JMAP
REGENTS BY DATE

NY Geometry Regents Exam Questions from Spring 2014 to August 2018 Sorted by Date

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1. 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) $(1,-1)$

2. 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) $54^\circ$  
2) $72^\circ$  
3) $108^\circ$  
4) $360^\circ$

3. 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) $y = 2x + 1$

4. 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.

5. 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.
6. In the diagram below, triangles \( \triangle XYZ \) and \( \triangle UVZ \) are drawn such that \( \angle X \cong \angle U \) and \( \angle XZY \cong \angle UZV \).

![Diagram](image)

Describe a sequence of similarity transformations that shows \( \triangle XYZ \) is similar to \( \triangle UVZ \).

7. Explain why \( \cos(x) = \sin(90 - x) \) for \( x \) such that \( 0 < x < 90 \).

8. In the diagram of \( \triangle LAC \) and \( \triangle DNC \) below, \( LA \cong DN \), \( CA \cong CN \), and \( DAC \perp LCN \).

![Diagram](image)

a) Prove that \( \triangle LAC \cong \triangle DNC \).

b) Describe a sequence of rigid motions that will map \( \triangle LAC \) onto \( \triangle DNC \).

9. 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.

![Diagram](image)

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

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

![Diagram](image)

If \( AC \cong BD \), find the area of sector \( BOD \) in terms of \( \pi \).
11 Given: \( \triangle XYZ, \overline{XY} \cong \overline{ZY}, \) and \( \overline{YW} \) bisects \( \angle XYZ \)
Prove that \( \angle YWZ \) is a right angle.

12 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.

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

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. \( AC \cdot AD = AB^2 \)

14 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: \( \triangle ABC \cong \triangle DEC \)

15 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
16 The image of \( \triangle ABC \) after a rotation of 90º clockwise about the origin is \( \triangle DEF \), as shown below.

Which statement is true?
1) \( BC \cong DE \)
2) \( AB \cong DF \)
3) \( \angle C \cong \angle E \)
4) \( \angle A \cong \angle D \)

17 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) \( y = 3x - 6 \)

18 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) \( \frac{5}{\pi} \)

19 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.

20 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.
21 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.

22 Given right triangles $ABC$ and $DEF$ 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 $\triangle ABC \cong \triangle DEF$.

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

24 Prove the sum of the exterior angles of a triangle is $360^\circ$.

25 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 $AH$. 
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 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.
1. Which object is formed when right triangle $RST$ shown below is rotated around leg $RS$?

- a pyramid with a square base
- an isosceles triangle
- a right triangle
- a cone

2. The vertices of $\triangle JKL$ have coordinates $J(5,1)$, $K(-2,-3)$, and $L(-4,1)$. Under which transformation is the image $\triangle J'K'L'$ not congruent to $\triangle JKL$?

- a translation of two units to the right and two units down
- a counterclockwise rotation of 180 degrees around the origin
- a reflection over the $x$-axis
- a dilation with a scale factor of 2 and centered at the origin

3. The center of circle $Q$ has coordinates $(3,-2)$. If circle $Q$ passes through $R(7,1)$, what is the length of its diameter?

- 50
- 25
- 10
- 5

4. In the diagram below, congruent figures 1, 2, and 3 are drawn.

Which sequence of transformations maps figure 1 onto figure 2 and then figure 2 onto figure 3?

- a reflection followed by a translation
- a rotation followed by a translation
- a translation followed by a reflection
- a translation followed by a rotation

5. As shown in the diagram below, the angle of elevation from a point on the ground to the top of the tree is $34^\circ$.

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?

- 29.7
- 16.6
- 13.5
- 11.2
6 Which figure can have the same cross section as a sphere?

1) 2) 3) 4)

7 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

8 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) $\frac{CE}{EG} = \frac{FD}{DG}$ 4) $\triangle CEG \sim \triangle FDG$

9 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) $y = 2x + 6$

10 Which regular polygon has a minimum rotation of $45^\circ$ to carry the polygon onto itself?

1) octagon 2) decagon 3) hexagon 4) pentagon
11 In the diagram of \( \triangle ADC \) below, \( \overline{EB} \parallel \overline{DC} \), \( AE = 9 \), \( ED = 5 \), and \( AB = 9.2 \).

What is the length of \( \overline{AC} \), to the nearest tenth?
1) 5.1
2) 5.2
3) 14.3
4) 14.4

12 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) \( \sin A = \cos B \)

13 Quadrilateral \( ABCD \) has diagonals \( \overline{AC} \) and \( \overline{BD} \). Which information is not sufficient to prove \( ABCD \) is a parallelogram?
1) \( \overline{AC} \) and \( \overline{BD} \) bisect each other.
2) \( \overline{AB} \cong \overline{CD} \) and \( \overline{BC} \cong \overline{AD} \)
3) \( \overline{AB} \cong \overline{CD} \) and \( \overline{AB} \parallel \overline{CD} \)
4) \( \overline{AB} \cong \overline{CD} \) and \( \overline{BC} \parallel \overline{AD} \)

14 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

15 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) \( \frac{AB}{DE} = \frac{FE}{CB} \)

16 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) \( 3(m\angle C') = m\angle C \)
17. 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) $\angle CBF \cong \angle GFC$

18. 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) $\frac{EA}{EC}$

19. 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

20. 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) $\angle ACB \cong \angle BCD$
2) $\angle ABC \cong \angle ACD$
3) $\angle BAC \cong \angle DCB$
4) $\angle CBA \cong \angle AEC$

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

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
22 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) $3x - 2y = 5$

23 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

24 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 $\angle E$.

25 Use a compass and straightedge to construct an inscribed square in circle $T$ shown below. [Leave all construction marks.]

26 The diagram below shows parallelogram $LMNO$ with diagonal $LN$, $m\angle M = 118^\circ$, and $m\angle LNO = 22^\circ$.

Explain why $m\angle NLO$ is 40 degrees.
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.]

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.

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 $m\angle AOC$.

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

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

If $m\angle EGB = 50^\circ$ and $m\angle DIG = 115^\circ$, explain why $AB \parallel CD$.

33 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 $\triangle CEB$.

34 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.
35 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 $m\angle EFD = 47^\circ$, 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.

36 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.]
1. 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

2. 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

3. If the rectangle below is continuously rotated about side $w$, which solid figure is formed?

   ![Rectangle](image)

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

4. 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) $\cos x$

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

   ![Square](image)

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

6. The image of $\triangle ABC$ after a dilation of scale factor $k$ centered at point $A$ is $\triangle ADE$, as shown in the diagram below.

   ![Dilation](image)

   Which statement is always true?
   1) $2AB = AD$
   2) $AD \perp DE$
   3) $AC = CE$
   4) $BC \parallel DE$
7 A sequence of transformations maps rectangle 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

8 In the diagram of parallelogram \(FRED\) shown below, \(ED\) is extended to \(A\), and \(AF\) is drawn such that \(AF \equiv DF\).

If \(m\angle R = 124^\circ\), what is \(m\angle AFD\)?

1) 124°
2) 112°
3) 68°
4) 56°

9 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

10 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) \(y = \frac{3}{2}x - 8\)

11 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
12. In the diagram shown below, \( \overline{AC} \) is tangent to circle \( O \) at \( A \) and to circle \( P \) at \( C \). \( \overline{OP} \) intersects \( \overline{AC} \) 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

13. In the diagram below, which single transformation was used to map triangle \( A \) onto triangle \( B \)?

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

14. 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) \( \frac{m\angle A}{m\angle D} = \frac{1}{2} \)  
2) \( \frac{m\angle C}{m\angle F} = \frac{2}{1} \)  
3) \( \frac{m\angle A}{m\angle C} = \frac{m\angle F}{m\angle D} \)  
4) \( \frac{m\angle B}{m\angle E} = \frac{m\angle C}{m\angle F} \)

15. 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) \( 110^\circ \)
16 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

17 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) \( AD = 5, AB = 8, AE = 8, \) and \( AC = 10 \)
3) \( AD = 3, AB = 9, AE = 5, \) and \( AC = 10 \)
4) \( AD = 2, AB = 6, AE = 5, \) and \( AC = 15 \)

18 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) \( 24\pi \)

19 As shown in the diagram below, \( AB \) and \( CD \) intersect at \( E \), and \( AC \parallel BD \).

![Diagram with points A, B, C, D, E, F, G, H, and O] (Note: The diagram is not directly translatable due to the limitations of text-based representation.)

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) \( \frac{ED}{EC} = \frac{AC}{BD} \)

20 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.
21 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

22 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

23 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 \(E(0,4)\).

![Diagram](image)

The ratio of the lengths of \(\overline{BE}\) to \(\overline{CD}\) is
1) \(\frac{2}{3}\)
2) \(\frac{3}{2}\)
3) \(\frac{3}{4}\)
4) \(\frac{4}{3}\)

24 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) \(y = 3x - 1\)
25 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>

26 Construct an equilateral triangle inscribed in circle T shown below. [Leave all construction marks.]

27 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.

28 In parallelogram ABCD shown below, diagonals AC and BD intersect at E. Prove: ∠ACD ≅ ∠CAB

29 Triangles RST and XYZ are drawn below. If RS = 6, ST = 14, XY = 9, YZ = 21, and ∠S ≅ ∠Y, is ΔRST similar to ΔXYZ? Justify your answer.

Use the surveyor's information to determine and state the distance from point B to point C, to the nearest yard.
30 In the diagram below, \( \triangle ABC \) and \( \triangle XYZ \) are graphed.

![Diagram](image)

Use the properties of rigid motions to explain why \( \triangle ABC \cong \triangle XYZ \).

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

32 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°.

![Diagram](image)

To the nearest foot, determine and state how far the ship traveled from point \( A \) to point \( D \).

33 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.]

![Diagram](image)

34 In the diagram below, \( \overline{AC} \cong \overline{DF} \) and points \( A \), \( C \), \( D \), and \( F \) are collinear on line \( \ell \).

![Diagram](image)

Let \( \triangle D'EF' \) be the image of \( \triangle DEF \) after a translation along \( \ell \), such that point \( D \) is mapped onto point \( A \). Determine and state the location of \( F' \). Explain your answer. Let \( \triangle D''EF'' \) be the image of \( \triangle D'EF' \) after a reflection across line \( \ell \). Suppose that \( E'' \) is located at \( B \). Is \( \triangle DEF \) congruent to \( \triangle ABC \)? Explain your answer.
35 In the diagram of parallelogram $ABCD$ below, $BE \perp CED$, $DF \perp BFC$, $CE \cong CF$.

Prove $ABCD$ is a rhombus.

36 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?
1 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)  

2 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) $y = 2x - 16$  

3 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 $m\angle S = 60^\circ$, $m\angle SRT = 83^\circ$, and $m\angle TWU = 35^\circ$, what is $m\angle WVQ$?

1) $37^\circ$  

2) $60^\circ$  

3) $72^\circ$  

4) $83^\circ$  

4 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  

5 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) $(x,y) \rightarrow (x+2,y-5)$
6. In the diagram below, $FE \rightarrow \leftarrow \overrightarrow{AC}$ at $B$, and $GE \rightarrow \leftarrow \overrightarrow{BD}$ 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 $B$.

7. 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

8. 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 $180^\circ$ rotation about the origin followed by a reflection over the line $y = x$
3) a $90^\circ$ 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 $90^\circ$ counterclockwise rotation about the origin

9. 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) $\sin \angle A = \cos \angle B$

10. 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
11 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 $B'(-3,4)$

12 In the diagram below of circle $O$, the area of the shaded sector $LOM$ is $2\pi$ cm².

If the length of $\overline{NL}$ is 6 cm, what is $m\angle N$?

1) 10°
2) 20°
3) 40°
4) 80°

13 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 $\angle C \cong \angle F$

14 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

15 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) $25\sqrt{2}$
16. 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

17. 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

18. 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

19. 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

20. 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

21. In the diagram below, $\overline{DC}$, $\overline{AC}$, $\overline{DOB}$, $\overline{CB}$, and $\overline{AB}$ are chords of circle $O$, $\overrightarrow{FDE}$ 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) $\angle FDB$

22. In the diagram below, $\overline{CD}$ is the altitude drawn to the hypotenuse $\overline{AB}$ 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 $AB = 17$
23 A designer needs to create perfectly circular necklaces. The necklaces each need to have a radius of 10 cm. What is the largest number of necklaces that can be made from 1000 cm of wire?
1) 15
2) 16
3) 31
4) 32

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

![Diagram of SCU](image)

If $TU = 4$, $OU = 5$, and $OC = 7$, what is the length of $ST$?
1) 5.6
2) 8.75
3) 11
4) 15

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

![Diagram of A'B'C'](image)

26 In the diagram below of circle $O$ with diameter $BC$ and radius $OA$, chord $DC$ is parallel to chord $BA$.

![Diagram of circle O](image)

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

27 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.]
28 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.

29 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.

30 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.

31 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 \( m \).

32 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.
33 Given the theorem, “The sum of the measures of the interior angles of a triangle is 180°,” 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>
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<tbody>
<tr>
<td>(1) ( \triangle ABC )</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point C, draw ( DCE ) parallel to ( AB )</td>
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<td>(3) ( m\angle 1 = m\angle ACD, m\angle 3 = m\angle BCE )</td>
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<td>(4) ( m\angle ACD + m\angle 2 + m\angle BCE = 180^\circ )</td>
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<td>(5) ( m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ )</td>
<td>(5) ___________</td>
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</tbody>
</table>
34 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 \( \triangle XYZ \).

35 Given: Parallelogram ANDR with \( \overline{AW} \) and \( \overline{DE} \) bisecting \( \angle NWD \) and \( \angle REA \) at points \( W \) and \( E \), respectively

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

36 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.
1 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)  
2)  
3)  
4)  

2 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  

3 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
4. Which transformation of $\overline{OA}$ would result in an image parallel to $\overline{OA}$?

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

5. Using the information given below, which set of triangles can *not* be proven similar?

1) 
2) 
3) 
4)
6 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) \((8.5)^3 - \pi(8)^2 (8)\)
2) \((8.5)^3 - \pi(4)^2 (8)\)
3) \((8.5)^3 - \frac{1}{3} \pi(8)^2 (8)\)
4) \((8.5)^3 - \frac{1}{3} \pi(4)^2 (8)\)

7 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

8 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

9 In parallelogram \(ABCD\), diagonals \(AC\) and \(BD\) intersect at \(E\). Which statement does not prove parallelogram \(ABCD\) is a rhombus?

1) \(AC \cong DB\)
2) \(AB \cong BC\)
3) \(AC \perp DB\)
4) \(AC\) bisects \(\angle DCB\)

10 In the diagram below of circle \(O\), \(OB\) and \(OC\) are radii, and chords \(AB\), \(BC\), and \(AC\) 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 \(\triangle BOC\).

