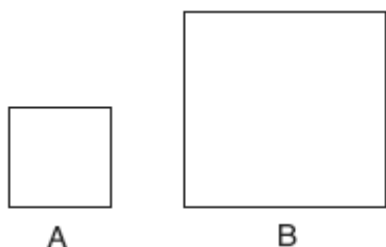


## CHAPTER 3

### IDENTIFYING TRANSFORMATIONS

1. 010804a, P.I. G.G.60

In the accompanying diagram, figure  $B$  is the image of figure  $A$ .



Which type of transformation was performed?

- [A] translation      [B] rotation  
[C] reflection      [D] dilation

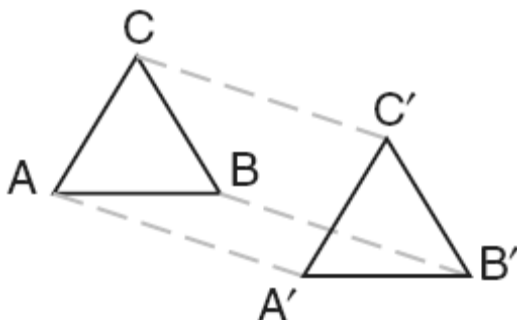
2. 010809a

Which transformation produces a figure that is always the mirror image of the original figure?

- [A] line reflection      [B] translation  
[C] dilation      [D] rotation

3. 080719a, P.I. G.G.56

In the accompanying diagram,  $\triangle A'B'C'$  is the image of  $\triangle ABC$  and  $\triangle A'B'C' \cong \triangle ABC$ .

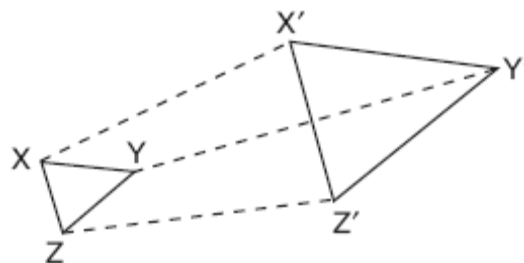


Which type of transformation is shown in the diagram?

- [A] translation      [B] dilation  
[C] rotation      [D] line reflection

4. 060711a, P.I. G.G.60

The accompanying diagram shows the transformation of  $\triangle XYZ$  to  $\triangle X'Y'Z'$ .



This transformation is an example of a

- [A] line reflection      [B] rotation  
[C] dilation      [D] translation

5. 080611a

Which transformation does *not* always result in an image that is congruent to the original figure?

- [A] reflection      [B] translation  
[C] dilation      [D] rotation

6. 060603a, P.I. G.G.58

One function of a movie projector is to enlarge the image on the film. This procedure is an example of a

- [A] line of symmetry      [B] translation  
[C] line reflection      [D] dilation

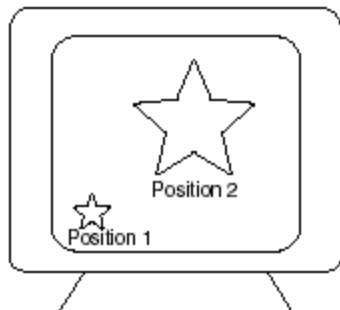
7. 010605b, P.I. G.G.61

Which transformation of the graph of  $y = x^2$  would result in the graph of  $y = x^2 + 2$ ?

- [A]  $r_{y=2}$       [B]  $T_{0,2}$       [C]  $R_{0,90}$       [D]  $D_2$

8. 080506a, P.I. G.G.60

As shown in the accompanying diagram, the star in position 1 on a computer screen transforms to the star in position 2.

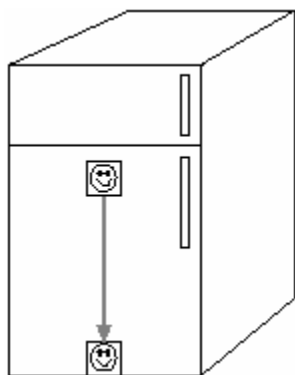


This transformation is best described as a

- [A] rotation                      [B] line reflection  
[C] dilation                      [D] translation

9. 060508a, P.I. G.G.56

A picture held by a magnet to a refrigerator slides to the bottom of the refrigerator, as shown in the accompanying diagram.

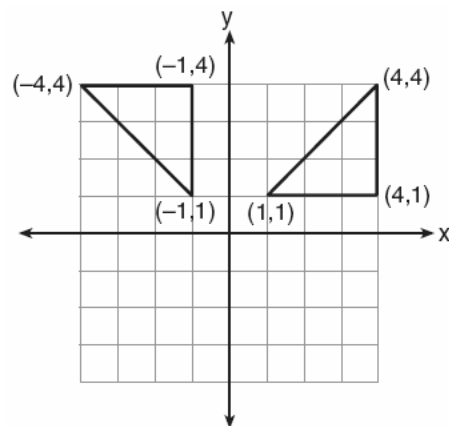


This change of position is an example of a

- [A] translation                      [B] reflection  
[C] rotation                      [D] dilation

10. 060410a, P.I. G.G.56

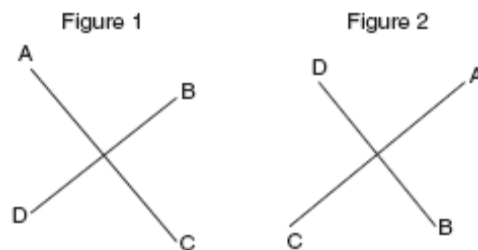
Which type of transformation is illustrated in the accompanying diagram?



- [A] reflection                      [B] rotation  
[C] dilation                      [D] translation

11. 010305a, P.I. G.G.56

The accompanying diagram shows a transformation.

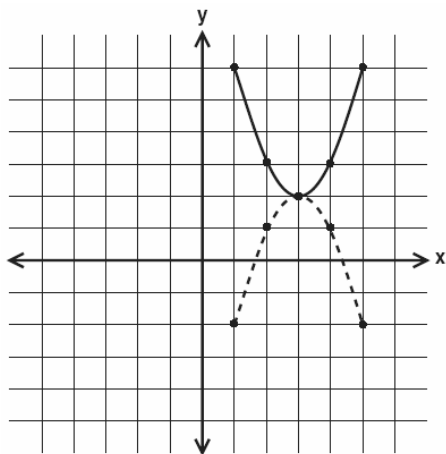


Which transformation performed on figure 1 resulted in figure 2?

- [A] translation                      [B] dilation  
[C] reflection                      [D] rotation

12. 080212a, P.I. G.G.56

In the accompanying diagram, which transformation changes the solid-line parabola to the dotted-line parabola?



- [A] translation [B] line reflection, only  
[C] rotation, only  
[D] line reflection or rotation

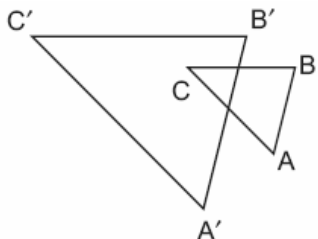
13. 060217b, P.I. G.G.61

Point  $P'$  is the image of point  $P(-3, 4)$  after a translation defined by  $T_{(7, -1)}$ . Which other transformation on  $P$  would also produce  $P'$ ?

- [A]  $R_{-90^\circ}$  [B]  $r_{y\text{-axis}}$   
[C]  $R_{90^\circ}$  [D]  $r_{y=-x}$

14. 060216a, P.I. G.G.60

In the accompanying diagram,  $\triangle ABC$  is similar to but not congruent to  $\triangle A'B'C'$ . Which transformation is represented by  $\triangle A'B'C'$ ?



- [A] dilation [B] translation  
[C] reflection [D] rotation

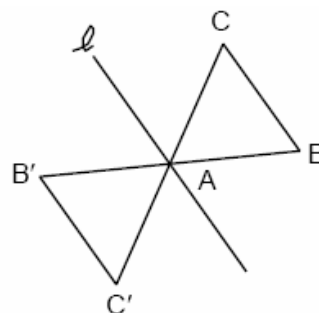
15. 060013a

Which transformation does *not* always produce an image that is congruent to the original figure?

- [A] reflection [B] dilation  
[C] translation [D] rotation

16. 089903a, P.I. G.G.56

The transformation of  $\triangle ABC$  to  $\triangle A'B'C'$  is shown in the accompanying diagram.



This transformation is an example of a

- [A] translation [B] dilation  
[C] line reflection in line  $\ell$   
[D] rotation about point A

## CHAPTER 3-1

### ISOMETRIES

17. 010210b, P.I. G.G.61

Which transformation is *not* an isometry?

