

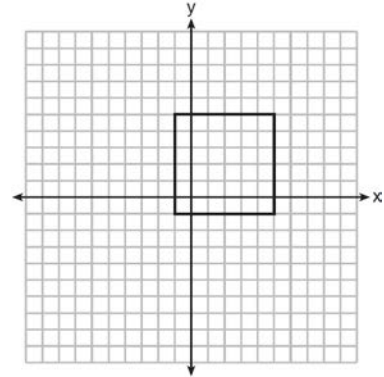
0815geo

- 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?



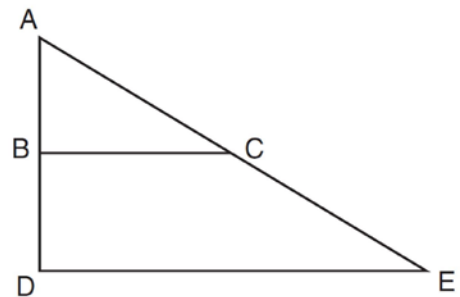
- 1) pyramid
  - 2) rectangular prism
  - 3) cone
  - 4) cylinder
- 
- 4 Which expression is always equivalent to  $\sin x$  when  $0^\circ < x < 90^\circ$ ?
    - 1)  $\cos(90^\circ - x)$
    - 2)  $\cos(45^\circ - x)$
    - 3)  $\cos(2x)$
    - 4)  $\cos x$

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



A reflection over which line does *not* carry the square onto itself?

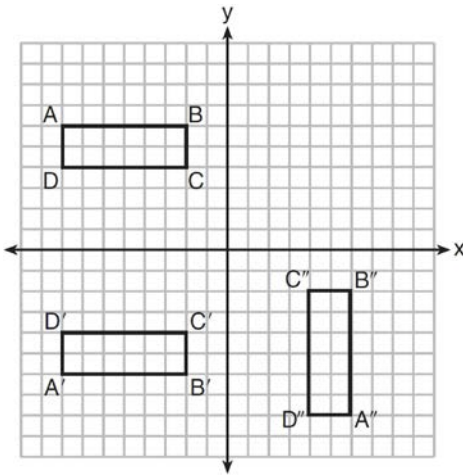
- 1)  $x = 5$
  - 2)  $y = 2$
  - 3)  $y = x$
  - 4)  $x + y = 4$
- 
- 6 The image of  $\triangle ABC$  after a dilation of scale factor  $k$  centered at point  $A$  is  $\triangle ADE$ , as shown in the diagram below.



Which statement is always true?

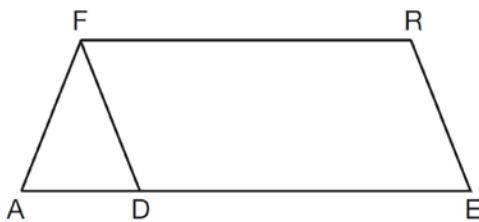
- 1)  $\overline{2AB} = \overline{AD}$
- 2)  $\overline{AD} \perp \overline{DE}$
- 3)  $\overline{AC} = \overline{CE}$
- 4)  $\overline{BC} \parallel \overline{DE}$

- 7 A sequence of transformations maps rectangle  $ABCD$  onto rectangle  $A''B''C''D''$ , as shown in the diagram below.



Which sequence of transformations maps  $ABCD$  onto  $A'B'C'D'$  and then maps  $A'B'C'D'$  onto  $A''B''C''D''$ ?

- 1) a reflection followed by a rotation
  - 2) a reflection followed by a translation
  - 3) a translation followed by a rotation
  - 4) a translation followed by a reflection
- 8 In the diagram of parallelogram  $FRED$  shown below,  $\overline{ED}$  is extended to  $A$ , and  $\overline{AF}$  is drawn such that  $AF \cong DF$ .