11 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
12. 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) \( y - 6 = -\frac{3}{4}(x - 8) \)

13. 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) \( 6\sqrt{35} \)

14. 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) \( -\frac{5}{2} \)
15 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) \( \tan E = \frac{TM}{JM} \)

16 On the set of axes below, rectangle \( ABCD \) can be proven congruent to rectangle \( KLMN \) using which transformation?

1) rotation
2) translation
3) reflection over the \( x \)-axis
4) reflection over the \( y \)-axis

17 In the diagram below, \( \overline{DB} \) and \( \overline{AF} \) intersect at point \( C \), and \( \overline{AD} \) and \( FBE \) are drawn.

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

18 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
19 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 $T$.

20 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

21 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

22 Triangle $RST$ is graphed on the set of axes below.

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

What could be a correct equation for circle $O$?
1) $(x - 1)^2 + (y + 2)^2 = 29$
2) $(x + 5)^2 + (y - 2)^2 = 29$
3) $(x - 1)^2 + (y - 2)^2 = 25$
4) $(x - 5)^2 + (y + 2)^2 = 25$

24 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) $\frac{64\pi}{3}$

25 Describe a sequence of transformations that will map $\triangle ABC$ onto $\triangle DEF$ as shown below.

26 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 $P$.

27 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 $\overline{AB}$ is parallel to $\overline{CD}$. 
28 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.

29 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.

30 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.

31 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.]

32 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.
33 Given: Parallelogram $ABCD$, $EFG$, and diagonal $DFB$

Prove: $\triangle DEF \sim \triangle BGF$

34 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 $\triangle A'B'C' \sim \triangle ABC$.

35 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

36 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.
1 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) \( m \parallel n \)

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

3 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

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

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

5 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) \( D \)
6 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) \( \frac{5}{\sqrt{21}} \)

7 Quadrilateral \( ABCD \) with diagonals \( \overline{AC} \) and \( \overline{BD} \) 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 \( BC \parallel AD \)

8 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

9 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 \( E \)

10 In the diagram of right triangle \( ABC, \overline{CD} \) intersects hypotenuse \( \overline{AB} \) at \( D \).

If \( AD = 4 \) and \( DB = 6 \), which length of \( \overline{AC} \) makes \( \overline{CD} \perp \overline{AB} \)?

1) \( 2\sqrt{6} \)
2) \( 2\sqrt{10} \)
3) \( 2\sqrt{15} \)
4) \( 4\sqrt{2} \)
11 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) $DE, CE$

12 In triangle $CHR$, $O$ is on $HR$, and $D$ is on $CR$ so that $\angle H \equiv \angle RDO$.

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

13 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

14 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) $y = -x - 3$

15 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) $(6,3)$

16 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

17 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
18 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) $\left(-4\frac{1}{2},0\right)$
4) $\left(-4,-\frac{1}{2}\right)$

19 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 $\frac{108}{360} \cdot \pi \cdot \frac{1}{2} (AB)^2$

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

20 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

21 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

22 Given: $\triangle ABE$ and $\triangle CBD$ shown in the diagram below with $\overline{DB} \cong \overline{BE}$

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) $\overline{AD} \cong \overline{CE}$
4) $\overline{AE} \cong \overline{CD}$
23. In the diagram below, \( BC \) 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.

24. In the diagram below, \( ABCD \) is a parallelogram, \( AB \) is extended through \( B \) to \( E \), and \( CE \) is drawn.

If \( CE \parallel BE \) and \( \angle D = 112^\circ \), what is \( \angle E \)?
1) 44°
2) 56°
3) 68°
4) 112°

25. 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 \( CD \).

26. 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 \( y = 0 \).

27. 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.
28 In the diagram of \( \triangle ABC \) shown below, use a compass and straightedge to construct the median to \( AB \). [Leave all construction marks.]

![Diagram of \( \triangle ABC \)]

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

![Diagram of \( \triangle JKL \) and \( \triangle MNP \)]

30 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.

![Diagram of a circle with center and radius indicated]

31 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.

![Diagram of a ladder against a house]

32 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 \( A'C' \).
33 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.

34 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.

35 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 \( AE \cdot EB = CE \cdot ED \).

36 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/cm\(^3\), and the cost, per kilogram, of ice is $3.83. Determine and state the cost of the ice needed to make 50 snow cones.
1 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) \(y = -2x + 3\)

2 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 \(\frac{AE}{AC}\) 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) \(m\angle ACB \cong \frac{1}{2} m\angle DAB\)

3 Given \(\triangle ABC \cong \triangle DEF\), which statement is not always true?
1) \(BC \cong DF\)
2) \(m\angle A = m\angle D\)
3) area of \(\triangle ABC\) = area of \(\triangle DEF\)
4) perimeter of \(\triangle ABC\) = perimeter of \(\triangle DEF\)

4 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) \(AB + AC\)
5 In the diagram below, if $\triangle ABE \cong \triangle CDF$ and $\overline{AEFC}$ is drawn, then it could be proven that quadrilateral $ABCD$ is a

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

6 Under which transformation would $\triangle A'B'C'$, the image of $\triangle ABC$, not be congruent to $\triangle ABC$?
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

7 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

8 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

9 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

10 Identify which sequence of transformations could map pentagon $ABCDE$ 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
11 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

12 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

13 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 \( C' (3,0) \)

14 In the diagram of right triangle \( ADE \) below, \( \overline{BC} \parallel \overline{DE} \).

Which ratio is always equivalent to the sine of \( \angle A \)?
1) \( \frac{AD}{DE} \)
2) \( \frac{AE}{AD} \)
3) \( \frac{BC}{AB} \)
4) \( \frac{AB}{AC} \)
15 In circle $O$, secants $\overline{ADB}$ and $\overline{AEC}$ 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

16 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

17 Which rotation about its center will carry a regular decagon onto itself?
1) $54^\circ$
2) $162^\circ$
3) $198^\circ$
4) $252^\circ$

18 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 $\sqrt{35}$

19 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 $\frac{1}{3}$.

20 Point $Q$ is on $\overline{MN}$ 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) $(6,0)$

21 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) $\frac{160\pi}{3}$

22 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) $(-8,5\sqrt{21})$
23. 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

24. 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

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

26. The graph below shows $\triangle ABC$ and its image, $\Delta A'B'C'$. Describe a sequence of rigid motions which would map $\triangle ABC$ onto $\Delta A'B'C'$.

27. When instructed to find the length of $HJ$ 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.
28 In the diagram below, tangent $\overline{DA}$ and secant $\overline{DBC}$ are drawn to circle $O$ from external point $D$, such that $\overline{AC} \cong \overline{BC}$.

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

29 In the diagram below, $\overline{GI}$ is parallel to $\overline{NT}$, and $\overline{IN}$ intersects $\overline{GT}$ at $A$.

Prove: $\triangle GIA \sim \triangle TNA$

30 In the diagram below of isosceles triangle $ABC$, $\overline{AB} \cong \overline{CB}$ and angle bisectors $\overline{AD}$, $\overline{BF}$, and $\overline{CE}$ are drawn and intersect at $X$.

If $m\angle BAC = 50^\circ$, find $m\angle AXC$.

31 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.]
32 Triangle $QRS$ is graphed on the set of axes below.

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

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

34 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.

35 In quadrilateral $ABCD$, $AB \cong CD$, $AB \parallel CD$, and $BF$ and $DE$ are perpendicular to diagonal $AC$ at points $F$ and $E$.

Prove: $AE \cong CF$

36 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/cm$^3$, 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?
1 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

2 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

3 In right triangle $ABC$, $\angle C = 90^\circ$. If $\cos B = \frac{5}{13}$, which function also equals $\frac{5}{13}$?
1) $\tan A$
2) $\tan B$
3) $\sin A$
4) $\sin B$
4 In the diagram below, $\angle ABC = 268^\circ$.

What is the number of degrees in the measure of $\angle ABC$?
1) $134^\circ$
2) $92^\circ$
3) $68^\circ$
4) $46^\circ$

5 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

6 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.

7 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

8 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
9. 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

10. 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) $82^\circ$

11. 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

12. 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

13. 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) $23^\circ$
2) $43^\circ$
3) $47^\circ$
4) $67^\circ$
14 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

15 Line segment $RW$ has endpoints $R(-4,5)$ and $W(6,20)$. Point $P$ is on $\overline{RW}$ 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)

16 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

17 In the diagram below of triangle $MNO$, $\angle M$ and $\angle O$ are bisected by $\overline{MS}$ and $\overline{OR}$, 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) $70^\circ$

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

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) $144\pi$
19. 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) \(y = \frac{2}{3}x + 10\)

20. In quadrilateral \(BLUE\) shown below, \(BE \cong UL\).

Which information would be sufficient to prove quadrilateral \(BLUE\) is a parallelogram?

1) \(BL \parallel EU\)
2) \(LU \parallel BE\)
3) \(BE \cong BL\)
4) \(LU \cong EU\)

21. 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

22. 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 \(DE\)

23. 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
24 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 \( BC = 8.7 \)

25 Given: Trapezoid \( JKLM \) with \( JK \parallel ML \)

Using a compass and straightedge, construct the altitude from vertex \( J \) to \( ML \). [Leave all construction marks.]

26 Determine and state, in terms of \( \pi \), the area of a sector that intercepts a 40° arc of a circle with a radius of 4.5.

27 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.

28 When volleyballs are purchased, they are not fully inflated. A partially inflated volleyball can be modeled by a sphere whose volume is approximately 180 in\(^3\). After being fully inflated, its volume is approximately 294 in\(^3\). To the nearest tenth of an inch, how much does the radius increase when the volleyball is fully inflated?

29 In right triangle \( ABC \) shown below, altitude \( CD \) is drawn to hypotenuse \( AB \). Explain why \( \triangle ABC \sim \triangle ACD \).
30 Triangle $ABC$ and triangle $DEF$ are drawn below.

If $AB \cong DE$, $AC \cong DF$, and $\angle A \cong \angle D$, write a sequence of transformations that maps triangle $ABC$ onto triangle $DEF$.

31 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.

32 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 $\triangle ABC$ and $\triangle DEF$ on the set of axes below. Determine and state the single transformation where $\triangle DEF$ is the image of $\triangle ABC$. Use your transformation to explain why $\triangle ABC \cong \triangle DEF$.

33 Given: $RS$ and $TV$ bisect each other at point $X$ $\overline{TR}$ and $\overline{SV}$ are drawn

Prove: $\overline{TR} \parallel \overline{SV}$
34 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 ft\(^3\)=7.48 gallons]

35 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.]

36 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.
1. 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

2. The image of $\triangle DEF$ is $\triangle D'E'F'$. 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

3. 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) $4\sqrt{40}$

4. In the diagram below of circle $O$, chord $\overline{CD}$ is parallel to diameter $\overline{AOB}$ and $m\overline{CD} = 130$.

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

5. In the diagram below, $\overline{AD}$ intersects $\overline{BE}$ at $C$, and $\overline{AB} \parallel \overline{DE}$.

   If $CD = 6.6\text{ cm}$, $DE = 3.4\text{ cm}$, $CE = 4.2\text{ cm}$, and $BC = 5.25\text{ cm}$, 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
6 As shown in the graph below, the quadrilateral is a rectangle.

![Graph of 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° about the origin
4) a rotation of 180° about the point (4,0)

7 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 \(AD = 18\).

![Diagram of triangle ACD with points B, E, and D]

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

8 In the diagram below of parallelogram \(ROCK\), \(m\angle C\) is 70° and \(m\angle ROS\) is 65°.

![Diagram of parallelogram ROCK with angles labeled]

What is \(m\angle KSO\)?
1) 45°
2) 110°
3) 115°
4) 135°

9 In the diagram below, \(\angle GRS \cong \angle ART\), \(GR = 36\), \(SR = 45\), \(AR = 15\), and \(RT = 18\).

![Diagram of triangle GRT with sides labeled]

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 \(\triangle ART\).

10 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) \(4x + 3y = 9\)
11 Given \( \triangle ABC \) with \( m \angle B = 62^\circ \) and side \( AC \) extended to \( D \), as shown below.

Which value of \( x \) makes \( AB \cong CB \)?
1) 59º  
2) 62º  
3) 118º  
4) 121º 

12 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 

13 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 

14 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) \( AB \perp CD \) 

15 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) \( 85.24 \)
16 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

17 The coordinates of the endpoints of \( \overline{AB} \) are \( A(-8,-2) \) and \( B(16,6) \). Point \( P \) is on \( AB \). What are the coordinates of point \( P \), such that \( AP:PB = 3:5 \)?
1) (1,1)  
2) (7,3)  
3) (9.6,3.6)  
4) (6.4,2.8)

18 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 \( NM = 10 \)

19 In right triangle \( ABC \), \( m \angle A = 32^\circ \), \( m \angle B = 90^\circ \), 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

20 The 2010 U.S. Census populations and population densities are shown in the table below.

<table>
<thead>
<tr>
<th>State</th>
<th>Population Density (( \text{people/m}^2 ))</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  
21 In a right triangle, \( \sin(40^\circ - x) = \cos(3x)^\circ \). What is the value of \( x \)?

1) 10
2) 15
3) 20
4) 25

22 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\(^\circ\)

23 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) \( \frac{64\pi}{3} \)

24 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) \( 2y - x = 0 \)

25 Sue believes that the two cylinders shown in the diagram below have equal volumes. Is Sue correct? Explain why.
26 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 \( PQRS \).

27 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 \( M''A''T''H'' \).

28 Using a compass and straightedge, construct a regular hexagon inscribed in circle \( O \). [Leave all construction marks.]

29 The coordinates of the endpoints of \( \overline{AB} \) are \( A(2,3) \) and \( B(5,-1) \). Determine the length of \( A'B' \), the image of \( \overline{AB} \), after a dilation of \( \frac{1}{2} \) centered at the origin. [The use of the set of axes below is optional.]
30 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 \( \overline{AC} \) onto \( \overline{XZ} \).

Determine and state whether \( BC \cong YZ \). Explain why.

31 Determine and state the coordinates of the center and the length of the radius of a circle whose equation is \( x^2 + y^2 - 6x = 56 - 8y \).

32 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 \( AB \) is parallel to \( PR \) and is half the length of \( PR \). [The use of the set of axes below is optional.]

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

Prove: \( \frac{BC}{CA} = \frac{AB}{EC} \)
34 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.

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

Prove $\triangle ADE \cong \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

36 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 ft$^3$=7.48 gallons]
1. In the diagram below, a sequence of rigid motions maps $ABCD$ onto $JKLM$.

   \[ \text{If } m\angle A = 82^\circ, \ m\angle B = 104^\circ, \text{ and } m\angle L = 121^\circ, \text{ the measure of } \angle M \text{ is} \]
   
   1) 53°  
   2) 82°  
   3) 104°  
   4) 121°

2. Parallelogram $HAND$ is drawn below with diagonals $HN$ and $AD$ intersecting at $S$.

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

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

   Which rigid motion would map $\triangle ABC$ onto $\triangle A'B'C'$?
   
