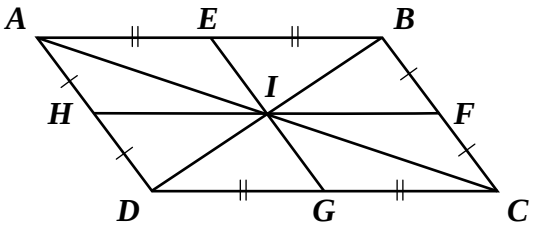
1. What term describes a transformation that does not change a figure's size or shape?

   (A) similarity
   (B) isometry
   (C) collinearity
   (D) symmetry

For questions 2–4, use the diagram showing parallelogram *ABCD*.



2. A reflection across $\overleftrightarrow{EG}$ carries parallelogram *ABCD* onto itself.

   (A) True
   (B) False

3. A rotation of 90° about *I* carries parallelogram *ABCD* onto itself.

   (A) True
   (B) False

4. A rotation of 180° about *I* carries parallelogram *ABCD* onto itself.

   (A) True
   (B) False

---

5. Which of these is equivalent to a translation?

   (A) a reflection across one line
   (B) a composition of two reflections across intersecting lines
   (C) a composition of two reflections across parallel lines

6. A regular polygon with *n* sides is carried onto itself by a positive rotation about its center that is a multiple of 60°, but less than 360°.

   Which could NOT be the value of *n*?

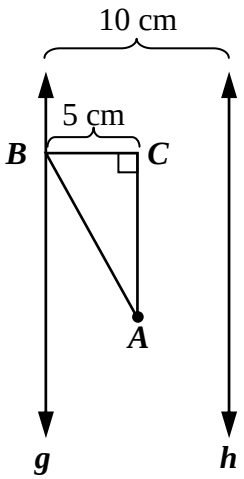
   (A) 3

   (B) 4

   (C) 5

   (D) 6

7. In the diagram, $g \parallel h$ and *B* lies on line *g*.



   The figure *ABC* is reflected across line *g*, and its image is reflected across line *h*. What is the distance from line *g* to the final image of point *A*?

   (A) 5 cm

   (B) 15 cm

   (C) 20 cm

   (D) 25 cm

8. What is the image of the point (–4, 6) under the transformation $T(x, y) \rightarrow (-y, x)$?

   (A) (6, 4)

   (B) (–6, –4)

   (C) (4, 6)

   (D) (–4, –6)

9. A figure is rotated about the origin by 180°, then is translated 4 units right and one unit up. Which describes the results of the two transformations?

   (A) $(x, y) \rightarrow (-x+4, -y+1)$

   (B) $(x, y) \rightarrow (-x-4, -y-1)$

   (C) $(x, y) \rightarrow (-y+4,\ x+1)$

   (D) $(x, y) \rightarrow (-y-4,\ x+1)$

10. The point $A(4, 3)$ is rotated –90° about the origin. In which quadrant is A' ?

    (A) I

    (B) II

    (C) III

    (D) IV

11. A figure is reflected across the line $y = 2$, then reflected across the line $y = 4$. Which <u>single</u> transformation results in the same image?

    (A) a reflection across the line $y = 3$

    (B) a reflection across the line $y = 6$

    (C) a translation 2 units up

    (D) a translation 4 units up

12. Point A' is the image of point A under a transformation T. Line ℓ is the perpendicular bisector of $\overline{AA'}$ at point M. Which describes the transformation T?

    (A) a reflection across ℓ

    (B) a 90° rotation about M

    (C) a translation by the vector from A to M

    (D) a dilation about M with scale factor 2

For questions 13–16, determine if the described transformation(s) is/are an isometry.

13. A reflection is an isometry.

    (A) True
    (B) False

14. A composition of two reflections is an isometry.

    (A) True
    (B) False

15. A dilation is an isometry.

    (A) True
    (B) False

16. A composition of a rotation and a dilation is an isometry.

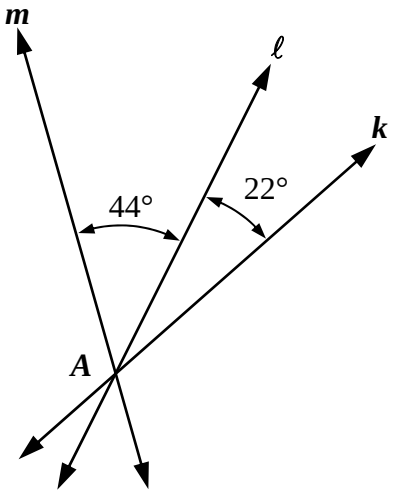
    (A) True
    (B) False

---

17. In ΔABC, M is the midpoint of $\overline{AB}$ and N is the midpoint of $\overline{AC}$. For which type of triangle is $MN = \frac{1}{2}BC$?

    (A) equilateral only
    (B) isosceles only
    (C) scalene only
    (D) any triangle

18. Use the diagram.



Which series of reflections would result in a rotation of –44° about *A*?

(A) reflect across k, then reflect across ℓ

(B) reflect across ℓ, then reflect across k

(C) reflect across ℓ, then reflect across m

(D) reflect across m, then reflect across ℓ

19. After a figure is rotated, $P' = P$. Which statement(s) could be true?

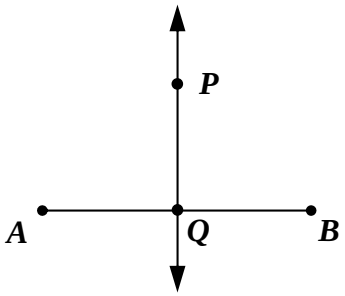
(A) The center of rotation is *P*.

(B) The angle of rotation is a multiple of 360°.

(C) Either A or B or both.

(D) Neither A nor B.

For questions 20–23, use the diagram where B is the reflection of A across $\overleftrightarrow{PQ}$.



20. $PA = PB$

(A) True
(B) False

21. $\overleftrightarrow{PQ} \perp \overline{AB}$

(A) True
(B) False

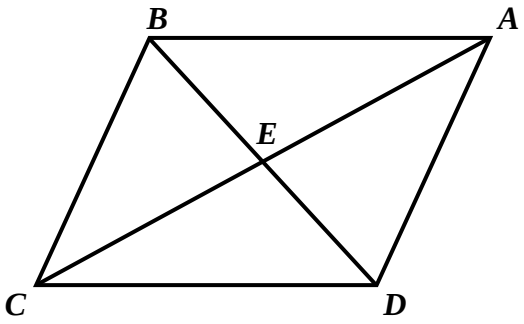
22. $AQ = QB$

(A) True
(B) False

23. $PQ = \frac{1}{2}AB$

(A) True
(B) False

For questions 24–26, use the diagram where *ABCD* is a quadrilateral with $\overline{AB} \parallel \overline{CD}$ and $\overline{AD} \parallel \overline{BC}$. Diagonals $\overline{AC}$ and $\overline{BD}$ intersect at *E*.



24. $\Delta CBE \cong \Delta ABE$

    (A) True

    (B) False

25. $\Delta ADE \cong \Delta ABE$

    (A) True

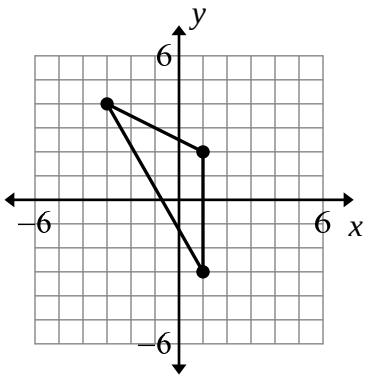
    (B) False

26. $\Delta CDE \cong \Delta ABE$

    (A) True

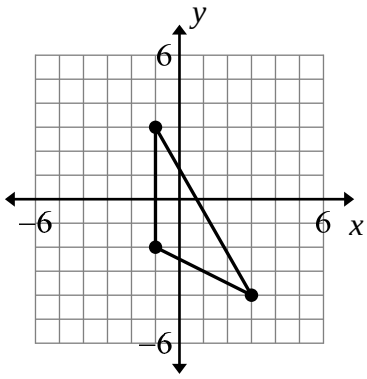
    (B) False

27. Use the figure.

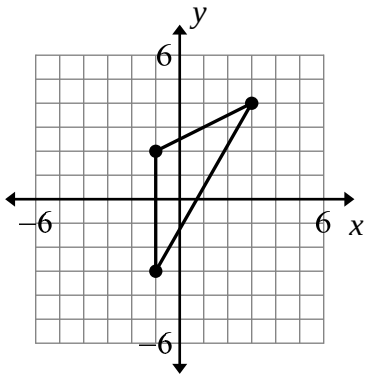


A transformation T is defined as $(x, y) \rightarrow (x, -y)$. Which shows the image of figure under T?

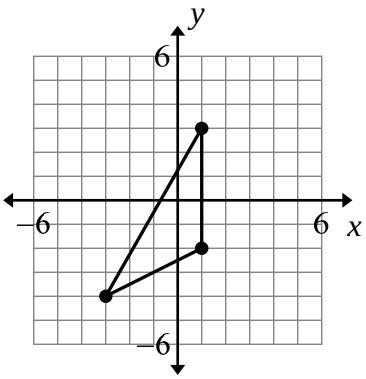
(A)



(B)



(C)



For questions 28–29, a transformation *S* is defined as $(x, y) \rightarrow (3x,\ y-1)$.

28. The pre-image of $A'(3, 6)$ under *S* is $A(9, 5)$.

    (A) True
    (B) False

29. *S* is an isometry.

    (A) True
    (B) False

---

30. Given point *A* is located at (1, 3). What is the final image of *A* after this series of transformations?

    (1) Reflect *A* across the *y* axis.
    (2) Translate the image such that $(x, y) \rightarrow (x-4,\ y+2)$.

    (A) (–1, –3)
    (B) (–3, 5)
    (C) (–3, –1)
    (D) (–5, 5)

31. Which transformation does NOT preserve the orientation of a figure?

    (A) dilation
    (B) reflection
    (C) rotation
    (D) translation

For questions 32–35, determine if the mapping is an isometry.

32. $(x, y) \rightarrow (x,\ y+2)$ is an isometry.

    (A) True
    (B) False

33. $(x, y) \rightarrow (-x,\ y)$ is an isometry.

    (A) True
    (B) False

34. $(x, y) \rightarrow (y,\ x)$ is an isometry.

    (A) True
    (B) False

35. $(x, y) \rightarrow (2x,\ y)$ is an isometry.

    (A) True
    (B) False

---

36. A figure is transformed in the plane such that no point maps to itself. What type of transformation must this be?

    (A) dilation
    (B) reflection
    (C) rotation
    (D) translation

For questions 37–38, determine the truth of the statements about rotations.

37. Rotations preserve the orientation of a figure.

    (A) True
    (B) False

38. Under a rotation, no point can map to itself.

    (A) True
    (B) False

For questions 39–41, point P is located at (6, 0) and undergoes a transformation.

39. A rotation of 90° about P results in $P' = P$.

    (A) True
    (B) False

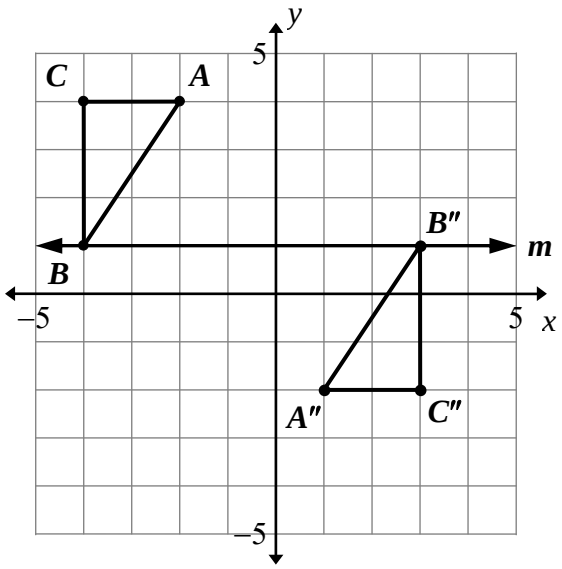
40. A translation by the vector $\langle -6, 0 \rangle$ results in $P' = P$.