- [A]  $R_{0, 90^\circ}$  [B]  $T_{3, 6}$  [C]  $D_2$  [D]  $r_{y=x}$

18. 080308b, P.I. G.G.54

Which transformation is *not* an isometry?

- [A] rotation [B] dilation  
[C] translation [D] line reflection

19. 080105b, P.I. G.G.61

Which transformation is a direct isometry?

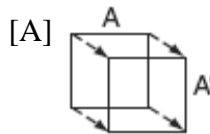
- [A]  $D_{-2}$  [B]  $D_2$  [C]  $T_{2, 5}$  [D]  $r_{y\text{-axis}}$

20. 060313b, P.I. G.G.54  
Which transformation is an opposite isometry?  
[A] line reflection [B] translation  
[C] dilation [D] rotation of  $90^\circ$
21. 010507b, P.I. G.G.54  
Which transformation is an example of an opposite isometry?  
[A]  $(x,y) \rightarrow (3x,3y)$  [B]  $(x,y) \rightarrow (y,x)$   
[C]  $(x,y) \rightarrow (x+3,y-6)$   
[D]  $(x,y) \rightarrow (y,-x)$
22. 060218b, P.I. G.G.54  
Which transformation does *not* preserve orientation?  
[A] dilation [B] rotation  
[C] reflection in the  $y$ -axis  
[D] translation

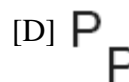
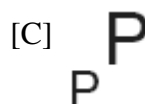
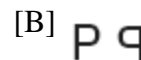
## REFLECTIONS

23. 080418a, P.I. G.G.54  
What is the image of point  $(-3, -1)$  under a reflection in the origin?  
[A]  $(-3, 1)$  [B]  $(-1, -3)$   
[C]  $(3, 1)$  [D]  $(1, 3)$

24. 010602a, P.I. G.G.56  
Ms. Brewer's art class is drawing reflected images. She wants her students to draw images reflected in a line. Which diagram represents a correctly drawn image?



25. 010701a, P.I. G.G.56  
Which image represents a line reflection?

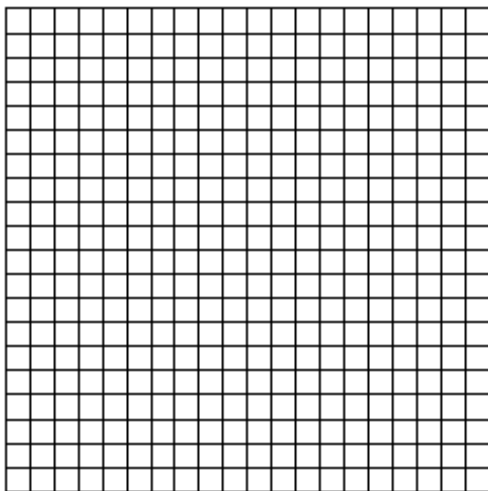


26. 010007a, P.I. G.G.54  
When the point  $(2, -5)$  is reflected in the  $x$ -axis, what are the coordinates of its image?  
[A]  $(5, 2)$  [B]  $(2, 5)$   
[C]  $(-2, 5)$  [D]  $(-5, 2)$

27. 080713a, P.I. G.G.54  
What are the coordinates of point  $(2, -3)$  after it is reflected over the  $x$ -axis?  
[A]  $(-2, 3)$  [B]  $(-3, 2)$   
[C]  $(2, 3)$  [D]  $(-2, -3)$

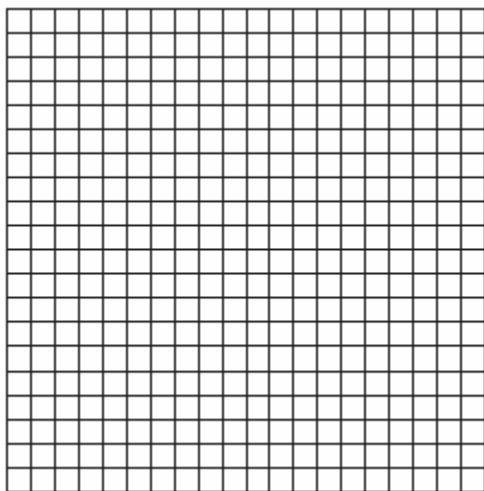
28. 010124a, P.I. G.G.54

The coordinates of the endpoints of  $\overline{AB}$  are  $A(0,2)$  and  $B(4,6)$ . Graph and state the coordinates of  $A'$  and  $B'$ , the images of  $A$  and  $B$  after  $\overline{AB}$  is reflected in the  $x$ -axis.



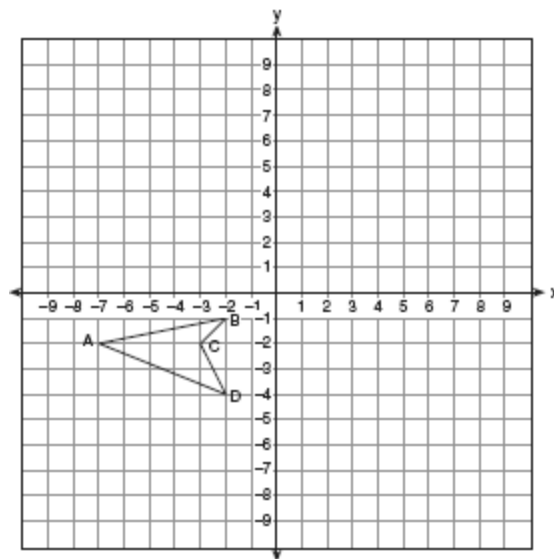
29. 060135a, P.I. G.G.54

Triangle  $SUN$  has coordinates  $S(0,6)$ ,  $U(3,5)$ , and  $N(3,0)$ . On the accompanying grid, draw and label  $\triangle SUN$ . Then, graph and state the coordinates of  $\triangle S'U'N'$ , the image of  $\triangle SUN$  after a reflection in the  $y$ -axis.



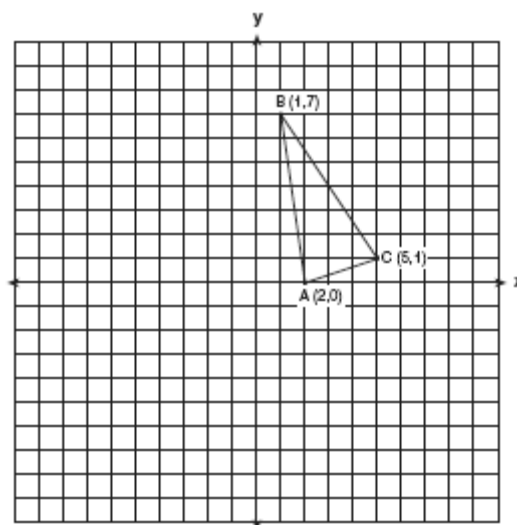
30. 060537a, P.I. G.G.54

On the accompanying set of axes, draw the reflection of  $ABCD$  in the  $y$ -axis. Label and state the coordinates of the reflected figure.



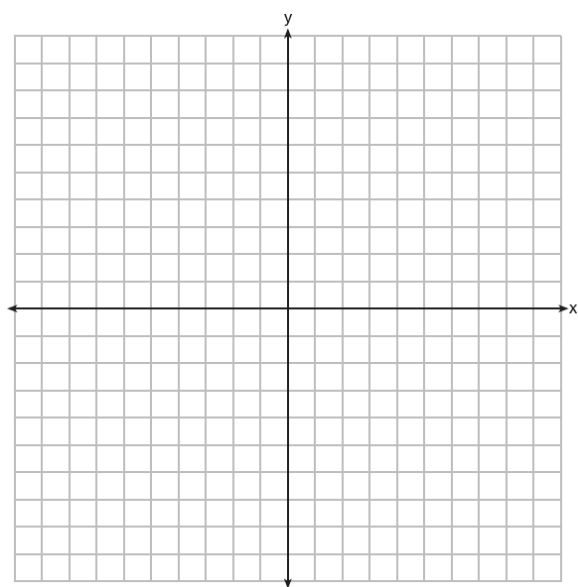
31. 080637a, P.I. G.G.54

Triangle  $ABC$  has coordinates  $A(2,0)$ ,  $B(1,7)$ , and  $C(5,1)$ . On the accompanying set of axes, graph, label, and state the coordinates of  $\triangle A'B'C'$ , the reflection of  $\triangle ABC$  in the  $y$ -axis.