   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 $y = x$
4  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

5  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

6  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) $(1,-6)$

7  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) $24\frac{3}{4}$
8 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) \((x,y) \rightarrow (x+2,y+3)\)

9 In \( \triangle ABC \) shown below, side \( AC \) is extended to point \( D \) with \( m\angle DAB = (180 - 3x)\)°, \( m\angle B = (6x - 40)\)°, and \( m\angle C = (x + 20)\)°. What is \( m\angle BAC \)?
   1) 20°
   2) 40°
   3) 60°
   4) 80°

10 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

11 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 \( ABCD \).

12 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

13 In the diagram of \( \triangle ABC \) below, \( \overline{DE} \) is parallel to \( AB \), \( CD = 15 \), \( AD = 9 \), and \( AB = 40 \).

The length of \( \overline{DE} \) is
   1) 15
   2) 24
   3) 25
   4) 30
14 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.

15 Which transformation would not carry a square onto itself?

1) a reflection over one of its diagonals
2) a 90° rotation clockwise about its center
3) a 180° rotation about one of its vertices
4) a reflection over the perpendicular bisector of one side

16 In circle \(M\) below, diameter \(AC\), chords \(AB\) and \(BC\), and radius \(MB\) are drawn.

Which statement is not true?

1) \(\triangle ABC\) is a right triangle.
2) \(\triangle ABM\) is isosceles.
3) \(m\angle BC = m\angle BMC\)
4) \(m\angle AB = \frac{1}{2} m\angle ACB\)

17 In the diagram below, \(XS\) and \(YR\) intersect at \(Z\). Segments \(XY\) and \(RS\) are drawn perpendicular to \(YR\) 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) \(\frac{XY}{SR} = \frac{YZ}{RZ}\)

18 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°
2) 68.75°
3) 95°
4) 137.5°

19 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
20. 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) $y + 9 = \frac{2}{3}(x + 6)$

21. Quadrilateral $ABCD$ is inscribed in circle $O$, as shown below.

If $m\angle A = 80^\circ$, $m\angle B = 75^\circ$, $m\angle C = (y + 30)^\circ$, and $m\angle D = (x - 10)^\circ$, 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 $y = 70$

22. 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

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

What is the length of $BC$?

1) $4\sqrt{2}$
2) $4\sqrt{3}$
3) $4\sqrt{5}$
4) $4\sqrt{6}$
24 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 \(CD\).

25 Given: Parallelogram \(ABCD\) with diagonal \(AC\) drawn

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

26 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.]

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

28 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.
29 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?

30 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.

31 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.

32 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 \( ABC \).

33 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.
34 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.

![Diagram of island, boat house, and marina](image)

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).

35 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.
1. 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) $CB \cong TR$
4) $CA \cong TS$

2. In the diagram below, $\overline{AB} \parallel \overline{DEF}$, $\overline{AE}$ and $\overline{BD}$ intersect at $C$, $m\angle B = 43^\circ$, and $m\angle CEF = 152^\circ$.

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

3. 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
4. In the diagram below, \( \overline{AF} \), and \( \overline{DB} \) intersect at \( C \), and \( \overline{AD} \) and \( \overline{FBE} \) are drawn such that \( \angle D = 65^\circ \), \( \angle CBE = 115^\circ \), \( DC = 7.2 \), \( AC = 9.6 \), and \( FC = 21.6 \).

What is the length of \( CB \)?
1) 3.2
2) 4.8
3) 16.2
4) 19.2

5. 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

6. In right triangle \( ABC \), hypotenuse \( \overline{AB} \) 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°

7. 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

8. 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
9 In the diagram below, $\overline{AB} \parallel \overline{DFC}$, $\overline{EDA} \parallel \overline{CBG}$, and $\overline{EFB}$ and $\overline{AG}$ 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) $\triangle DEF \sim \triangle AEB$

10 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

11 In the diagram below of right triangle $AED$, $\overline{BC} \parallel \overline{DE}$.

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) $\frac{DE}{BC} = \frac{DB}{AB}$

12 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) $y + 8 = -\frac{2}{3}(x + 6)$
13. The diagram below shows parallelogram $ABCD$ with diagonals $AC$ and $BD$ intersecting at $E$.

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 $BD$.

14. 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) $(2,4)$

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

What is the area of $\triangle DAN$?

1) $60$
2) $120$
3) $20\sqrt{13}$
4) $40\sqrt{13}$
16 Triangle \(\triangle ABC\), 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) 

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

If \(m\overarc{AC} = 72^\circ\) and \(m\angle AEC = 58^\circ\), how many degrees are in \(m\overarc{DB}\)?

1) 108°
2) 65°
3) 44°
4) 14°

18 In triangle \(\triangle SRK\) 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) \(SM = KM\)
19. 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°

20. What is an equation of circle $O$ shown in the graph below?

1) $x^2 + 10x + y^2 + 4y = -13$
2) $x^2 - 10x + y^2 - 4y = -13$
3) $x^2 + 10x + y^2 + 4y = -25$
4) $x^2 - 10x + y^2 - 4y = -25$

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

What is the length of $\overline{QR}$?
1) 7
2) 2
3) $12\frac{1}{2}$
4) $17\frac{1}{2}$

22. The diagram below shows circle $O$ with radii $\overline{OA}$ and $\overline{OB}$. 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) $\frac{1}{3}(12\pi)$
23. Line segment $CD$ is the altitude drawn to hypotenuse $EF$ 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

24. 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) $y = -6x + 6$

25. 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.

26. 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 $D$.

27. Quadrilaterals $BIKE$ and $GOLF$ are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral $BIKE$ onto quadrilateral $GOLF$. 
28 In the diagram below, secants $\overline{RST}$ and $\overline{RQP}$, drawn from point $R$, intersect circle $O$ at $S$, $T$, $Q$, and $P$.

![Diagram of a circle with secants $\overline{RST}$ and $\overline{RQP}$]

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

29 Using a compass and straightedge, construct the median to side $\overline{AC}$ in $\triangle ABC$ below. [Leave all construction marks.]

![Diagram of a triangle $\triangle ABC$ with a median drawn to side $\overline{AC}$]

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

![Two triangles with measurements]

Are Skye and Margaret both correct? Explain why.

31 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.

32 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.]
33 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.

34 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.

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

Prove: $BEDF$ is a rectangle
1 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°
2) 43°
3) 75°
4) 105°

2 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

3 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

4 In regular hexagon \( ABCDEF \) shown below, \( \overline{AD} \), \( \overline{BE} \), and \( \overline{CF} \) all intersect at \( G \).

When \( \triangle ABG \) is reflected over \( \overline{BG} \) and then rotated 180° about point \( G \), \( \triangle ABG \) is mapped onto
1) \( \triangle FEG \)
2) \( \triangle AFG \)
3) \( \triangle CBG \)
4) \( \triangle DEG \)

5 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

6 Yolanda is making a springboard to use for gymnastics. She has 8-inch-tall springs and wants to form a 16.5° 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
7. 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

8. 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) $4\sqrt{10}$

9. 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) $23^\circ$  
2) $25^\circ$  
3) $65^\circ$  
4) $67^\circ$
10 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) $\overline{AS}$ and $\overline{NC}$ bisect each other.
2) $K$ is the midpoint of $\overline{NC}$.
3) $\overline{AS} \perp \overline{CN}$
4) $\overline{AN} \parallel \overline{SC}$

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

12 In the diagram of $\triangle ABC$ below, points $D$ and $E$ are on sides $AB$ and $CB$ respectively, such that $\overline{DE} \parallel \overline{AC}$.

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

13 Quadrilateral $MATH$ has both pairs of opposite sides congruent and parallel. Which statement about quadrilateral $MATH$ is always true?

1) $\overline{MT} \cong \overline{AH}$
2) $\overline{MT} \perp \overline{AH}$
3) $\angle MHT \cong \angle ATH$
4) $\angle MAT \cong \angle MHT$
14 In the figure shown below, quadrilateral $TAEO$ 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 $TAEO$?

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

15 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) $(3,-6)$

16 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
17. 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° about the point (6,6)
4) a rotation of 180° about the point (5,5)

18. 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

19. 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

20. 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) $\frac{AB}{BC} = \frac{BD}{AC}$

21. 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
22. In \( \triangle ABC \), \( \overline{BD} \) is the perpendicular bisector of \( \overline{ADC} \). Based upon this information, which statements below can be proven?

I. \( \overline{BD} \) is a median.
II. \( \overline{BD} \) 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

23. Triangle \( \triangle RJM \) 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 \( \triangle R'J'M' \)?

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

24. If \( \sin(2x + 7)^\circ = \cos(4x - 7)^\circ \), what is the value of \( x \)?

1) 7
2) 15
3) 21
4) 30

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

If \( m\angle A = 68^\circ \), determine and state \( m\angle BEC \).
27 In circle $A$ below, chord $BC$ and diameter $DAE$ intersect at $F$.

If $m\overline{CD} = 46^\circ$ and $m\overline{DB} = 102^\circ$, what is $m\angle CF E$?

28 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 $A'B'C'D'$.

29 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.
30 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.]

31 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?

32 Given: \(\triangle ABC, \triangle AEC, \overline{BDE}\) with \(\angle ABE \cong \angle CBE\), and \(\angle ADE \cong \angle CDE\)

Prove: \(\overline{BDE}\) is the perpendicular bisector of \(\overline{AC}\)

Fill in the missing statement and reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
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<tbody>
<tr>
<td>1 (\triangle ABC, \triangle AEC, \overline{BDE}) with (\angle ABE \cong \angle CBE), and (\angle ADE \cong \angle CDE)</td>
<td>1 Given</td>
</tr>
<tr>
<td>2 (\overline{BD} \cong \overline{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 (\overline{AD} \cong \overline{CD}, \overline{AB} \cong \overline{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>
33 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.

34 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.

35 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.]
1 ANS: 4
\[-5 + \frac{3}{5}(5 - 5) - 4 + \frac{3}{5}(1 - 4)\]
\[-5 + \frac{3}{5}(10) - 4 + \frac{3}{5}(5)\]
\[-5 + 6 - 4 + 3\]
\[1 - 1\]

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

2 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.

\[\frac{360}{5} = 72\]

PTS: 2 REF: spr1402geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

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

PTS: 2 REF: spr1403geo NAT: G.SRT.A.1 TOP: Line Dilations

4 ANS:
Circle \(A\) can be mapped onto circle \(B\) by first translating circle \(A\) along vector \(\overline{AB}\) 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 \(B\).

PTS: 2 REF: spr1404geo NAT: G.C.A.1 TOP: Similarity Proofs

5 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
6 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 $\triangle X'Y'Z'$ by a scale factor of $\frac{ZU}{ZX}$ with its center at point $Z$. Since dilations preserve parallelism, $\overline{XY}$ maps onto $\overline{UV}$. Therefore, $\triangle XYZ \sim \triangle UVZ$.

7 ANS:
The acute angles in a right triangle are always complementary. The sine of any acute angle is equal to the cosine of its complement.

8 ANS:
$LA \cong DN$, $CA \cong CN$, and $\angle DAC \perp \angle LCN$ (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 $D$.

9 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. $\tan 6^\circ = \frac{112 - 1.5}{x}$, $\tan(49^\circ + 6^\circ) = \frac{112 - 1.5}{y}$, $\frac{1051.3 - 77.4}{5} \approx 195$

$x \approx 1051.3$
$y \approx 77.4$

10 ANS:
$\left(\frac{180 - 20}{2}\right) \div 360 \times \pi (6)^2 = \frac{80}{360} \times 36\pi = 8\pi$

PTS: 2 REF: spr1406geo NAT: G.SRT.A.2 TOP: Compositions of Transformations KEY: grids

PTS: 2 REF: spr1407geo NAT: G.SRT.C.7 TOP: Cofunctions

PTS: 4 REF: spr1408geo NAT: G.CO.B.8 TOP: Triangle Congruency

PTS: 4 REF: spr1409geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side KEY: advanced

11 ANS:

\[ \triangle XYZ, XY \cong ZY, \text{ and } YW \text{ bisects } \angle XYZ \text{ (Given)} \]

\( \triangle XYZ \) is isosceles (Definition of isosceles triangle).

\( YW \) is an altitude of \( \triangle XYZ \) (The angle bisector of the vertex of an isosceles triangle is also the altitude of that triangle).

\( YW \perp XZ \) (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

12 ANS:

\[ r = 25 \text{ cm} \left( \frac{1 \text{ m}}{100 \text{ cm}} \right) = 0.25 \text{ m} \]

\[ V = \pi (0.25 \text{ m})^2 (10 \text{ m}) = 0.625 \pi \text{ m}^3 \]

\[ W = 0.625 \pi \text{ m}^3 \left( \frac{380 \text{ K}}{1 \text{ m}^3} \right) \approx 746.1 \text{ K} \]

\[ n = \left( \frac{\$50,000}{\$4.75 \text{ K}} \right) (746.1 \text{ K}) = 14.1 \text{ 15 trees} \]

PTS: 4
REF: spr1412geo
NAT: G.MG.A.2
TOP: Density

13 ANS:

Circle \( O \), secant \( ACD \), tangent \( AB \) (Given). Chords \( BC \) and \( BD \) are drawn (Auxiliary lines). \( \angle A \cong \angle A \), \( BC \cong BC \) (Reflexive property).

\[ \angle BDC = \frac{1}{2} m\overparen{BC} \] (The measure of an inscribed angle is half the measure of the intercepted arc).

\[ \angle CBA = \frac{1}{2} m\overparen{BC} \] (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
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.

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}

\Rightarrow x \approx 34.1

The measures of the angles of a triangle remain the same after all rotations because rotations are rigid motions which preserve angle measure.

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, \(\left(0, \frac{3}{2}, -4 \cdot \frac{3}{2}\right) \rightarrow (0, -6)\). So the equation of the dilated line is \(y = 2x - 6\).