    (A) True
    (B) False

41. A reflection about the x axis results in $P' = P$.

    (A) True
    (B) False

For questions 42–43, use the diagram which shows ΔABC has been reflected across an unknown line ℓ, then reflected across line m to produce $\Delta A''B''C''$.



42. The equation of line ℓ is $x = -0.5$.

    (A) True
    (B) False

43. If ΔABC were reflected across line m first, then reflected across line ℓ to produce $\Delta A''B''C''$, the equation of line ℓ would be $x = -0.5$.

    (A) True
    (B) False

For questions 44–46, consider a triangle ΔABC that has been transformed through rigid motions and its image compared to ΔXYZ. Determine if the given information is sufficient to draw the provided conclusion.

44.

Given	Conclusion
$\angle A \cong \angle X$ $\angle B \cong \angle Y$ $\angle C \cong \angle Z$	$\Delta ABC \cong \Delta XYZ$

(A) True

(B) False

45.

Given	Conclusion
$\angle A \cong \angle X$ $\angle B \cong \angle Y$ $\overline{BC} \cong \overline{YZ}$	$\Delta ABC \cong \Delta XYZ$

(A) True

(B) False

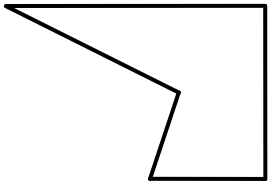
46.

Given	Conclusion
$\angle A \cong \angle X$ $\overline{AB} \cong \overline{XY}$ $\overline{BC} \cong \overline{YZ}$	$\Delta ABC \cong \Delta XYZ$

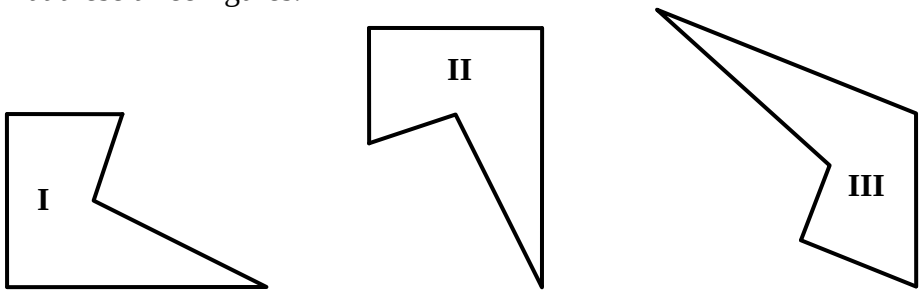
(A) True

(B) False

47. Look at the figure below.



Look at these three figures.



Which figures are congruent to the first figure?

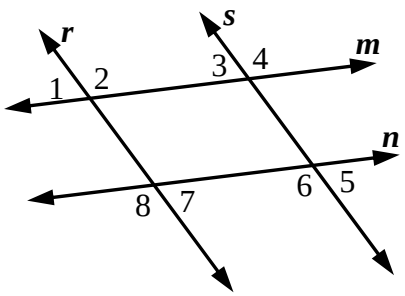
(A) I only

(B) II only

(C) I and II only

(D) I, II, and III

48. Use the diagram.



Which statement would be used to prove lines *r* and *s* are parallel?

(A) $\angle 1$ and $\angle 3$ are congruent

(B) $\angle 2$ and $\angle 7$ are complementary

(C) $\angle 4$ and $\angle 1$ are congruent

(D) $\angle 8$ and $\angle 6$ are supplementary

For questions 49–51, evaluate whether the image of a figure under the described transformation is congruent to the figure.

49. A transformation T follows the rule $(x, y) \rightarrow (x+3, y)$. The image of a figure under T is congruent to the figure.

    (A) True
    (B) False

50. A transformation T follows the rule $(x, y) \rightarrow (-y, -x)$. The image of a figure under T is congruent to the figure.

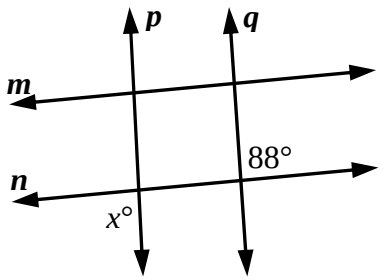
    (A) True
    (B) False

51. A transformation T follows the rule $(x, y) \rightarrow (x, 2y)$. The image of a figure under T is congruent to the figure.

    (A) True
    (B) False

---

52. In the diagram, $m \parallel n$ and $p \parallel q$.



What is the value of x?

(A) 44
(B) 88
(C) 92
(D) 176

For questions 53–54, consider ΔABC where $AB = BC$ and $m\angle A = 40°$.

53. $m\angle B + m\angle C = 140°$

(A) True

(B) False

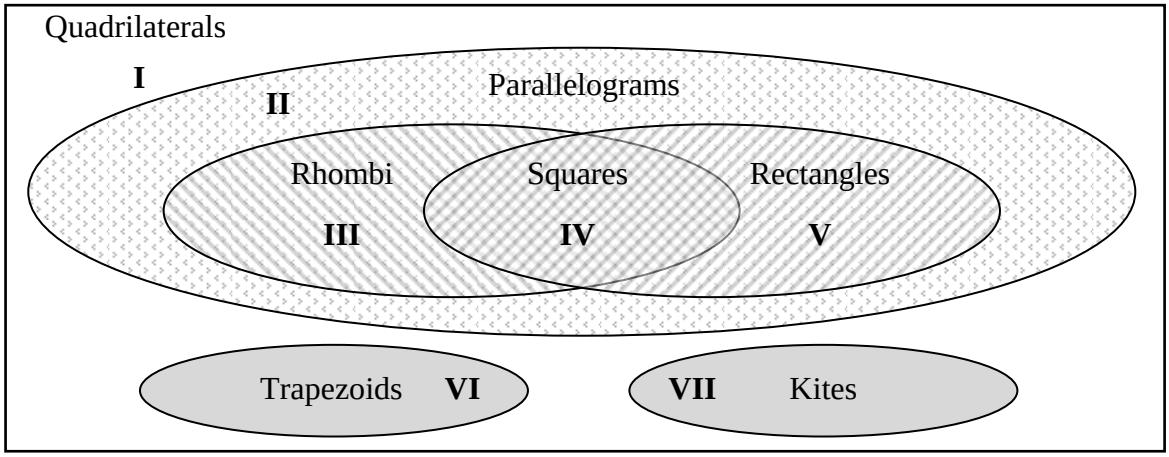
54. $m\angle C = 100°$

(A) True

(B) False

---

55. Use the Venn diagram.



A quadrilateral *ABCD* has 4 lines of symmetry. Identify the area of the diagram in which *ABCD* resides.

(A) III

(B) IV

(C) V

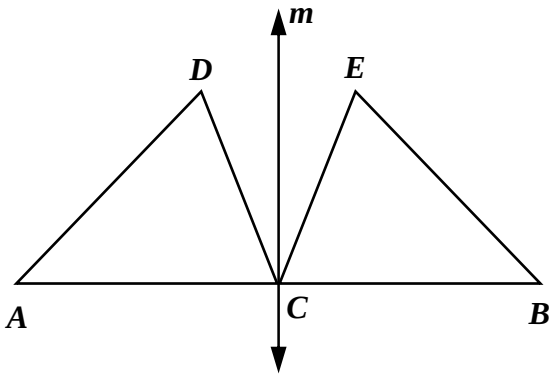
(D) VII

56. On the coordinate plane, draw triangles ΔABC and $\Delta A'B'C'$ such that:

    (1) $A = A'$

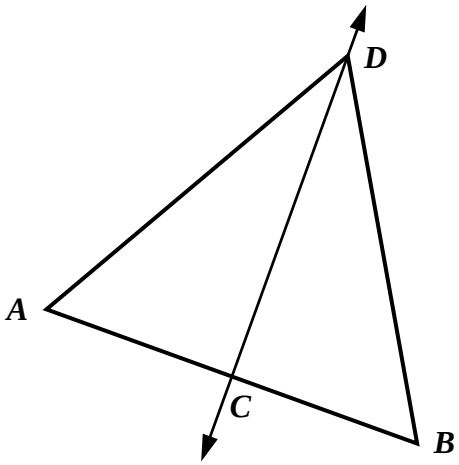
    (2) ΔABC has been rotated 90°.

57. In the diagram, *m* is the perpendicular bisector of $\overline{AB}$ at *C*, and $r_m(D) = E$.



    Prove $\Delta ADC \cong \Delta BEC$.

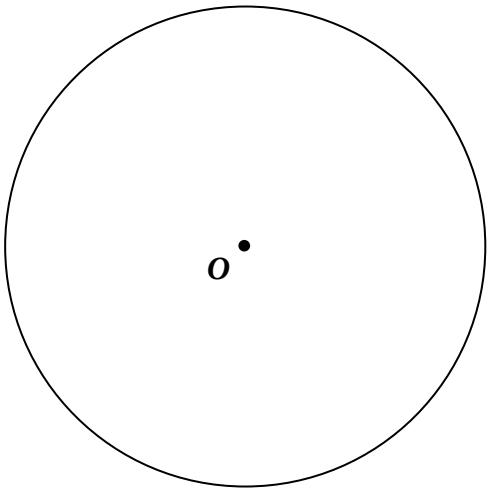
58. In the diagram, $\overleftrightarrow{DC}$ is the perpendicular bisector of $\overline{AB}$.



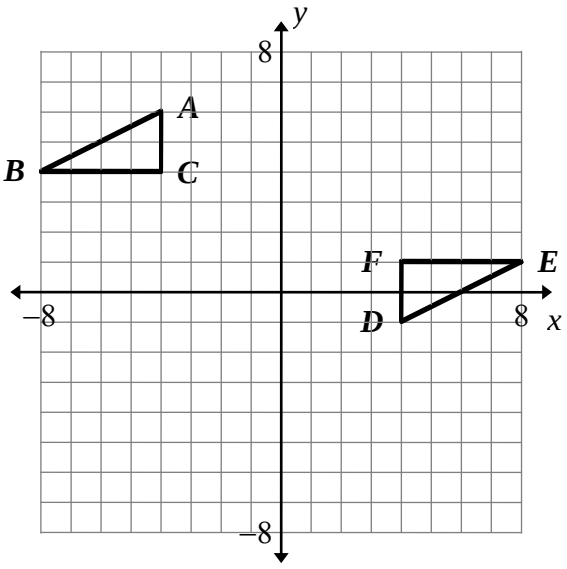
    Prove $\angle DAB \cong \angle DBA$.

59. Prove the sum of the measures of the interior angles of any triangle is 180°.

60. Construct an equilateral triangle inscribed in circle O.



61. Use the figure.



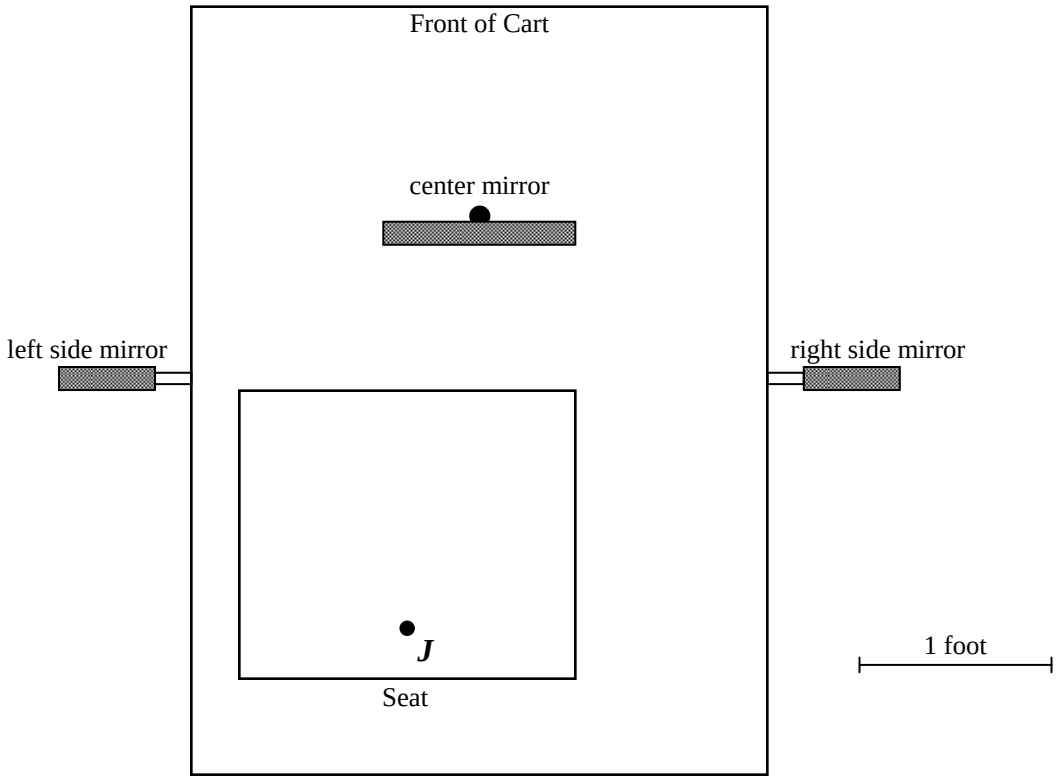
(a) Transform ΔABC by reflecting it across the y-axis to produce $\Delta A'B'C'$.

