1 If $\triangle MNP \cong \triangle VWX$ and $PM$ is the shortest side of $\triangle MNP$, what is the shortest side of $\triangle VWX$?
   1) $XV$
   2) $WX$
   3) $VW$
   4) $NP$

2 In circle $O$ shown in the diagram below, chords $AB$ and $CD$ are parallel.

If $m\overline{AB} = 104$ and $m\overline{CD} = 168$, what is $m\overline{BD}$?
   1) 38
   2) 44
   3) 88
   4) 96

3 As shown in the diagram below, $CD$ is a median of $\triangle ABC$.

Which statement is always true?
   1) $\overline{AD} \cong \overline{DB}$
   2) $\overline{AC} \cong \overline{AD}$
   3) $\angle ACD \cong \angle CDB$
   4) $\angle BCD \cong \angle ACD$

4 In the diagram below, under which transformation is $\triangle A'B'C'$ the image of $\triangle ABC$?

   1) $D_2$
   2) $r_{x-axis}$
   3) $r_{y-axis}$
   4) $(x,y) \rightarrow (x-2,y)$

5 Line segment $AB$ is a diameter of circle $O$ whose center has coordinates $(6,8)$. What are the coordinates of point $B$ if the coordinates of point $A$ are $(4,2)$?
   1) $(1,3)$
   2) $(5,5)$
   3) $(8,14)$
   4) $(10,10)$

6 Plane $\mathcal{A}$ and plane $\mathcal{B}$ are two distinct planes that are both perpendicular to line $\ell$. Which statement about planes $\mathcal{A}$ and $\mathcal{B}$ is true?
   1) Planes $\mathcal{A}$ and $\mathcal{B}$ have a common edge, which forms a line.
   2) Planes $\mathcal{A}$ and $\mathcal{B}$ are perpendicular to each other.
   3) Planes $\mathcal{A}$ and $\mathcal{B}$ intersect each other at exactly one point.
   4) Planes $\mathcal{A}$ and $\mathcal{B}$ are parallel to each other.
7 Triangle $ABC$ is similar to triangle $DEF$. The lengths of the sides of $\triangle ABC$ are 5, 8, and 11. What is the length of the shortest side of $\triangle DEF$ if its perimeter is 60?
1) 10
2) 12.5
3) 20
4) 27.5

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

If $AD = 3$ and $DB = 12$, what is the length of altitude $CD$?
1) 6
2) $6\sqrt{5}$
3) 3
4) $3\sqrt{5}$

9 The diagram below shows the construction of an equilateral triangle.

Which statement justifies this construction?
1) $\angle A + \angle B + \angle C = 180$
2) $m\angle A = m\angle B = m\angle C$
3) $AB = AC = BC$
4) $AB + BC > AC$

10 What is the slope of the line perpendicular to the line represented by the equation $2x + 4y = 12$?
1) $-2$
2) 2
3) $-\frac{1}{2}$
4) $\frac{1}{2}$

11 Triangle $ABC$ is shown in the diagram below.

If $DE$ joins the midpoints of $ADC$ and $AEB$, which statement is not true?
1) $DE = \frac{1}{2} CB$
2) $DE \parallel CB$
3) $\frac{AD}{DC} = \frac{DE}{CB}$
4) $\triangle ABC \sim \triangle AED$

12 The equations $x^2 + y^2 = 25$ and $y = 5$ are graphed on a set of axes. What is the solution of this system?
1) $(0,0)$
2) $(5,0)$
3) $(0,5)$
4) $(5,5)$

13 Square $ABCD$ has vertices $A(-2, -3), B(4, -1), C(2, 5)$, and $D(-4, 3)$. What is the length of a side of the square?
1) $2\sqrt{5}$
2) $2\sqrt{10}$
3) $4\sqrt{5}$
4) $10\sqrt{2}$
14. The diagram below shows \( \triangle ABD \), with \( \overrightarrow{ABC} \), \( BE \perp AD \), and \( \angle EBD \cong \angle CBD \).

If \( m\angle ABE = 52 \), what is \( m\angle D? \)
1) 26
2) 38
3) 52
4) 64

15. As shown in the diagram below, \( FD \) and \( CB \) intersect at point \( A \) and \( ET \) is perpendicular to both \( FD \) and \( CB \) at \( A \).