\(\theta = \frac{s}{r} = \frac{2\pi}{10} = \frac{\pi}{5}\)

\(\Delta MNO\) is congruent to \(\Delta PNO\) by SAS. Since \(\Delta MNO \cong \Delta PNO\), then \(\overline{MO} \cong \overline{PO}\) by CPCTC. So \(\overline{NO}\) must divide \(\overline{MP}\) in half, and \(\overline{MO} = 8\).
20 ANS: No, the weight of the bricks is greater than 900 kg. 

\[ 500 \times (5.1 \text{ cm} \times 10.2 \text{ cm} \times 20.3 \text{ cm}) = 528,003 \text{ cm}^3. \]

\[ 528,003 \text{ cm}^3 \times \frac{1 \text{ m}^3}{100 \text{ cm}^3} = 0.528003 \text{ m}^3. \]

\[ \frac{1920 \text{ kg}}{\text{m}^3} \times 0.528003 \text{ m}^3 \approx 1013 \text{ kg}. \]

PTS: 2 REF: fall1406geo NAT: G.MG.A.2 TOP: Density

21 ANS: 

\[ 4x - .07 = 2x + .01 \]

\[ \sin A \] is the ratio of the opposite side and the hypotenuse while \( \cos B \) is the ratio of the adjacent 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

22 ANS: 

Translate \( \triangle ABC \) along \( \overline{CF} \) such that point \( C \) maps onto point \( F \), resulting in image \( \triangle A'B'C' \). Then reflect \( \triangle A'B'C' \) over \( \overline{DF} \) such that \( \triangle A'B'C' \) maps onto \( \triangle DEF \).

or

Reflect \( \triangle ABC \) over the perpendicular bisector of \( \overline{EB} \) such that \( \triangle ABC \) maps onto \( \triangle DEF \).

PTS: 2 REF: fall1408geo NAT: G.CO.B.7 TOP: Triangle Congruency

23 ANS: 

PTS: 2 REF: fall1409geo NAT: G.CO.D.12 TOP: Constructions

KEY: parallel and perpendicular lines

24 ANS: 

As the sum of the measures of the angles of a triangle is 180°, \( m\angle ABC + m\angle BCA + m\angle CAB = 180^\circ \). 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°. When the angle measures of the triangle are subtracted from this sum, the result is 360°, the sum of the exterior angles of the triangle.

PTS: 4 REF: fall1410geo NAT: G.CO.C.10 TOP: Triangle Proofs
25 ANS:
\[
M\left(\frac{4 + 0}{2}, \frac{6 - 1}{2}\right) = M\left(\frac{2}{2}, \frac{5}{2}\right) \quad m = \frac{6 - 1}{4 - 0} = \frac{7}{4} \quad m_{\perp} = \frac{-4}{7} \quad y - 2.5 = \frac{-4}{7}(x - 2)
\]
The diagonals, MT and AH, of rhombus MATH are perpendicular bisectors of each other.

26 ANS:

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.

27 ANS:

\[
\tan 3.47 = \frac{M}{6336} \quad \tan 0.64 = \frac{A}{20,493}
\]
\[
M \approx 384 \quad A \approx 229
\]
\[
4960 + 384 = 5344 \quad 5344 - 229 = 5115
\]
0615geo
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: 061502geo  NAT: G.CO.A.2
   TOP: Identifying Transformations  KEY: basic

3. 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

   TOP: Compositions of Transformations  KEY: identify

5. 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  KEY: graphics

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

7. ANS: 3
   \[ V = 12 \cdot 8.5 \cdot 4 = 408 \]
   \[ W = 408 \cdot 0.25 = 102 \]
   PTS: 2  REF: 061507geo  NAT: G.MG.A.2
   TOP: Density

   TOP: Chords, Secants and Tangents  KEY: inscribed

9. ANS: 1
   \[ m = \frac{-A}{B} = \frac{-2}{-1} = 2 \]
   \[ m_{\perp} = \frac{1}{2} \]
   PTS: 2  REF: 061509geo  NAT: G.GPE.B.5
   TOP: Parallel and Perpendicular Lines  KEY: identify perpendicular lines

10. ANS: 1
    \[ \frac{360^\circ}{45^\circ} = 8 \]
    PTS: 2  REF: 061510geo  NAT: G.CO.A.3
    TOP: Mapping a Polygon onto Itself
11 ANS: 3
\[
\frac{9}{5} = \frac{9.2}{x} \quad \Rightarrow \quad 5.1 + 9.2 = 14.3
\]
\[
9x = 46
\]
\[
x \approx 5.1
\]
PTS: 2
REF: 061511geo
NAT: G.SRT.B.5
TOP: Side Splitter Theorem

12 ANS: 4
PTS: 2
REF: 061512geo
NAT: G.SRT.C.7
TOP: Cofunctions

13 ANS: 4
PTS: 2
REF: 061513geo
NAT: G.CO.C.11
TOP: Parallelograms

14 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

15 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

16 ANS: 2
PTS: 2
REF: 061516geo
NAT: G.SRT.A.2
TOP: Dilations

17 ANS: 1
Alternate interior angles

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

18 ANS: 1
PTS: 2
REF: 061518geo
NAT: G.SRT.A.1
TOP: Line Dilations

19 ANS: 2
\[
SA = 6 \cdot 12^2 = 864
\]
\[
\frac{864}{450} = 1.92
\]
PTS: 2
REF: 061519geo
NAT: G.MG.A.3
TOP: Surface Area

20 ANS: 1
PTS: 2
REF: 061520geo
NAT: G.C.A.2
TOP: Chords, Secants and Tangents
KEY: mixed
21 ANS: 4
\[
\frac{7}{12} \cdot 30 = 17.5
\]

PTS: 2 REF: 061521geo NAT: G.SRT.B.5 TOP: Similarity
KEY: perimeter and area

22 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 \(-\frac{2}{3}\).

PTS: 2 REF: 061522geo NAT: G.SRT.A.1 TOP: Line Dilations

23 ANS: 2

\(x\) is \(\frac{1}{2}\) the circumference. \(\frac{10\pi}{2} \approx 16\)

PTS: 2 REF: 061523geo NAT: G.GMD.A.1 TOP: Circumference

24 ANS: 3

TOP: Triangle Congruency

25 ANS:

PTS: 2 REF: 061524geo NAT: G.CO.B.7 TOP: Triangle Congruency

26 ANS:

Opposite angles in a parallelogram are congruent, so \(m\angle O = 118^\circ\). The interior angles of a triangle equal 180\(^\circ\).

\(180 - (118 + 22) = 40\).

27 ANS:

\[-6 + \frac{2}{5}(4 - 6) - 5 + \frac{2}{5}(0 - 5) = (2, -3)\]

\[-6 + \frac{2}{5}(10) - 5 + \frac{2}{5}(5)\]

\[-6 + 4 - 5 + 2\]

\[-2 - 3\]

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

28 ANS:

\[
\sin x = \frac{4.5}{11.75}
\]

\[x \approx 23\]

PTS: 2 REF: 061528geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find an Angle

29 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

30 ANS:

Reflections are rigid motions that preserve distance.

PTS: 2 REF: 061530geo NAT: G.CO.B.7 TOP: Triangle Congruency
31 ANS:
\[ \frac{1.65}{4.15} = \frac{x}{16.6} \]
\[ 4.15x = 27.39 \]
\[ x = 6.6 \]

PTS: 2 REF: 061531geo NAT: G.SRT.B.5 TOP: Similarity
KEY: basic

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

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

33 ANS:
Quadrilateral \( ABCD \) is a parallelogram with diagonals \( \overline{AC} \) and \( \overline{BD} \) intersecting at \( E \) (Given). \( \overline{AD} \cong \overline{BC} \) (Opposite sides of a parallelogram are congruent). \( \triangle AED \cong \triangle CEB \) (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

34 ANS:
\[ x = \sqrt{.55^2 - .25^2} \approx 0.49 \] No, \( .49^2 = .25 \) \( .9604 + .25 < 1.5 \)
\[ .9604 = y \]

PTS: 4 REF: 061534geo NAT: G.SRT.B.5 TOP: Similarity
KEY: leg

35 ANS:
\[ \tan 47 = \frac{x}{8.5} \] Cone: \( V = \frac{1}{3} \pi (8.5)^2 (9.115) \approx 689.6 \) Cylinder: \( V = \pi (8.5)^2 (25) \approx 5674.5 \) Hemisphere:
\[ x \approx 9.115 \]
\[ V = \frac{1}{2} \left( \frac{4}{3} \pi (8.5)^3 \right) \approx 1286.3 \]
\[ 689.6 + 5674.5 + 1286.3 \approx 7650 \] No, because \( 7650 \cdot 62.4 = 477,360 \)
\[ 477,360 \cdot .85 = 405,756, \text{ which is greater than } 400,000 \]

ANS:
\[ m_{TS} = \frac{-10}{6} = -\frac{5}{3} \quad m_{SR} = \frac{3}{5} \]
Since the slopes of \(TS\) and \(SR\) are opposite reciprocals, they are perpendicular and form a right angle. \(\triangle RST\) is a right triangle because \(\angle S\) is a right angle. \(P(0,9) \quad m_{RP} = \frac{-10}{6} = -\frac{5}{3} \quad m_{PT} = \frac{3}{5} \)

Since the slopes of all four adjacent sides (\(TS\) and \(SR\), \(SR\) and \(RP\), \(PT\) and \(TS\), \(RP\) and \(PT\)) are opposite reciprocals, they are perpendicular and form right angles. Quadrilateral \(RSTP\) is a rectangle because it has four right angles.
0815geo

Answer Section

1. ANS: 2   PTS: 2   REF: 081501geo   NAT: G.CO.C.11
   TOP: Special Quadrilaterals

2. ANS: 3   PTS: 2   REF: 081502geo   NAT: G.CO.A.2
   TOP: Identifying Transformations   KEY: basic

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

4. ANS: 1   PTS: 2   REF: 081504geo   NAT: G.SRT.C.7
   TOP: Cofunctions

5. ANS: 1   PTS: 2   REF: 081505geo   NAT: G.CO.A.3
   TOP: Mapping a Polygon onto Itself

   TOP: Dilations

   TOP: Compositions of Transformations   KEY: identify

8. ANS: 3

   TOP: Interior and Exterior Angles of Polygons

\[ x^2 + 4x + 4 + y^2 - 6y + 9 = 12 + 4 + 9 \]
\[ (x + 2)^2 + (y - 3)^2 = 25 \]

PTS: 2   REF: 081509geo   NAT: G.GPE.A.1
   TOP: Equations of Circles   KEY: completing the square

10. ANS: 1

\[ m = \frac{2}{3} \]
\[ 1 = \left( \frac{2}{3} \right) 6 + b \]
\[ 1 = -4 + b \]
\[ 5 = b \]

PTS: 2   REF: 081510geo   NAT: G.GPE.B.5
   TOP: Parallel and Perpendicular Lines   KEY: write equation of parallel line
11 ANS: 2
\[ s^2 + s^2 = 7^2 \]
\[ 2s^2 = 49 \]
\[ s^2 = 24.5 \]
\[ s \approx 4.9 \]

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

12 ANS: 3
\[ 5 \cdot \frac{10}{4} = \frac{50}{4} = 12.5 \]

PTS: 2  REF: 081512geo  NAT: G.C.A.2  TOP: Chords, Secants and Tangents

KEY: common tangents

13 ANS: 2
TOP: Identifying Transformations  REF: 081513geo  NAT: G.CO.A.2

14 ANS: 4
TOP: Compositions of Transformations  REF: 081514geo  NAT: G.SRT.A.2

KEY: grids

15 ANS: 3
TOP: Inscribed Quadrilaterals  REF: 081515geo  NAT: G.C.A.3

16 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  REF: 081516geo  NAT: G.MG.A.2  TOP: Density

17 ANS: 4
\[ \frac{2}{6} = \frac{5}{15} \]

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

18 ANS: 3
\[ \frac{60}{360} \cdot 6^2 \pi = 6\pi \]

PTS: 2  REF: 081518geo  NAT: G.C.B.5  TOP: Sectors

19 ANS: 2
TOP: Similarity  REF: 081519geo  NAT: G.SRT.B.5

KEY: basic

20 ANS: 1
\[ 3^3 = 9 \]

PTS: 2  REF: 081520geo  NAT: G.SRT.A.2  TOP: Dilations
21 ANS: 4

\[ 2592276 = \frac{1}{3} \cdot s^2 \cdot 146.5 \]

\[ 230 \approx s \]

PTS: 2  REF: 081521geo  NAT: G.GMD.A.3  TOP: Volume
KEY: pyramids

22 ANS: 4

\[ \frac{-2-1}{-1-3} = \frac{3-2}{0-5} = \frac{1}{-5} \]

\[ \frac{3-1}{0-3} = \frac{2}{3} \]

\[ \frac{2-2}{5-1} = \frac{4}{6} = \frac{2}{3} \]

PTS: 2  REF: 081522geo  NAT: G.GPE.B.4  TOP: Quadrilaterals in the Coordinate Plane
KEY: general

23 ANS: 1

\[ \frac{4}{6} = \frac{3}{4.5} = \frac{2}{3} \]

PTS: 2  REF: 081523geo  NAT: G.SRT.A.2  TOP: Dilations

24 ANS: 4

The line \( y = 3x - 1 \) passes through the center of dilation, so the dilated line is not distinct.

PTS: 2  REF: 081524geo  NAT: G.SRT.A.1  TOP: Line Dilations

25 ANS:

\[ \frac{137.8}{6^2} \approx 0.638 \text{ Ash} \]

PTS: 2  REF: 081525geo  NAT: G.MG.A.2  TOP: Density

26 ANS:

\[ \frac{120}{230} = \frac{x}{315} \]

\[ x = 164 \]

PTS: 2  REF: 081526geo  NAT: G.CO.D.13  TOP: Constructions
KEY: basic

27 ANS:

\[ \frac{120}{230} = \frac{x}{315} \]

\[ x = 164 \]

PTS: 2  REF: 081527geo  NAT: G.SRT.B.5  TOP: Similarity
28 ANS:
Parallelogram $ABCD$, diagonals $AC$ and $BD$ intersect at $E$ (given). $DC \parallel AB; DA \parallel CB$ (opposite sides of a parallelogram are parallel). $\angle ACD \cong \angle CAB$ (alternate interior angles formed by parallel lines and a transversal are congruent).


29 ANS:
\[
\frac{6}{14} = \frac{9}{21} \text{ SAS}
\]
\[126 = 126\]

PTS: 2 REF: 081529geo NAT: G.SRT.B.5 TOP: Similarity
KEY: basic

30 ANS:
The transformation is a rotation, which is a rigid motion.

PTS: 2 REF: 081530geo NAT: G.CO.B.7 TOP: Triangle Congruency

31 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

32 ANS:
\[
\tan 7 = \frac{125}{x} \quad \tan 16 = \frac{125}{y} \quad 1018 - 436 \approx 582
\]
\[x \approx 1018 \quad y \approx 436\]

PTS: 4 REF: 081532geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side
KEY: advanced
33 ANS:
The slopes of perpendicular lines are opposite reciprocals. Since the lines are perpendicular, they form right angles and a right triangle. 

$$m_{BC} = -\frac{3}{2} \quad -1 = \frac{2}{3}(-3) + b \quad \text{or} \quad -4 = \frac{2}{3}(-1) + b$$

$$m_\perp = \frac{2}{3} \quad -1 = -2 + b$$

$$1 = b$$

$$3 = \frac{2}{3}x + 1$$

$$\frac{10}{3} = b$$

$$2 = \frac{2}{3}x$$

$$3 = \frac{2}{3}x - \frac{10}{3}$$

$$3 = x$$

$$9 = 2x - 10$$

$$19 = 2x$$

$$9.5 = x$$

PTS: 4 REF: 081533geo NAT: G.GPE.B.4 TOP: Triangles in the Coordinate Plane

34 ANS:
Translations preserve distance. If point $D$ is mapped onto point $A$, point $F$ would map onto point $C$. $\triangle DEF \cong \triangle ABC$ as $AC \cong DF$ and points are collinear on line $\ell$ and a reflection preserves distance.