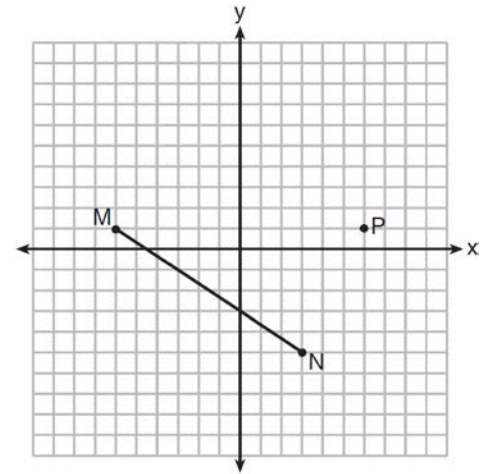


If  $m\angle R = 124^\circ$ , what is  $m\angle AFD$ ?

- 1)  $124^\circ$
- 2)  $112^\circ$
- 3)  $68^\circ$
- 4)  $56^\circ$

- 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

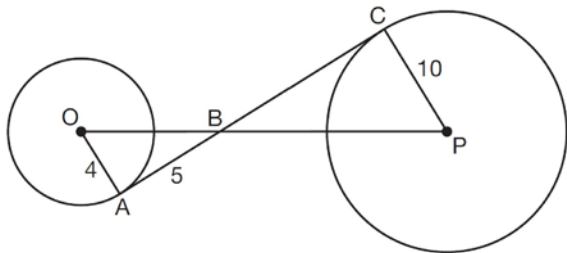
- 10 Given  $\overline{MN}$  shown below, with  $M(-6, 1)$  and  $N(3, -5)$ , what is an equation of the line that passes through point  $P(6, 1)$  and is parallel to  $\overline{MN}$ ?



- 1)  $y = -\frac{2}{3}x + 5$
- 2)  $y = -\frac{2}{3}x - 3$
- 3)  $y = \frac{3}{2}x + 7$
- 4)  $y = \frac{3}{2}x - 8$

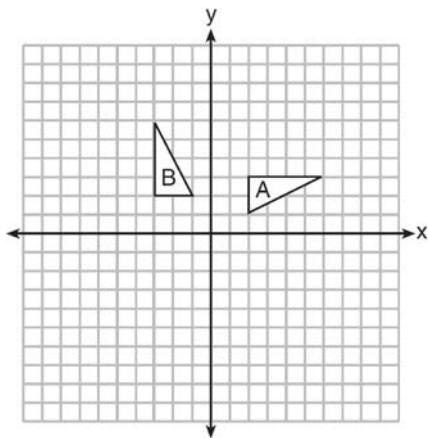
- 11 Linda is designing a circular piece of stained glass with a diameter of 7 inches. She is going to sketch a square inside the circular region. To the *nearest tenth of an inch*, the largest possible length of a side of the square is
- 1) 3.5
  - 2) 4.9
  - 3) 5.0
  - 4) 6.9

- 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  $PC = 10$ .



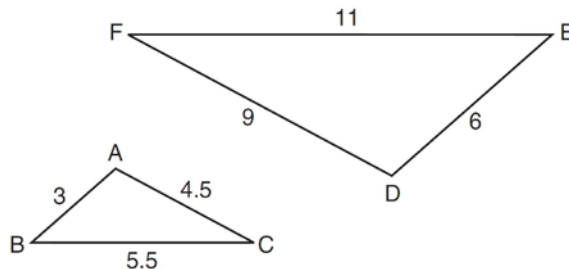
What is the length of  $\overline{BC}$ ?

- 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  $B$ ?



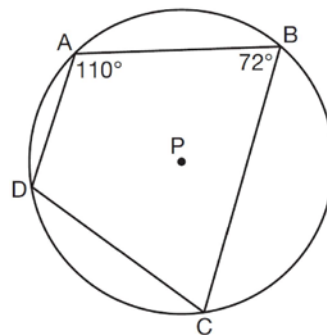
- 1) line reflection
- 2) rotation
- 3) dilation
- 4) translation

- 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  $P$ .