16. Which set of numbers could \textit{not} represent the lengths of the sides of a right triangle?
1) \{1, 3, \( \sqrt{10} \} \)
2) \{2, 3, 4\}
3) \{3, 4, 5\}
4) \{8, 15, 17\}

17. How many points are 5 units from a line and also equidistant from two points on the line?
1) 1
2) 2
3) 3
4) 0

18. The equation of a circle is \((x - 2)^2 + (y + 5)^2 = 32\). What are the coordinates of the center of this circle and the length of its radius?
1) \((-2, 5)\) and 16
2) \((2, -5)\) and 16
3) \((-2, 5)\) and \(4\sqrt{2}\)
4) \((2, -5)\) and \(4\sqrt{2}\)

19. The equation of a line is \( y = \frac{2}{3} x + 5 \). What is an equation of the line that is perpendicular to the given line and that passes through the point \((4, 2)\)?
1) \( y = \frac{2}{3} x - \frac{2}{3} \)
2) \( y = \frac{3}{2} x - 4 \)
3) \( y = -\frac{3}{2} x + 7 \)
4) \( y = -\frac{3}{2} x + 8 \)
20 Consider the relationship between the two statements below.

If $\sqrt{16 + 9} \neq 4 + 3$, then $5 \neq 4 + 3$

If $\sqrt{16 + 9} = 4 + 3$, then $5 = 4 + 3$

These statements are
1) inverses
2) converses
3) contrapositives
4) biconditionals

21 In the diagram of trapezoid $ABCD$ below, $\overline{AB} \parallel \overline{DC}$, $\overline{AD} \cong \overline{BC}$, $m\angle A = 4x + 20$, and $m\angle C = 3x - 15$.

What is $m\angle D$?
1) 25
2) 35
3) 60
4) 90

22 In circle $R$ shown below, diameter $\overline{DE}$ is perpendicular to chord $\overline{ST}$ at point $L$.

Which statement is not always true?
1) $\overline{SL} \cong \overline{TL}$
2) $RS = DR$
3) $RL \cong LE$
4) $(DL)(LE) = (SL)(LT)$

23 Which equation represents circle $A$ shown in the diagram below?

1) $(x - 4)^2 + (y - 1)^2 = 3$
2) $(x + 4)^2 + (y + 1)^2 = 3$
3) $(x - 4)^2 + (y - 1)^2 = 9$
4) $(x + 4)^2 + (y + 1)^2 = 9$
24 Which equation represents a line that is parallel to the line whose equation is $3x - 2y = 7$?

1) $y = -\frac{3}{2}x + 5$
2) $y = -\frac{2}{3}x + 4$
3) $y = \frac{3}{2}x - 5$
4) $y = \frac{2}{3}x - 4$

25 In the diagram below of circle $O$, $PAC$ and $PBD$ are secants.

If $\overline{CD} = 70$ and $\overline{AB} = 20$, what is the degree measure of $\angle P$?

1) 25
2) 35
3) 45
4) 50

26 The measure of an interior angle of a regular polygon is $120^\circ$. How many sides does the polygon have?

1) 5
2) 6
3) 3
4) 4

27 As shown in the diagram of rectangle $ABCD$ below, diagonals $\overline{AC}$ and $\overline{BD}$ intersect at $E$.

If $AE = x + 2$ and $BD = 4x - 16$, then the length of $\overline{AC}$ is

1) 6
2) 10
3) 12
4) 24

28 If the vertices of $\triangle ABC$ are $A(-2,4)$, $B(-2,8)$, and $C(-5,6)$, then $\triangle ABC$ is classified as

1) right
2) scalene
3) isosceles
4) equilateral

29 After the transformation $r_{y=x}$, the image of $\triangle ABC$ is $\triangle A'B'C'$. If $AB = 2x + 13$ and $A'B' = 9x - 8$, find the value of $x$.

30 In the diagram below, circles $A$ and $B$ are tangent at point $C$ and $\overline{AB}$ is drawn. Sketch all common tangent lines.
31 On the set of axes below, graph the locus of points 4 units from (0, 1) and the locus of points 3 units from the origin. Label with an $\times$ any points that satisfy both conditions.

32 Write an equation of a circle whose center is $(-3, 2)$ and whose diameter is 10.

33 Using a compass and straightedge, construct a line perpendicular to line $\ell$ through point $P$. [Leave all construction marks.]

34 Write an equation of the line that is the perpendicular bisector of the line segment having endpoints $(3, -1)$ and $(3, 5)$. [The use of the grid below is optional]
35 A right circular cylinder with a height of 5 cm has a base with a diameter of 6 cm. Find the lateral area of the cylinder to the nearest hundredth of a square centimeter. Find the volume of the cylinder to the nearest hundredth of a cubic centimeter.