PTS: 4 REF: 081534geo NAT: G.CO.B.7 TOP: Triangle Congruency

35 ANS:
Parallelogram $ABCD$, $BE \perp CED$, $DF \perp BFC$, $CE \cong CF$ (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). $BC \cong CD$ (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

36 ANS:

$$V = \frac{1}{3} \pi \left( \frac{3}{2} \right)^2 \cdot 8 \approx 18.85 \cdot 100 = 1885 \quad 1885 \cdot 0.52 \cdot 0.10 = 98.02 \quad 1.95(100) - (37.83 + 98.02) = 59.15$$

PTS: 6 REF: 081536geo NAT: G.MG.A.2 TOP: Density
0116geo

Answer Section

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

2 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

3 ANS: 3


4 ANS: 2
\[ 14 \times 16 \times 10 = 2240, \quad \frac{2240 - 1680}{2240} = 0.25 \]

PTS: 2 REF: 011604geo NAT: G.GMD.A.3 TOP: Volume KEY: prisms

5 ANS: 3 PTS: 2 REF: 011605geo NAT: G.CO.A.2 TOP: Analytical Representations of Transformations KEY: basic

6 ANS: 1 PTS: 2 REF: 011606geo NAT: G.CO.C.9 TOP: Lines and Angles

7 ANS: 2
\[ V = \frac{1}{3} \cdot 6^2 \cdot 12 = 144 \]

PTS: 2 REF: 011607geo NAT: G.GMD.A.3 TOP: Volume KEY: pyramids

8 ANS: 1 PTS: 2 REF: 011608geo NAT: G.CO.A.5 TOP: Compositions of Transformations KEY: identify

9 ANS: 4 PTS: 2 REF: 011609geo NAT: G.SRT.C.7 TOP: Cofunctions

10 ANS: 2 PTS: 2 REF: 011610geo NAT: G.SRT.A.1 TOP: Line Dilations

12 ANS: 3
\[
\frac{x}{360} \cdot 3^2 \pi = 2\pi \quad 180 - 80 = 100
\]
\[
x = 80 \quad \frac{180 - 100}{2} = 40
\]

PTS: 2 \hspace{1cm} REF: 011612geo \hspace{1cm} NAT: G.C.B.5 \hspace{1cm} TOP: Sectors

13 ANS: 1
\[
\frac{6}{8} = \frac{9}{12}
\]

PTS: 2 \hspace{1cm} REF: 011613geo \hspace{1cm} NAT: G.SRT.B.5 \hspace{1cm} TOP: Similarity

14 ANS: 3
\[
\frac{4}{3} \pi \left( \frac{9.5}{2} \right)^3
\]
\[
\frac{4}{3} \pi \left( \frac{2.5}{2} \right)^3 \approx 55
\]

PTS: 2 \hspace{1cm} REF: 011614geo \hspace{1cm} NAT: G.GMD.A.3 \hspace{1cm} TOP: Volume

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

PTS: 2 \hspace{1cm} REF: 011615geo \hspace{1cm} NAT: G.GPE.B.7 \hspace{1cm} TOP: Polygons in the Coordinate Plane

16 ANS: 3
\[
\cos A = \frac{9}{14}
\]
\[
A \approx 50^\circ
\]

PTS: 2 \hspace{1cm} REF: 011616geo \hspace{1cm} NAT: G.SRT.C.8 \hspace{1cm} TOP: Using Trigonometry to Find an Angle

17 ANS: 4
\[
x^2 + 6x + 9 + y^2 - 4y + 4 = 23 + 9 + 4
\]
\[
(x + 3)^2 + (y - 2)^2 = 36
\]

PTS: 2 \hspace{1cm} REF: 011617geo \hspace{1cm} NAT: G.GPE.A.1 \hspace{1cm} TOP: Equations of Circles

18 ANS: 1
\[
m_{RT} = \frac{5 - 3}{4 - -2} = \frac{8}{6} = \frac{4}{3} \quad m_{ST} = \frac{5 - 2}{4 - -8} = \frac{3}{4}
\]
Slopes are opposite reciprocals, so lines form a right angle.

PTS: 2 \hspace{1cm} REF: 011618geo \hspace{1cm} NAT: G.GPE.B.4 \hspace{1cm} TOP: Triangles in the Coordinate Plane
19 ANS: 2
\[ \frac{4}{3} \pi \cdot 4^3 + 0.075 \approx 20 \]

PTS: 2 REF: 011619geo NAT: G.MG.A.2 TOP: Density

20 ANS: 4
\[ \frac{1}{2} = \frac{x + 3}{3x - 1} \quad GR = 3(7) - 1 = 20 \]
\[ 3x - 1 = 2x + 6 \]
\[ x = 7 \]

PTS: 2 REF: 011620geo NAT: G.SRT.B.5 TOP: Similarity KEY: basic


22 ANS: 2
\[ \sqrt{3} \cdot 21 = \sqrt{63} = 3 \sqrt{7} \]

PTS: 2 REF: 011622geo NAT: G.SRT.B.5 TOP: Similarity KEY: altitude

23 ANS: 1
\[ \frac{1000}{20 \pi} \approx 15.9 \]

PTS: 2 REF: 011623geo NAT: G.GMD.A.1 TOP: Circumference

24 ANS: 3
\[ \frac{12}{4} = \frac{x}{5} \quad 15 - 4 = 11 \]
\[ x = 15 \]

PTS: 2 REF: 011624geo NAT: G.SRT.B.5 TOP: Similarity KEY: basic

25 ANS:

PTS: 2 REF: 011625geo NAT: G.CO.A.5 TOP: Reflections KEY: grids
26 ANS:
\[
180 - 2(30) = 120
\]
PTS: 2 
REF: 011626geo 
NAT: G.C.A.2 
TOP: Chords, Secants and Tangents
KEY: parallel lines

27 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

28 ANS:
Yes. The sequence of transformations consists of a reflection and a translation, which are isometries which preserve distance and congruency.

PTS: 2 
REF: 011628geo 
NAT: G.CO.B.7 
TOP: Triangle Congruency

29 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

30 ANS:
\[
\frac{40000}{\pi \left( \frac{51}{2} \right)^2} \approx 19.6 \
\frac{72000}{\pi \left( \frac{75}{2} \right)^2} \approx 16.3 
\]
Dish A
PTS: 2 
REF: 011630geo 
NAT: G.MG.A.2 
TOP: Density
31. ANS:
\[ \ell: y = 3x - 4 \]
\[ m: y = 3x - 8 \]

PTS: 2  REF: 011631geo  NAT: G.SRT.A.1  TOP: Line Dilations

32. ANS:
\[ \frac{16}{9} = \frac{x}{20.6} \]
\[ D = \sqrt{36.6^2 + 20.6^2} \approx 42 \]
\[ x \approx 36.6 \]

PTS: 4  REF: 011632geo  NAT: G.SRT.C.8  TOP: Pythagorean Theorem
KEY: without graphics

33. 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


34. ANS:
\[ \triangle \text{SAS} \cong \triangle \text{SAS} \]

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

35. ANS:
Parallelogram \( ANDR \) with \( AW \) and \( DE \) bisecting \( NWD \) and \( REA \) 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
36 ANS:

\[ \tan 52.8 = \frac{h}{x} \]

\[ x \tan 52.8 = x \tan 34.9 + 8 \tan 34.9 \]

\[ \tan 52.8 \approx \frac{h}{9} \]

\[ 11.86 + 1.7 \approx 13.6 \]

\[ h = x \tan 52.8 \]

\[ x \tan 52.8 - x \tan 34.9 = 8 \tan 34.9 \]

\[ x \approx 11.86 \]

\[ x \tan 34.9 - x = 8 \tan 34.9 \]

\[ x = \frac{8 \tan 34.9}{\tan 52.8 - \tan 34.9} \]

\[ x \approx 9 \]

\[ h = (x + 8) \tan 34.9 \]

PTS: 6

REF: 011636geo

NAT: G.SRT.C.8

TOP: Using Trigonometry to Find a Side

KEY: advanced
0616geo

Answer Section

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

2  ANS: 4
   \[3 \times 6 = 18\]
   PTS: 2   REF: 061602geo   NAT: G.SRT.A.1   TOP: Line Dilations

3  ANS: 2
   PTS: 2   REF: 061603geo   NAT: G.GPE.A.1
   TOP: Equations of Circles
   KEY: find center and radius | completing the square

4  ANS: 1
   PTS: 2   REF: 061604geo   NAT: G.CO.A.2
   TOP: Identifying Transformations
   KEY: graphics

5  ANS: 3
   1) \(\frac{12}{9} = \frac{4}{3}\)  2) AA  3) \(\frac{32}{16} \neq \frac{8}{2}\)  4) SAS
   PTS: 2   REF: 061605geo   NAT: G.SRT.B.5   TOP: Similarity
   KEY: basic

6  ANS: 4
   PTS: 2   REF: 061606geo   NAT: G.GMD.A.3
   TOP: Volume
   KEY: compositions

7  ANS: 3
   1) only proves AA; 2) need congruent legs for HL; 3) SAS; 4) only proves product of altitude and base is equal
   PTS: 2   REF: 061607geo   NAT: G.SRT.B.5   TOP: Triangle Proofs
   KEY: statements

8  ANS: 4
   PTS: 2   REF: 061608geo   NAT: G.SRT.A.2
   TOP: Compositions of Transformations
   KEY: grids

9  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
   KEY: inscribed

10 ANS: 2
    PTS: 2   REF: 061610geo   NAT: G.C.A.2
    TOP: Chords, Secants and Tangents
    KEY: inscribed

11 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

12 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
13 ANS: 2
\[ h^2 = 30 \cdot 12 \]
\[ h^2 = 360 \]
\[ h = 6\sqrt{10} \]

PTS: 2 REF: 061613geo NAT: G.SRT.B.5 TOP: Similarity
KEY: altitude

14 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

15 ANS: 4 PTS: 2 REF: 061615geo NAT: G.SRT.C.6
TOP: Trigonometric Ratios

16 ANS: 3 PTS: 2 REF: 061616geo NAT: G.CO.A.2
TOP: Identifying Transformations
KEY: graphics

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

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

18 ANS: 2
\[ \frac{11}{1.2} \left( \frac{16 \text{ oz}}{1 \text{ lb}} \right) = \frac{13.31 \text{ lb}}{1 \text{ lb}} \left( \frac{1 \text{ g}}{3.7851 \text{ lb}} \right) \approx \frac{3.5 \text{ g}}{1 \text{ lb}} \]

PTS: 2 REF: 061618geo NAT: G.MG.A.2 TOP: Density

19 ANS: 2

PTS: 2 REF: 061619geo NAT: G.CO.C.10 TOP: Triangle Proofs

20 ANS: 1
\[ \frac{1}{2} \left( \frac{4}{3} \right) \pi \cdot 5^3 \cdot 62.4 \approx 16,336 \]

PTS: 2 REF: 061620geo NAT: G.MG.A.2 TOP: Density
21 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

22 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

23 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 KEY: other REF: 061623geo NAT: G.GPE.A.1 TOP: Equations of Circles

24 ANS: 3

\[
\frac{60}{360} \cdot 8^2 \pi = \frac{1}{6} \cdot 64 \pi = \frac{32\pi}{3}
\]

PTS: 2 REF: 061624geo NAT: G.C.B.5 TOP: Sectors

25 ANS:

\[T_{6,0} \circ r_{x-axis}\]

PTS: 2 KEY: identify REF: 061625geo NAT: G.CO.A.5 TOP: Compositions of Transformations
26 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

27 ANS:
\[ \frac{3.75}{5} = \frac{4.5}{6} \]
\[ \overline{AB} \text{ is parallel to } \overline{CD} \text{ because } \overline{AB} \text{ divides the sides proportionately.} \]
\[ 39.375 = 39.375 \]

PTS: 2 REF: 061627geo NAT: G.SRT.B.5 TOP: Side Splitter Theorem

28 ANS:
\[ 73 + R = 90 \quad \text{Equal cofunctions are complementary.} \]
\[ R = 17 \]

PTS: 2 REF: 061628geo NAT: G.SRT.C.7 TOP: Cofunctions

29 ANS:
\[ s = \theta \cdot r \quad s = \theta \cdot r \quad \text{Yes, both angles are equal.} \]
\[ \pi = A \cdot 4 \quad \frac{13\pi}{8} = B \cdot 6.5 \]
\[ \frac{\pi}{4} = A \quad \frac{\pi}{4} = B \]


KEY: arc length

30 ANS:
\[ \tan x = \frac{10}{4} \]
\[ x \approx 68 \]

PTS: 2 REF: 061630geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find an Angle
31 ANS: 

![Diagram of a circle with a point marked on it.]

**PTS:** 2  
**REF:** 061631geo  
**NAT:** G.CO.D.12  
**TOP:** Constructions

**KEY:** parallel and perpendicular lines

32 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

33 ANS: 

Parallelogram \(ABCD, \overline{EFG}\), 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

34 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

35 ANS: 

Quadrilateral \(ABCD\) with diagonals \(\overline{AC}\) and \(\overline{BD}\) 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); \(AD \cong DC\) (the sides of an isosceles triangle are congruent); quadrilateral \(ABCD\) is a rhombus (a rhombus has consecutive congruent sides); \(AE \perp BE\) (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).