(b) Describe a transformation, or composition of transformations, that maps $\Delta A'B'C'$ to ΔDEF.

(c) Describe a single transformation that maps ΔABC to ΔDEF.

62. Jimmy is building a go-cart to race. Jimmy sits in a seat toward the left rear corner of the cart. To see other carts behind him, he mounts 3 plane mirrors: one on each side of the cart and one in the center.

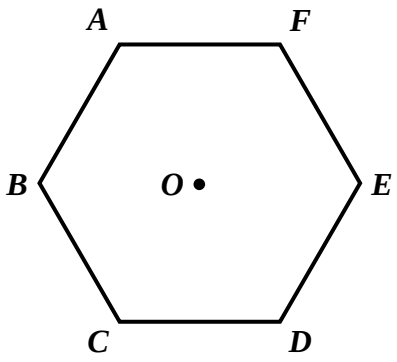
    The scale diagram shows a top view of the cart.



(a) Jimmy's eyes are at point *J*. The mirrors are mounted in a way that Jimmy does not block his own view. Show the area behind the cart that Jimmy can see using the mirrors.

(b) Describe how Jimmy could improve his visibility behind the cart using the same three mirrors.

63. The diagram shows regular hexagon *ABCDEF* with center *O*.



For each part, fill in the blank.

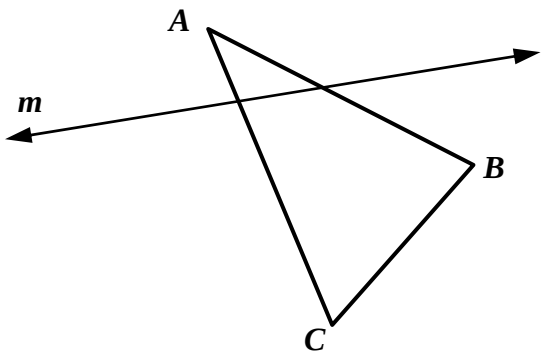
(a) _____ is the image of *A* under a 60° rotation about *O*.

(b) The figure is reflected across $\overleftrightarrow{AD}$. The pre-image of *E* is _____.

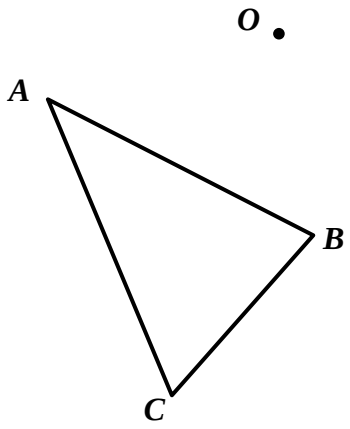
(c) *F* is the image of *D* when the figure is rotated _____° about *O*.

(d) *B* is first reflected across $\overleftrightarrow{FC}$. That image maps to *F* when reflected across _____.

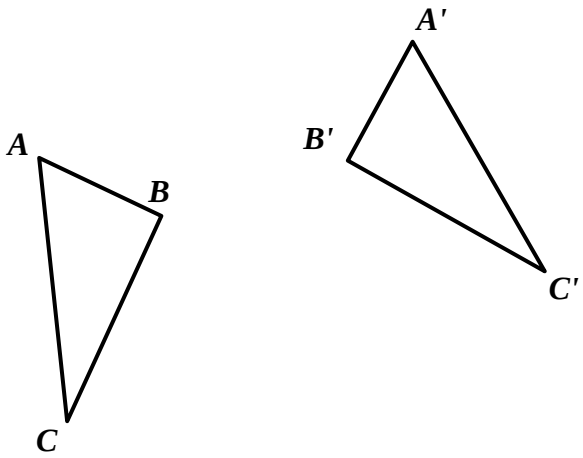
64. Draw the image of ΔABC when reflected across line *m*.



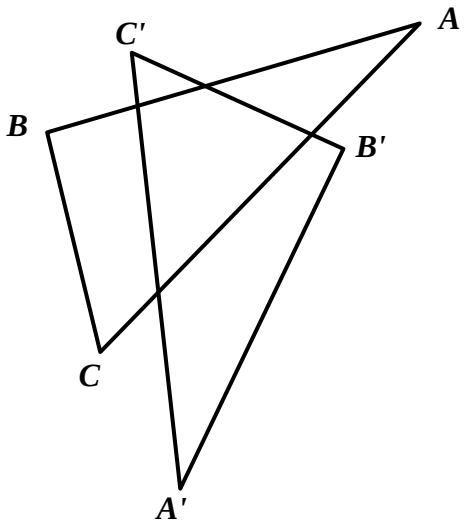
65. Draw the image of ΔABC when rotated 70° about O.



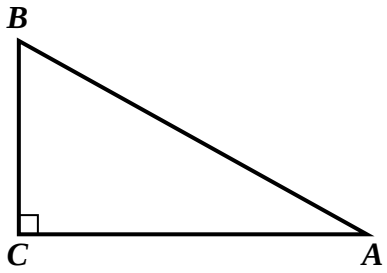
66. $\Delta A'B'C'$ is the image of ΔABC when a reflected about line ℓ. Construct line ℓ.



67. $\Delta A'B'C'$ is the image of ΔABC when rotated about point O. Construct point O and compute the angle of rotation.



68. Use scalene right triangle *ABC*.



Describe and sketch the transformations required so that the union of the triangle and its image forms

(a) a kite.

(b) an isosceles triangle.

(c) a rectangle.

69. Right triangle *PQR* has sides of length 6 units, 8 units, and 10 units. The triangle is dilated by a scale factor of 4 about point *Q*. What is the area of triangle *P'Q'R'*?

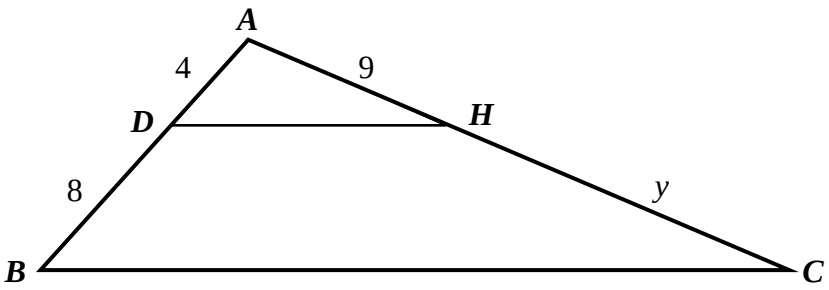
    (A) 96 square units

    (B) 192 square units

    (C) 384 square units

    (D) 768 square units

70. In the diagram below $\overline{BC} \parallel \overline{DH}$.



    What is the value of *y*?

    (A) 13

    (B) 18

    (C) 27

71. The ratio of the side lengths of a triangle is 3:6:8. A second triangle is similar to the first and its shortest side measures 8.0 centimeters. What is the length of the longest side of the second triangle?

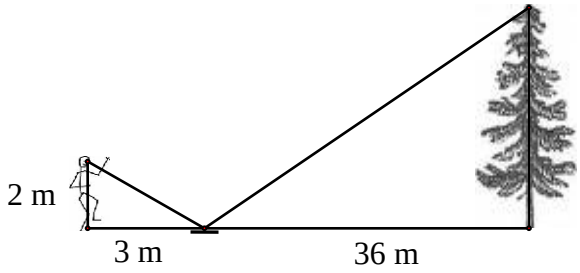
    (A) 3.0 cm

    (B) 10.7 cm

    (C) 13.0 cm

    (D) 21.3 cm

72. In the diagram, a student has placed a mirror on level ground, then stands so that the top of a nearby tree is visible in the mirror.



What is the height of the tree?

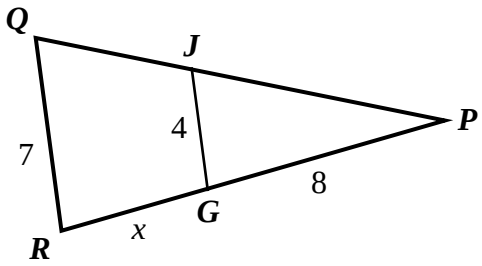
(A) 24 m

(B) 35 m

(C) 41 m

(D) 59 m

73. In the diagram, $\overline{JG} \parallel \overline{QR}$.



What is the value of x?

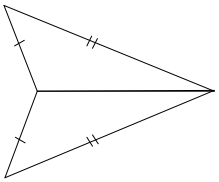
(A) 11

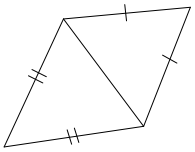
(B) 6

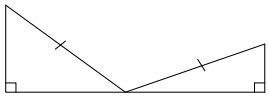
(C) 5

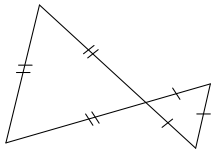
(D) 3

74. Which figure contains two similar triangles that are NOT congruent?

(A) 

(B) 

(C) 

(D) 

75. Sally constructs a triangle where two of the angles measure 50° and 60°. Tom constructs a triangle where two of the angles measure 50° and 70°. What is true about the two triangles?

(A) The triangles *cannot be* similar.

(B) The triangles *could be* similar.

(C) The triangles *must be* similar.

76. Triangle *ABC* has vertices $A(-2, 2)$, $B(-5, 5)$, and $C(-5, 3)$. The triangle is dilated about the point $(1, 1)$ with scale factor 4. What is the location of A'?

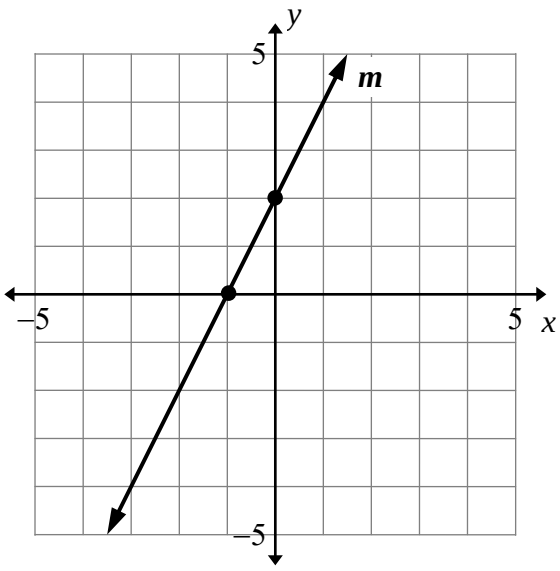
(A) $(-8, 8)$

(B) $(-10, 10)$

(C) $(-11, 5)$

(D) $(-14, 6)$

77. Use the diagram.



Dilate line *m* about the origin with scale factor 2. What is the equation of the line's image?