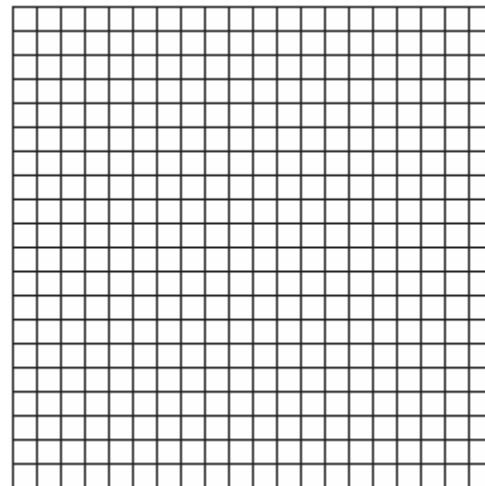
32. 060739a, P.I. G.G.54

Carson is a decorator. He often sketches his room designs on the coordinate plane. He has graphed a square table on his grid so that its corners are at the coordinates  $A(2,6)$ ,  $B(7,8)$ ,  $C(9,3)$ , and  $D(4,1)$ . To graph a second identical table, he reflects  $ABCD$  over the  $y$ -axis. On the accompanying set of coordinate axes, sketch and label  $ABCD$  and its image  $A'B'C'D'$ , which show the locations of the two tables. Then find the number of square units in the area of  $ABCD$ .



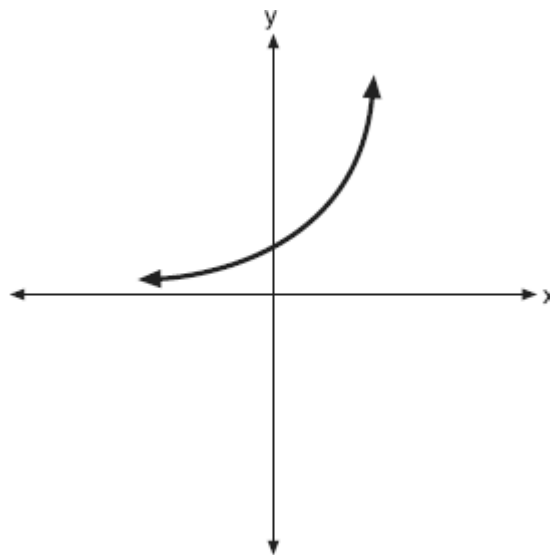
33. 010333a, P.I. G.G.54

On the accompanying grid, draw and label quadrilateral  $ABCD$  with points  $A(1,2)$ ,  $B(6,1)$ ,  $C(7,6)$ , and  $D(3,7)$ . On the same set of axes, plot and label quadrilateral  $A'B'C'D'$ , the reflection of quadrilateral  $ABCD$  in the  $y$ -axis. Determine the area, in square units, of quadrilateral  $A'B'C'D'$ .



34. 080721b, P.I. A2.A.46

The graph of the function  $f(x) = a^x$  is shown on the accompanying set of axes. On the same set of axes, sketch the reflection of  $f(x)$  in the  $y$ -axis. State the coordinates of the point where the graphs intersect.



35. 060306b, P.I. G.G.54

What are the coordinates of point  $P$ , the image of point  $(3,-4)$  after a reflection in the line  $y = x$ ?

- [A]  $(-4,3)$  [B]  $(4,-3)$   
[C]  $(-3,4)$  [D]  $(3,4)$

36. 060710b, P.I. A2.A.46

A function,  $f$ , is defined by the set  $\{(2,3), (4,7), (-1,5)\}$ . If  $f$  is reflected in the line  $y = x$ , which point will be in the reflection?

- [A]  $(-1,5)$  [B]  $(-5,1)$   
[C]  $(5,-1)$  [D]  $(1,-5)$

37. 060613b, P.I. A2.A.46

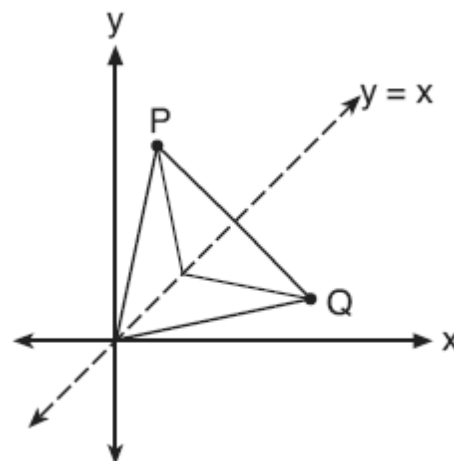
Which transformation best describes the relationship between the functions  $f(x) = 2^x$

and  $g(x) = \left(\frac{1}{2}\right)^x$ ?

- [A] reflection in the line  $y = x$   
[B] reflection in the origin  
[C] reflection in the  $y$ -axis  
[D] reflection in the  $x$ -axis

38. 010804b, P.I. A2.A.46

Matthew is a fan of the Air Force's Thunderbirds flying team and is designing a jacket patch for the team, as shown in the accompanying diagram.

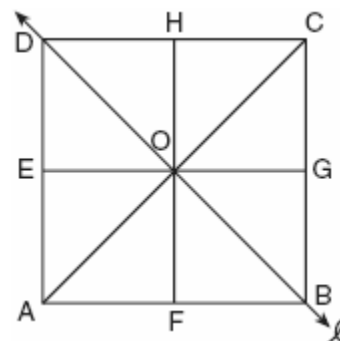


If  $P$  has the coordinates  $(a,b)$ , what are the coordinates of  $Q$ , the reflection of  $P$  in the line  $y = x$ ?

- [A]  $(y,x)$  [B]  $(a,b)$   
[C]  $(-a,b)$  [D]  $(b,a)$

39. 060424b, P.I. G.G.56

In the accompanying diagram of square  $ABCD$ ,  $F$  is the midpoint of  $\overline{AB}$ ,  $G$  is the midpoint of  $\overline{BC}$ ,  $H$  is the midpoint of  $\overline{CD}$ , and  $E$  is the midpoint of  $\overline{DA}$ .

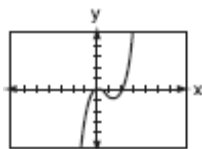


Find the image of  $\triangle EOA$  after it is reflected in line  $\ell$ .

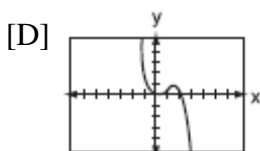
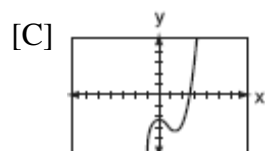
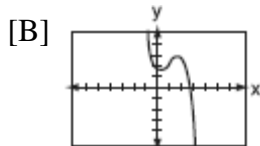
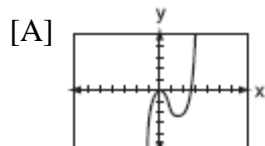
Is this isometry direct or opposite? Explain your answer.

40. 060701b, P.I. A2.A.46

The accompanying graph represents the equation  $y = f(x)$ .

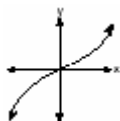


Which graph represents  $g(x)$ , if  $g(x) = -f(x)$ ?

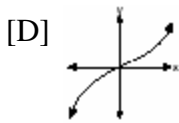
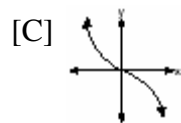
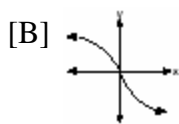
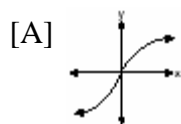


41. 080406b, P.I. A2.A.46

The graph below represents  $f(x)$ .



Which graph best represents  $f(-x)$ ?

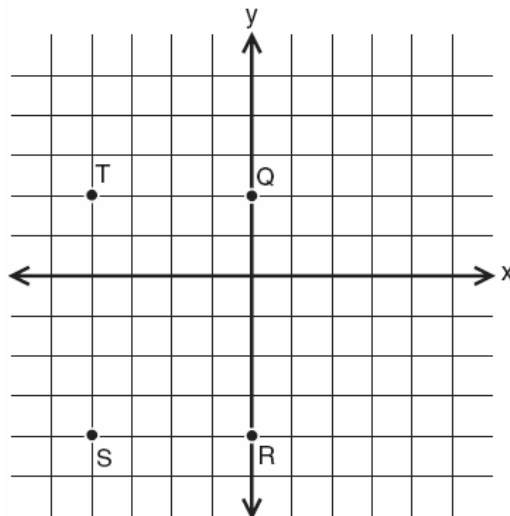


## CHAPTER 3-2

### TRANSLATIONS

42. 080211a, P.I. G.G.61

If  $x = -2$  and  $y = -1$ , which point on the accompanying set of axes represents the translation  $(x, y) \rightarrow (x + 2, y - 3)$ ?



