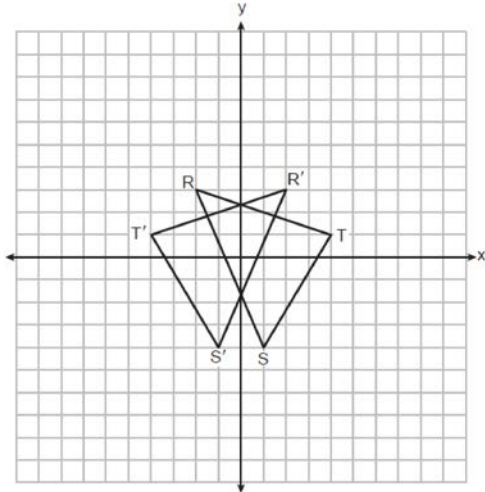


0126geo

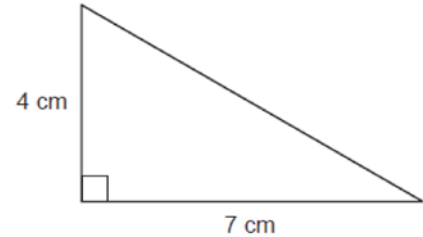
- 1 On the set of axes below, $\triangle RST$ and its image, $\triangle R'S'T'$, are graphed.



Which rigid motion is sufficient to prove $\triangle RST \cong \triangle R'S'T'$?

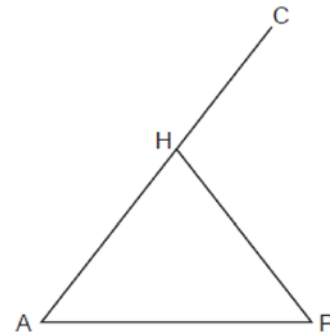
- 1) a rotation of 90° clockwise about the origin
 - 2) a translation 4 units to the right
 - 3) a reflection over the x -axis
 - 4) a reflection over the y -axis
- 2 Which regular polygon would carry onto itself after a rotation of 60° about its center?
- 1) pentagon
 - 2) hexagon
 - 3) octagon
 - 4) decagon

- 3 The right triangle below is continuously rotated about the 4 cm side.



The solid formed is

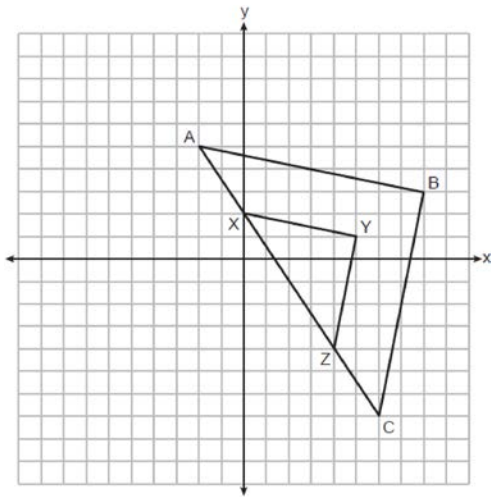
- 1) a cone with a height of 4 cm and a radius of 7 cm
 - 2) a cone with a height of 4 cm and a radius of 14 cm
 - 3) a pyramid with a height of 4 cm and a base length of 7 cm
 - 4) a pyramid with a height of 4 cm and a base length of 14 cm
- 4 In isosceles triangle AHP below, $\overline{AH} \cong \overline{PH}$, and \overline{AH} is extended through H to C .



If $m\angle A = (2x + 12)^\circ$ and $m\angle P = (3x - 8)^\circ$, what is the measure of $\angle CHP$?

- 1) 52°
- 2) 76°
- 3) 104°
- 4) 128°

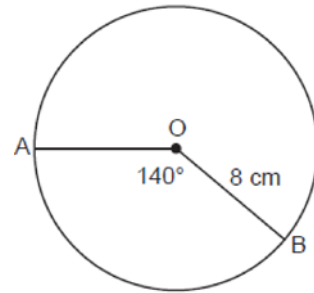
- 5 In the diagram below, $\triangle XYZ$ is the image of $\triangle ABC$ after a dilation of scale factor $\frac{1}{2}$.



Which point must be the center of dilation?