(A) $y = 2x + 2$

(B) $y = 2x + 4$

(C) $y = 4x + 2$

(D) $y = 4x + 4$

78. Which is NOT a criterion for triangle similarity?

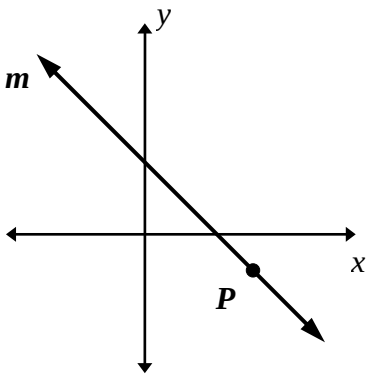
(A) angle-angle

(B) angle-side-angle

(C) side-angle-side

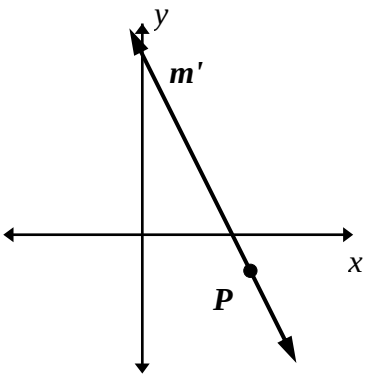
(D) side-side

79. Use the diagram.

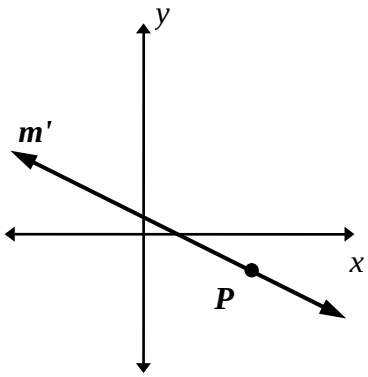


Dilate line m by a factor $\frac{1}{2}$ about P. Which shows the result of the dilation?

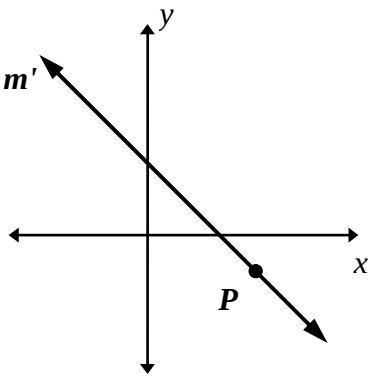
(A)



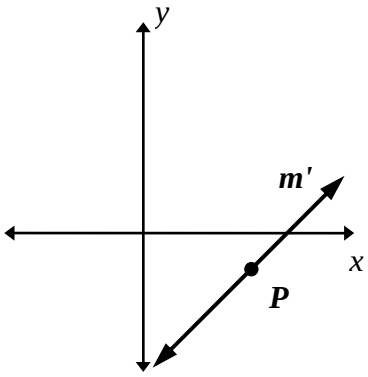
(B)



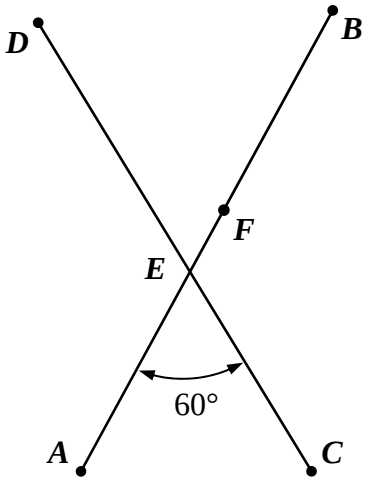
(C)



(D)



80. In the diagram, segments $\overline{AB}$ and $\overline{CD}$ intersect at E, F lies on $\overline{AB}$, and $m\angle AEC = 60°$.



The two segments are dilated about F with scale factor $\frac{1}{2}$. What is $m\angle A'E'C'$?

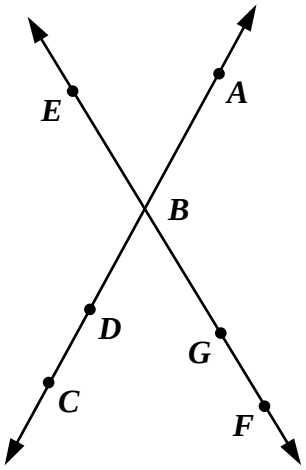
(A) 30°

(B) 60°

(C) 90°

(D) 120°

For questions 81–83, use the diagram.



Let the figure be dilated with scale factor k, where $k \neq 0$ and $k \neq 1$.

81. $m\angle A'B'E' = k\left(m\angle ABE\right)$.

(A) True

(B) False

82. G' is between B' and F'.

(A) True

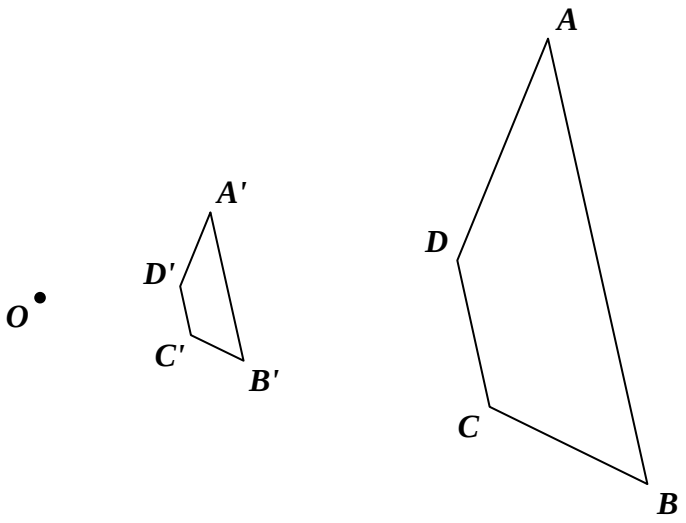
(B) False

83. $C'D' = k\left(CD\right)$

(A) True

(B) False

84. In the diagram, $ABCD$ is dilated with center O to produce $A'B'C'D'$, and $A'B' = \frac{1}{3}AB$.



What is $\frac{OA'}{AA'}$?

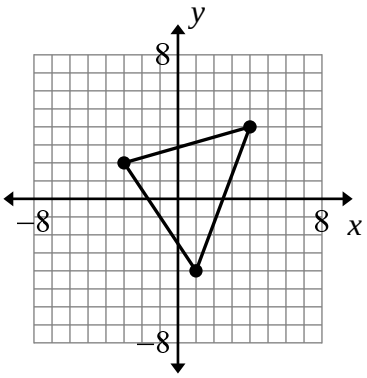
(A) $\frac{1}{3}$

(B) $\frac{1}{2}$

(C) 2

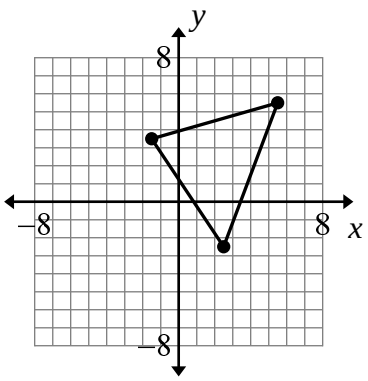
(D) 3

85. Use the figure below.

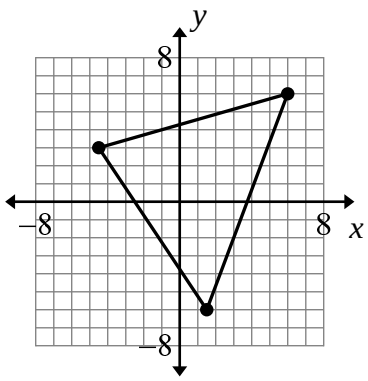


Which shows the figure dilated about the origin with scale factor 1.5?

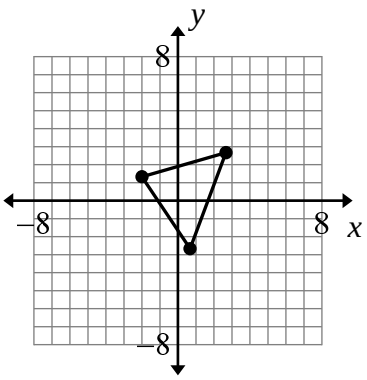
(A)



(B)



(C)



86. One vertex of a polygon is $A(-4, 5)$. If the polygon is dilated about the point (0, 2) with scale factor –2, what is the location of A'?

(A) (–8, 8)

(B) (–8, 10)

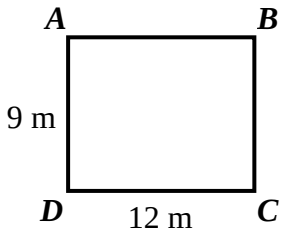
(C) (8, –10)

(D) (8, –4)

87. $J'(5, 7)$ is the image of $J(3, 3)$ after a dilation with scale factor 3. Where is the center of dilation?

(A) (–3, –9)
(B) (0, 0)
(C) (2, 1)
(D) (4, 5)

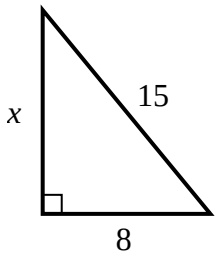
88. Fred stands at corner *A* of a rectangular field shown below. He needs to get to corner *C*.



What is the shortest distance from A to C?

(A) 9 m
(B) 13 m
(C) 15 m
(D) 21 m

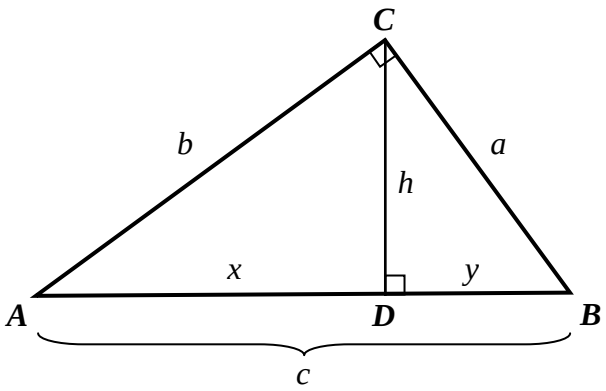
89. Use the right triangle. What is the value of *x*?



What is the value of *x*?

(A) $\sqrt{7}$
(B) $\sqrt{161}$
(C) 7
(D) 17

90. Use the diagram.



Which is equal to h?

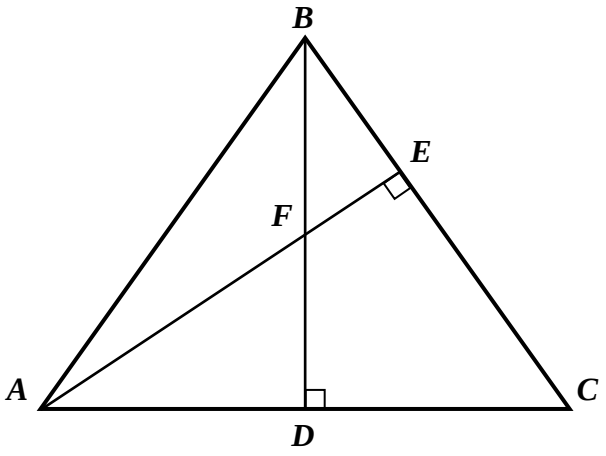
(A) $\sqrt{ay}$

(B) $\sqrt{bx}$

(C) $\sqrt{xy}$

(D) $\sqrt{ab}$

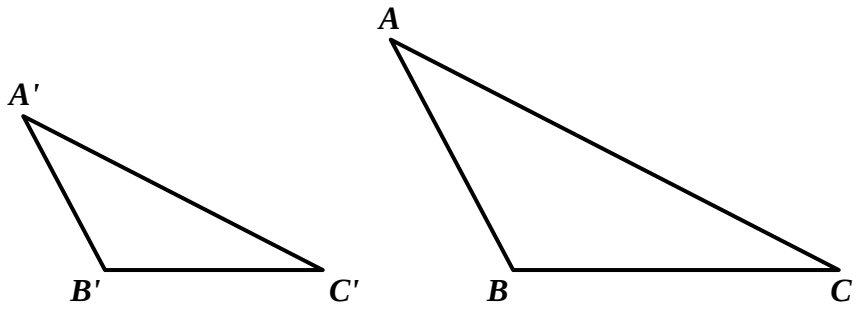
91. Use the diagram.