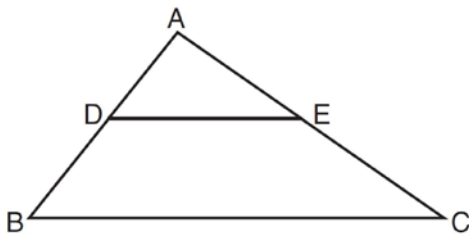
What is  $m\angle ADC$ ?

- 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?

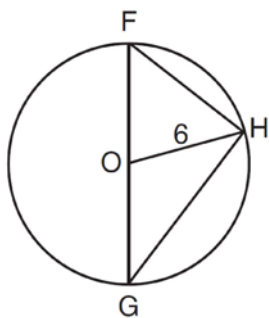
- 1) 16,336
- 2) 32,673
- 3) 130,690
- 4) 261,381

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



Which measurements are justified by this similarity?

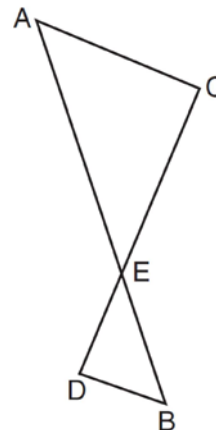
- 1)  $AD = 3$ ,  $AB = 6$ ,  $AE = 4$ , and  $AC = 12$
  - 2)  $AD = 5$ ,  $AB = 8$ ,  $AE = 7$ , and  $AC = 10$
  - 3)  $AD = 3$ ,  $AB = 9$ ,  $AE = 5$ , and  $AC = 10$
  - 4)  $AD = 2$ ,  $AB = 6$ ,  $AE = 5$ , and  $AC = 15$
- 18 Triangle  $\triangle FGH$  is inscribed in circle  $O$ , the length of radius  $\overline{OH}$  is 6, and  $\overline{FH} \cong \overline{OG}$ .



What is the area of the sector formed by angle  $\angle FOH$ ?

- 1)  $2\pi$
- 2)  $\frac{3}{2}\pi$
- 3)  $6\pi$
- 4)  $24\pi$

- 19 As shown in the diagram below,  $\overline{AB}$  and  $\overline{CD}$  intersect at  $E$ , and  $\overline{AC} \parallel \overline{BD}$ .



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.

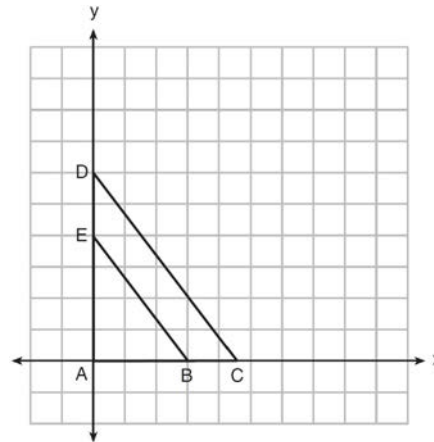
21 The Great Pyramid of Giza was constructed as a regular pyramid with a square base. It was built with an approximate volume of 2,592,276 cubic meters and a height of 146.5 meters. What was the length of one side of its base, to the *nearest meter*?

- 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  $E(0, 4)$ .



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)  $\frac{4}{3}$

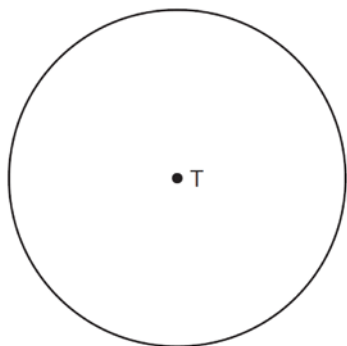
24 Line  $y = 3x - 1$  is transformed by a dilation with a scale factor of 2 and centered at  $(3, 8)$ . The line's image is

- 1)  $y = 3x - 8$
- 2)  $y = 3x - 4$
- 3)  $y = 3x - 2$
- 4)  $y = 3x - 1$

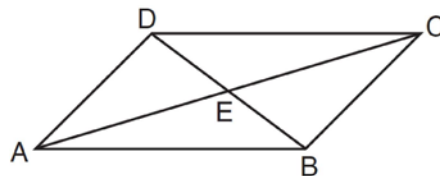
- 25 A wooden cube has an edge length of 6 centimeters and a mass of 137.8 grams. Determine the density of the cube, to the *nearest thousandth*. State which type of wood the cube is made of, using the density table below.

