of elevation. Therefore, tangent must be used to find the angle of elevation.} \]
\[ \tan x = \frac{69}{102} \]
\[ x \approx 34.1 \]

ANS: 1  
REF: fall1401geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find an Angle

\[ \sin x = \frac{4.5}{11.75} \]
\[ x \approx 23 \]

ANS: 2  
REF: 061528geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find an Angle

\[ \tan x = \frac{10}{4} \]
\[ x \approx 68 \]

ANS: 2  
REF: 061630geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find an Angle
\[ \cos A = \frac{9}{14} \]

\[ A \approx 50^\circ \]

\[
\text{PTS: 2} \quad \text{REF: 011616geo} \quad \text{NAT: G.SRT.C.8} \quad \text{TOP: Using Trigonometry to Find an Angle}
\]

\[ \tan x = \frac{12}{75} \quad \tan y = \frac{72}{75} \]

\[ 43.83 - 9.09 \approx 34.7 \]

\[ x \approx 9.09 \quad y \approx 43.83 \]

\[
\text{PTS: 4} \quad \text{REF: 081634geo} \quad \text{NAT: G.SRT.C.8} \quad \text{TOP: Using Trigonometry to Find an Angle}
\]

\[ \cos S = \frac{60}{65} \]

\[ S \approx 23 \]

\[
\text{PTS: 2} \quad \text{REF: 061713geo} \quad \text{NAT: G.SRT.C.8} \quad \text{TOP: Using Trigonometry to Find an Angle}
\]

\[ \tan x = \frac{1}{12} \]

\[ x \approx 4.76 \]

\[
\text{PTS: 2} \quad \text{REF: 081715geo} \quad \text{NAT: G.SRT.C.8} \quad \text{TOP: Using Trigonometry to Find an Angle}
\]

\[ \cos W = \frac{6}{18} \]

\[ W \approx 71 \]

\[
\text{PTS: 2} \quad \text{REF: 011831geo} \quad \text{NAT: G.SRT.C.8} \quad \text{TOP: Using Trigonometry to Find an Angle}
\]

\[ \cos B = \frac{17.6}{26} \]

\[ B \approx 47 \]

\[
\text{PTS: 2} \quad \text{REF: 061806geo} \quad \text{NAT: G.SRT.C.8} \quad \text{TOP: Using Trigonometry to Find an Angle}
\]

\[ \cos x = \frac{12}{13} \]

\[ x \approx 23 \]

\[
\text{PTS: 2} \quad \text{REF: 081809ai} \quad \text{NAT: G.SRT.C.8} \quad \text{TOP: Using Trigonometry to Find an Angle}
\]
It is given that point $D$ is the image of point $A$ after a reflection in line $CH$. It is given that $CH$ is the perpendicular bisector of $BCE$ at point $C$. Since a bisector divides a segment into two congruent segments at its midpoint, $BC \cong EC$. Point $E$ is the image of point $B$ after a reflection over the line $CH$, since points $B$ and $E$ are equidistant from point $C$ and it is given that $CH$ is perpendicular to $BE$. Point $C$ is on $CH$, and therefore, point $C$ maps to itself after the reflection over $CH$. Since all three vertices of triangle $ABC$ map to all three vertices of triangle $DEC$ under the same line reflection, then $\triangle ABC \cong \triangle DEC$ because a line reflection is a rigid motion and triangles are congruent when one can be mapped onto the other using a sequence of rigid motions.

ANS: 6
REF: spr1414geo
NAT: G.CO.B.7
TOP: Triangle Congruency

Translate $\triangle ABC$ along $\vec{CF}$ such that point $C$ maps onto point $F$, resulting in image $\triangle A'B'C'$. Then reflect $\triangle A'B'C'$ over $\vec{DF}$ such that $\triangle A'B'C'$ maps onto $\triangle DEF$.

or

Reflect $\triangle ABC$ over the perpendicular bisector of $EB$ such that $\triangle ABC$ maps onto $\triangle DEF$.