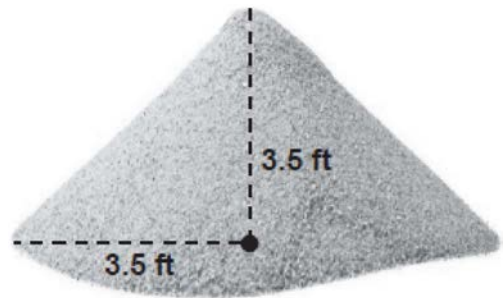
- 1) $(2, -1)$
 - 2) $(8, 3)$
 - 3) $(5, 1)$
 - 4) $(0, 0)$
- 6 In a right triangle, the acute angles have the relationship $\cos(5x + 7)^\circ = \sin(3x + 3)^\circ$. Which equation is always true?
- 1) $5x + 7 = 3x + 3$
 - 2) $5x + 7 + 3x + 3 = 90$
 - 3) $5x + 7 + 3x + 3 = 180$
 - 4) $5x + 7 + 3x + 3 + x = 180$

- 7 In the diagram below, circle O has a radius of 8 cm and a central angle that measures 140° .



What is the length of \widehat{AB} , to the nearest centimeter?

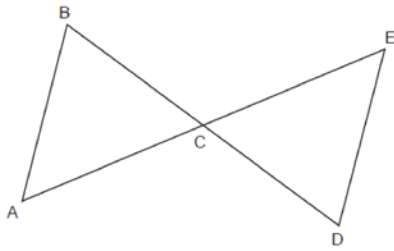
- 1) 10
 - 2) 20
 - 3) 25
 - 4) 78
- 8 Lucy wants to use a wagon to move a pile of sand in as few trips as possible. The pile of sand can be modeled by a cone, as shown below. The height and radius of the sandpile are both 3.5 feet.



If the wagon holds 5 cubic feet of sand, what is the fewest number of trips Lucy needs to make to move the entire pile of sand?

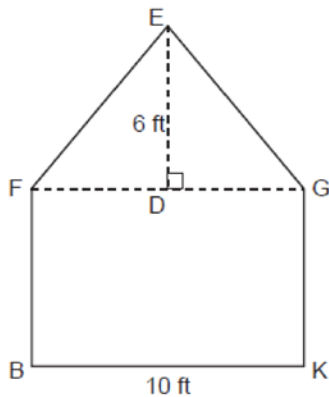
- 1) 27
- 2) 14
- 3) 3
- 4) 9

- 9 In the diagram below, \overline{BD} and \overline{AE} intersect at C , and \overline{AB} and \overline{DE} are drawn.



If $\overline{AB} \parallel \overline{DE}$, which statement is *not* always true?

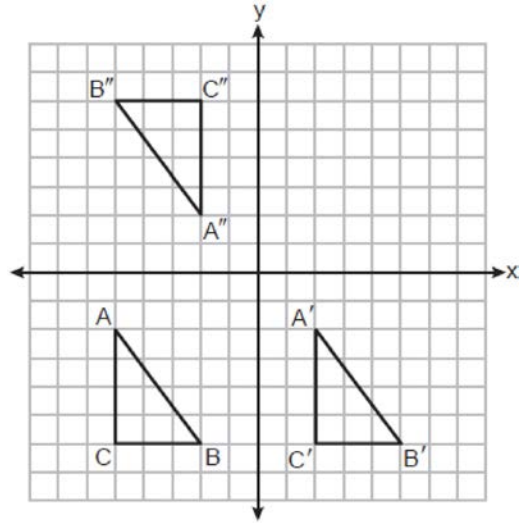
- 1) $\angle ABC \cong \angle EDC$
 - 2) $\angle ACB \cong \angle ECD$
 - 3) $\triangle ABC \sim \triangle EDC$
 - 4) $\triangle ABC \cong \triangle EDC$
- 10 The face of a shed is modeled below. The rectangular section of the face, $BFGK$, is 10 feet wide. The triangular section of the face, FEG , is an isosceles triangle with vertex angle FEG and a height of 6 feet.



What is $m\angle EGD$, to the nearest degree?

- 1) 34°
- 2) 40°
- 3) 50°
- 4) 56°

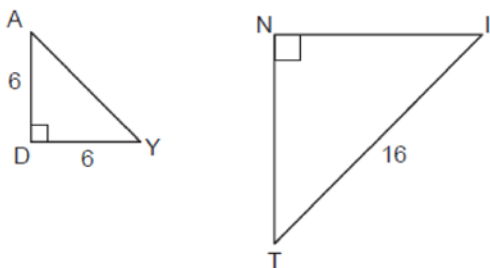
- 11 Triangles ABC , $A'B'C'$, and $A''B''C''$ are graphed on the set of axes below.