**PTS:** 6  
**REF:** 061635geo  
**NAT:** G.CO.C.11  
**TOP:** Quadrilateral Proofs
ANS:

Similar triangles are required to model and solve a proportion. 

\[
\frac{x + 5}{1.5} = \frac{x}{1} \quad \frac{1}{3} \pi (1.5)^2 (15) - \frac{1}{3} \pi (1)^2 (10) \approx 24.9
\]

\[
x + 5 = 1.5x
\]

\[
5 = .5x
\]

\[
10 = x
\]

\[
10 + 5 = 15
\]
0816geo

Answer Section

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

2. **ANS: 2**
   **PTS: 2**
   **TOP:** Identifying Transformations  **KEY:** basic
   **REF:** 081602geo  **NAT:** G.CO.A.2

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

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4. **ANS: 2**

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5. **ANS: 1**
   **PTS: 2**
   **TOP:** Rotations  **KEY:** grids
   **REF:** 081605geo  **NAT:** G.CO.A.5

6. **ANS: 1**
   **PTS: 2**
   **TOP:** Cofunctions
   **REF:** 081606geo  **NAT:** G.SRT.C.7

---

7. **ANS: 3**
   *(3) Could be a trapezoid.*
   **PTS: 2**
   **TOP:** Parallelograms
   **REF:** 081607geo  **NAT:** G.CO.C.11

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8. **ANS: 3**
   \[
   \sqrt{20^2 - 10^2} \approx 17.3
   \]
   **PTS: 2**
   **TOP:** Pythagorean Theorem  **KEY:** without graphics
   **REF:** 081608geo  **NAT:** G.SRT.C.8

---

9. **ANS: 4**
   **PTS: 2**
   **TOP:** Compositions of Transformations  **KEY:** grids
   **REF:** 081609geo  **NAT:** G.SRT.A.2

---

10. **ANS: 2**
    \[
    x^2 = 4 \cdot 10
    \]
    \[
    x = \sqrt{40}
    \]
    \[
    x = 2\sqrt{10}
    \]
   **PTS: 2**
   **TOP:** Similarity  **KEY:** leg
   **REF:** 081610geo  **NAT:** G.SRT.B.5

---

11. **ANS: 4**
    **PTS: 2**
    **TOP:** Lines and Angles
    **REF:** 081611geo  **NAT:** G.CO.C.9
12 ANS: 3
\[ \frac{x}{10} = \frac{6}{4} \implies \overline{CD} = 15 - 4 = 11 \]
\[ x = 15 \]

PTS: 2 REF: 081612geo NAT: G.SRT.B.5 TOP: Similarity
KEY: basic

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

14 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

15 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

16 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

17 ANS: 2
\[ C = \pi d \quad V = \pi \left( \frac{2.25}{\pi} \right)^2 \cdot 8 \approx 12.8916 \quad W = 12.8916 \cdot 752 \approx 9694 \]
\[ 4.5 = \pi d \]
\[ \frac{4.5}{\pi} = d \]
\[ \frac{2.25}{\pi} = r \]

PTS: 2 REF: 081617geo NAT: G.MG.A.2 TOP: Density
18 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


20 ANS: 4
\[ V = \pi \left( \frac{6.7}{2} \right)^2 (4 \cdot 6.7) \approx 945 \]

PTS: 2  REF: 081620geo  NAT: G.GMD.A.3  TOP: Volume  KEY: cylinders

21 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

22 ANS: 3  PTS: 2  REF: 081622geo  NAT: G.SRT.B.5  TOP: Triangle Proofs  KEY: statements

23 ANS: 1
The other statements are true only if \( AD \perp BC \).

PTS: 2  REF: 081623geo  NAT: G.C.A.2  TOP: Chords, Secants and Tangents  KEY: inscribed

24 ANS: 1
\[ 180 - (68 \cdot 2) \]

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

25 ANS:
\[ \frac{3}{8} \cdot 56 = 21 \]

26 ANS:

\[
\begin{align*}
\text{PTS: } & 2 & \text{REF: } & 081626geo & \text{NAT: } & G.CO.A.5 & \text{TOP: } \text{Compositions of Transformations} \\
\text{KEY: } & \text{grids}
\end{align*}
\]

27 ANS:

\[
\frac{360}{6} = 60
\]

28 ANS:

\[
\begin{align*}
\text{PTS: } & 2 & \text{REF: } & 081627geo & \text{NAT: } & G.CO.A.3 & \text{TOP: } \text{Mapping a Polygon onto Itself} \\
\text{KEY: } & \text{line bisector}
\end{align*}
\]

29 ANS:

\[
M = 180 - (47 + 57) = 76 \text{ Rotations do not change angle measurements.}
\]

30 ANS:

\[
\begin{align*}
\text{Yes. } & (x - 1)^2 + (y + 2)^2 = 4^2 \\
(3.4 - 1)^2 + (1.2 + 2)^2 &= 16 \\
5.76 + 10.24 &= 16 \\
16 &= 16
\end{align*}
\]

\[
\text{PTS: } 2 & \text{REF: } 081630geo & \text{NAT: } & G.GPE.B.4 & \text{TOP: } \text{Circles in the Coordinate Plane}
\]
31 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

32 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

33 ANS:

\( A'B'C' \) is a reflection of \( \triangle ABC \) and reflections preserve distance.

\( \angle A'B'C' \triangle DEF \cong \triangle A'B'C' \) because \( \triangle DEF \) is a reflection of

\( A(2, -3) - (2, -3) = (0, 0) \rightarrow (0, 0) + (2, -3) = A'(2, -3) \)

\( B(6, -8) - (2, -3) = (4, -5) \rightarrow (5, 4) + (2, -3) = B'(7, 1) \)

\( C(2, -9) - (2, -3) = (0, -6) \rightarrow (6, 0) + (2, -3) = C'(8, -3) \)

PTS: 4  REF: 081633geo  NAT: G.CO.A.5  TOP: Rotations
KEY: grids

34 ANS:

\[
\tan x = \frac{12}{75} \quad \tan y = \frac{72}{75}
\]
\[
x \approx 9.09 \quad y \approx 34.83
\]

PTS: 4  REF: 081634geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find an Angle
35. **ANS:**

Circle $O$, chords $AB$ and $CD$ intersect at $E$ (Given); Chords $CB$ and $AD$ 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

36. **ANS:**

$V = \frac{1}{3} \pi \left( \frac{8.3}{2} \right)^2 (10.2) + \frac{1}{2} \cdot \frac{4}{3} \pi \left( \frac{8.3}{2} \right)^3 \approx 183.961 + 149.693 \approx 333.65 \text{ cm}^3 \cdot 333.65 \times 50 = 16682.7 \text{ cm}^3$

$16682.7 \times 0.697 = 11627.8 \text{ g}$ $11.6278 \times 3.83 = $44.53

**PTS:** 6 **REF:** 081636geo **NAT:** G.MG.A.2 **TOP:** Density
0117geo

Answer Section

1. 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

2. ANS: 2  PTS: 2  REF: 011702geo  NAT: G.SRT.A.2  TOP: Compositions of Transformations
   KEY: basic


5. ANS: 4  PTS: 2  REF: 011705geo  NAT: G.CO.C.11  TOP: Special Quadrilaterals

   KEY: basic

7. ANS: 2
   \[ \tan \theta = \frac{2.4}{x} \]
   \[ \frac{3}{7} = \frac{2.4}{x} \]
   \[ x = 5.6 \]
   PTS: 2  REF: 011707geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

8. ANS: 1
   \[ \frac{64}{4} = 16 \quad 16^2 = 256 \quad 2w + 2(w + 2) = 64 \quad 15 \times 17 = 255 \quad 2w + 2(w + 4) = 64 \quad 14 \times 18 = 252 \quad 2w + 2(w + 6) = 64 \]
   \[ w = 15 \]
   \[ w = 14 \]
   \[ w = 13 \]
   \[ 13 \times 19 = 247 \]
   PTS: 2  REF: 011708geo  NAT: G.MG.A.3  TOP: Area of Polygons

9. 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

10. ANS: 3  PTS: 2  REF: 011710geo  NAT: G.CO.A.5  TOP: Compositions of Transformations
    KEY: identify
11 ANS: 2
\[4 \times 4 \times 6 - \pi (1)^2 (6) \approx 77\]

PTS: 2REF: 011711geo NAT: G.GMD.A.3 TOP: Volume
KEY: compositions

12 ANS: 3
\[\cos 40 = \frac{14}{x}\]
\[x \approx 18\]

PTS: 2REF: 011712geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side

13 ANS: 1
\[B: (4 - 3, 3 - 4) \rightarrow (1, -1) \rightarrow (2, -2) \rightarrow (2 + 3, -2 + 4)\]
\[C: (2 - 3, 1 - 4) \rightarrow (-1, -3) \rightarrow (-2, -6) \rightarrow (-2 + 3, -6 + 4)\]

PTS: 2REF: 011713geo NAT: G.SRT.A.1 TOP: Line Dilations

14 ANS: 3PTS: 2REF: 011714geo NAT: G.SRT.C.6 TOP: Trigonometric Ratios

15 ANS: 2
\[8(x + 8) = 6(x + 18)\]
\[8x + 64 = 6x + 108\]
\[2x = 44\]
\[x = 22\]

PTS: 2REF: 011715geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents
KEY: secants drawn from common point, length

16 ANS: 1PTS: 2REF: 011716geo NAT: G.CO.C.11 TOP: Special Quadrilaterals

17 ANS: 4
\[\frac{360^\circ}{10} = 36^\circ \text{ 252}^\circ \text{ is a multiple of } 36^\circ\]

PTS: 2REF: 011717geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

18 ANS: 1
\[x^2 + y^2 - 6y + 9 = -1 + 9\]
\[x^2 + (y - 3)^2 = 8\]

PTS: 2REF: 011718geo NAT: G.GPE.A.1 TOP: Equations of Circles
KEY: completing the square

19 ANS: 3
\[\frac{7 - 1}{0 - 2} = \frac{6}{-2} = -3 \text{  The diagonals of a rhombus are perpendicular.}\]

PTS: 2REF: 011719geo NAT: G.GPE.B.4 TOP: Quadrilaterals in the Coordinate Plane
20 ANS: 1
\[
3 + \frac{2}{5}(8 - 3) = 3 + \frac{2}{5}(5) = 3 + 2 = 5 
5 + \frac{2}{5}(-5 - 5) = 5 + \frac{2}{5}(-10) = 5 - 4 = 1
\]
PTS: 2  REF: 011720geo  NAT: G.GPE.B.6  TOP: Directed Line Segments

21 ANS: 4
\[
\frac{300}{360} \cdot 8^2 \pi = \frac{160\pi}{3}
\]
PTS: 2  REF: 011721geo  NAT: G.C.B.5  TOP: Sectors

22 ANS: 3
\[
\sqrt{(-5)^2 + 12^2} = \sqrt{169} \cdot \sqrt{11^2 + (2\sqrt{12})^2} = \sqrt{121 + 48} = \sqrt{169}
\]
PTS: 2  REF: 011722geo  NAT: G.GPE.B.4  TOP: Circles in the Coordinate Plane

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

24 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

25 ANS:

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

26 ANS:
\[
T_{0, -2} \circ r_{y-axis}
\]
PTS: 2  REF: 011726geo  NAT: G.CO.A.5  TOP: Compositions of Transformations  KEY: identify

27 ANS:
Yes, because 28° and 62° 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
28 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

29 ANS: \[
\overline{GI} \parallel \overline{NT}, \text{ and } \overline{IN} \text{ intersects at } A \text{ (given); } \angle I \cong \angle N, \angle G \cong \angle T \text{ (paralleling lines cut by a transversal form congruent alternate interior angles); } \triangle GIA \sim \triangle TNA \text{ (AA)}. 
\]

PTS: 2 REF: 011729geo NAT: G.SRT.A.3 TOP: Similarity Proofs

30 ANS: \[
180 - 2(25) = 130
\]

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

31 ANS:

![Diagram](image1)

PTS: 2 REF: 011731geo NAT: G.GPE.B.4 TOP: Quadrilaterals in the Coordinate Plane

KEY: grids

32 ANS:

![Diagram](image2)

A dilation preserves slope, so the slopes of \( \overline{QR} \) and \( \overline{Q'R'} \) are equal. Because the slopes are equal, \( Q'R'||QR \).

PTS: 4 REF: 011732geo NAT: G.SRT.A.2 TOP: Dilations

KEY: grids
33 ANS: 

Right triangle because $\angle CBF$ is inscribed in a semi-circle.

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

34 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

35 ANS:

Quadrilateral $ABCD$, $AB \cong CD$, $AB \parallel CD$, and $BF$ and $DE$ are perpendicular to diagonal $AC$ at points $F$ and $E$ (given). $\angle AED$ and $\angle CFB$ are right angles (perpendicular lines form right angles). $\angle AED \cong \angle CFB$ (All right angles are congruent). $ABCD$ 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). $\triangle ADE \cong \triangle CBF$ (AAS). $\overline{AE} \cong \overline{CF}$ (CPCTC).

PTS: 6 REF: 011735geo NAT: G.SRT.B.5 TOP: Quadrilateral Proofs

36 ANS:

$$C: \quad V = \pi (26.7)^2 (750) - \pi (24.2)^2 (750) = 95,437.5\pi$$

$$95,437.5\pi \text{ cm}^3 \left( \frac{2.7 \text{ g}}{\text{cm}^3} \right) \left( \frac{1 \text{ kg}}{1000 \text{ g}} \right) \left( \frac{\$0.38}{\text{kg}} \right) = \$307.62$$

$$P: \quad V = 40^2 (750) - 35^2 (750) = 281,250 \quad \$307.62 - 288.56 \approx \$19.06$$

$$281,250 \text{ cm}^3 \left( \frac{2.7 \text{ g}}{\text{cm}^3} \right) \left( \frac{1 \text{ kg}}{1000 \text{ g}} \right) \left( \frac{\$0.38}{\text{kg}} \right) = \$288.56$$

PTS: 6 REF: 011736geo NAT: G.MG.A.2 TOP: Density
0617geo

Answer Section

1. ANS: 2
TOP: Compositions of Transformations
PTS: 2
REF: 061701geo
NAT: G.CO.A.5

2. ANS: 3
TOP: Polygons in the Coordinate Plane
PTS: 2
REF: 061702geo
NAT: G.GPE.B.7

3. ANS: 3
TOP: Cofunctions
PTS: 2
REF: 061703geo
NAT: G.SRT.C.7

4. ANS: 4
\[ \frac{1}{2} (360 - 268) = 46 \]

5. ANS: 4
\[ \frac{2}{4} = \frac{9-x}{x} \]
\[ 36 - 4x = 2x \]
\[ x = 6 \]

6. ANS: 3
TOP: Line Dilations
PTS: 2
REF: 061705geo
NAT: G.SRT.B.5
TOP: Side Splitter Theorem

7. ANS: 1
TOP: Mapping a Polygon onto Itself
PTS: 2
REF: 061707geo
NAT: G.CO.A.3

8. ANS: 2
\[ 6 \cdot 6 = x(x-5) \]
\[ 36 = x^2 - 5x \]
\[ 0 = x^2 - 5x - 36 \]
\[ 0 = (x-9)(x+4) \]
\[ x = 9 \]

9. ANS: 2
TOP: Triangle Proofs
PTS: 2
REF: 061709geo
NAT: G.SRT.B.5

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

PTS: 2
REF: 061710geo
NAT: G.CO.C.10
TOP: Interior and Exterior Angles of Triangles
11 ANS: 4  PTS: 2  REF: 061711geo  NAT: G.CO.C.11  TOP: Special Quadrilaterals

12 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

13 ANS: 1  
\[ \cos S = \frac{60}{65} \]
\[ S \approx 23 \]

PTS: 2  REF: 061713geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find an Angle

14 ANS: 1  
NYSED accepts either (1) or (3) as a correct answer. Statement III is not true if \( A, B, A', \) and \( B' \) are collinear.