[A] R [B] S [C] T [D] Q

43. 060402a, P.I. G.G.61

What is the image of  $(x, y)$  after a translation of 3 units right and 7 units down?

[A]  $(x + 3, y - 7)$  [B]  $(x + 3, y + 7)$   
[C]  $(x - 3, y - 7)$  [D]  $(x - 3, y + 7)$

44. 069903a, P.I. G.G.61

What is the image of point  $(2, 5)$  under the translation that shifts  $(x, y)$  to  $(x + 3, y - 2)$ ?

[A]  $(5, 3)$  [B]  $(5, 8)$  [C]  $(0, 8)$  [D]  $(0, 3)$

45. 080409a, P.I. G.G.61

What are the coordinates of  $P'$ , the image of  $P(-4, 0)$  under the translation  $(x - 3, y + 6)$ ?

[A]  $(1, 6)$  [B]  $(7, -6)$   
[C]  $(-7, 6)$  [D]  $(2, -3)$



46. 010509a, P.I. G.G.61

The image of point  $(3, -5)$  under the translation that shifts  $(x, y)$  to  $(x - 1, y - 3)$  is

- [A]  $(2, -8)$  [B]  $(-4, 8)$   
[C]  $(-3, 15)$  [D]  $(2, 8)$

47. 080609a, P.I. G.G.61

What is the image of point  $(-3, 4)$  under the translation that shifts  $(x, y)$  to  $(x - 3, y + 2)$ ?

- [A]  $(6, 6)$  [B]  $(-6, 8)$   
[C]  $(-6, 6)$  [D]  $(0, 6)$

48. 060309a, P.I. G.G.54

A translation moves  $P(3, 5)$  to  $P'(6, 1)$ . What are the coordinates of the image of point  $(-3, -5)$  under the same translation?

- [A]  $(-6, -1)$  [B]  $(-6, -9)$   
[C]  $(0, -9)$  [D]  $(-5, -3)$

49. 010614a, P.I. G.G.54

The image of point  $(-2, 3)$  under translation  $T$  is  $(3, -1)$ . What is the image of point  $(4, 2)$  under the same translation?

- [A]  $(0, 7)$  [B]  $(5, 4)$   
[C]  $(-1, 6)$  [D]  $(9, -2)$

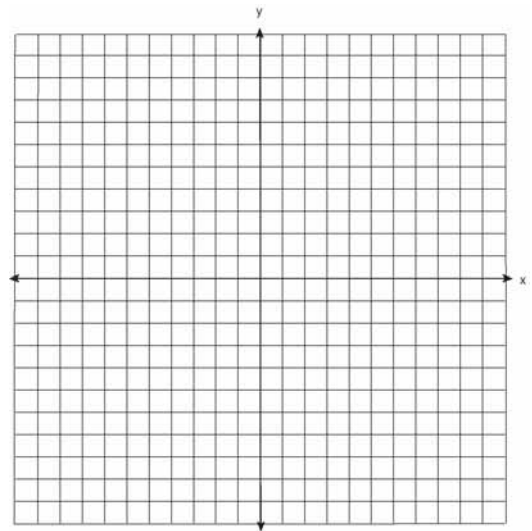
50. 080508b, P.I. G.G.54

The image of the origin under a certain translation is the point  $(2, -6)$ . The image of point  $(-3, -2)$  under the same translation is the point

- [A]  $(-5, 4)$  [B]  $(-1, -8)$   
[C]  $(-6, 12)$  [D]  $(-\frac{3}{2}, \frac{1}{3})$

51. 060129b, P.I. G.G.61

Two parabolic arches are to be built. The equation of the first arch can be expressed as  $y = -x^2 + 9$ , with a range of  $0 \leq y \leq 9$ , and the second arch is created by the transformation  $T_{7,0}$ . On the accompanying set of axes, graph the equations of the two arches. Graph the line of symmetry formed by the parabola and its transformation and label it with the proper equation.

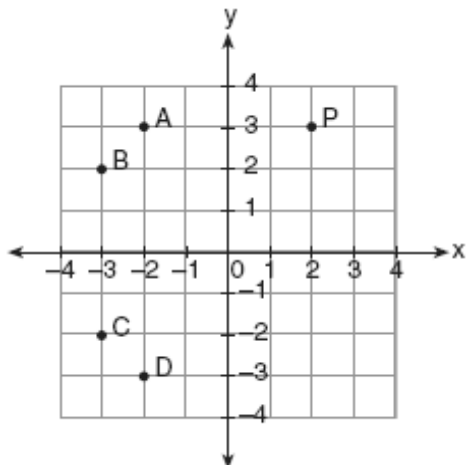


## CHAPTER 3-3

### ROTATIONS

52. 010418a, P.I. G.G.61

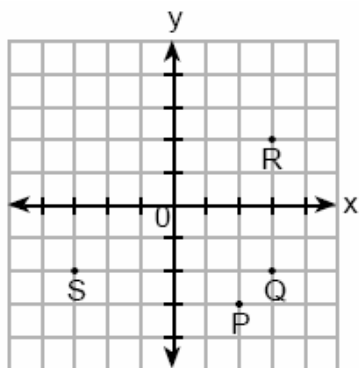
In the accompanying graph, if point  $P$  has coordinates  $(a,b)$ , which point has coordinates  $(-b,a)$ ?



- [A]  $B$     [B]  $D$     [C]  $A$     [D]  $C$

53. 069908a, P.I. G.G.61

If  $x = -3$  and  $y = 2$ , which point on the accompanying graph represents  $(-x, -y)$ ?



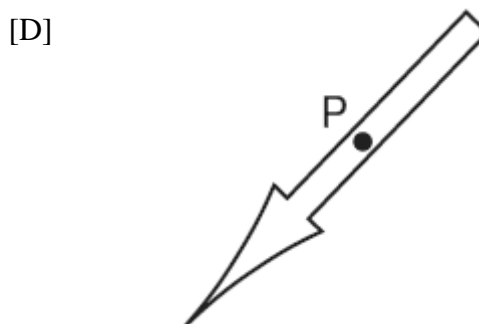
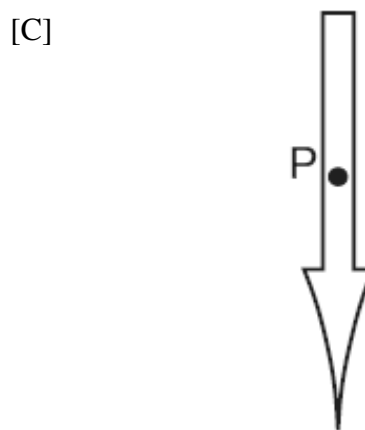
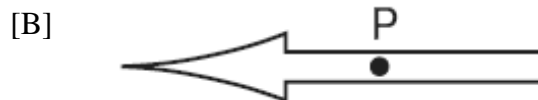
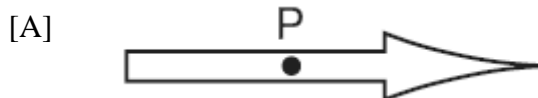
- [A]  $D$     [B]  $B$     [C]  $A$     [D]  $C$

54. 080721a, P.I. G.G.61

The accompanying diagram shows the starting position of the spinner on a board game.



How does this spinner appear after a  $270^\circ$  counterclockwise rotation about point  $P$ ?

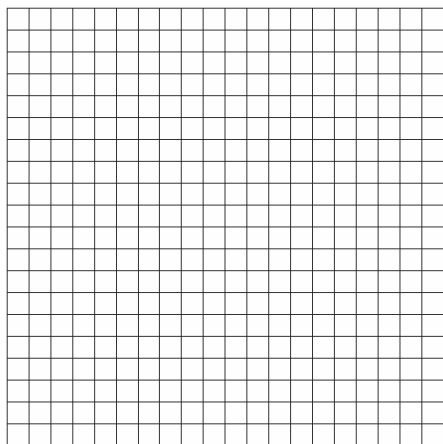


## CHAPTER 3-4

### COMPOSITIONS OF TRANSFORMATIONS

55. 080028a, P.I. G.G.54, G.G.58

The coordinates of the endpoints of  $\overline{AB}$  are  $A(2,6)$  and  $B(4,2)$ . Is the image  $\overline{A''B''}$  the same if it is reflected in the  $x$ -axis, then dilated by  $\frac{1}{2}$  as the image is if it is dilated by  $\frac{1}{2}$ , then reflected in the  $x$ -axis? Justify your answer.