PTS: 2
REF: fall1408geo
NAT: G.CO.B.7
TOP: Triangle Congruency

ANS: 3
PTS: 2
REF: 061530geo
NAT: G.CO.B.7
TOP: Triangle Congruency

Reflections are rigid motions that preserve distance.

ANS: 3
PTS: 2
REF: 061524geo
NAT: G.CO.B.7
TOP: Triangle Congruency

The transformation is a rotation, which is a rigid motion.

ANS: 3
PTS: 2
REF: 081530geo
NAT: G.CO.B.7
TOP: Triangle Congruency

Translations preserve distance. If point $D$ is mapped onto point $A$, point $F$ would map onto point $C$. $\triangle DEF \cong \triangle ABC$ as $\overline{AC} \cong \overline{DF}$ and points are collinear on line $\ell$ and a reflection preserves distance.

ANS: Yes. The sequence of transformations consists of a reflection and a translation, which are isometries which preserve distance and congruency.

ANS: 3
PTS: 2
REF: 011628geo
NAT: G.CO.B.7
TOP: Triangle Congruency

NYSED has stated that all students should be awarded credit regardless of their answer to this question.
ANS:
Yes. \( \angle A \cong \angle X, \angle C \cong \angle Z, \overline{AC} \cong \overline{XZ} \) after a sequence of rigid motions which preserve distance and angle measure, so \( \triangle ABC \cong \triangle XYZ \) by ASA. \( \overline{BC} \cong \overline{YZ} \) by CPCTC.

PTS: 2  REF: 081730geo  NAT: G.CO.B.7  TOP: Triangle Congruency

ANS:
No. Since \( \overline{BC} = 5 \) and \( \overline{ST} = \sqrt{18} \) are not congruent, the two triangles are not congruent. Since rigid motions preserve distance, there is no rigid motion that maps \( \triangle ABC \) onto \( \triangle RST \).

PTS: 2  REF: 011830geo  NAT: G.CO.B.7  TOP: Triangle Congruency

ANS:
\( \overline{LA} \cong \overline{DN}, \overline{CA} \cong \overline{CN}, \) and \( \overline{DAC} \perp \overline{LCN} \) (Given). \( \angle LCA \) and \( \angle DCN \) are right angles (Definition of perpendicular lines). \( \triangle LAC \) and \( \triangle DNC \) are right triangles (Definition of a right triangle). \( \triangle LAC \cong \triangle DNC \) (HL). \( \triangle LAC \) will map onto \( \triangle DNC \) after rotating \( \triangle LAC \) counterclockwise 90º about point \( C \) such that point \( L \) maps onto point \( D \).

PTS: 4  REF: spr1408geo  NAT: G.CO.B.8  TOP: Triangle Congruency

ANS: 1
PTS: 2  REF: 011703geo  NAT: G.SRT.B.5  TOP: Triangle Congruency

ANS:
Yes. The triangles are congruent because of SSS \( 5^2 + 12^2 = 13^2 \). All congruent triangles are similar.

PTS: 2  REF: 061830geo  NAT: G.SRT.B.5  TOP: Triangle Congruency

ANS:
\( \Delta XYZ, \overline{XY} \cong \overline{ZY}, \) and \( \overline{YW} \) bisects \( \angle XYZ \) (Given). \( \Delta XYZ \) is isosceles (Definition of isosceles triangle). \( \overline{YW} \) is an altitude of \( \Delta XYZ \) (The angle bisector of the vertex of an isosceles triangle is also the altitude of that triangle). \( \overline{YW} \perp \overline{XZ} \) (Definition of altitude). \( \angle YWZ \) is a right angle (Definition of perpendicular lines).