Which sequence of transformations maps $\triangle ABC$ onto $\triangle A'B'C'$, and then maps $\triangle A'B'C'$ onto $\triangle A''B''C''$.

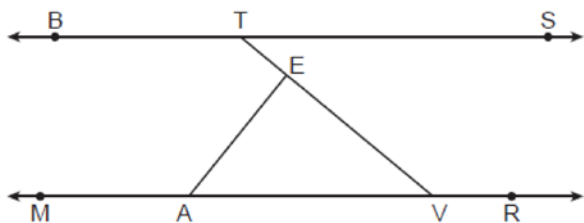
- 1) a translation followed by a rotation
 - 2) a rotation followed by a translation
 - 3) a line reflection followed by a rotation
 - 4) a translation followed by a line reflection
- 12 A line contains the points $(-1, -4)$ and $(3, -1)$. An equation of a line perpendicular to this line is
- 1) $y + 4 = \frac{3}{4}(x + 1)$
 - 2) $y - 4 = \frac{4}{3}(x - 1)$
 - 3) $y - 1 = -\frac{3}{4}(x + 3)$
 - 4) $y + 1 = -\frac{4}{3}(x - 3)$

- 13 In the diagram below of right triangles DAY and NIT , $AD = 6$, $DY = 6$, $IT = 16$, and $\triangle DAY \sim \triangle NIT$.



The length of \overline{TN} is

- 1) 8
 - 2) $8\sqrt{2}$
 - 3) $8\sqrt{3}$
 - 4) $16\sqrt{2}$
- 14 The volume of a sphere is 333 cm^3 . To the *nearest tenth of a centimeter*, the diameter of the sphere is
- 1) 4.3
 - 2) 5.2
 - 3) 8.6
 - 4) 10.4
- 15 Line BTS is parallel to line $MAVR$, as shown in the diagram below, and $AE \perp TV$.

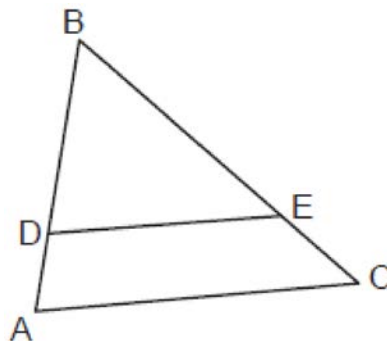


If $m\angle STE = 38^\circ$, what is the measure of $\angle VAE$?

- 1) 38°
- 2) 52°
- 3) 128°
- 4) 142°

- 16 Segment RAZ has endpoints with coordinates $R(6,6)$ and $Z(-12,-3)$. If A divides \overline{RZ} such that $RA:AZ = 5:4$, then the coordinates of A are
- 1) $(-6,0)$
 - 2) $(-2,2)$
 - 3) $(0,3)$
 - 4) $(-4,1)$

- 17 In $\triangle ABC$ below, points D and E are on \overline{AB} and \overline{CB} respectively, such that $\overline{DE} \parallel \overline{AC}$.



If $BD = 9$, $DA = 3$, and $EC = 4$, what is the length of \overline{BC} ?

- 1) 10
 - 2) 12
 - 3) 14
 - 4) 16
- 18 Triangle ABC is mapped onto $A'B'C'$ after a sequence of rigid motions. Which statement is always true?
- 1) Segment AB is parallel to segment $A'B'$.
 - 2) Segment AB is congruent to segment $A'B'$.
 - 3) The measure of angle A is the same as the measure of angle B' .
 - 4) The orientation of $\triangle ABC$ is the same as the orientation of $\triangle A'B'C'$.

19 What are the coordinates of the center and the length of the radius of the circle whose equation is $x^2 - 16x + y^2 + 20y = -155$?

- 1) center $(8, -10)$ and radius 9
- 2) center $(-8, 10)$ and radius 9
- 3) center $(8, -10)$ and radius 3
- 4) center $(-8, 10)$ and radius 3

20 State populations and land areas from the 2020 US Census are shown in the table below.

2020 State Population and Land Area		
State	Population	Land Area (mi ²)
Connecticut	3,605,944	4,842
New Jersey	9,288,994	7,354
New York	20,201,249	47,126
Pennsylvania	13,002,700	44,743

Which list shows the state population densities, in order from smallest to largest?