56. 010520b, P.I. G.G.61

If the coordinates of point  $A$  are  $(-2,3)$ , what is the image of  $A$  under  $r_{y\text{-axis}} \circ D_3$ ?

- [A]  $(-6,-9)$  [B]  $(9,-6)$   
[C]  $(6,9)$  [D]  $(5,6)$

57. 080715b, P.I. G.G.61

The coordinates of  $\triangle JRB$  are  $J(1,-2)$ ,  $R(-3,6)$ , and  $B(4,5)$ . What are the coordinates of the vertices of its image after the transformation  $T_{2,-1} \circ r_{y\text{-axis}}$ ?

- [A]  $(1,-3)$ ,  $(5,5)$ ,  $(-2,4)$   
[B]  $(-1,-2)$ ,  $(3,6)$ ,  $(-4,5)$   
[C]  $(3,1)$ ,  $(-1,-7)$ ,  $(6,-6)$   
[D]  $(3,-3)$ ,  $(-1,5)$ ,  $(6,4)$

58. 080413b, P.I. G.G.61

What is the image of point  $(1,1)$  under  $r_{x\text{-axis}} \circ R_{0,90^\circ}$ ?

- [A]  $(1,1)$  [B]  $(-1,-1)$   
[C]  $(-1,1)$  [D]  $(1,-1)$

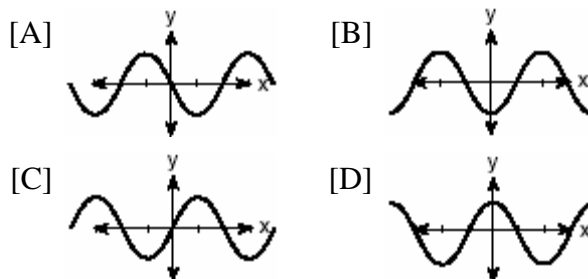
59. 010618b, P.I. G.G.61

What are the coordinates of point  $A'$ , the image of point  $A(-4,1)$  after the composite transformation  $R_{90^\circ} \circ r_{y=x}$  where the origin is the center of rotation?

- [A]  $(1,4)$  [B]  $(-1,-4)$   
[C]  $(-4,-1)$  [D]  $(4,1)$

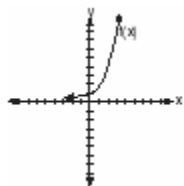
60. 060309b, P.I. G.G.61

If  $f(x) = \cos x$ , which graph represents  $f(x)$  under the composition  $r_{y\text{-axis}} \circ r_{x\text{-axis}}$ ?



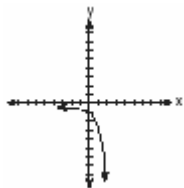
61. 080115b, P.I. G.G.61

The graph of  $f(x)$  is shown in the accompanying diagram.

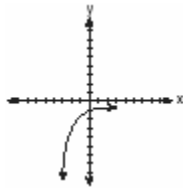


Which graph represents  $f(x)_{r_{x-axis} \circ r_{y-axis}}$ ?

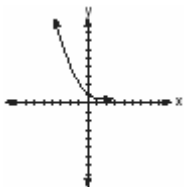
[A]



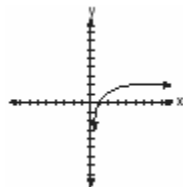
[B]



[C]

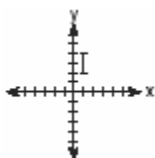


[D]



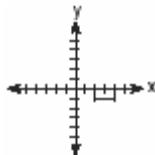
62. 080219b, P.I. G.G.61

The accompanying graph represents the figure  $\perp$ .

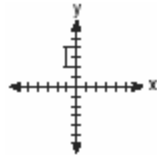


Which graph represents  $\perp$  after a transformation defined by  $r_{y=x} \circ R_{90^\circ}$ ?

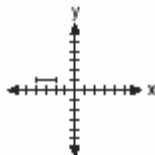
[A]



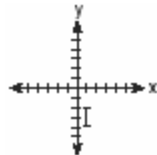
[B]



[C]



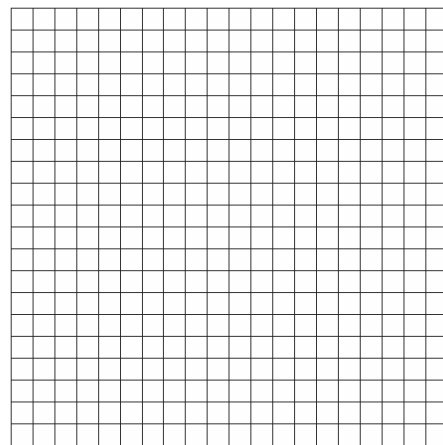
[D]



63. 010232b, P.I. G.G.61

a On the accompanying grid, graph the equation  $2y = 2x^2 - 4$  in the interval  $-3 \leq x \leq 3$  and label it  $a$ .

b On the same grid, sketch the image of  $a$  under  $T_{5,-2} \circ r_{x-axis}$  and label it  $b$ .



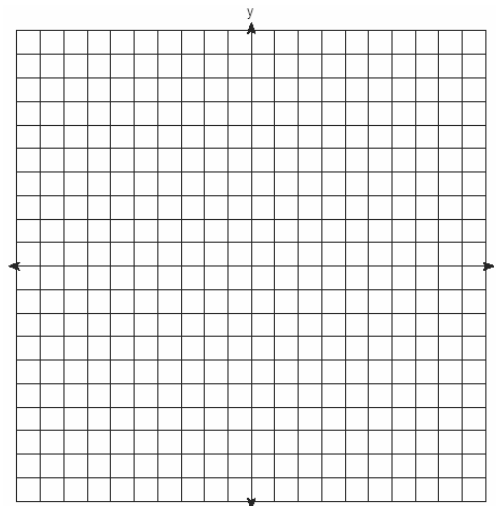
64. 080231b, P.I. G.G.61

Graph and label the following equations,  $a$  and  $b$ , on the accompanying set of coordinate axes.

$$a: y = x^2$$

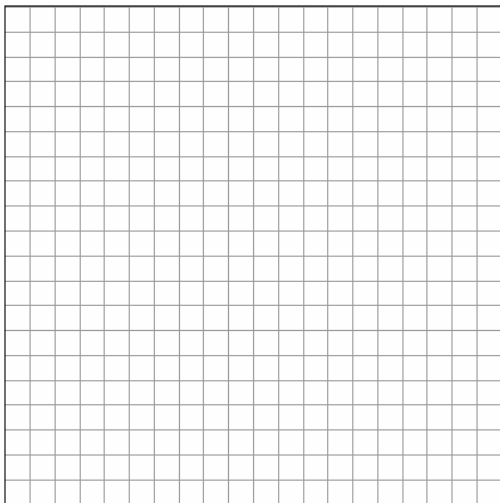
$$b: y = -(x-4)^2 + 3$$

Describe the composition of transformations performed on  $a$  to get  $b$ .



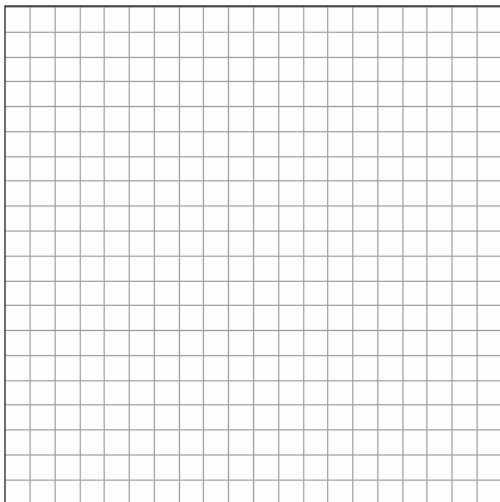
65. 080327b, P.I. G.G.61

On the accompanying grid, graph and label  $\overline{AB}$ , where  $A$  is  $(0,5)$  and  $B$  is  $(2,0)$ . Under the transformation  $r_{x\text{-axis}} \circ r_{y\text{-axis}}(\overline{AB})$ ,  $A$  maps to  $A''$  and  $B$  maps to  $B''$ . Graph and label  $\overline{A''B''}$ . What single transformation would map  $\overline{AB}$  to  $\overline{A''B''}$ ?



66. 080626b, P.I. G.G.61

Given point  $A(-2,3)$ . State the coordinates of the image of  $A$  under the composition  $T_{-3,-4} \circ r_{x\text{-axis}}$ . [The use of the accompanying grid is optional.]



## CHAPTER 3-5

### SYMMETRY

67. 060209a

Which letter has point symmetry?