Type of Wood	Density (g/cm <sup>3</sup> )
Pine	0.373
Hemlock	0.431
Elm	0.554
Birch	0.601
Ash	0.638
Maple	0.676
Oak	0.711

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

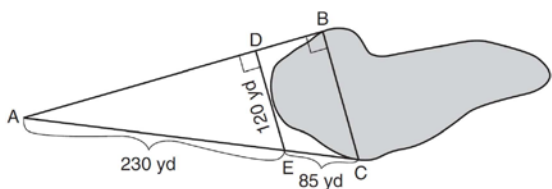


- 28 In parallelogram  $ABCD$  shown below, diagonals  $AC$  and  $BD$  intersect at  $E$ .



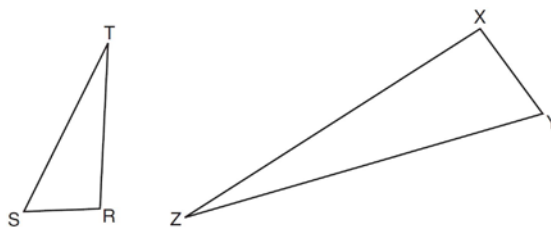
Prove:  $\angle ACD \cong \angle CAB$

- 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.

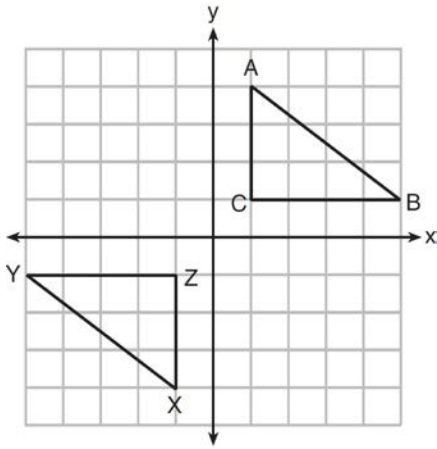


Use the surveyor's information to determine and state the distance from point  $B$  to point  $C$ , to the *nearest yard*.

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



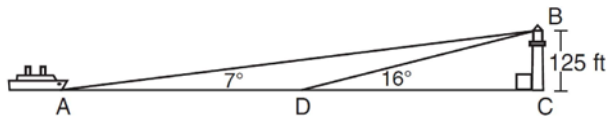
- 30 In the diagram below,  $\triangle ABC$  and  $\triangle XYZ$  are graphed.



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

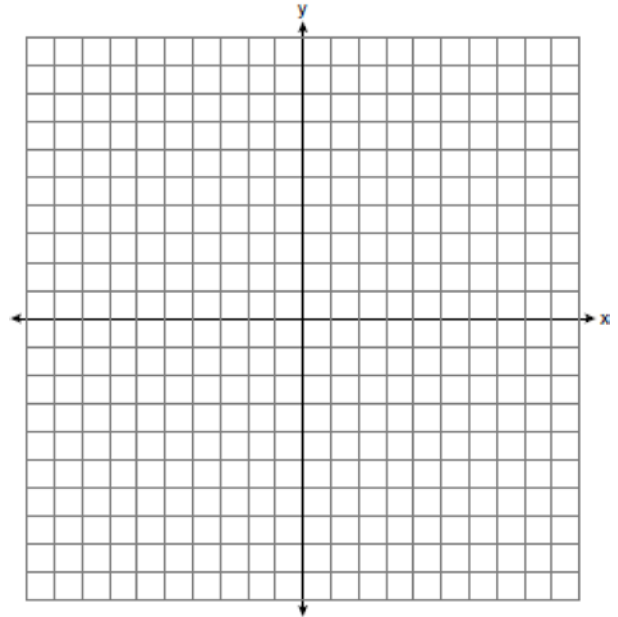
- 31 The endpoints of  $\overline{DEF}$  are  $D(1, 4)$  and  $F(16, 14)$ . Determine and state the coordinates of point  $E$ , if  $DE:EF = 2:3$ .