- 1) Pennsylvania, New York, Connecticut,
- 2) Connecticut, New Jersey, Pennsylvania,
- 3) New York, Pennsylvania, New Jersey, Connecticut
- 4) New Jersey, Connecticut, New York, Pennsylvania

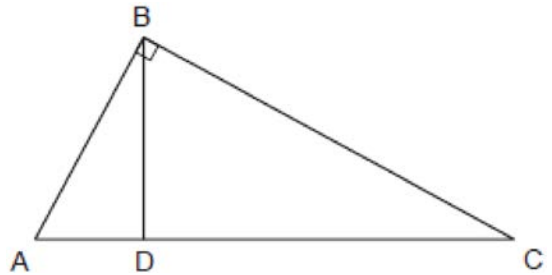
21 Line t is represented by the equation $y = 2x - 1$. If the line is dilated by a scale factor of 3 centered at the origin, which equation represents the image of line t after the dilation?

- 1) $y = 2x - 3$
- 2) $y = 6x - 3$
- 3) $y = 2x - 1$
- 4) $y = 6x - 1$

22 Quadrilateral $ABCD$ is a parallelogram. Which additional statement is sufficient to prove $ABCD$ is a rhombus?

- 1) $\overline{AB} \cong \overline{CD}$
- 2) $\overline{AD} \parallel \overline{BC}$
- 3) $\overline{AD} \cong \overline{DC}$
- 4) $\angle ADC \cong \angle ABC$

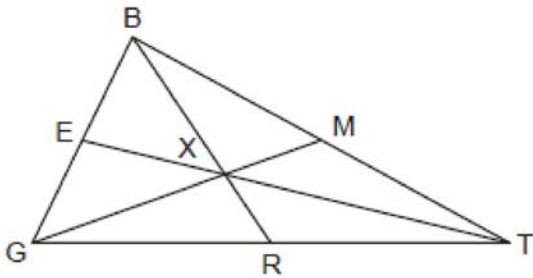
23 In right triangle ABC below, $m\angle ABC = 90^\circ$, and $\overline{BD} \perp \overline{AC}$.



If $AD = 3$ and $CD = 12$, the length of \overline{AB} is

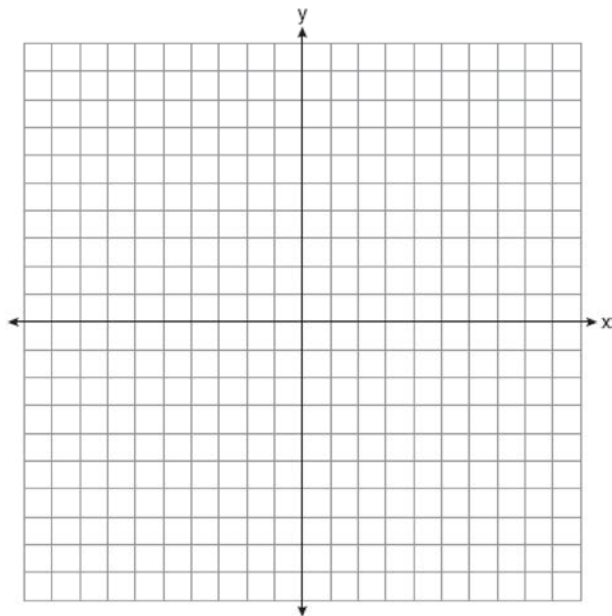
- 1) 6
- 2) 9
- 3) $3\sqrt{5}$
- 4) $5\sqrt{3}$

- 24 In $\triangle GBT$ shown below, \overline{GXM} , \overline{BXR} , and \overline{TXE} are drawn such that point X is the centroid.



Which statement is always true?