- [A] W      [B] B      [C] A      [D] H

68. 060304a

Which shape does *not* have rotational symmetry?

- [A] regular pentagon      [B] circle  
[C] square      [D] trapezoid

69. 060701a

Which letter has both point and line symmetry?

- [A] H      [B] T      [C] Z      [D] C

70. 010510a

Which letter has point symmetry, but *not* line symmetry?

- [A] S      [B] T      [C] H      [D] X

71. 080106a

Which letter below has point symmetry, but does not have line symmetry?

- [A] H      [B] E      [C] A      [D] N

72. 080519a

Which letter demonstrates line symmetry but *not* point symmetry?

- [A] **N**      [B] **T**      [C] **S**      [D] **H**

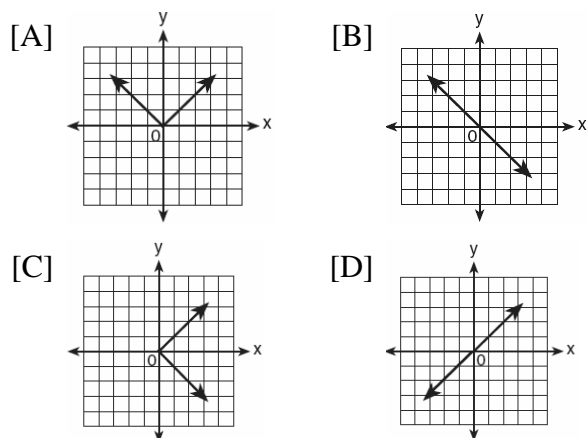
73. 010110a

Helen is using a capital H in an art design.  
The H has

- [A] two lines of symmetry and two points of symmetry
- [B] only one line of symmetry
- [C] only two points of symmetry
- [D] two lines of symmetry and only one point of symmetry

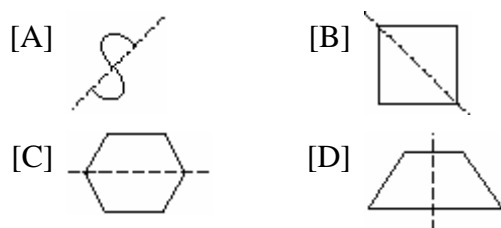
74. 010411a

Which graph is symmetric with respect to the y-axis?



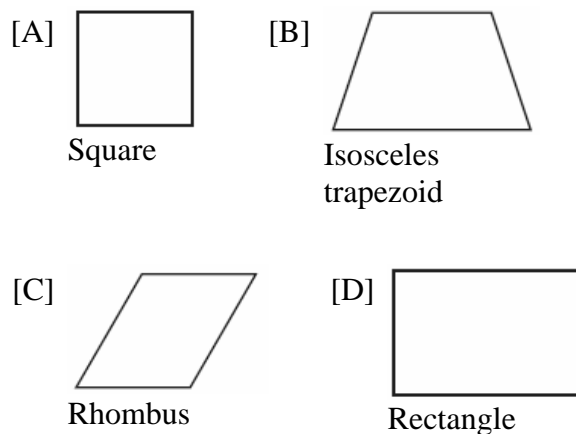
75. 080401a

Which diagram shows a dotted line that is *not* a line of symmetry?



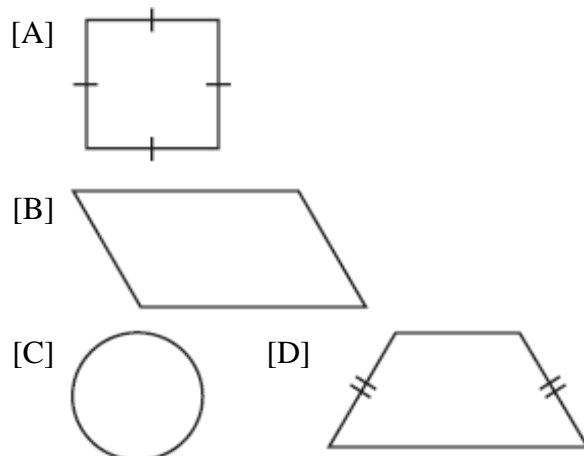
76. 060002a

Which geometric figure has one and only one line of symmetry?



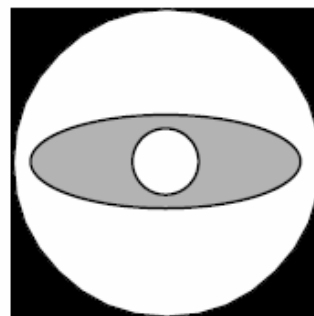
77. 080709a

Which geometric shape does *not* have any lines of symmetry?



78. 069921a

Draw all the symmetry lines on the accompanying figure.



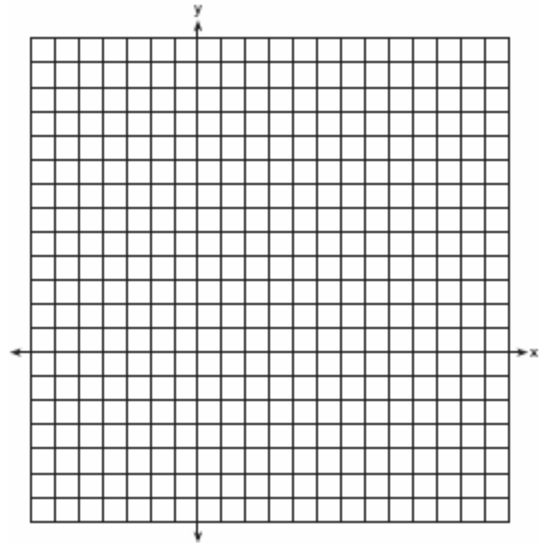
79. 060635a

On the accompanying square, draw all the lines of symmetry.



82. 080128a, P.I. G.G.58

On the accompanying set of axes, graph  $\triangle ABC$  with coordinates  $A(-1,2)$ ,  $B(0,6)$ , and  $C(5,4)$ . Then graph  $\triangle A'B'C'$ , the image of  $\triangle ABC$  after a dilation of 2.



83. 010719b, P.I. G.G.61

Which transformation represents a dilation?

- [A]  $(8,4) \rightarrow (-4,-8)$       [B]  $(8,4) \rightarrow (-8,4)$   
[C]  $(8,4) \rightarrow (4,2)$       [D]  $(8,4) \rightarrow (11,7)$

84. 010311b, P.I. G.G.58

In which quadrant would the image of point  $(5, -3)$  fall after a dilation using a factor of  $-3$ ?

- [A] I      [B] II      [C] III      [D] IV

85. 080711b, P.I. G.G.58

Under a dilation with respect to the origin, the image of  $P(-15,6)$  is  $P'(-5,2)$ . What is the constant of dilation?

- [A] 10      [B] 3      [C]  $\frac{1}{3}$       [D]  $-4$

## CHAPTER 3-7

### DILATIONS

80. 010302a, P.I. G.G.59

Triangle  $A'B'C'$  is the image of  $\triangle ABC$  under a dilation such that  $A'B' = 3AB$ . Triangles  $ABC$  and  $A'B'C'$  are

- [A] both congruent and similar  
[B] congruent but not similar  
[C] neither congruent nor similar  
[D] similar but not congruent

81. 010725a, P.I. G.G.58

The image of point  $A$  after a dilation of 3 is  $(6,15)$ . What was the original location of point  $A$ ?

- [A]  $(2,5)$       [B]  $(3,12)$   
[C]  $(18,45)$       [D]  $(9,18)$

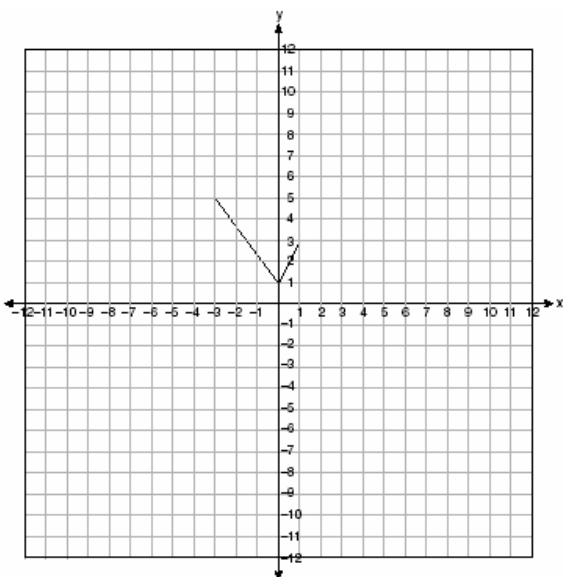
86. 010803b, P.I. G.G.58

Under a dilation where the center of dilation is the origin, the image of  $A(-2,-3)$  is  $A'(-6,-9)$ . What are the coordinates of  $B'$ , the image of  $B(4,0)$  under the same dilation?