Given: $\overline{BD} \perp \overline{AC}$
$\overline{AE} \perp \overline{BC}$

Prove: $\Delta AEC \sim \Delta BDC$

92. In the diagram, $\Delta A'B'C'$ is a dilation of ΔABC.

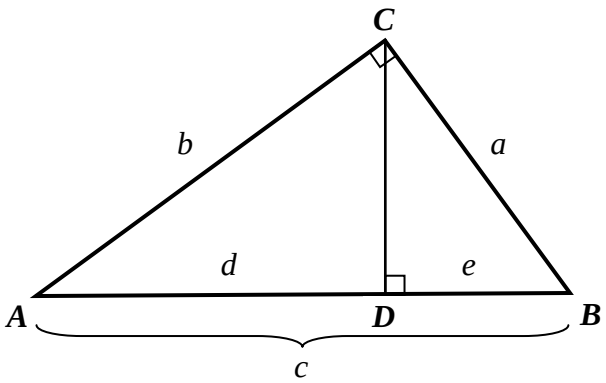


(a) Find the center of dilation *O*.

(b) Compute the scale factor of the dilation.

93. Prove that any two isosceles right triangles are similar.

94. In the diagram, ΔABC is a right triangle with right angle *C*, and $\overline{CD}$ is an altitude of ΔABC.



Use the fact that $\Delta ABC \sim \Delta ACD \sim \Delta CBD$ to prove $a^2 + b^2 = c^2$.

95. Triangle One has vertices (2, 4), (2, 8), and (5, 4). Triangle Two is similar to Triangle One and has two of its vertices at (–1, 1) and (–7, 1).

(a) Draw Triangle One and Triangle Two on the coordinate plane and label the vertices.

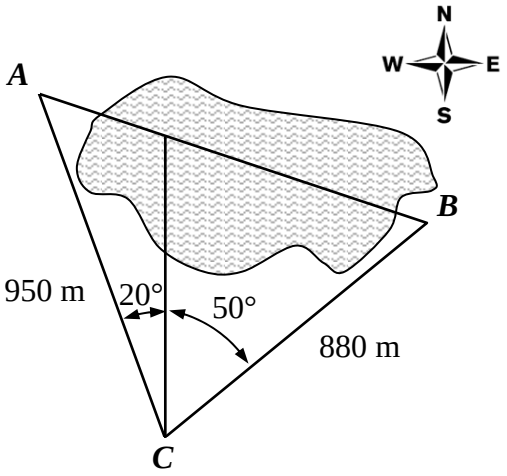
(b) Draw and label a third triangle that is similar to Triangle One, has two vertices at (–1, 1) and (–7, 1), but is <u>not</u> congruent to Triangle Two.

96. Triangle *ABC* has sides of length 3, 6, and 8. Triangle *DEF* is similar to triangle *ABC* and has one side with length 24.

    (a) What are the possible scale factors of the dilation of triangle *ABC* to triangle *DEF*?

    (b) Compute one possible area of triangle *DEF*.

97. The diagram shows a surveyor's map.



The surveyor is trying to measure the direct distance between points *A* and *B*, which are on opposite sides of a lake. From point *C*, point *A* is 950 meters away in a direction 20° west of north. From point *C*, point *B* is 880 meters away in a direction 50° east of north.

Which represents the distance between *A* and *B*?

(A) $\sqrt{950^2+880^2-2(950)(880)\cos 70°}$

(B) $\dfrac{880}{\sin 50°}+\dfrac{950}{\sin 20°}$

(C) $\dfrac{950\sin 70°}{\sin 55°}$

98. Consider a triangle *ABC*. Which statement is true?

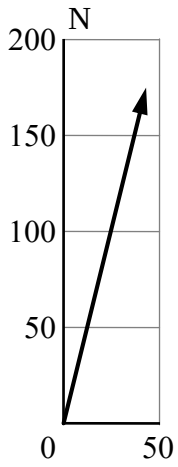
(A) $c^2=a^2-b^2-2ab\cos C$

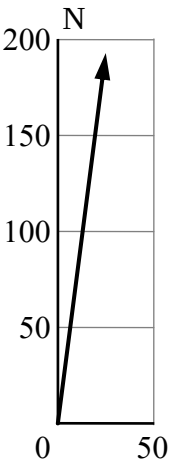
(B) $c^2=a^2-b^2+2ab\cos C$

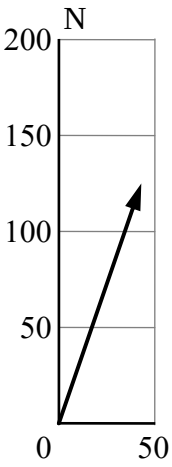
(C) $c^2=a^2+b^2-2ab\cos C$

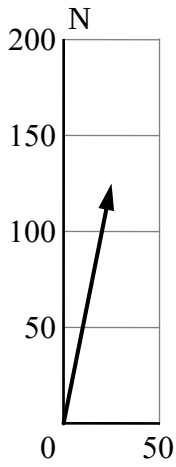
(D) $c^2=a^2+b^2+2ab\cos C$

99. A small airplane flies due north at 150 kilometers per hour. A wind is blowing towards the direction 60° east of north at 50 kilometers per hour. Which figure represents the final speed and direction of the airplane?

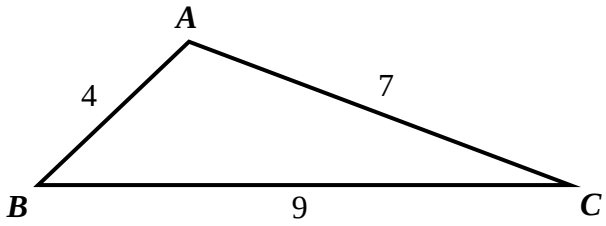
(A) 

(B) 

(C) 

(D) 

100. Use the diagram.



What is $\cos A$?

(A) $\frac{16}{56}$

(B) $\frac{56}{16}$

(C) $-\frac{16}{56}$

(D) $-\frac{56}{16}$

For questions 101–103, consider a triangle *ABC* and each given set of measurements.

101. *AB*, *AC*, and $m\angle A$ are sufficient to solve the triangle using the Law of Sines.

(A) True

(B) False

102. *AB*, *AC*, and $m\angle B$ are sufficient to solve the triangle using the Law of Sines.

(A) True

(B) False

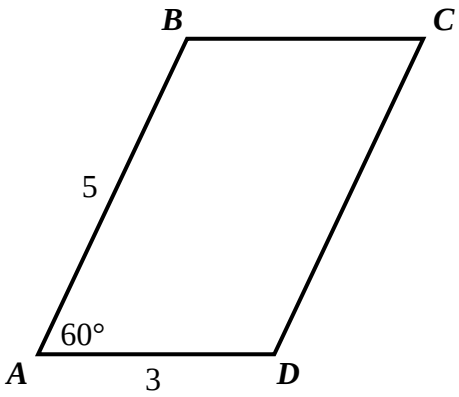
103. *AB*, *AC*, and *BC* are sufficient to solve the triangle using the Law of Sines.

(A) True

(B) False

---

104. The diagram shows a parallelogram *ABCD*.



What is the parallelogram's area?

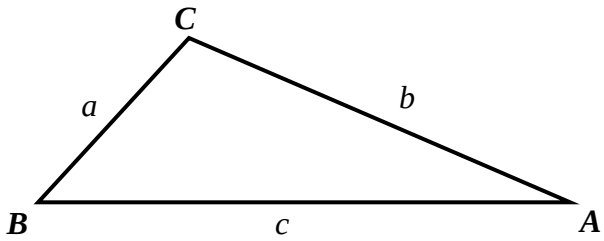
(A) $7.5\sqrt{3}$

(B) 15

(C) $15\sqrt{3}$

(D) $30\sqrt{3}$

105. In the diagram, ΔABC is a non-right triangle.



Which describes the area of the triangle?

(A) $\frac{1}{2}ab$

(B) $ab\sin C$

(C) $\frac{1}{2}ab\sin C$

(D) $\frac{1}{2}ab\cos C$

106. Given: $\cos 26° \approx 0.90$ and $\sin 26° \approx 0.44$

What is the approximate value of $\cos 154°$?

(A) –0.90

(B) –0.44

(C) 0.44

(D) 0.90

For questions 107–109 use the statement below.

Given: An angle measures $k°$, where $k > 0$.

107. $\sin k° = \cos(90 - k)°$

(A) True

(B) False

108. $\sin k° = \sin(180 - k)°$

(A) True

(B) False

109. $\cos k° = \cos(180 - k)°$

(A) True

(B) False

---

110. Let $\cos A = m$. What is the value of $\sin A$?

(A) $\sqrt{m}$

(B) $1 - m$

(C) $\sqrt{1 - m^2}$

(D) $\sqrt{1 - m}$

111. In ΔABC where C is a right angle, $\sin A = \frac{\sqrt{7}}{4}$. What is cos B?

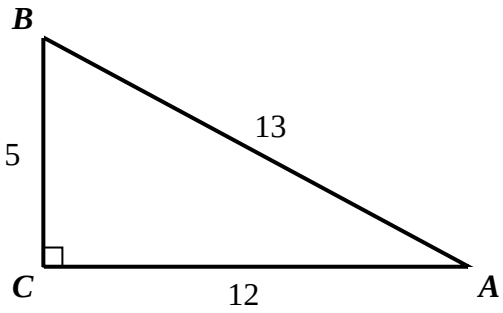
(A) $\frac{\sqrt{7}}{4}$

(B) $\frac{\sqrt{7}}{3}$

(C) $\frac{3}{4}$

(D) $\frac{3}{\sqrt{7}}$

112. Use the diagram.



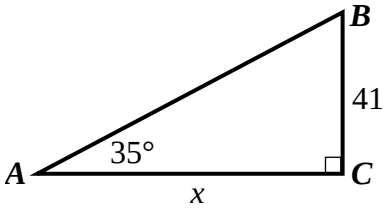
Which statement is true?

(A) $\sin A = \frac{13}{5}$

(B) $\cos A = \frac{12}{13}$

(C) $\tan A = \frac{12}{5}$

113. Use the diagram.



Which is the value of x?

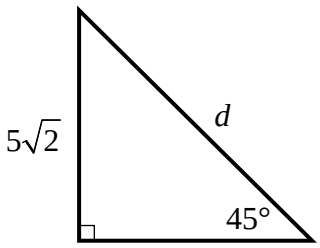
(A) $x = 41\cos 35°$

(B) $x = \dfrac{\tan 35°}{41}$

(C) $x = \dfrac{41}{\cos 35°}$

(D) $x = \dfrac{41}{\tan 35°}$

114. Use the diagram.



What is the value of d?

(A) 5

(B) $5\sqrt{2}$

(C) 10

(D) $10\sqrt{2}$

For questions 115–117, let $\cos x° = m$.

115. $\cos(180 - x)° = m$

(A) True

(B) False

116. $\cos(90 - x)° = m$

(A) True

(B) False

117. $\sin(90 - x)° = m$

(A) True

(B) False

---

118. Let $a = \cos 28°$. Which statement is true?

(A) $a = \cos 62°$

(B) $a = \cos 152°$

(C) $a = \sin 62°$

(D) $a = \sin 152°$

119. What is $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$?

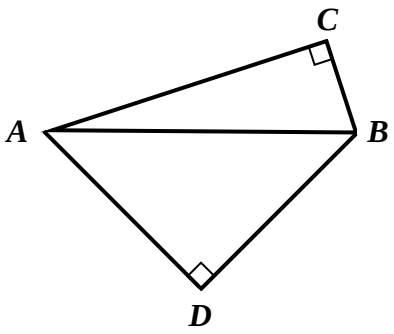
(A) 30°

(B) 45°

(C) 60°

(D) 90°

120. In the diagram, $BC < BD$ and $BD = AD$.



Which statement is true?