PTS: 4  REF: spr1411geo  NAT: G.CO.C.10  TOP: Triangle Proofs

ANS:
(2) Euclid’s Parallel Postulate; (3) Alternate interior angles formed by parallel lines and a transversal are congruent; (4) Angles forming a line are supplementary; (5) Substitution

As the sum of the measures of the angles of a triangle is $180^\circ$, $m\angle ABC + m\angle BCA + m\angle CAB = 180^\circ$. Each interior angle of the triangle and its exterior angle form a linear pair. Linear pairs are supplementary, so $m\angle ABC + m\angle FBC = 180^\circ$, $m\angle BCA + m\angle DCA = 180^\circ$, and $m\angle CAB + m\angle EAB = 180^\circ$. By addition, the sum of these linear pairs is $540^\circ$. When the angle measures of the triangle are subtracted from this sum, the result is $360^\circ$, the sum of the exterior angles of the triangle.
ANS: Parallelogram $ABCD$, diagonals $AC$ and $BD$ intersect at $E$ (given). $\overline{DC} \parallel \overline{AB}$; $\overline{DA} \parallel \overline{CB}$ (opposite sides of a parallelogram are parallel). $\angle ACD \cong \angle CAB$ (alternate interior angles formed by parallel lines and a transversal are congruent).


ANS: Quadrilateral $ABCD$ with diagonals $AC$ and $BD$ that bisect each other, and $\angle 1 \cong \angle 2$ (given); quadrilateral $ABCD$ is a parallelogram (the diagonals of a parallelogram bisect each other); $\overline{AB} \parallel \overline{CD}$ (opposite sides of a parallelogram are parallel); $\angle 1 \cong \angle 3$ and $\angle 2 \cong \angle 4$ (alternate interior angles are congruent); $\angle 2 \cong \angle 3$ and $\angle 3 \cong \angle 4$ (substitution); $\triangle ACD$ is an isosceles triangle (the base angles of an isosceles triangle are congruent); $\overline{AD} \cong \overline{DC}$ (the sides of an isosceles triangle are congruent); quadrilateral $ABCD$ is a rhombus (a rhombus has consecutive congruent sides); $\overline{AE} \perp \overline{BE}$ (the diagonals of a rhombus are perpendicular); $\angle BEA$ is a right angle (perpendicular lines form a right angle); $\triangle AEB$ is a right triangle (a right triangle has a right angle).


ANS: Parallelogram $ABCD$, $BF \perp AFD$, and $DE \perp BEC$ (given); $\overline{BC} \parallel \overline{AD}$ (opposite sides of a $\square$ are $||$); $\overline{BE} \parallel \overline{FD}$ (parts of $||$ lines are $||$); $\overline{BF} \perp \overline{DE}$ (two lines $\perp$ to the same line are $||$); $\square BEDF$ is $\square$ (a quadrilateral with both pairs of opposite sides $||$ is a $\square$); $\angle DEB$ is a right $\angle$ ($\perp$ lines form right $\angle$s); $\square BEDF$ is a rectangle (a $\square$ with one right $\angle$ is a rectangle).


ANS: Quadrilateral $ABCD$ is a parallelogram with diagonals $AC$ and $BD$ intersecting at $E$ (Given). $\overline{AD} \cong \overline{BC}$ (Opposite sides of a parallelogram are congruent). $\angle AED \cong \angle CEB$ (Vertical angles are congruent). $\overline{BC} \parallel \overline{DA}$ (Definition of parallelogram). $\angle DBC \cong \angle BDA$ (Alternate interior angles are congruent). $\triangle AED \cong \triangle CEB$ (AAS). $180^\circ$ rotation of $\triangle AED$ around point $E$.

PTS: 4 REF: 061533geo NAT: G.SRT.B.5 TOP: Quadrilateral Proofs

ANS: Quadrilateral $ABCD$, $\overline{AB} \cong \overline{CD}$, $\overline{AB} \parallel \overline{CD}$, and $BF$ and $DE$ are perpendicular to diagonal $\overline{AC}$ at points $F$ and $E$ (given). $\angle AED$ and $\angle CFB$ are right angles (perpendicular lines form right angles). $\triangle AED \cong \triangle CFB$ (All right angles are congruent). $\triangle ABD$ is a parallelogram (A quadrilateral with one pair of sides congruent and parallel is a parallelogram). $\overline{AD} \parallel \overline{BC}$ (Opposite sides of a parallelogram are parallel). $\angle DAE \cong \angle BCF$ (Parallel lines cut by a transversal form congruent alternate interior angles). $\overline{DA} \cong \overline{BC}$ (Opposite sides of a parallelogram are congruent). $\triangle ADE \cong \triangle CBF$ (AAS). $\overline{AE} \cong \overline{CF}$ (CPCTC).