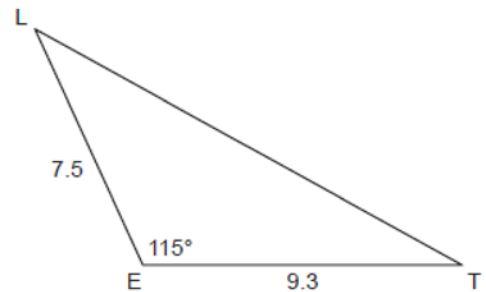
- 1) $\frac{MX}{GX} = \frac{1}{3}$
 - 2) $\frac{TX}{EX} = \frac{2}{1}$
 - 3) $\overline{BX} \cong \overline{RX}$
 - 4) $\overline{TM} \cong \overline{TR}$
- 25 A triangle has vertices with coordinates $(2, 1)$, $(0, 3)$, and $(-2, -1)$. Determine and state the coordinates of the vertices of the image of the triangle after a reflection over the x -axis followed by a translation of 3 units to the right and 2 units down. [The use of the set of axes below is optional.]



- 26 A cylindrical bucket is being used to transport topsoil. The bucket has an inside diameter of 10 inches and a height of 15 inches. If the topsoil weighs 0.0231 pound per cubic inch, determine and state the weight of the topsoil in the bucket when the bucket is full, to the *nearest pound*.

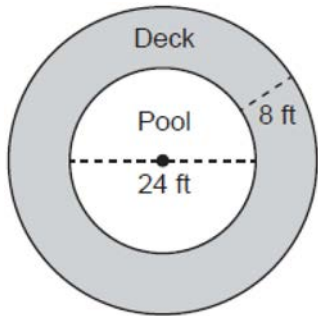
- 27 In right triangle SRT , $m\angle R = 90^\circ$, $m\angle S = 27^\circ$, and $ST = 31.8$. Determine and state the length of \overline{SR} , to the *nearest tenth*.

- 28 In $\triangle LET$ below, $LE = 7.5$, $ET = 9.3$, and $m\angle LET = 115^\circ$.



Determine and state the area of $\triangle LET$, to the *nearest tenth*.

- 29 A pool owner has a circular deck that surrounds her circular pool, as modeled in the diagram below. The pool has a diameter of 24 feet. The distance from the edge of the pool to the outer edge of the deck is 8 feet.

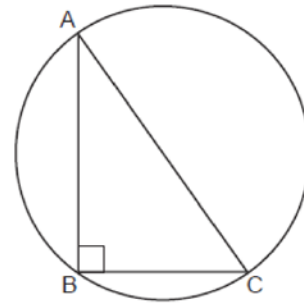


Determine and state the number of square feet of the deck, to the nearest square foot.

- 30 Use a compass and straightedge to construct an equilateral triangle with \overline{AB} , shown below, as one of the sides. [Leave all construction marks.]

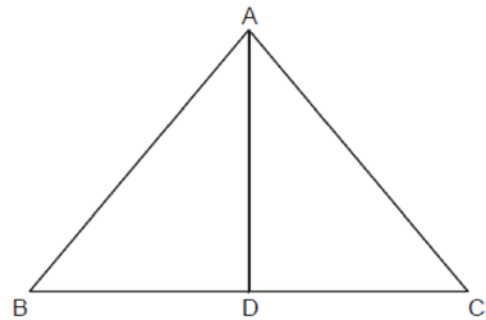


- 31 In the diagram below, right triangle ABC is inscribed in the circle with right angle ABC .



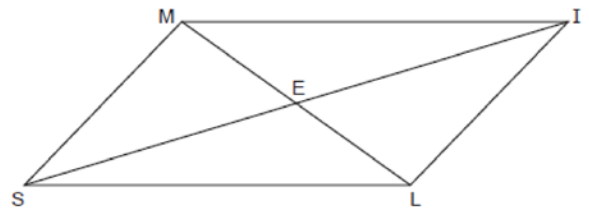
Explain why \overline{AC} must be a diameter of the circle.

- 32 In isosceles triangle ABC below, \overline{AD} is an altitude drawn to base \overline{BC} .



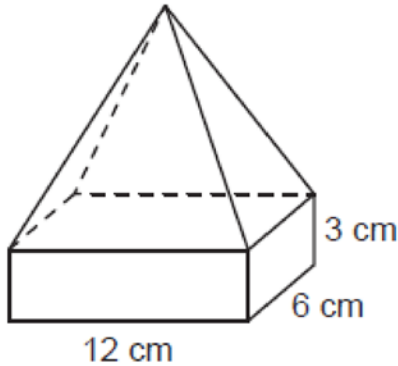
If $m\angle BAC = 80^\circ$ and $AD = 8$, determine and state the perimeter of $\triangle ABC$, to the nearest tenth.