PTS: 2  REF: 061714geo  NAT: G.SRT.A.2  TOP: Compositions of Transformations  KEY: basic

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

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

16 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

17 ANS: 4

PTS: 2  REF: 061717geo  NAT: G.CO.C.10  TOP: Interior and Exterior Angles of Triangles

18 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
19 ANS: 2

\[ m = \frac{3}{2} \quad 1 = -\frac{2}{3}(-6) + b \]

\[ m_\perp = -\frac{2}{3} \quad 1 = 4 + b \]

PTS: 2 REF: 061719geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: write equation of perpendicular line

20 ANS: 2 PTS: 2 REF: 061720geo NAT: G.CO.C.11
TOP: Parallelograms

21 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

22 ANS: 3

NYSED has stated that all students should be awarded credit regardless of their answer to this question.

PTS: 2 REF: 061722geo NAT: G.CO.B.7 TOP: Triangle Congruency

23 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

24 ANS: 2
(1) AA; (3) SAS; (4) SSS. NYSED has stated that all students should be awarded credit regardless of their answer to this question.

PTS: 2 REF: 061724geo NAT: G.SRT.B.5 TOP: Similarity
KEY: basic

25 ANS:

PTS: 2 REF: 061725geo NAT: G.CO.D.12 TOP: Constructions
KEY: parallel and perpendicular lines
26 ANS:
\[
\frac{40}{360} \cdot \pi (4.5)^2 = 2.25\pi
\]
PTS: 2 REF: 061726geo NAT: G.C.B.5 TOP: Sectors

27 ANS:
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.

PTS: 2 REF: 061727geo NAT: G.GMD.A.1 TOP: Volume

28 ANS:
\[
3 \sqrt{\frac{3V_f}{4\pi}} - 3 \sqrt{\frac{3V_p}{4\pi}} = 3 \sqrt{\frac{3(294)}{4\pi}} - 3 \sqrt{\frac{3(180)}{4\pi}} \approx 0.6
\]

PTS: 2 REF: 061728geo NAT: G.GMD.A.3 TOP: Volume

KEY: spheres

29 ANS:
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.

PTS: 2 REF: 061729geo NAT: G.SRT.B.5 TOP: Similarity

KEY: altitude

30 ANS:
Rotate \( \triangle ABC \) clockwise about point \( C \) until \( DF \parallel AC \). Translate \( \triangle ABC \) along \( CF \) so that \( C \) maps onto \( F \).

PTS: 2 REF: 061730geo NAT: G.CO.A.5 TOP: Compositions of Transformations

KEY: identify

31 ANS:
\[
\text{The line is on the center of dilation, so the line does not change. } p: 3x + 4y = 20
\]

PTS: 2 REF: 061731geo NAT: G.SRT.A.1 TOP: Line Dilations
Reflections are rigid motions that preserve distance, so $\triangle ABC \cong \triangle DEF$.

33 ANS:
$RS$ and $TV$ bisect each other at point $X$; $TR$ and $SV$ are drawn (given); $TX \cong VX$ and $RX \cong XS$ (segment bisectors create two congruent segments); $\angle TXR \cong \angle VXS$ (vertical angles are congruent); $\triangle TXR \cong \triangle VXS$ (SAS); $\angle T \cong \angle V$ (CPCTC); $TR \parallel SV$ (a transversal that creates congruent alternate interior angles cuts parallel lines).

34 ANS:
$20000 \left( \frac{1 \text{ ft}^3}{7.48 \text{ g}} \right) = 2673.8 \text{ ft}^3$

$2673.8 = \pi r^2 (34.5) \quad 9.9 + 1 = 10.9$

$r \approx 4.967$

$d \approx 9.9$

35 ANS:
$PQ \sqrt{(8-3)^2 + (3-2)^2} = \sqrt{50}$

$QR \sqrt{(1-8)^2 + (4-3)^2} = \sqrt{50}$

$RS \sqrt{(-4-1)^2 + (-1-4)^2} = \sqrt{50}$

$PS \sqrt{(-4-3)^2 + (-1-2)^2} = \sqrt{50}$

$PQRS$ is a rhombus because all sides are congruent. $m_{\overline{PQ}} = \frac{8-3}{3-2} = \frac{5}{1} = 5$

$m_{\overline{QR}} = \frac{1-8}{4-3} = -7$ 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.
36  ANS:
\[
\tan 15 = \frac{6250}{x} \quad \tan 52 = \frac{6250}{y} \quad 23325.3 - 4883 = 18442 \times \frac{18442 \text{ ft}}{1 \text{ min}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} \times \frac{60 \text{ min}}{1 \text{ h}} \approx 210
\]
\[
x \approx 23325.3 \quad y \approx 4883
\]

PTS: 6  
KEY: advanced

REF: 061736geo  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side
0817geo
Answer Section

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

2 ANS: 4 PTS: 2 REF: 081702geo NAT: G.CO.A.2
TOP: Identifying Transformations KEY: basic

3 ANS: 3
\[ 4\sqrt{(-1-3)^2 + (5-1)^2} = 4\sqrt{20} \]

PTS: 2 REF: 081703geo NAT: G.GPE.B.7 TOP: Polygons in the Coordinate Plane

4 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

5 ANS: 4
\[ \frac{6.6}{x} = \frac{4.2}{5.25} \]
\[ 4.2x = 34.65 \]
\[ x = 8.25 \]

PTS: 2 REF: 081705geo NAT: G.SRT.B.5 TOP: Similarity KEY: basic

6 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

7 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
8 ANS: 4

9 ANS: 4
\[
\frac{36}{45} \neq \frac{15}{18} \\
\frac{4}{5} \neq \frac{5}{6}
\]

10 ANS: 1
Since a dilation preserves parallelism, the line \(4y = 3x + 7\) and its image \(3x - 4y = 9\) are parallel, with slopes of \(\frac{3}{4}\).

11 ANS: 4

12 ANS: 2
\[x^2 = 3 \cdot 18 \]
\[x = \sqrt{3 \cdot 3 \cdot 6} \]
\[x = 3\sqrt{6}\]

13 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) \(3^2 \cdot 10 = 900\)
In (1) and (2), $ABCD$ could be a rectangle with non-congruent sides. (4) is not possible.

14 ANS: 3

15 ANS: 1

$\tan x = \frac{1}{12}$

$x \approx 4.76$

16 ANS: 4

17 ANS: 1

$-8 + \frac{3}{8}(16 - 8) = -8 + \frac{3}{8}(24) = -8 + 9 = 1$

$-2 + \frac{3}{8}(6 - 2) = -2 + \frac{3}{8}(8) = -2 + 3 = 1$

18 ANS: 2

$12^2 = 9 \cdot 16$

$144 = 144$

19 ANS: 1

$\sin 32 = \frac{x}{6.2}$

$x \approx 3.3$

20 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: $\frac{12702379}{283.9} \approx 44742$

21 ANS: 4

$40 - x + 3x = 90$

$2x = 50$

$x = 25$
22 ANS: 4
\[
\frac{360^\circ}{10} = 36^\circ \quad 252^\circ \text{ is a multiple of } 36^\circ
\]

PTS: 2 REF: 081722geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

23 ANS: 2
\[
\frac{512\pi}{3} \cdot \frac{4\pi}{3} = \frac{(32\pi)^2}{\pi}
\]

PTS: 2 REF: 081723geo NAT: G.C.B.5 TOP: Sectors

24 ANS: 4
The segment’s midpoint is the origin and slope is \(-2\). The slope of a perpendicular line is \(\frac{1}{2}\).

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

\[
2y = x
\]

\[
2y - x = 0
\]

PTS: 2 REF: 081724geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines
KEY: perpendicular bisector

25 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

26 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

27 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

28 ANS:

PTS: 2 REF: 081728geo NAT: G.CO.D.13 TOP: Constructions
29 ANS:
\[ \sqrt{(2.5 - 1)^2 + (-.5 - 1.5)^2} = \sqrt{2.25 + 4} = 2.5 \]

PTS: 2 REF: 081729geo NAT: G.SRT.A.2 TOP: Dilations

30 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

31 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

32 ANS:
33 ANS:
Circle $O$, tangent $\overline{EC}$ to diameter $\overline{AC}$, chord $\overline{BC}$ || 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); $\overline{EC} \bot \overline{OC}$ (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 REF: 081733geo NAT: G.SRT.B.5 TOP: Circle Proofs

34 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

35 ANS:
Isosceles trapezoid $ABCD$, $\angle CDE \cong \angle DCE$, $\overline{AE} \bot \overline{DE}$, and $\overline{BE} \bot \overline{CE}$ (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); $\angle CDA \cong \angle DCB$ (base angles of an isosceles trapezoid are congruent); $\angle CDA - \angle CDE \cong \angle DCB - \angle DCE$ (subtraction postulate); $\triangle ADE \cong \triangle BCE$ (AAS); $\overline{EA} \cong \overline{EB}$ (CPCTC); $\angle DEA \cong \angle ECA$

$\triangle AEB$ is an isosceles triangle (an isosceles triangle has two congruent sides).


36 ANS:
$\tan 16.5 = \frac{x}{13.5} \quad 9 \times 16 \times 4.5 = 648 \quad 3752 - (35 \times 16 \times 5) = 3472$
$x \approx 4 \quad 13.5 \times 16 \times 4.5 = 972 \quad 3472 \times 7.48 \approx 25971$
$4 + 4.5 = 8.5 \quad \frac{1}{2} \times 13.5 \times 16 \times 4 = 432 \quad \frac{25971}{10.5} \approx 2473.4$
$12.5 \times 16 \times 8.5 = \frac{1700}{3752} \approx 41$

1. \[360 - (82 + 104 + 121) = 53\]

2. \[
\begin{align*}
3\sin \theta &= \frac{O}{129.5} \\
O &= 68.6
\end{align*}
\]

3. \[
\begin{align*}
x &= -5 + \frac{1}{3}(4 - (-5)) = -5 + 3 = -2 \\
y &= 2 + \frac{1}{3}(-10 - 2) = 2 - 4 = -2
\end{align*}
\]

4. \[
\begin{align*}
V &= \frac{1}{3}\pi r^2 h \\
54.45\pi &= \frac{1}{3}\pi(3.3)^2 h \\
h &= 15
\end{align*}
\]

5. \[
\begin{align*}
x - 40 + x + 20 &= 180 - 3x \\
6x &= 200 \\
x &= 20
\end{align*}
\]
11 ANS: 1 PTS: 2 REF: 011811geo NAT: G.SRT.A.2 TOP: Dilations

12 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

13 ANS: 3

\[ \frac{24}{40} = \frac{15}{x} \]
\[ 24x = 600 \]
\[ x = 25 \]

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


15 ANS: 3 PTS: 2 REF: 011815geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself


17 ANS: 4 PTS: 2 REF: 011817geo NAT: G.SRT.B.5 TOP: Similarity KEY: basic

18 ANS: 2

PTS: 2 REF: 011818geo NAT: G.CO.C.9 TOP: Lines and Angles

19 ANS: 4 PTS: 2 REF: 011819geo NAT: G.CO.C.11 TOP: Special Quadrilaterals
20 ANS: 1
\[ m = -\frac{4}{6} = \frac{2}{3} \]
\[ m_{\perp} = -\frac{3}{2} \]

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

21 ANS: 4
Opposite angles of an inscribed quadrilateral are supplementary.

PTS: 2  REF: 011821geo  NAT: G.C.A.3  TOP: Inscribed Quadrilaterals

22 ANS: 2
\[ V = \frac{1}{3} \left( \frac{36}{4} \right)^{\frac{2}{3}} \cdot 15 = 405 \]

PTS: 2  REF: 011822geo  NAT: G.GMD.A.3  TOP: Volume
KEY: pyramids

23 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

24 ANS: 3
\[ \frac{s_L}{s_S} = \frac{6\theta}{4\theta} = 1.5 \]

KEY: arc length

25 ANS:
Parallelogram $ABCD$ with diagonal $AC$ 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
26 ANS:

PTS: 2 REF: 011826geo NAT: G.CO.D.13 TOP: Constructions

27 ANS:

\[ \cos B \text{ increases because } \angle A \text{ and } \angle B \text{ are complementary and } \sin A = \cos B. \]

PTS: 2 REF: 011827geo NAT: G.SRT.C.7 TOP: Cofunctions

28 ANS:

\[ \frac{Q}{360} (\pi) \left( 25^2 \right) = (\pi) \left( 25^2 \right) - 500\pi \]
\[ Q = \frac{125\pi(360)}{625\pi} \]
\[ Q = 72 \]

PTS: 2 REF: 011828geo NAT: G.C.B.5 TOP: Sectors

29 ANS:

\[ 500 \times 1015 \text{ cc} \times \frac{0.29}{\text{kg}} \times \frac{7.95 \text{ g}}{\text{cc}} \times \frac{1 \text{ kg}}{1000 \text{ g}} = \$1170 \]

PTS: 2 REF: 011829geo NAT: G.MG.A.2 TOP: Density

30 ANS:

No. Since \( BC = 5 \) and \( ST = \sqrt{18} \) 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

31 ANS:

\[ \cos W = \frac{6}{18} \]
\[ W \approx 71 \]

PTS: 2 REF: 011831geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find an Angle
32 ANS:
A dilation of 3 centered at \( A \). A dilation preserves angle measure, so the triangles are similar.