- [A]  $(-12,0)$  [B]  $(4,0)$   
[C]  $(12,0)$  [D]  $(-4,0)$

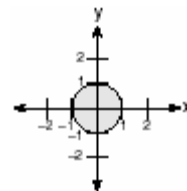
87. 060521b, P.I. G.G.58

The graph of the function  $g(x)$  is shown on the accompanying set of axes. On the same set of axes, sketch the image of  $g(x)$  under the transformation  $D_2$ .

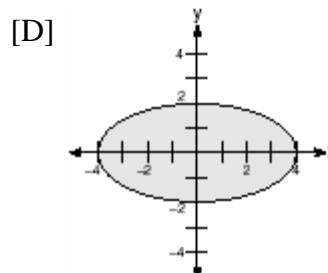
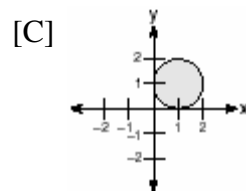
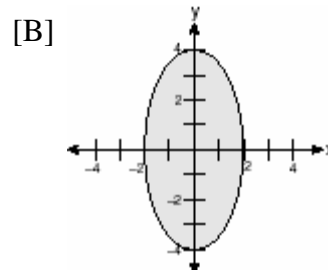
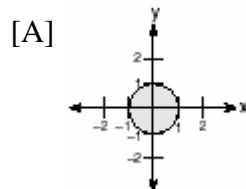


88. 060405b, P.I. G.G.60

In the accompanying graph, the shaded region represents set  $A$  of all points  $(x,y)$  such that  $x^2 + y^2 \leq 1$ . The transformation  $T$  maps point  $(x, y)$  to point  $(2x, 4y)$ .



Which graph shows the mapping of set  $A$  by the transformation  $T$ ?





- [1] D
- [2] A
- [3] A
- [4] C
- [5] C
- [6] D
- [7] B
- [8] C
- [9] A
- [10] B
- [11] D
- [12] D
- [13] A
- [14] A
- [15] B
- [16] D
- [17] C
- [18] B
- [19] C
- [20] A
- [21] B
- [22] C
- [23] C
- [24] B
- [25] B
- [26] B
- [27] C

[2]  $A'$  (0,-2) and  $B'$  (4,-6) are stated, and an appropriate graph is drawn.

[1] Only one endpoint,  $A'$  or  $B'$ , is graphed and stated correctly.

or [1] Both endpoints are reflected in other than the  $x$ -axis, and the coordinates are graphed and stated correctly, such as:

$y$ -axis  $A'$  (0,2) and  $B'$  (-4,6)

$y = x$   $A'$  (2,0) and  $B'$  (6,4)

Origin  $A'$  (0,-2) and  $B'$  (-4,-6)

or [1] Both points  $A'$  and  $B'$  are stated correctly, but no graph is drawn.

or [1] An appropriate graph is drawn, but no coordinates or incorrect coordinates are labeled.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[28] incorrect procedure.

- [4]  $S'(0,6)$ ,  $U'(-3,5)$ ,  $N'(-3,0)$ , and the correct graphs of both triangles are shown.
- [3] The correct graphs of both triangles are shown, but the coordinates of  $\Delta S'U'N'$  are not stated correctly.
- or [3]  $\Delta SUN$  is graphed and labeled correctly, and the coordinates of  $\Delta S'U'N'$  are stated correctly but not graphed correctly.
- or [3] The coordinates of  $\Delta S'U'N'$  are graphed and stated correctly, but  $\Delta SUN$  is not graphed or labeled.
- or [3]  $\Delta SUN$  is graphed incorrectly, but the graph and the coordinates of  $\Delta S'U'N'$  are appropriate, based on that error.
- [2]  $\Delta S'U'N'$  is graphed correctly, but the coordinates of  $\Delta S'U'N'$  are not stated, and  $\Delta SUN$  is not graphed.
- or [2]  $\Delta SUN$  is graphed and labeled correctly, but  $\Delta S'U'N'$  is reflected in the x-axis, and the coordinates  $S'(0,-6)$ ,  $U'(3,-5)$ ,  $N'(3,0)$  are stated.
- or [2]  $\Delta SUN$  is graphed incorrectly, but  $\Delta S'U'N'$  is graphed appropriately, based on that error, but the coordinates of  $\Delta S'U'N'$  are not stated.
- [1]  $\Delta SUN$  is graphed and labeled correctly, but no other work or completely incorrect work for  $\Delta S'U'N'$  is shown.
- or [1]  $\Delta S'U'N'$  is graphed correctly, but the coordinates of  $\Delta S'U'N'$  are not stated, and  $\Delta SUN$  is not graphed or is graphed incorrectly.
- or [1]  $S'(0,6)$ ,  $U'(-3,5)$ ,  $N'(-3,0)$ , but no work or graph is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [29] incorrect procedure.

- [3] The figure is drawn accurately and the new coordinates are labeled and stated as  $J'(7,-2)$ ,  $B'(2,-1)$ ,  $C'(3,-2)$ , and  $D'(2,-4)$ .
- [2] One error is made in drawing the figure, such as misplotting one point, but the new coordinates are labeled and stated appropriately, based on that figure.
- or [2] The figure is drawn and labeled accurately, but the new coordinates are not stated or are stated incorrectly.
- or [2] The new coordinates are labeled and stated correctly, but the figure is not drawn.
- [1] Two errors are made in drawing the reflected figure, but the new coordinates are labeled and stated appropriately, based on that figure.
- or [1] Appropriate work is shown, but one conceptual error is made, such as reflecting the figure in the x-axis or the origin.
- or [1] Correct points are plotted and labeled, but the figure is not drawn, and the coordinates are not stated.
- or [1] The figure is drawn correctly, but the new coordinates are not labeled or stated.
- [0] An appropriate reflection in the x-axis is drawn, and the coordinates are not labeled or stated.
- or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [30] obviously incorrect procedure.

- [3]  $A'(-2,0)$ ,  $B'(-1,7)$ , and  $C'(-5,1)$  are graphed, labeled, and stated correctly.  
[2] Appropriate work is shown, but one graphing or labeling error is made.  
or [2]  $A'(-2,0)$ ,  $B'(-1,7)$ , and  $C'(-5,1)$ , but no graph is drawn.  
[1] Appropriate work is shown, but two or more graphing or labeling errors are made.  
or [1] Appropriate work is shown, but one conceptual error is made, such as reflecting over the  $x$ -axis.  
or [1] The three points are plotted correctly, but the coordinates  $A'$ ,  $B'$ , and  $C'$  are not stated.  
[0]  $(-2,0)$ ,  $(-1,7)$ , and  $(-5,1)$ , but no further correct work is shown.  
or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- 

- [4]  $ABCD$  and its image  $A'B'C'D'$  are graphed and labeled correctly and 29, and appropriate work is shown.  
[3] Appropriate work is shown, but one computational or graphing error is made.  
or [3]  $A'B'C'D'$  is graphed and labeled correctly and 29, but  $ABCD$  is not graphed.  
or [3]  $ABCD$  is graphed incorrectly, but an appropriate image is graphed and labeled, and an appropriate area is found.  
or [3]  $ABCD$  and  $A'B'C'D'$  are graphed correctly and 29, but neither quadrilateral is labeled.  
[2] Appropriate work is shown, but two or more computational or graphing errors are made.  
or [2] Appropriate work is shown, but one conceptual error is made, such as an incorrect transformation, but the graphs are labeled, and an appropriate area is found.  
or [2] Both  $ABCD$  and  $A'B'C'D'$  are graphed and labeled correctly, but the area is not found.  
or [2] 29, and appropriate work is shown, such as using the distance formula and finding the area, but neither  $ABCD$  nor  $A'B'C'D'$  is graphed.  
[1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.  
or [1] Either  $ABCD$  or  $A'B'C'D'$  is graphed and labeled correctly, but no further correct work is shown.  
or [1] 29, but no work is shown and no graph is drawn.  
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-

[4] Quadrilaterals  $ABCD$  and  $A'B'C'D'$  are drawn and labeled correctly and 24 is found as the area, and appropriate work is shown.