- 33 In quadrilateral $SMIL$ below, diagonals \overline{IS} and \overline{ML} intersect at point E , $\overline{MS} \parallel \overline{IL}$, and $\overline{MS} \cong \overline{IL}$.



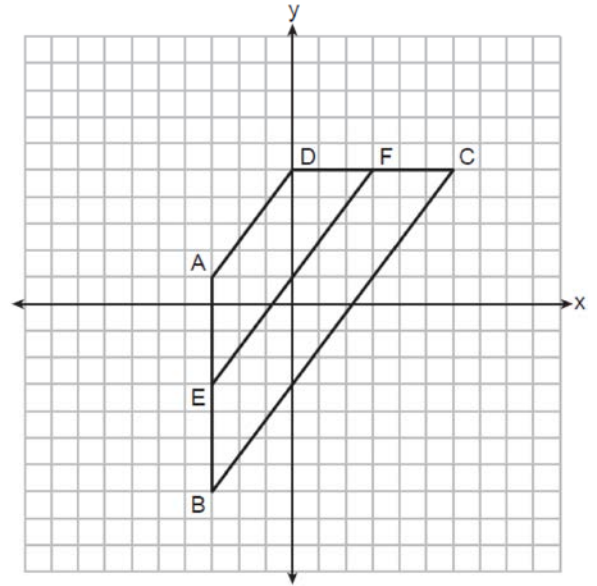
Prove: $\triangle MIE \cong \triangle LSE$

- 34 A solid glass trophy is composed of a rectangular prism and a rectangular pyramid, as modeled below. The rectangular prism has a length of 12 centimeters, a width of 6 centimeters, and a height of 3 centimeters.



The height of the pyramid is 10 centimeters. If the density of glass is 2.5 grams per cubic centimeter, determine and state the mass of the trophy, in grams.

- 35 Quadrilateral $ABCD$ is graphed on the set of axes below, with vertices at coordinates $A(-3, 1)$, $B(-3, -7)$, $C(6, 5)$, and $D(0, 5)$. Segment EF is graphed with endpoints at coordinates $E(-3, -3)$ and $F(3, 5)$.



Prove $ABCD$ is a trapezoid. Use coordinate geometry to prove \overline{EF} is parallel to \overline{AD} and \overline{BC} . Is $EF = \frac{1}{2}(AD + BC)$? Use coordinate geometry to justify your answer.

0126geo

Answer Section

1 ANS: 4 PTS: 2 REF: 012601geo NAT: G.CO.A.2
TOP: Identifying Transformations

2 ANS: 2
 $\frac{360}{6} = 60$

PTS: 2 REF: 012602geo NAT: G.CO.A.3 TOP: Mapping a Polygon onto Itself

3 ANS: 1 PTS: 2 REF: 012603geo NAT: G.GMD.B.4
TOP: Rotations of Two-Dimensional Objects

4 ANS: 3
 $2x + 12 = 3x - 8 \quad m\angle A = m\angle P = 2(20) + 12 = 3(20) - 8 = 52$
 $20 = x$

PTS: 2 REF: 012604geo NAT: G.CO.C.10 TOP: Exterior Angle Theorem

5 ANS: 1

$$x_0 = \frac{kx_1 - x_2}{k - 1} = \frac{\frac{1}{2}(-2) - 0}{\frac{1}{2} - 1} = \frac{-1}{-\frac{1}{2}} = 2 \quad y_0 = \frac{ky_1 - y_2}{k - 1} = \frac{\frac{1}{2}(5) - 2}{\frac{1}{2} - 1} = \frac{\frac{1}{2}}{-\frac{1}{2}} = -1$$

PTS: 2 REF: 012605geo NAT: G.SRT.A.2 TOP: Dilations

6 ANS: 2
Sine and cosine are cofunctions.

PTS: 2 REF: 012606geo NAT: G.SRT.C.7 TOP: Cofunctions

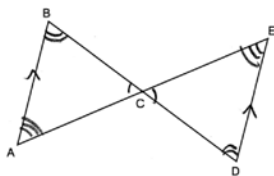
7 ANS: 2
 $\frac{140}{360} \cdot 16\pi \approx 20$