PTS: 4 REF: 011832geo NAT: G.SRT.A.2 TOP: Dilations

33 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

34 ANS:
\[ \cos 54 = \frac{4.5}{m} \quad \tan 54 = \frac{h}{4.5} \]
\[ m \approx 7.7 \quad h \approx 6.2 \]

PTS: 4 REF: 011834geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side

35 ANS:
\( \Delta PAT \) 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

\[ (m_{\overline{AR}} = \frac{4}{6} = \frac{2}{3}; \ m_{\overline{PT}} = \frac{4}{6} = \frac{2}{3}; \ m_{\overline{PA}} = -\frac{11}{3}; \ m_{\overline{RT}} = -\frac{11}{3}) \]

PTS: 6 REF: 011835geo NAT: G.GPE.B.4 TOP: Quadrilaterals in the Coordinate Plane

KEY: grids
0618geo
Answer Section

1 ANS: 1 PTS: 2 REF: 061801geo NAT: G.CO.B.6
TOP: Properties of Transformations KEY: graphics

2 ANS: 3 PTS: 2 REF: 061802geo NAT: G.CO.C.9
TOP: Lines and Angles

3 ANS: 4 PTS: 2 REF: 061803geo NAT: G.CO.A.2
TOP: Identifying Transformations KEY: graphics

4 ANS: 3
\[ \triangle CFB \sim \triangle CAD \quad \frac{CB}{CF} = \frac{CD}{CA} \]
\[ \frac{x}{21.6} = \frac{7.2}{9.6} \]
\[ x = 16.2 \]
PTS: 2 REF: 061804geo NAT: G.SRT.B.5 TOP: Similarity KEY: basic

5 ANS: 4
9 \cdot 3 = 27, 27 \cdot 4 = 108
PTS: 2 REF: 061805geo NAT: G.SRT.A.2 TOP: Dilations

6 ANS: 2
\[ \cos B = \frac{17.6}{26} \]
\[ B \approx 47 \]
PTS: 2 REF: 061806geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find an Angle

7 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

8 ANS: 1
2x + 4 + 46 = 90
\[ 2x = 40 \]
\[ x = 20 \]
PTS: 2 REF: 061808geo NAT: G.SRT.C.7 TOP: Cofunctions

9 ANS: 4
AA
PTS: 2 REF: 061809geo NAT: G.SRT.A.3 TOP: Similarity Proofs
10. \[ 82.8 = \frac{1}{3} (4.6)(9)h \]
   \[ h = 6 \]
   \[ \text{PTS: 2} \]
   \[ \text{REF: 061810geo} \]
   \[ \text{NAT: G.GMD.A.3} \]
   \[ \text{TOP: Volume} \]
   \[ \text{KEY: pyramids} \]

11. \[ \triangle ACB \sim \triangle AED \]
   \[ \text{PTS: 2} \]
   \[ \text{REF: 061811geo} \]
   \[ \text{NAT: G.SRT.B.5} \]
   \[ \text{TOP: Similarity} \]
   \[ \text{KEY: basic} \]

12. \[ m = \frac{3}{2} \]
   \[ m_{\perp} = \frac{-2}{3} \]
   \[ \text{PTS: 2} \]
   \[ \text{REF: 061812geo} \]
   \[ \text{NAT: G.GPE.B.5} \]
   \[ \text{TOP: Parallel and Perpendicular Lines} \]
   \[ \text{KEY: write equation of perpendicular line} \]

13. \[ \text{ANS: 4} \]
   \[ \text{PTS: 2} \]
   \[ \text{REF: 061813geo} \]
   \[ \text{NAT: G.CO.C.11} \]
   \[ \text{TOP: Special Quadrilaterals} \]

14. \[ -4 + \frac{2}{5} (1 - 4) = -4 + \frac{2}{5} (5) = -4 + 2 = -2 \]
   \[ -2 + \frac{2}{5} (8 - 2) = -2 + \frac{2}{5} (10) = -2 + 4 = 2 \]
   \[ \text{PTS: 2} \]
   \[ \text{REF: 061814geo} \]
   \[ \text{NAT: G.GPE.B.6} \]
   \[ \text{TOP: Directed Line Segments} \]

15. \[ (12 \cdot 11) - \left( \frac{1}{2} (12 \cdot 4) + \frac{1}{2} (7 \cdot 9) + \frac{1}{2} (11 \cdot 3) \right) = 60 \]
   \[ \text{PTS: 2} \]
   \[ \text{REF: 061815geo} \]
   \[ \text{NAT: G.GPE.B.7} \]
   \[ \text{TOP: Polygons in the Coordinate Plane} \]

16. \[ \text{ANS: 3} \]
   \[ \text{PTS: 2} \]
   \[ \text{REF: 061816geo} \]
   \[ \text{NAT: G.GMD.B.4} \]
   \[ \text{TOP: Rotations of Two-Dimensional Objects} \]
17 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

18 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

19 ANS: 3
\[
\frac{360^\circ}{5} = 72^\circ \quad 216^\circ \text{ is a multiple of } 72^\circ
\]

PTS: 2 REF: 061819geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

20 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

21 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

22 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
23. \(24x = 10^2\) 
\(24x = 100\) 
\(x \approx 4.2\)

PTS: 2  REF: 061823geo  NAT: G.SRT.B.5  TOP: Similarity
KEY: leg

24. 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

25. Yes, as translations do not change angle measurements.

KEY: basic

26. \(A(-2,1) \rightarrow (-3,-1) \rightarrow (-6,-2) \rightarrow (-5,0),\ B(0,5) \rightarrow (-1,3) \rightarrow (-2,6) \rightarrow (-1,8),\ C(4,-1) \rightarrow (3,-3) \rightarrow (6,-6) \rightarrow (7,-4)\)

PTS: 2  REF: 061826geo  NAT: G.SRT.A.2  TOP: Dilations

27. Reflection across the \(y\)-axis, then translation up 5.

PTS: 2  REF: 061827geo  NAT: G.CO.A.5  TOP: Compositions of Transformations
KEY: grids

28. \(10 \cdot 6 = 15x\) 
\(x = 4\)

PTS: 2  REF: 061828geo  NAT: G.C.A.2  TOP: Chords, Secants and Tangents
KEY: secants drawn from common point, length

29. Yes. The triangles are congruent because of SSS \(5^2 + 12^2 = 13^2\). All congruent triangles are similar.

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

30. 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
31 ANS:

\[ V = \frac{4}{3} \pi \left( \frac{29.5}{2\pi} \right)^3 \approx 434 \]

PTS: 2 REF: 061831geo NAT: G.GMD.A.3 TOP: Volume

KEY: spheres

32 ANS:

Because \( AB \cong AC \), \( \triangle ABC \) has two congruent sides and is isosceles. Because \( AB \cong BC \) is not true, \( \triangle ABC \) has sides that are not congruent and \( \triangle ABC \) is not equilateral.

PTS: 4 REF: 061832geo NAT: G.GPE.B.4 TOP: Triangles in the Coordinate Plane

KEY: advanced

33 ANS:

\[
\begin{align*}
\tan 72 &= \frac{x}{400} \\
\sin 55 &= \frac{400\tan 72}{y} \\
x &= 400\tan 72 \\
y &= \frac{400\tan 72}{\sin 55} \approx 1503
\end{align*}
\]

PTS: 4 REF: 061833geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side

KEY: advanced

34 ANS:

\[ V = \pi (10)^2 (18) = 1800\pi \text{ in}^3 \approx \frac{1}{12} \frac{25}{24} \pi \text{ ft}^3 \frac{25}{24} \pi (95.46)(0.85) \approx 266 \approx 266 + 270 = 536 \]

PTS: 4 REF: 061834geo NAT: G.MG.A.2 TOP: Density

35 ANS:

Parallelogram \( ABCD \), \( BF \perp AFD \), and \( DE \perp BEC \) (given); \( BC \parallel AD \) (opposite sides of a \( \square \) are \( \parallel \)); \( BE \parallel FD \) (parts of \( \parallel \) lines are \( \parallel \)); \( BF \parallel DE \) (two lines \( \perp \) to the same line are \( \parallel \)); \( BEDF \) is \( \square \) (a quadrilateral with both pairs of opposite sides \( \parallel \) is a \( \square \)); \( \angle DEB \) is a right \( \angle \) (\( \perp \) lines form right \( \angle \)s); \( BEDF \) is a rectangle (a \( \square \) with one right \( \angle \) is a rectangle).

1. ANS: 4  PTS: 2  REF: 081801geo  NAT: G.CO.C.9
   TOP: Lines and Angles

2. ANS: 1
   Distance and angle measure are preserved after a reflection and translation.
   KEY: basic

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

4. ANS: 1  PTS: 2  REF: 081804geo  NAT: G.SRT.A.2
   TOP: Compositions of Transformations  KEY: grids

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

6. ANS: 4
   \[
   \sin 16.5 = \frac{8}{x} \\
   x \approx 28.2
   \]
   PTS: 2  REF: 081806ai  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find a Side

7. ANS: 3
   \[
   x(x - 6) = 4^2 \\
   x^2 - 6x - 16 = 0 \\
   (x - 8)(x + 2) = 0 \\
   x = 8
   \]
   PTS: 2  REF: 081807geo  NAT: G.SRT.B.5  TOP: Similarity
   KEY: altitude

8. ANS: 4
   \[
   4\sqrt{(-1 - 2)^2 + (2 - 3)^2} = 4\sqrt{10}
   \]
   PTS: 2  REF: 081808geo  NAT: G.GPE.B.7  TOP: Polygons in the Coordinate Plane

9. ANS: 1
   \[
   \cos x = \frac{12}{13} \\
   x \approx 23
   \]
   PTS: 2  REF: 081809ai  NAT: G.SRT.C.8  TOP: Using Trigonometry to Find an Angle

    TOP: Triangle Proofs  KEY: statements
11 ANS: 1

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

12 ANS: 2

\[
\frac{x}{x + 3} = \frac{14}{21} \quad 14 - 6 = 8
\]

\[
21x = 14x + 42
\]

\[
7x = 42
\]

\[
x = 6
\]

PTS: 2 REF: 081812geo NAT: G.SRT.B.5 TOP: Side Splitter Theorem


14 ANS: 2

PTS: 2 REF: 081814geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents
KEY: tangents drawn from common point, length

15 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.5 TOP: Directed Line Segments

16 ANS: 3

\[
\frac{x}{6.3} = \frac{3}{5} \quad \frac{y}{9.4} = \frac{6.3}{6.3 + 3.78}
\]

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

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

17 ANS: 3 PTS: 2 REF: 081817geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself
18 \text{ ANS: } 2
\frac{30}{360} (5)^2 (\pi) \approx 6.5

\text{PTS: } 2 \quad \text{REF: } 081818\text{geo} \quad \text{NAT: } G.C.B.5 \quad \text{TOP: } \text{Sectors}

19 \text{ ANS: } 2
V = \frac{1}{3} \left(\frac{60}{12}\right)^2 \left(\frac{84}{12}\right) \approx 58

\text{PTS: } 2 \quad \text{REF: } 081819\text{geo} \quad \text{NAT: } G.GMD.A.3 \quad \text{TOP: } \text{Volume}
\text{KEY: } \text{pyramids}

20 \text{ ANS: } 2
\overline{AB} = 10 \text{ since } \triangle ABC \text{ is a 6-8-10 triangle. } 6^2 = 10x
3.6 = x

\text{PTS: } 2 \quad \text{REF: } 081820\text{geo} \quad \text{NAT: } G.SRT.B.5 \quad \text{TOP: } \text{Similarity}
\text{KEY: } \text{leg}

21 \text{ ANS: } 4
x^2 + 4x + 4 + y^2 - 8y + 16 = -16 + 4 + 16
(x + 2)^2 + (y - 4)^2 = 4

\text{PTS: } 2 \quad \text{REF: } 081821\text{geo} \quad \text{NAT: } G.GPE.A.1 \quad \text{TOP: } \text{Equations of Circles}
\text{KEY: } \text{completing the square}

22 \text{ ANS: } 4 \quad \text{PTS: } 2
\text{REF: } 081822\text{geo} \quad \text{NAT: } G.CO.C.10
\text{TOP: } \text{Medians, Altitudes and Bisectors}

23 \text{ ANS: } 3
6 \cdot 3^2 = 54 \quad 12 \cdot 3 = 36

\text{PTS: } 2 \quad \text{REF: } 081823\text{geo} \quad \text{NAT: } G.SRT.A.2 \quad \text{TOP: } \text{Dilations}

24 \text{ ANS: } 2
2x + 7 + 4x - 7 = 90
6x = 90
x = 15

\text{PTS: } 2 \quad \text{REF: } 081824\text{geo} \quad \text{NAT: } G.SRT.C.7 \quad \text{TOP: } \text{Cofunctions}
25 ANS:

![Diagram of parallel and perpendicular lines]

PTS: 2  REF: 081825geo  NAT: G.CO.D.12  TOP: Constructions
KEY: parallel and perpendicular lines

26 ANS:

![Diagram of parallelogram]

PTS: 2  REF: 081826geo  NAT: G.CO.C.11  TOP: Parallelograms

27 ANS:

\[
\frac{134 + 102}{2} = 118
\]

PTS: 2  REF: 081827geo  NAT: G.C.A.2  TOP: Chords, Secants and Tangents
KEY: intersecting chords, angle

28 ANS:
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

PTS: 2  REF: 081828geo  NAT: G.CO.A.5  TOP: Compositions of Transformations
KEY: identify
\[ \triangle ABC \sim \triangle AED \text{ by AA.} \quad \angle DAE \cong \angle CAB \text{ because they are the same } \angle. \]
\[ \angle DEA \cong \angle CBA \text{ because they are both right } \angle \text{s.} \]

**30 ANS:**

No, The line \( 4x + 3y = 24 \) passes through the center of dilation, so the dilated line is not distinct.

\[ 4x + 3y = 24 \]
\[ 3y = -4x + 24 \]
\[ y = -\frac{4}{3}x + 8 \]

**31 ANS:**

\[ 2 \left( \frac{36}{12} \times \frac{36}{12} \times \frac{4}{12} \right) \times 3.25 = 19.50 \]

**32 ANS:**

2 Reflexive; 4 \( \angle BDA \equiv \angle BDC \); 6 CPCTC; 7 If points \( B \) and \( D \) are equidistant from the endpoints of \( \overline{AC} \), then \( B \) and \( D \) are on the perpendicular bisector of \( \overline{AC} \).

**33 ANS:**

\[ \tan 36 = \frac{x}{10} \quad \cos 36 = \frac{10}{y} \quad 12.3607 \times 3 \approx 37 \]
\[ x \approx 7.3 \quad y \approx 12.3607 \]

**34 ANS:**

\[ \frac{4\pi}{3} (2^3 - 1.5^3) \approx 19.4 \quad 19.4 \cdot 1.308 \cdot 8 \approx 203 \]

**KEY:** basic, prisms, proof, volume, line dilations, triangle proofs, using trigonometry to find a side, density.
\[ m_{MH} = \frac{6}{10} = \frac{3}{5}, \quad m_{AT} = \frac{6}{10} = \frac{3}{5}, \quad m_{MA} = -\frac{5}{3}, \quad m_{HT} = -\frac{5}{3}; \quad MH \parallel AT \text{ and } MA \parallel HT. \]

*MATH* is a parallelogram since both sides of opposite sides are parallel. \( m_{MA} = -\frac{5}{3}, m_{AT} = \frac{3}{5} \). 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.