[3] One graphing error is made in the transformation, but an appropriate area of  $A'B'C'D'$  is found.

or [3] Correct quadrilaterals are drawn and labeled, but one computational error is made in determining the area.

or [3] Quadrilaterals  $ABCD$  and  $A'B'C'D'$  are drawn correctly and 24 is found as the area, but the vertices are not labeled.

[2] Correct quadrilaterals are drawn and labeled, but no further correct work is shown.

or [2] One conceptual error is made, such as reflecting in the  $x$ -axis, but the correct area is found.

[1] 24, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[33] incorrect procedure.

[2] A correct graph is drawn, and the coordinates  $(0,1)$  are stated.

[1] One graphing error is made, but appropriate coordinates are stated.

or [1] A correct graph is drawn, but the coordinates of the point of intersection are not stated or are stated incorrectly

or [1] The coordinates  $(0,1)$  are stated, but no graph is drawn.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[34] incorrect procedure.

[35] A

[36] C

[37] C

[38] D

[2]  $\triangle HOC$  and opposite, and an appropriate explanation is written.

[1] The image of  $\triangle EOA$  is identified incorrectly, but the type of isometry is appropriate, and an appropriate explanation is written.

or [1] The difference between a direct and opposite isometry is explained correctly, but no further correct work is shown.

or [1]  $\triangle HOC$ , but no explanation or an incorrect explanation is written.

[0] Opposite, but no further correct work is shown.

or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[39] obviously incorrect procedure.

[40] D

[41] C

[42] A

[43] A

[44] A

[45] C

[46] A

[47] C

[48] C

[49] D

[50] B

[4] Both parabolas are graphed correctly with the line of symmetry  $x = 3.5$  drawn and labeled as  $x = 3.5$ .

[3]  $y = -x^2 + 9$  is graphed incorrectly, but an appropriate translation is drawn, and an appropriate line of symmetry is drawn and labeled correctly.

or [3]  $y = -x^2 + 9$  and its translation are graphed correctly, but no line of symmetry or an incorrect line of symmetry is drawn for the translation or no equation or an incorrect equation is shown for the line of symmetry.

[2]  $y = -x^2 + 9$  is graphed correctly, but its translation is graphed incorrectly, but an appropriate line of symmetry is drawn and labeled correctly.

or [2]  $y = -x^2 + 9$  is graphed incorrectly, but an appropriate translation is graphed, but an incorrect line of symmetry is drawn.

[1]  $y = -x^2 + 9$  and its translation are graphed incorrectly, but an appropriate line of symmetry is drawn and labeled correctly.

or [1]  $y = -x^2 + 9$  is graphed correctly, but an incorrect translation and line of symmetry are drawn.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[51] incorrect procedure.

[52] A

[53] B

[54] A

[3] Yes,  $A''$  is  $(1, -3)$  and  $B''$  is  $(2, -1)$  and appropriate work is shown, algebraically or graphically.

[2] Correct coordinates for  $A''$  and  $B''$  are found, but no conclusion is shown.

or [2] Either  $A''$  or  $B''$  is correct, and an appropriate conclusion is shown.

or [2] One transformation is correct and one is incorrect, such as the reflection in  $y$ , but an appropriate conclusion is shown.

[1] Neither transformation is correct, but an appropriate conclusion is shown.

or [1] One transformation is correct.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[55] incorrect procedure.

[56] C

[57] A

[58] B

[59] D

[60] B

[61] B

[62] D

a [2] The equation  $2y = 2x^2 - 4$  is graphed correctly over the required interval and labeled.

[1] An appropriate graph is shown, but less than the required interval is drawn.

or [1] An appropriate graph is shown, but one coordinate is calculated incorrectly.

b [2] A correct composition of transformations of the graph drawn in part a is sketched and labeled.

[1] Only one of the transformations is correct.

or [1] The composition of transformations is correct, but done in reverse order.

a and b [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[63] obviously incorrect procedure.

- [4] Both equations are graphed correctly and the description of the transformation  $a \rightarrow b$  is correct, such as  $T_{(4,3)} \circ r_{x\text{-axis}}$  or  $r_{y=3} \circ T_{(4,3)}$  or  $T_{(4,3)} \circ R_{180^\circ}$  or an equivalent explanation, such as a shift right of 4 followed by a reflection over the x-axis followed by a shift up of 3.
- [3] Both equations are graphed correctly, but only one transformation is shown or described correctly.
- [2] Both equations are graphed correctly, but no further correct work is shown.
- [1] Only one equation is graphed correctly, and no composition formula or explanation is shown.
- or [1] The correct composition formula or explanation is shown, but no graphs or incorrect graphs are drawn.
- or [1] Both equations are graphed incorrectly, but an appropriate composition formula or explanation is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- 
- [64]

- [4]  $\overline{AB}$  and  $\overline{A''B''}$  are graphed and labeled correctly,  $A''(0,-5)$  and  $B''(-2,0)$ , and a correct transformation is identified, such as  $R_{180^\circ}$ ,  $R_{-180^\circ}$ , or  $r_{(0,0)}$ .
- [3] One error is made in graphing  $\overline{AB}$ , but  $\overline{A''B''}$  is graphed and labeled appropriately, and an appropriate transformation is identified.
- [2]  $\overline{AB}$  is graphed and labeled correctly but one mistake is made in finding  $\overline{A''B''}$ , but an appropriate transformation is identified.
- or [2] Both  $\overline{AB}$  and  $\overline{A''B''}$  are graphed and labeled correctly, but the transformation is missing or is incorrect.
- [1]  $\overline{AB}$  is graphed and labeled correctly, but one mistake is made in finding  $\overline{A''B''}$ , and the transformation is missing or is incorrect.
- or [1] One error is made in graphing  $\overline{AB}$ , but  $\overline{A''B''}$  is graphed and labeled appropriately, but the transformation is missing or is incorrect.
- or [1]  $R_{180^\circ}$ ,  $R_{-180^\circ}$ , or  $r_{(0,0)}$ , but no graph is drawn.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- 
- [65]
- [2]  $(-5,-7)$ , and appropriate work is shown, such as stating the coordinates of each transformation or graphing each transformation.
- [1] Appropriate work is shown, but one computational or graphing error is made.
- or [1] Appropriate work is shown, but one conceptual error is made, such as performing the translation before the reflection.
- or [1] Only one of the transformations is performed correctly.
- or [1]  $(-5,-7)$ , but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- 
- [66]

[67] D

[68] D

[69] A

[70] A

[71] D

[72] B

[73] D

[74] A

[75] A

[76] B

[77] B

[2] Both correct lines of symmetry are drawn:  
one horizontal, one vertical.

[1] Only one correct line is drawn.

or [1] Two correct and one or two incorrect  
lines, such as the diagonals, are drawn.

[0] More than two incorrect lines are drawn.

or [0] A zero response is completely  
incorrect, irrelevant, or incoherent or is a  
correct response that was obtained by an

[78] obviously incorrect procedure.

[2] The four correct lines of symmetry are  
drawn.

[1] At least two correct lines of symmetry are  
drawn, and no inappropriate lines are drawn.

or [1] All four correct lines of symmetry are  
drawn, but one or more inappropriate lines are  
also drawn.

[0] At least one of the correct lines of  
symmetry is missing, and one or more  
inappropriate lines are drawn.

or [0] A zero response is completely  
incorrect, irrelevant, or incoherent or is a  
correct response that was obtained by an

[79] obviously incorrect procedure.

[80] D

[81] A

[3]  $\triangle ABC$  and  $\triangle A'B'C'$ ,  $A'(-2,4)$ ,  $B'(0,12)$ ,  
 $C'(10,8)$ , are graphed correctly.

[2]  $\triangle ABC$  is graphed correctly, but only two  
image points are graphed correctly.

or [2]  $\triangle ABC$  is graphed incorrectly, but  
 $\triangle A'B'C'$ , is graphed appropriately, based on  
an incorrect  $\triangle ABC$ .

[1] Only  $\triangle ABC$  is graphed correctly.

[0] A zero response is completely incorrect,  
irrelevant, or incoherent or is a correct  
response that was obtained by an obviously

[82] incorrect procedure.

[83] C

[84] B

[85] C

[86] C

[2] A graph is sketched that maps  $(-3,5)$  to  
 $(-6,10)$ ,  $(0,1)$  to  $(0,2)$ , and  $(1,3)$  to  $(2,6)$ .

[1] One graphing or computational error is  
made, but an appropriate graph is sketched.

[0] A graph is sketched that represents a  
dilation of only  $x$  or  $y$ .

or [0] A zero response is completely  
incorrect, irrelevant, or incoherent or is a  
correct response that was obtained by an

[87] obviously incorrect procedure.

[88] B