PTS: 2 REF: 012607geo NAT: G.C.B.5 TOP: Arc Length

8 ANS: 4
 $\frac{\frac{1}{3}\pi(3.5)^2(3.5)}{5} \approx 9$

PTS: 2 REF: 012608geo NAT: G.GMD.A.3 TOP: Volume
KEY: cones

9 ANS: 4



PTS: 2 REF: 012609geo NAT: G.SRT.B.5 TOP: Triangle Proofs
KEY: statements

10 ANS: 3

$$\tan x = \frac{6}{5}$$

$$x \approx 50^\circ$$

PTS: 2 REF: 012610geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find an Angle

11 ANS: 1 PTS: 2 REF: 012611geo NAT: G.CO.A.5

TOP: Compositions of Transformations

12 ANS: 4

$$m = \frac{-4 - (-1)}{-1 - 3} = \frac{-3}{-4} = \frac{3}{4}$$

$$m_{\perp} = -\frac{4}{3}$$

PTS: 2 REF: 012612geo NAT: G.GPE.B.5 TOP: Parallel and Perpendicular Lines

KEY: write equation of perpendicular line

13 ANS: 2

$$\frac{16}{x} = \frac{\sqrt{6^2 + 6^2}}{6}$$

$$\sqrt{72}x = 96$$

$$6\sqrt{2}x = 96$$

$$x = \frac{96}{6\sqrt{2}} = \frac{16}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = 8\sqrt{2}$$

PTS: 2 REF: 012613geo NAT: G.SRT.B.5 TOP: Similarity

KEY: basic

14 ANS: 3

$$333 = \frac{4}{3}\pi r^3$$

$$4.3 \approx r$$

$$8.6 \approx r$$

PTS: 2 REF: 012614geo NAT: G.GMD.A.3 TOP: Volume

KEY: spheres

15 ANS: 2

$$180 - (90 + 38) = 180 - 128 = 52$$

PTS: 2 REF: 012615geo NAT: G.CO.C.9 TOP: Lines and Angles

16 ANS: 4

$$6 + \frac{5}{9}(-12 - 6) = 6 + \frac{5}{9}(-18) = 6 - 10 = -4 \quad 6 + \frac{5}{9}(-3 - 6) = 6 + \frac{5}{9}(-9) = 6 - 5 = 1$$

PTS: 2 REF: 012616geo NAT: G.GPE.B.6 TOP: Directed Line Segments

17 ANS: 4

$$\frac{x}{9} = \frac{x+4}{12}$$

$$12x = 9x + 36$$

$$3x = 36$$

$$x = 12$$

PTS: 2 REF: 012617geo NAT: G.SRT.B.4 TOP: Side Splitter Theorem

18 ANS: 2 PTS: 2 REF: 012618geo NAT: G.CO.B.6

TOP: Properties of Transformations

19 ANS: 3

$$x^2 - 16x + 64 + y^2 + 20y + 100 = -155 + 64 + 100$$

$$(x - 8)^2 + (y + 10)^2 = 9$$

PTS: 2 REF: 012619geo NAT: G.GPE.A.1 TOP: Equations of Circles

KEY: completing the square

20 ANS: 1

$$\text{Pennsylvania: } \frac{13002700}{44743} \approx 291 \quad \text{New York: } \frac{20201249}{47126} \approx 429, \quad \text{Connecticut: } \frac{3605944}{4842} \approx 745, \quad \text{New Jersey:}$$

$$\frac{9288994}{7354} \approx 1263$$

PTS: 2 REF: 012620geo NAT: G.MG.A.2 TOP: Density

21 ANS: 1 PTS: 2 REF: 012621geo NAT: G.SRT.A.1

TOP: Line Dilations

22 ANS: 3 PTS: 2 REF: 012622geo NAT: G.CO.C.11

TOP: Special Quadrilaterals

23 ANS: 3

$$x^2 = 3(3 + 12)$$

$$x = \sqrt{45} = 3\sqrt{5}$$

PTS: 2 REF: 012623geo NAT: G.SRT.B.4 TOP: Similarity

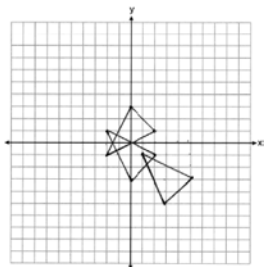
24 ANS: 2

A centroid cuts each median 2:1.