36 Triangle $ABC$ has vertices $A(5, 1), B(1, 4)$ and $C(1, 1)$. State and label the coordinates of the vertices of $ΔA''B''C''$, the image of $ΔABC$, following the composite transformation $T_{1, -1} \circ D_2$. [The use of the set of axes below is optional.]

37 In $ΔABC$, $m\angle A = x^2 + 12$, $m\angle B = 11x + 5$, and $m\angle C = 13x - 17$. Determine the longest side of $ΔABC$.

38 The diagram below shows rectangle $ABCD$ with points $E$ and $F$ on side $AB$. Segments $CE$ and $DF$ intersect at $G$, and $∠ADG \cong ∠BCG$. Prove: $AE \cong BF$.
0113ge
Answer Section

1 ANS: 1 PTS: 2 REF: 011301ge STA: G.G.29
TOP: Triangle Congruency

2 ANS: 2
Parallel chords intercept congruent arcs. \[
\frac{360 - (104 + 168)}{2} = 44
\]

3 ANS: 1 PTS: 2 REF: 011303ge STA: G.G.24
TOP: Statements

4 ANS: 3 PTS: 2 REF: 011304ge STA: G.G.56
TOP: Identifying Transformations

5 ANS: 3
\[
6 = \frac{4 + x}{2}, \quad 8 = \frac{2 + y}{2}.
\]
\[
4 + x = 12, \quad 2 + y = 16
\]
\[
x = 8, \quad y = 14
\]

6 ANS: 4 PTS: 2 REF: 011306ge STA: G.G.9
TOP: Planes

7 ANS: 2
Perimeter of \(\triangle DEF\) is \(5 + 8 + 11 = 24\). \[
\frac{5}{24} = \frac{x}{60}
\]
\[
24x = 300
\]
\[
x = 12.5
\]

8 ANS: 1
\[
x^2 = 3 \times 12
\]
\[
x = 6
\]

9 ANS: 3 PTS: 2 REF: 011309ge STA: G.G.20
TOP: Constructions

10 ANS: 2
The slope of \(2x + 4y = 12\) is \(m = \frac{-A}{B} = \frac{-2}{4} = -\frac{1}{2}\). \(m_\perp = 2\).

11 ANS: 3  PTS: 2  REF: 011311ge  STA: G.G.42
TOP: Midsegments

12 ANS: 3
\[ x^2 + 5^2 = 25 \]
x = 0

PTS: 2  REF: 011312ge  STA: G.G.70  TOP: Quadratic-Linear Systems

13 ANS: 2
\[ \sqrt{(-2 - 4)^2 + (-3 - (-1))^2} = \sqrt{40} = \sqrt{4 \cdot 10} = 2\sqrt{10} \]

PTS: 2  REF: 011313ge  STA: G.G.69  TOP: Quadrilaterals in the Coordinate Plane

14 ANS: 1
\[ \frac{180 - 52}{2} = 64. \quad 180 - (90 + 64) = 26 \]

PTS: 2  REF: 011314ge  STA: G.G.30  TOP: Interior and Exterior Angles of Triangles

15 ANS: 4  PTS: 2  REF: 011315ge  STA: G.G.1  
TOP: Planes

16 ANS: 2
\[ 2^2 + 3^2 \neq 4^2 \]

PTS: 2  REF: 011316ge  STA: G.G.48  TOP: Pythagorean Theorem

17 ANS: 2  PTS: 2  REF: 011317ge  STA: G.G.22  
TOP: Locus

18 ANS: 4  PTS: 2  REF: 011318ge  STA: G.G.73  
TOP: Equations of Circles

19 ANS: 4
\[ m = \frac{2}{3} \cdot 2 = -\frac{3}{2}(4) + b \]
\[ m_{\perp} = -\frac{3}{2} \cdot 2 = -6 + b \]
\[ 8 = b \]

PTS: 2  REF: 011319ge  STA: G.G.64  TOP: Parallel and Perpendicular Lines

20 ANS: 1  PTS: 2  REF: 011320ge  STA: G.G.26  
TOP: Conditional Statements

21 ANS: 3
\[ 2(4x + 20) + 2(3x - 15) = 360. \quad \angle D = 3(25) - 15 = 60 \]
\[ 8x + 40 + 6x - 30 = 360 \]
\[ 14x + 10 = 360 \]
\[ 14x = 350 \]
\[ x = 25 \]