- 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  $7^\circ$ . A short time later, at point  $D$ , the angle of elevation was  $16^\circ$ .

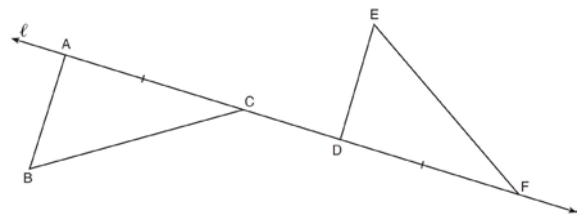


To the *nearest foot*, determine and state how far the ship traveled from point  $A$  to point  $D$ .

- 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.]

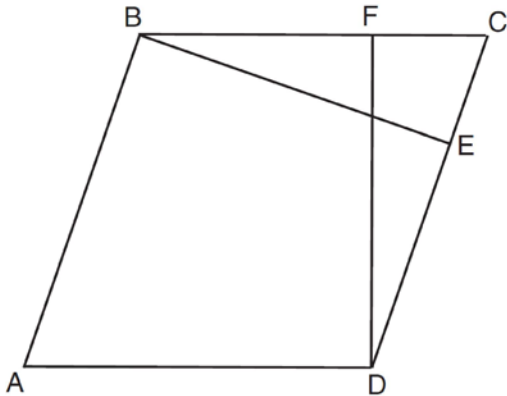


- 34 In the diagram below,  $\overline{AC} \cong \overline{DF}$  and points  $A$ ,  $C$ ,  $D$ , and  $F$  are collinear on line  $\ell$ .



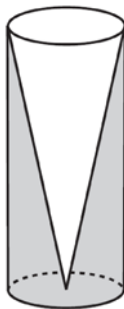
Let  $\triangle D'E'F'$  be the image of  $\triangle DEF$  after a translation along  $\ell$ , such that point  $D$  is mapped onto point  $A$ . Determine and state the location of  $F'$ . Explain your answer. Let  $\triangle D''E''F''$  be the image of  $\triangle D'E'F'$  after a reflection across 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,  
 $\overline{BE} \perp \overline{CED}$ ,  $\overline{DF} \perp \overline{BFC}$ ,  $\overline{CE} \cong \overline{CF}$ .



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?



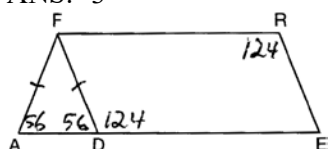
Walter goes to a hobby store to buy the wax for his candles. The wax costs \$0.10 per ounce. If the weight of the wax is 0.52 ounce per cubic inch, how much will it cost Walter to buy the wax for 100 candles? If Walter spent a total of \$37.83 for the molds and charges \$1.95 for each candle, what is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



## 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
- 6 ANS: 4 PTS: 2 REF: 081506geo NAT: G.SRT.A.2  
TOP: Dilations
- 7 ANS: 1 PTS: 2 REF: 081507geo NAT: G.CO.A.5  
TOP: Compositions of Transformations KEY: identify
- 8 ANS: 3



- PTS: 2 REF: 081508geo NAT: G.CO.C.11 TOP: Interior and Exterior Angles of Polygons
- 9 ANS: 3  

$$x^2 + 4x + 4 + y^2 - 6y + 9 = 12 + 4 + 9$$

$$(x + 2)^2 + (y - 3)^2 = 25$$
- PTS: 2 REF: 081509geo NAT: G.GPE.A.1 TOP: Equations of Circles  
KEY: completing the square
- 10 ANS: 1  