PTS: 6 REF: 011735geo NAT: G.SRT.B.5 TOP: Quadrilateral Proofs
ANS:
Parallelogram $ABCD$, $\overline{BE} \perp \overline{CED}$, $\overline{DF} \perp \overline{BFC}$, $\overline{CE} \cong \overline{CF}$ (given). $\angle BEC \cong \angle DFC$ (perpendicular lines form right angles, which are congruent). $\angle FCD \cong \angle BCE$ (reflexive property). $\triangle BEC \cong \triangle DFC$ (ASA). $\overline{BC} \cong \overline{CD}$ (CPCTC). $ABCD$ is a rhombus (a parallelogram with consecutive congruent sides is a rhombus).

PTS: 6   REF: 081535geo   NAT: G.SRT.B.5   TOP: Quadrilateral Proofs

ANS:
Parallelogram $ANDR$ with $\overline{AW}$ and $\overline{DE}$ bisecting $\overline{NWD}$ and $\overline{REA}$ at points $W$ and $E$ (Given). $\overline{AN} \cong \overline{RD}$, $\overline{AR} \cong \overline{DN}$ (Opposite sides of a parallelogram are congruent). $AE = \frac{1}{2} AR$, $WD = \frac{1}{2} DN$, so $\overline{AE} \cong \overline{WD}$ (Definition of bisect and division property of equality). $\overline{AR} \parallel \overline{DN}$ (Opposite sides of a parallelogram are parallel). $\overline{AWDE}$ is a parallelogram (Definition of parallelogram). $RE = \frac{1}{2} AR$, $NW = \frac{1}{2} DN$, so $\overline{RE} \cong \overline{NW}$ (Definition of bisect and division property of equality). $\overline{ED} \cong \overline{AW}$ (Opposite sides of a parallelogram are congruent). $\triangle ANW \cong \triangle DRE$ (SSS).

PTS: 6   REF: 011635geo   NAT: G.SRT.B.5   TOP: Quadrilateral Proofs

ANS:
Isosceles trapezoid $ABCD$, $\angle CDE \cong \angle DCE$, $\overline{AE} \perp \overline{DE}$, and $\overline{BE} \perp \overline{CE}$ (given); $\overline{AD} \cong \overline{BC}$ (congruent legs of isosceles trapezoid); $\angle DEA$ and $\angle CEB$ are right angles (perpendicular lines form right angles); $\angle DEA \cong \angle CEB$ (all right angles are congruent); $\angle CDA \cong \angle DBC$ (base angles of an isosceles trapezoid are congruent); $\angle CDA - \angle CDE \cong \angle DBC - \angle DCE$ (subtraction postulate); $\triangle ADE \cong \triangle BCE$ (AAS); $\overline{EA} \cong \overline{EB}$ (CPCTC); $\angle EDA \cong \angle ECB$
$\triangle AEB$ is an isosceles triangle (an isosceles triangle has two congruent sides).


ANS:
Parallelogram $ABCD$ with diagonal $\overline{AC}$ drawn (given). $\overline{AC} \cong \overline{AC}$ (reflexive property). $\overline{AD} \cong \overline{CB}$ and $\overline{BA} \cong \overline{DC}$ (opposite sides of a parallelogram are congruent). $\triangle ABC \cong \triangle CDA$ (SSS).

PTS: 2   REF: 011825geo   NAT: G.SRT.B.5   TOP: Quadrilateral Proofs

ANS:
Circle $O$, secant $\overline{ACD}$, tangent $\overline{AB}$ (Given). Chords $\overline{BC}$ and $\overline{BD}$ are drawn (Auxiliary lines). $\angle A \cong \angle A$, $\overline{BC} \cong \overline{BC}$ (Reflexive property). $m\angle BDC = \frac{1}{2} m\overline{BC}$ (The measure of an inscribed angle is half the measure of the intercepted arc). $m\angle CBA = \frac{1}{2} m\overline{BC}$ (The measure of an angle formed by a tangent and a chord is half the measure of the intercepted arc). $\angle BDC \cong \angle CBA$ (Angles equal to half of the same arc are congruent). $\triangle ABC \sim \triangle ADB$ (AA). $\frac{AB}{AC} = \frac{AD}{AB}$ (Corresponding sides of similar triangles are proportional). $AC \cdot AD = AB^2$ (In a proportion, the product of the means equals the product of the extremes).