PTS: 2 REF: 012624geo NAT: G.SRT.B.4

TOP: Centroid, Orthocenter, Incenter and Circumcenter

25 ANS:


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

PTS: 2 REF: 012625geo NAT: G.CO.A.5 TOP: Compositions of Transformations

26 ANS:

$$\pi \left(\frac{10}{2} \right)^2 (15)(0.0231) \approx 27$$

PTS: 2 REF: 012626geo NAT: G.MG.A.2 TOP: Density

27 ANS:

$$\cos 27 = \frac{x}{31.8}$$

$$x \approx 28.3$$

PTS: 2 REF: 012627geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side

28 ANS:

$$\frac{1}{2} \cdot 7.5 \cdot 9.3 \sin 115 \approx 31.6$$

PTS: 2 REF: 012628geo NAT: G.SRT.D.9 TOP: Using Trigonometry to Find Area

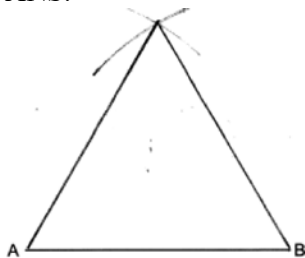
29 ANS:

$$20^2 \pi - 12^2 \pi \approx 804$$

PTS: 2 REF: 012629geo NAT: G.MG.A.3 TOP: Compositions of Polygons and Circles

KEY: area

30 ANS:



PTS: 2 REF: 012630geo NAT: G.CO.D.12 TOP: Constructions
KEY: polygons

31 ANS:

Since $\angle B$ is a right angle, \widehat{AC} is subtended by $\angle B$ and measures 180° . A diameter has a measure of 180° .

PTS: 2 REF: 012631geo NAT: G.C.A.2 TOP: Chords, Secants and Tangents
KEY: inscribed

32 ANS:

$$BD = DC \quad AB = BC = \sqrt{8^2 + 6.713^2} \approx 10.4434 \quad 2(6.713) + 2(10.4434) \approx 34.3$$

$$\tan 40 = \frac{x}{8}$$

$$x \approx 6.713$$

PTS: 2 REF: 012632geo NAT: G.SRT.C.8 TOP: Using Trigonometry to Find a Side

33 ANS:

Quadrilateral $SMIL$, diagonals \overline{IS} and \overline{ML} intersect at point E , $\overline{MS} \parallel \overline{IL}$, and $\overline{MS} \cong \overline{IL}$ (given); $SMIL$ is a parallelogram (A quadrilateral with parallel and congruent opposite sides is a parallelogram); $\overline{MI} \parallel \overline{LS}$ and $\overline{MI} \cong \overline{LS}$ (Opposite sides of a parallelogram are parallel and congruent); $\angle IMS \cong \angle SLE$ (Alternative interior angles formed by a transversal and parallel lines are congruent); $\angle MEI \cong \angle LES$ (Vertical angles are congruent); $\triangle MIE \cong \triangle LSE$ (AAS)

PTS: 4 REF: 012633geo NAT: G.SRT.B.5 TOP: Quadrilateral Proofs

34 ANS:

$$\left[(12)(6)(3) + \frac{1}{3} (12)(6)(10) \right] \times 2.5 = 1140$$

PTS: 4 REF: 012634geo NAT: G.MG.A.2 TOP: Density

35 ANS:

$m_{\overline{AD}} = \frac{5-1}{0--3} = \frac{4}{3}$ $m_{\overline{BC}} = \frac{5--7}{6--3} = \frac{12}{9} = \frac{4}{3}$ Since quadrilateral $ABCD$ has a pair of parallel opposite sides, it is a trapezoid. $m_{\overline{EF}} = \frac{5--3}{3--3} = \frac{8}{6} = \frac{4}{3}$ Since \overline{EF} , \overline{AD} and \overline{BC} have the same slope, they are parallel.

$$EF = \sqrt{(-3-3)^2 + (-3-5)^2} = \sqrt{36+64} = 10, AD = \sqrt{(-3-0)^2 + (1-5)^2} = \sqrt{9+16} = 5,$$

$$BC = \sqrt{(6--3)^2 + (5--7)^2} = \sqrt{81+144} = 15, 10 = \frac{1}{2}(5+15)$$

PTS: 6

REF: 012635geo

NAT: G.GPE.B.4

TOP: Quadrilaterals in the Coordinate Plane