(A) $\cos \angle ABC < \sin \angle DAB$

(B) $\cos \angle ABC = \sin \angle DAB$

(C) $\cos \angle ABC > \sin \angle DAB$

121. What is tan 60°?

(A) $\frac{\sqrt{2}}{2}$

(B) $\frac{\sqrt{3}}{2}$

(C) $\frac{1}{\sqrt{3}}$

(D) $\sqrt{3}$

122. What is $\tan^{-1}(1)$?

(A) 30°

(B) 45°

(C) 60°

(D) 90°

123. In ΔGHI, the sine of angle G equals $\frac{1}{2}$. $\Delta G'H'I'$ is a dilation of ΔGHI about G with a scale factor of 2. What is the sine of angle G'?

(A) $\frac{1}{4}$

(B) $\frac{1}{2}$

(C) $\frac{\sqrt{3}}{2}$

(D) 1

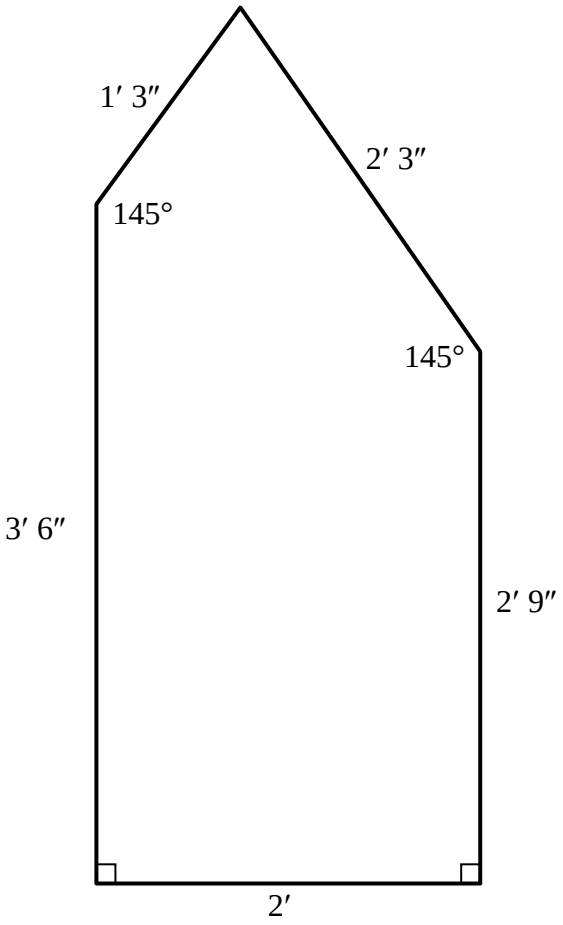
124. In triangle ΔABC, $m\angle B = 25°$, $a = 6.2$, and $b = 4$. Find all possible measures of the remaining two angles and the third side.

125. In triangle ΔABC, $m\angle B = 25°$, $a = 6.2$, and $c = 4$.

(a) Find all possible measures of the remaining two angles and the third side.

(b) Find all possible areas of the triangle.

126. The diagram shows a model of a closet floor on which Kim is laying carpet. (Measurements are approximate.)



(a) What is the area of the closet?

(b) The carpet Kim is using is cut by the carpet store in rectangular pieces from a 4-foot wide roll. What is the shortest length of carpet Kim would need to cover the closet floor in a single piece? Justify your answer.

Selected Response Key

#	Question Type	Unit	Common Core State Standard(s)	DOK Level	Key
1	MC	1	G.CO.2	1	B
2	MTF	1	G.CO.3	2	B
3	MTF	1	G.CO.3	2	B
4	MTF	1	G.CO.3	2	A
5	MC	1	G.CO.4	1	C
6	MC	1	G.CO.3	2	C
7	MC	1	G.CO.4	2	D
8	MC	1	G.CO.5	1	B
9	MC	1	G.CO.5	2	A
10	MC	1	G.CO.5	1	D
11	MC	1	G.CO.5	2	D
12	MC	1	G.CO.5	1	A
13	MTF	1	G.CO.2	1	A
14	MTF	1	G.CO.2	1	A
15	MTF	1	G.CO.2	1	B
16	MTF	1	G.CO.2	1	B
17	MC	1	G.CO.10	1	D
18	MC	1	G.CO.5	2	B
19	MC	1	G.CO.5	2	C
20	MTF	1	G.CO.9	2	A
21	MTF	1	G.CO.9	2	A
22	MTF	1	G.CO.9	2	A
23	MTF	1	G.CO.9	2	B
24	MTF	1	G.CO.11	2	B
25	MTF	1	G.CO.11	2	B
26	MTF	1	G.CO.11	2	A
27	MC	1	G.CO.5	1	C
28	MTF	1	G.CO.5	1	B
29	MTF	1	G.CO.5	1	B
30	MC	1	G.CO.5	1	D
31	MC	1	G.CO.2	1	B
32	MTF	1	G.CO.5	1	A
33	MTF	1	G.CO.5	1	A
34	MTF	1	G.CO.5	1	A
35	MTF	1	G.CO.5	1	B
36	MC	1	G.CO.2	1	D
37	MTF	1	G.CO.2	1	A
38	MTF	1	G.CO.2	1	B
39	MTF	1	G.CO.5	1	A
40	MTF	1	G.CO.5	1	B
41	MTF	1	G.CO.5	1	A
42	MTF	1	G.CO.5	1	A
43	MTF	1	G.CO.5	1	A
44	MTF	1	G.CO.8	1	B
45	MTF	1	G.CO.8	1	A
46	MTF	1	G.CO.8	1	B
47	MC	1	G.CO.6	2	C
48	MC	1	G.CO.9	1	A

Selected Response Key

#	Question Type	Unit	Common Core State Standard(s)	DOK Level	Key
49	MTF	1	G.CO.6	2	A
50	MTF	1	G.CO.6	2	A
51	MTF	1	G.CO.6	2	B
52	MC	1	G.CO.9	1	B
53	MTF	1	G.CO.10	1	A
54	MTF	1	G.CO.10	1	B
55	MC	1	G.CO.3	1	B
56	CR	1	G.CO.7	3	—
57	CR	1	G.CO.7	3	—
58	CR	1	G.CO.10	3	—
59	CR	1	G.CO.13	2	—
60	CR	1	G.CO.5	2	—
61	ER	1	G.CO.5, G.MG.3	3	—
62	CR	1	G.CO.3, G.CO.5	1	—
63	CR	1	G.CO.5	1	—
64	CR	1	G.CO.5	1	—
65	CR	1	G.CO.5	2	—
66	CR	1	G.CO.5	1	—
67	CR	1	G.CO.5	2	—
68	CR	1	G.CO.5	2	—
69	MC	2.1	G.SRT.5	2	C
70	MC	2.1	G.SRT.4	2	B
71	MC	2.1	G.SRT.5	2	D
72	MC	2.1	G.SRT.5	2	A
73	MC	2.1	G.SRT.5	2	B
74	MC	2.1	G.SRT.5	1	D
75	MC	2.1	G.SRT.3	2	C
76	MC	2.1	G.SRT.2	1	C
77	MC	2.1	G.SRT.1a	2	B
78	MC	2.1	G.SRT.2	1	D
79	MC	2.1	G.SRT.1b	1	C
80	MC	2.1	G.SRT.1a	1	B
81	MTF	2.1	G.SRT.1	1	B
82	MTF	2.1	G.SRT.1	1	A
83	MTF	2.1	G.SRT.1	1	A
84	MC	2.1	G.SRT.2	1	B
85	MC	2.1	G.SRT.1	1	B
86	MC	2.1	G.SRT.1	1	D
87	MC	2.1	G.SRT.1	2	C
88	MC	2.2	G.SRT.8	1	C
89	MC	2.2	G.SRT.8	1	B
90	MC	2.1	G.SRT.5	1	C
91	CR	2.1	G.SRT.5	3	—
92	CR	2.1	G.SRT.2	2	—
93	CR	2.1	G.SRT.5	3	—
94	CR	2.1	G.SRT.4	3	—
95	CR	2.1	G.SRT.2	2	—
96	CR	2.1 2.2	G.SRT.5, G.SRT.9, G.SRT.11	2	—

Shaded questions do not pertain to the non-honors CCSS-based Geometry course.

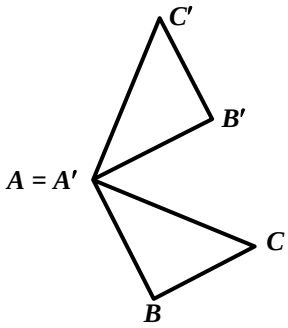
Selected Response Key

#	Question Type	Unit	Common Core State Standard(s)	DOK Level	Key
97	MC	2.2	G.SRT.11	1	A
98	MC	2.2	G.SRT.10	1	C
99	MC	2.2	G.SRT.11	2	A
100	MC	2.2	G.SRT.10	1	C
101	MTF	2.2	G.SRT.10	1	B
102	MTF	2.2	G.SRT.10	1	A
103	MTF	2.2	G.SRT.10	1	B
104	MC	2.2	G.SRT.9	2	A
105	MC	2.2	G.SRT.9	1	C
106	MC	2.2	G.SRT.11	1	A
107	MTF	2.2	G.SRT.7	1	A
108	MTF	2.2	G.SRT.11	1	A
109	MTF	2.2	G.SRT.11	1	B
110	MC	2.2	G.SRT.8	2	C
111	MC	2.2	G.SRT.7	1	A
112	MC	2.2	G.SRT.8	1	B
113	MC	2.2	G.SRT.8	1	D
114	MC	2.2	G.SRT.8	1	C
115	MTF	2.2	G.SRT.11	1	B
116	MTF	2.2	G.SRT.7	1	B
117	MTF	2.2	G.SRT.7	1	A
118	MC	2.2	G.SRT.6	2	C
119	MC	2.2	G.SRT.6	1	A
120	MC	2.2	G.SRT.6	2	A
121	MC	2.2	G.SRT.6	2	D
122	MC	2.2	G.SRT.6	2	B
123	MC	2.2	G.SRT.6	1	B
124	CR	2.2	G.SRT.11	2	—
125	CR	2.2	G.SRT.11	2	—
126	CR	2.2	G.SRT.8, G.MD.3	2	—

Constructed Response Solutions

56. This question assesses the student's ability to apply a transformation to a figure with certain conditions placed on the image.

Answers will vary, but the image of point A must be itself, and ΔABC must have been rotated 90° (counterclockwise). Thus, A is the center of rotation. See example at right.



57. This question assesses the student's ability to do geometric proofs.

Answers will vary. Solutions may be paragraph, 2-column, flow, or other type of proof. However, statements must be justified. Either transformation-based or Euclidean-based proofs are acceptable.

Here is one example of a transformational geometry based proof:

Statement	Justification
$r_m(D) = E$	given
m is the perpendicular bisector of $\overline{AB}$	given
$r_m(A) = B$	definition of a reflection
$r_m(C) = C$	definition of a reflection
$r_m(\Delta ADC) = \Delta BEC$	the image of a figure defined by a set of points is defined by the images of those points
ΔBEC is an isometry of ΔADC	reflections are isometries
$\Delta ADC \cong \Delta BEC$	figures are congruent if one is the image of the other under an isometry

58. This question assesses the student's ability to do geometric proofs.

Answers will vary. Solutions may be paragraph, 2-column, flow, or other type of proof. However, statements must be justified. Either transformation-based or Euclidean-based proofs are acceptable.

Here is one example of a transformational geometry based proof:

Statement	Justification
$\overleftrightarrow{DC}$ is the perpendicular bisector of $\overline{AB}$	given
$r_{\overline{CD}}(A) = B$	definition of a reflection
$r_{\overline{CD}}(C) = C$	definition of a reflection
$r_{\overline{CD}}(D) = D$	definition of a reflection
$r_{\overline{CD}}(\Delta ADC) = \Delta BDC$	the image of a figure defined by a set of points is defined by the images of those points
ΔBDC is an isometry of ΔADC	reflections are isometries
$\Delta ADC \cong \Delta BDC$	figures are congruent if one is the image of the other under an isometry
$\angle DAB \cong \angle DBA$	corresponding parts of congruent figures are congruent

Constructed Response Solutions

59. This question assesses the student's ability to do geometric proofs.

Answers will vary. The proof can be found in nearly every geometry textbook.