PTS: 2  REF: 011321ge  STA: G.G.40  TOP: Trapezoids
22. ANS: 3  PTS: 2  REF: 011322ge  STA: G.G.49  TOP: Chords


24. ANS: 3
\[ m = \frac{-A}{B} = \frac{-3}{-2} = \frac{3}{2} \]

PTS: 2  REF: 011324ge  STA: G.G.63  TOP: Parallel and Perpendicular Lines

25. ANS: 1
\[ \frac{70 - 20}{2} = 25 \]

PTS: 2  REF: 011325ge  STA: G.G.51  TOP: Ares Determined by Angles

26. ANS: 2
\[ \frac{(n - 2)180}{n} = 120 \cdot \frac{180n - 360}{120n} = 60n - 360 \]
\[ n = 6 \]

PTS: 2  REF: 011326ge  STA: G.G.37  TOP: Interior and Exterior Angles of Polygons

27. ANS: 4
\[ 2x - 8 = x + 2. \ AE = 10 + 2 = 12. \ AC = 2(AE) = 2(12) = 24 \]
\[ x = 10 \]

PTS: 2  REF: 011327ge  STA: G.G.39  TOP: Special Parallelograms

28. ANS: 3
\[ AB = 8 - 4 = 4. \ BC = \sqrt{(-2 - (-5))^2 + (8 - 6)^2} = \sqrt{13}. \ AC = \sqrt{(-2 - (-5))^2 + (4 - 6)^2} = \sqrt{13} \]

PTS: 2  REF: 011328ge  STA: G.G.69  TOP: Triangles in the Coordinate Plane

29. ANS:
Distance is preserved after the reflection.  \[ 2x + 13 = 9x - 8 \]
\[ 21 = 7x \]
\[ 3 = x \]

30 ANS:

PTS: 2  REF: 011330ge  STA: G.G.50  TOP: Tangents
KEY: common tangency

31 ANS:

PTS: 2  REF: 011331ge  STA: G.G.23  TOP: Locus

32 ANS:
If \( r = 5 \), then \( r^2 = 25 \). \((x + 3)^2 + (y - 2)^2 = 25\)

PTS: 2  REF: 011332ge  STA: G.G.71  TOP: Equations of Circles

33 ANS:

PTS: 2  REF: 011333ge  STA: G.G.19  TOP: Constructions

34 ANS:

\[
M = \left( \frac{3 + 3}{2}, \frac{-1 + 5}{2} \right) = (3, 2). \ y = 2.
\]

PTS: 2  REF: 011334ge  STA: G.G.68  TOP: Perpendicular Bisector

35 ANS:

\[
L = 2\pi rh = 2\pi \cdot 3 \cdot 5 \approx 94.25. \ V = \pi r^2 h = \pi (3)^2 (5) \approx 141.37
\]

PTS: 4  REF: 011335ge  STA: G.G.14  TOP: Volume and Lateral Area
36 ANS:

\[ A''(11, 1), B''(3, 7), C''(3, 1) \]

PTS: 4 REF: 011336ge STA: G.G.58 TOP: Compositions of Transformations

37 ANS:

\[ x^2 + 12 + 11x + 5 + 13x - 17 = 180. \quad m\angle A = 6^2 + 12 = 48 \quad \angle B \text{ is the largest angle, so } \overline{AC} \text{ in the longest side.} \]

\[ x^2 + 24x - 180 = 0 \quad m\angle B = 11(6) + 5 = 71 \]

\[ (x + 30)(x - 6) = 0 \quad m\angle C = 13(6) - 7 = 61 \]

\[ x = 6 \]

PTS: 4 REF: 011337ge STA: G.G.34 TOP: Angle Side Relationship

38 ANS:

Rectangle \( ABCD \) with points \( E \) and \( F \) on side \( AB \), segments \( CE \) and \( DF \) intersect at \( G \), and \( \angle ADG \cong \angle BCE \) are given. \( AD \cong BC \) because opposite sides of a rectangle are congruent. \( \angle A \) and \( \angle B \) are right angles and congruent because all angles of a rectangle are right and congruent. \( \triangle ADF \cong \triangle BCE \) by ASA. \( AF \cong BE \) per CPCTC.

\( EF \cong FE \) under the Reflexive Property. \( AF - EF \cong BE - FE \) using the Subtraction Property of Segments. \( AE \cong BF \) because of the Definition of Segments.