$$m = -\frac{2}{3} \quad 1 = \left(-\frac{2}{3}\right)6 + b$$

$$1 = -4 + b$$

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

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

PTS: 2

REF: 081513geo

NAT: G.CO.A.2

TOP: Identifying Transformations

KEY: graphics

14 ANS: 4

PTS: 2

REF: 081514geo

NAT: G.SRT.A.2

TOP: Compositions of Transformations

KEY: grids

15 ANS: 3

PTS: 2

REF: 081515geo

NAT: G.C.A.3

TOP: Inscribed Quadrilaterals

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

PTS: 2

REF: 081519geo

NAT: G.SRT.B.5

TOP: Similarity

KEY: basic

20 ANS: 1

$$3^2 = 9$$

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

$$\frac{-2-1}{-1-3} = \frac{-3}{2} \quad \frac{3-2}{0-5} = \frac{1}{-5} \quad \frac{3-1}{0-3} = \frac{2}{-3} \quad \frac{2-2}{5-1} = \frac{0}{4} = \frac{0}{4}$$

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.

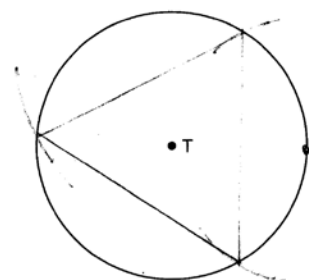
PTS: 2 REF: 081524geo NAT: G.SRT.A.1 TOP: Line Dilations

25 ANS:

$$\frac{137.8}{6^3} \approx 0.638 \text{ Ash}$$

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

26 ANS:



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

27 ANS:

$$\frac{120}{230} = \frac{x}{315}$$

$$x = 164$$

PTS: 2 REF: 081527geo NAT: G.SRT.B.5 TOP: Similarity

KEY: basic

28 ANS:

Parallelogram  $ABCD$ , diagonals  $\overline{AC}$  and  $\overline{BD}$  intersect at  $E$  (given).  $\overline{DC} \parallel \overline{AB}$ ;  $\overline{DA} \parallel \overline{CB}$  (opposite sides of a parallelogram are parallel).  $\angle ACD \cong \angle CAB$  (alternate interior angles formed by parallel lines and a transversal are congruent).

PTS: 2 REF: 081528geo NAT: G.CO.C.11 TOP: Quadrilateral Proofs

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:

$$\tan 7 = \frac{125}{x} \quad \tan 16 = \frac{125}{y} \quad 1018 - 436 \approx 582$$

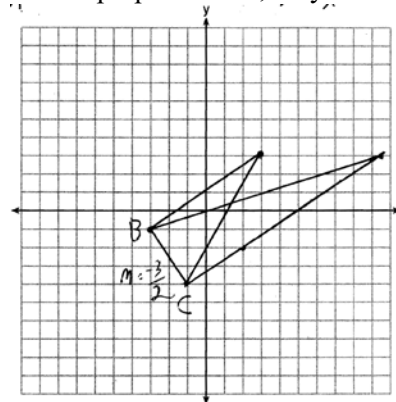
$$x \approx 1018 \quad y \approx 436$$

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

$$m_{\perp} = \frac{2}{3} \quad -1 = -2 + b \quad \frac{-12}{3} = \frac{-2}{3} + b$$

$$1 = b$$

$$3 = \frac{2}{3}x + 1 \quad -\frac{10}{3} = b$$

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

$$3 = x \quad 9 = 2x - 10$$

$$19 = 2x$$

$$9.5 = x$$

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  $\overline{AC} \cong \overline{DF}$  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  $ABCD$ ,  $\overline{BE} \perp \overline{CED}$ ,  $\overline{DF} \perp \overline{BFC}$ ,  $\overline{CE} \cong \overline{CF}$  (given).  $\angle BEC \cong \angle DFC$  (perpendicular lines form right angles, which are congruent).  $\angle FCD \cong \angle BCE$  (reflexive property).  $\triangle BEC \cong \triangle DFC$  (ASA).  $\overline{BC} \cong \overline{CD}$  (CPCTC).  $ABCD$  is a rhombus (a parallelogram with consecutive congruent sides is a rhombus).

PTS: 6 REF: 081535geo NAT: G.SRT.B.5 TOP: Quadrilateral Proofs

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