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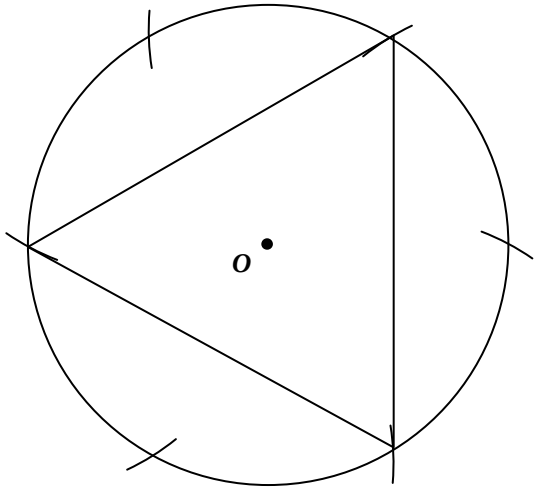
60. This question assesses the student's ability to construct figures.

The solution should look something like this.

Set compass equal to radius. Choose an arbitrary point on the circle to be the center of an arc and mark an arc on the circle. Use the intersection of the circle and the arc as the center of the next arc. Repeat. The six points are the vertices of a regular hexagon. Alternating points are the vertices of an equilateral triangle.



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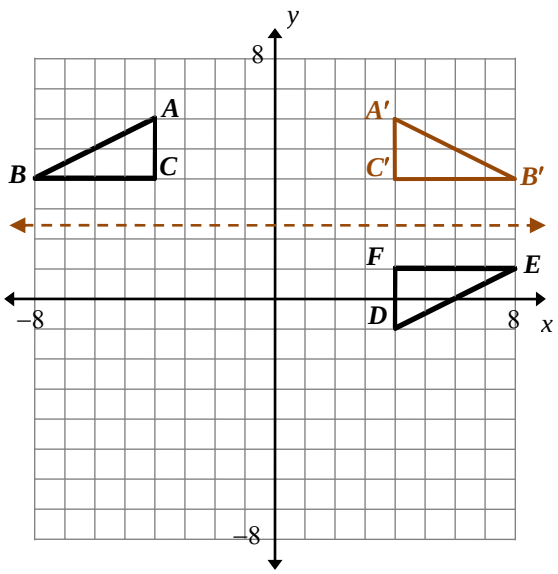
61. This question assesses the student's ability to apply a transformation to a figure, describe a series of transformations from one figure to another, and compose transformations into a single transformation, if possible.

(a) See figure

(b) Reflection across the line $y = 2.5$.

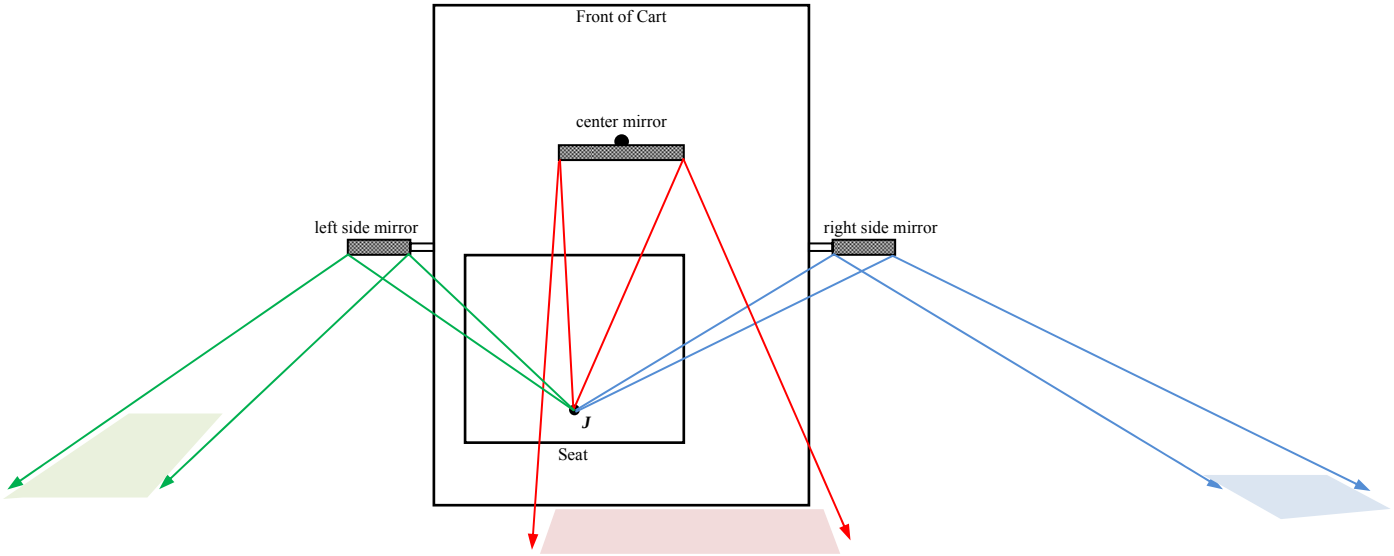
(c) A composition of two reflections is a rotation whose center is the intersection of the two lines, and the angle of rotation is twice the angle between the lines. Since $y = 2.5$ is perpendicular to the y-axis, a rotation of 180° (or –180°) about (0, 2.5) maps ΔABC to ΔDEF.



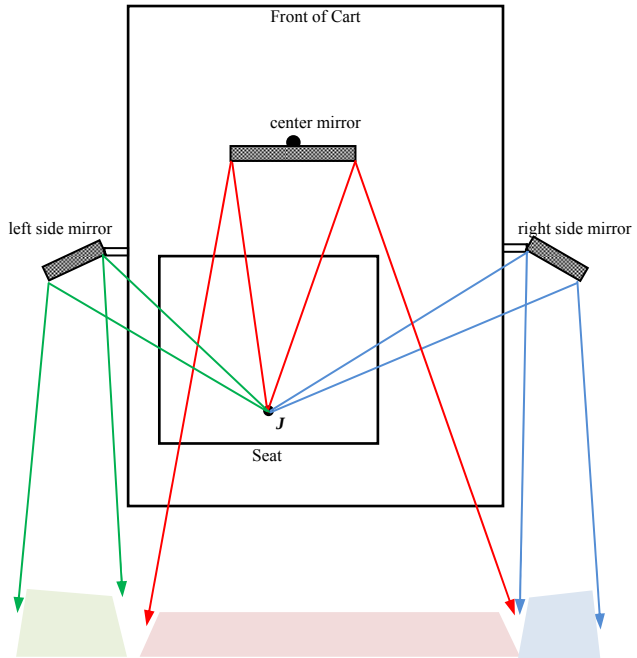
Constructed Response Solutions

62. This question assesses the student's ability to apply transformations to real-world situations.

The areas that Jimmy can see behind the cart are shown in the diagram below. He has some major blind spots.



A student may solve this problem by changing positions of mirrors, moving Jimmy's seat so his eyes are in a different location, rotating mirrors, or any combination of these to improve the areas of visibility behind the cart. They may not change the dimensions of the car or the mirrors. For example:
(1) moving the center mirror about 2" left
(2) rotating the left mirror counter-clockwise 25°.
(3) rotating the right mirror clockwise 30°



Constructed Response Solutions

63. This question assesses the student's knowledge of rigid transformations.

(a) B

(b) C

(c) 120 or –240

(d) $\overleftrightarrow{BE}$

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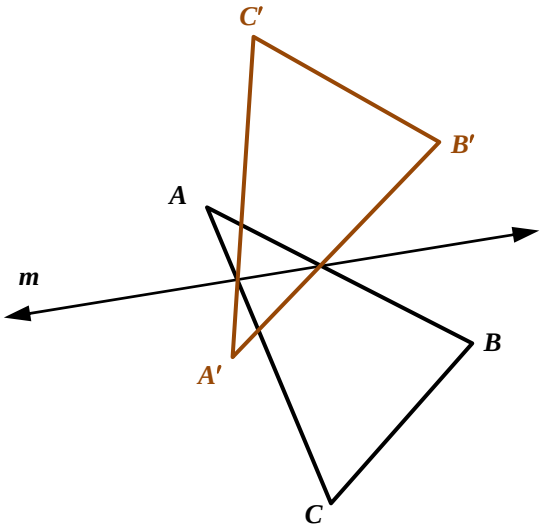
64. This question assesses the student's ability to apply rigid transformations.



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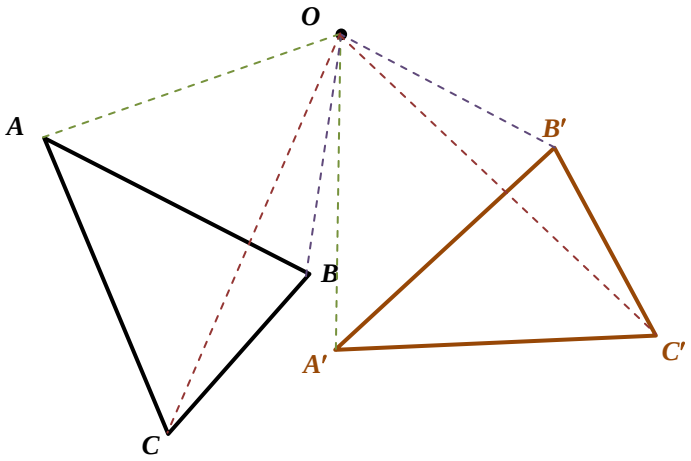
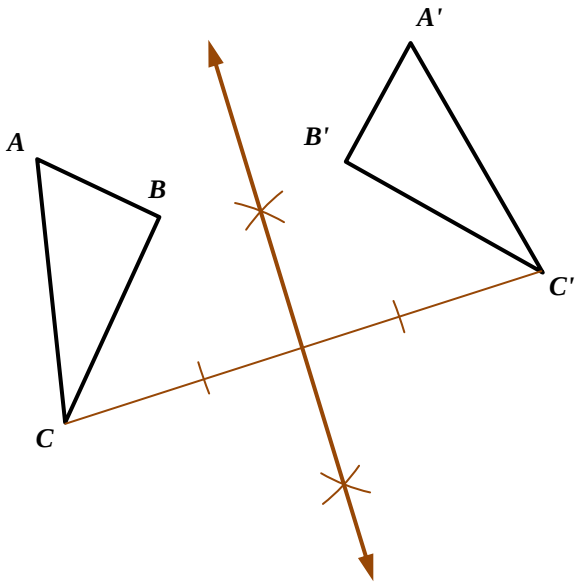
65. This question assesses the student's ability to apply rigid transformations.



$m\angle AOA' = m\angle BOB' = m\angle COC' = 70°$

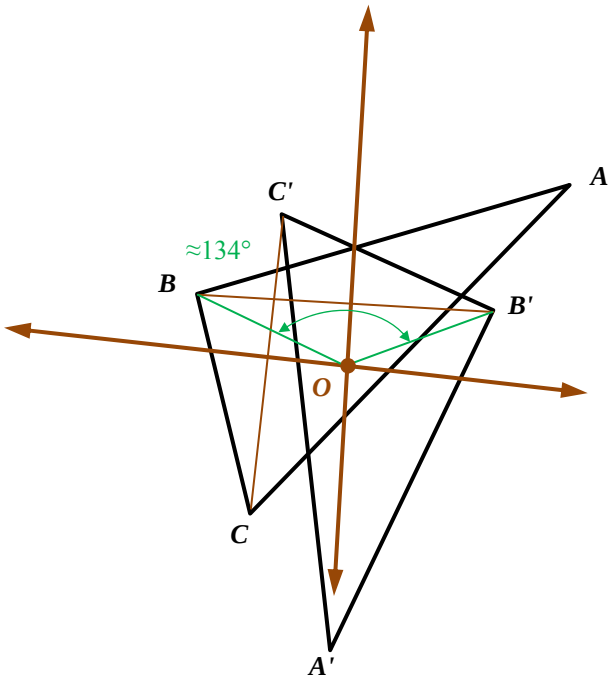
Constructed Response Solutions

66. This question assesses the student's ability to apply rigid transformations.



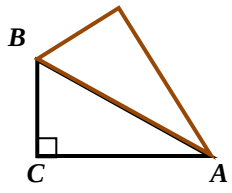
67. This question assesses the student's ability to apply rigid transformations.