PTS: 6   REF: spr1413geo   NAT: G.SRT.B.5   TOP: Circle Proofs
413 ANS:
Circle $O$, chords $\overline{AB}$ and $\overline{CD}$ intersect at $E$ (Given); Chords $\overline{CB}$ and $\overline{AD}$ are drawn (auxiliary lines drawn); $\angle CEB \cong \angle AED$ (vertical angles); $\angle C \cong \angle A$ (Inscribed angles that intercept the same arc are congruent); $\triangle BCE \sim \triangle DAE$ (AA); $\frac{AE}{CE} = \frac{ED}{EB}$ (Corresponding sides of similar triangles are proportional); $AE \cdot EB = CE \cdot ED$ (The product of the means equals the product of the extremes).

PTS: 6 REF: 081635geo NAT: G.SRT.B.5 TOP: Circle Proofs

414 ANS:
Circle $O$, tangent $\overline{EC}$ to diameter $\overline{AC}$, chord $\overline{BC} \parallel$ secant $\overline{ADE}$, and chord $\overline{AB}$ (given); $\angle B$ is a right angle (an angle inscribed in a semi-circle is a right angle); $\overline{EC} \perp \overline{OC}$ (a radius drawn to a point of tangency is perpendicular to the tangent); $\angle ECA$ is a right angle (perpendicular lines form right angles); $\angle B \cong \angle ECA$ (all right angles are congruent); $\angle BCA \cong \angle CAE$ (the transversal of parallel lines creates congruent alternate interior angles); $\triangle ABC \sim \triangle ECA$ (AA); $\frac{BC}{CA} = \frac{AB}{EC}$ (Corresponding sides of similar triangles are in proportion).

PTS: 4 ANS: 4

415 ANS:
$\frac{36}{45} \neq \frac{15}{18}$
$\frac{4}{5} \neq \frac{5}{6}$

PTS: 2 REF: 081709geo NAT: G.SRT.A.3 TOP: Similarity Proofs

416 ANS:
Parallelogram $ABCD$, $EFG$, and diagonal $\overline{DFB}$ (given); $\angle DFE \cong \angle BFG$ (vertical angles); $\overline{AD} \parallel \overline{CB}$ (opposite sides of a parallelogram are parallel); $\angle EDF \cong \angle GBF$ (alternate interior angles are congruent); $\triangle DEF \sim \triangle BGF$ (AA).

PTS: 4 REF: 061633geo NAT: G.SRT.A.3 TOP: Similarity Proofs

417 ANS:
A dilation of $\frac{5}{2}$ about the origin. Dilations preserve angle measure, so the triangles are similar by AA.

PTS: 4 REF: 061634geo NAT: G.SRT.A.3 TOP: Similarity Proofs

418 ANS:
$\overline{GI}$ is parallel to $\overline{NT}$, and $\overline{IN}$ intersects at $A$ (given); $\angle I \cong \angle N$, $\angle G \cong \angle T$ (paralleling lines cut by a transversal form congruent alternate interior angles); $\triangle GIA \sim \triangle TNA$ (AA).

PTS: 2 REF: 011729geo NAT: G.SRT.A.3 TOP: Similarity Proofs

419 ANS: 4

PTS: 2 REF: 061809geo NAT: G.SRT.A.3 TOP: Similarity Proofs
Circle $A$ can be mapped onto circle $B$ by first translating circle $A$ along vector $\overrightarrow{AB}$ such that $A$ maps onto $B$, and then dilating circle $A$, centered at $A$, by a scale factor of $\frac{5}{3}$. Since there exists a sequence of transformations that maps circle $A$ onto circle $B$, circle $A$ is similar to circle $B$. 