(Arc marks to construct perpendicular bisectors of BB' and CC' left off for clarity.)

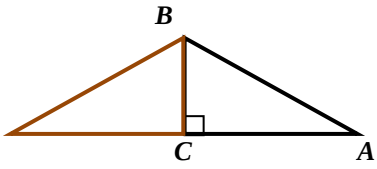


Constructed Response Solutions

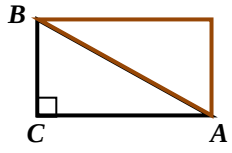
68. This question assesses the student's ability to apply rigid transformations.



(a) reflect across line *AB*



(b) reflect across line *BC*



(c) rotate 180° about midpoint of segment *AB*

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91. This question assesses the student's ability to do geometric proofs.

Answers will vary. Solutions may be paragraph, 2-column, flow, or other type of proof. However, statements must be justified.

Statement	Justification
$\overline{BD}$ is perpendicular to $\overline{AC}$	given
$\overline{AE}$ is perpendicular to $\overline{BC}$	given
$\angle AEC$ is a right angle	definition of perpendicular
$\angle BDC$ is a right angle	definition of perpendicular
$\angle AEC \cong \angle BDC$	all right angles are congruent
$\angle ECA \cong \angle DCB$	reflexive property
$\Delta AEC \sim \Delta BDC$	angle-angle similarity postulate

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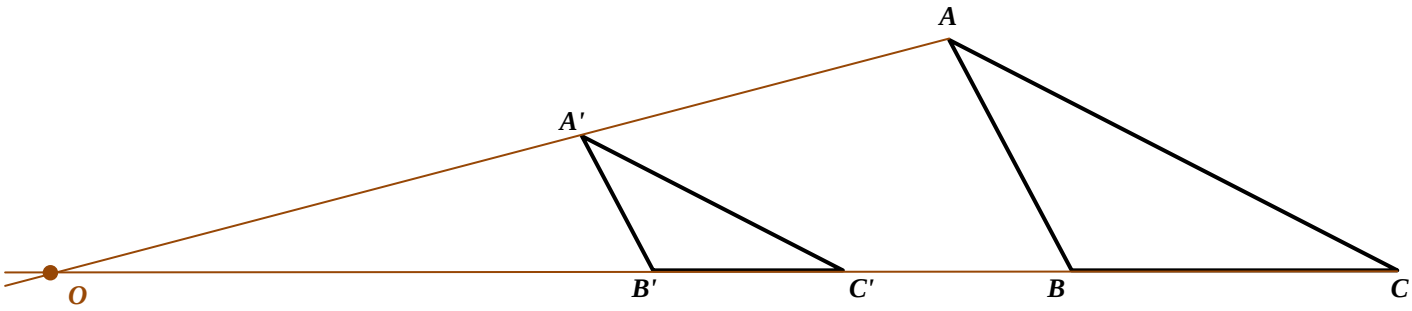
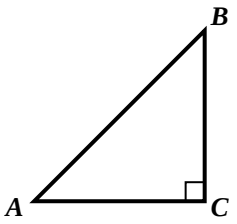
92. This question assesses the student's ability to apply similarity transformations.



$OA' \approx 7.2$ cm. $OA \approx 12.1$ cm. The scale factor is approximately $\frac{7.2 \text{ cm}}{12.2 \text{ cm}} \approx 0.6$.

Constructed Response Solutions

93. This question assesses the student's ability to do geometric proofs.



Given ΔABC is an arbitrary isosceles right triangle. Let angle C be the right angle. $m\angle C = 90°$ by the definition of right angle. The triangle sum theorem states $m\angle A + m\angle B + m\angle C = 180°$, so $m\angle A + m\angle B = 90°$ Since ΔABC is isosceles, two angles must be congruent. Since $m\angle A$ and $m\angle B$ must be greater than zero, neither can measure 90° and be congruent to angle C. Thus, $m\angle A = m\angle B = 45°$.

Consider a second arbitrary isosceles right triangle ΔXYZ with right angle at Z. By a parallel argument, it can be shown that $m\angle X = m\angle Y = 45°$.

$\Delta ABC \sim \Delta XYZ$ by angle-angle similarity.

---

94. This question assesses the student's ability to do geometric proofs.

Given $\Delta ABC \sim \Delta CBD$, then $\frac{e}{a} = \frac{a}{c}$, so $a^2 = ce$.

Given $\Delta ABC \sim \Delta ACD$, then $\frac{d}{b} = \frac{b}{c}$, so $b^2 = cd$.

Thus $a^2 + b^2 = ce + cd = c(d + e) = c(c) = c^2$.

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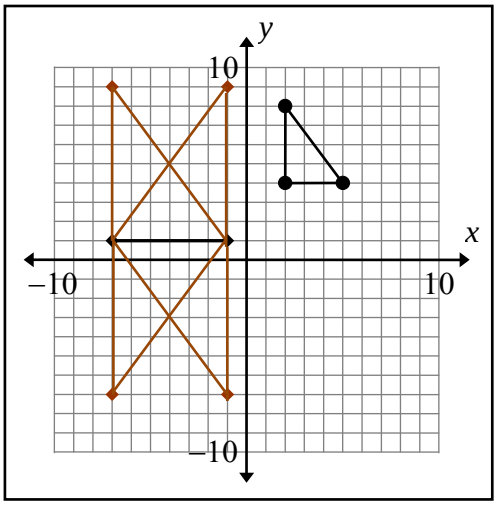
95. This question assesses the student's ability to apply similarity transformations.



(a) The lengths of the sides of (right) Triangle One are 3, 4, and 5. The distance between the two vertices given for Triangle Two is 6. Since it is not stated which vertices of Triangle One correspond to Triangle two, there are three possible scale factors: 2, 1.5, and 1.2.

If the scale factor is 2, then the sides of Triangle Two have lengths 6, 8, and 10. Since the given side is a leg of length 6, the other leg of length 8 could be one of four segments. The third vertex could be at (–7, 9), (–7, –7), (–1, 9), or (–1, –7). (See diagram.) Any <u>one</u> of these is a correct answer for the third vertex.

If the scale factor is 1.5, the sides have length 4.5, 6, and 7.5, and third vertex could be at (–7, 5.5), (–7, –3.5), (–1, 5.5), or (–1, –3.5). (Not shown)

If the scale factor is 1.2, the sides have length 3.6, 4.8, and 6, and third vertex could be at (–4.8, 3.8), (–4.8, –3.5), (–3.2, 5.5), or (–3.2, –3.5) to the nearest tenth. (Not shown. Students do not have to compute the location exactly; a reasonable approximation is sufficient.)

(b) One of the other scale factors must be chosen and a third vertex located.

Constructed Response Solutions

96. This question assesses the student's ability to apply similarity transformations and compute the area of a non-right triangle.

(a) The possible scale factors are 8, 4, and 3.

(b) Let $a = 3$, $b = 6$, and $c = 8$, using the law of cosines, $8^2 = 3^2 + 6^2 - 2(3)(6)\cos C$. So, $\cos C = \frac{8^2 - 3^2 - 6^2}{-2(3)(6)} = -\frac{19}{36}$.

$C = \cos^{-1}\left(-\frac{19}{36}\right) = 121.855...°$. The area of the triangle is $A = \frac{1}{2}ab\sin C = \frac{1}{2}(3)(6)\sin 121.855...° \approx 7.6$. The new triangle would be scaled up by a factor of 3, 4, or 8; the area would then scale by 9, 16, or 64. The resulting area would be about 69, 122, or 489.

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124. This question assesses the student's ability to use the law of sines.

Using the law of sines, $\frac{\sin A}{6.2} = \frac{\sin 25°}{4}$, so $A \approx 41°$. $C \approx 114°$. $\frac{\sin 114°}{c} = \frac{\sin 25°}{4}$, so $c \approx 8.6$.

There is a second possible solution, as this is an ambiguous case: $A \approx 139°$. $C \approx 16°$. $\frac{\sin 16°}{c} = \frac{\sin 25°}{4}$, so $c \approx 2.6$.

---

125. This question assesses the student's ability to use the law of cosines, law of sines, and the general formula for the area of the triangle.

(a) Using the law of cosines, $b^2 = 4^2 + 6.2^2 - 2(4)(6.2)\cos 25°$, so $b \approx 3.1$. Using the law of sines, $\frac{\sin A}{6.2} \approx \frac{\sin 25°}{3.1}$, so $A \approx 122°$. $C \approx 33°$.

(b) The area of the triangle is $A = \frac{1}{2}(4)(6.2)\sin 25° \approx 5.2$.

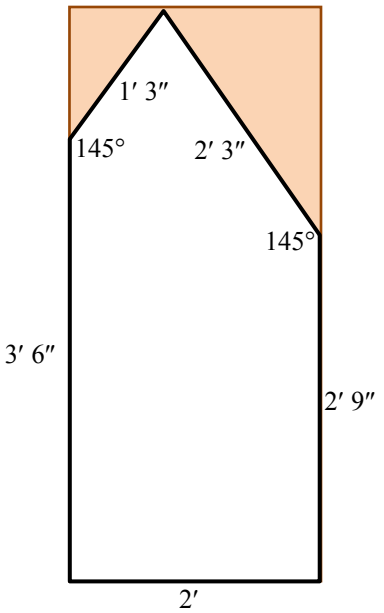
---

126. This question assesses the student's ability to apply the right triangle trigonometry to real-world situations.

(a) The area of the closet is equal to the area of a containing rectangle minus the areas of the two shaded right triangles. Using right triangle trigonometry, the smaller right triangle has legs of $1.25'\sin 35° \approx 0.72'$ and $1.25'\cos 35° \approx 1.02'$. The larger right triangle has legs of $3.5' + 1.02' - 2.75' \approx 1.77'$ and $2' - 0.72' \approx 1.28'$. The length of the rectangle is $3.5' + 1.02' \approx 4.57'$.

The area of the closet is $(4.57' \times 2') - \frac{1}{2}(0.72')(1.02') - \frac{1}{2}(1.77')(1.28') \approx 7.4$ square feet.

(b) The length of the closet is 4.57′, so Kim cannot just by a 2′ wide piece—it will be too short. She will have to buy a 4.57′ (about 4′7″) piece to fit the length of the closet and cut off 2 feet of it so it fits the width.



Notes on Practice Materials

The Geometry Honors Practice Materials are provided to help teachers and students prepare for the CCSD Semester Exams in Geometry Honors. School choosing to teach regular Geometry using the CCSS should also use these materials.

The questions are representative of the style, format, and type that will be on the exams. They are not, however, completely parallel in construction. That is, practice questions on a particular standard show how that standard may be assessed, but the questions on the actual exam could assess that standard in a different way. Teachers must provide students with opportunities to explore all aspects of a standard, and not simply focus on those addressed by the practice materials.

There are 3 types of questions in the practice materials that will appear on the semester exams.

- MC – Multiple Choice. This is a traditional selected-response type of question. Each item will have 3 or 4 possible responses.
- MTF – Multiple True/False. These items will have 2–4 true/false questions based on a common lead-in statement or concept. These should remain grouped together when provided for practice.
- CR – Constructed response. These items may have multiple parts that address one or more standards. The DOK level is the overall level of the item, though some parts may be at lower levels. Short CR items average about 6–8 minutes to complete; longer CR items average 10–15 minutes to complete.

A fourth type of question is the Extended Response (ER). These will not appear on the semester exam at this time, but are indicative of longer, performance-type tasks that will appear on the Smarter Balanced Assessments beginning in 2013–2014.

Sample solutions are provided for CR and ER questions. Student methods may vary and any logical, mathematically correct approach, including different types of proof, should be accepted as correct.

It is expected that students will have access to mathematical tools for these practice questions and the semester exam. Tools include compass, protractor, ruler, patty paper, and graph paper. Students may use calculators, including graphing calculators, constructed response questions.