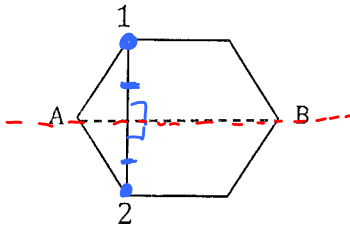


### 8.1 Line Symmetry

A line of symmetry:   
 • line that divides the object into two identical pieces   
 • halves are mirror images of each other   
 • show with a dashed line

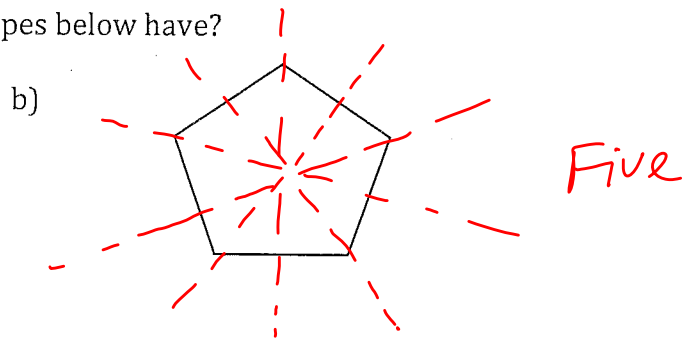
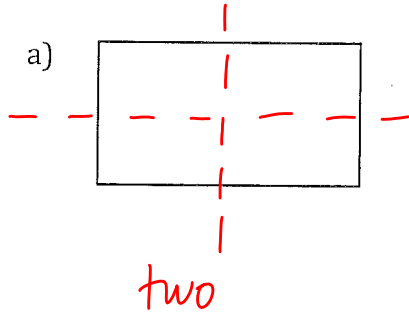


AB is a line of symmetry. Corresponding points 1 and 2 are perpendicular to the line.

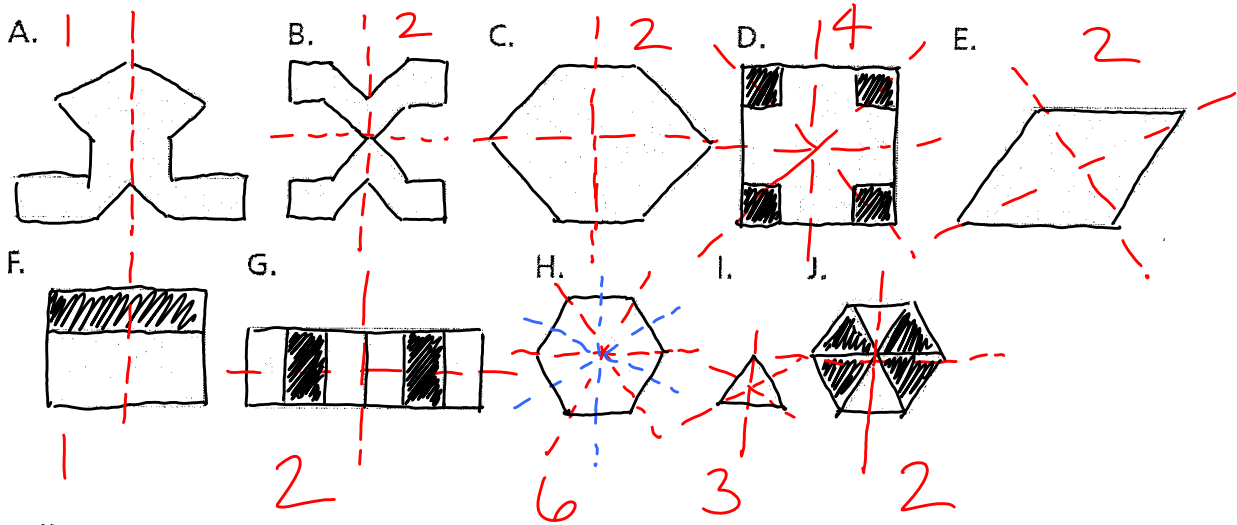
In a design, each corresponding point must be the same colour.

A shape can have more than 1 line of symmetry.

Ex: 1) How many lines of symmetry do the shapes below have?

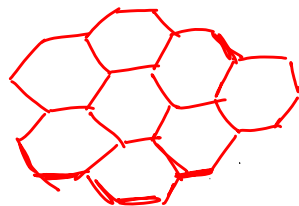


Ex: 2) How many lines of symmetry does each shape have?



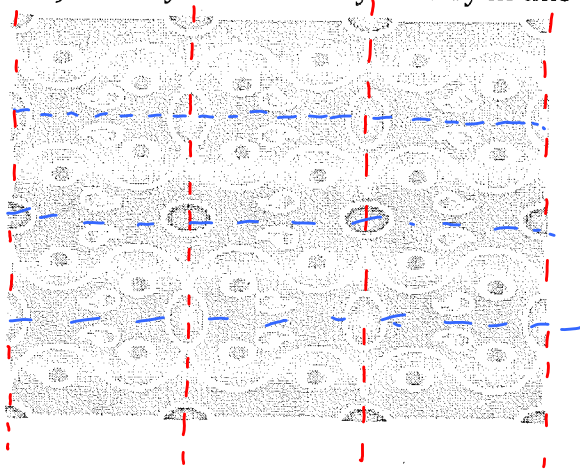
Tessellation:

• arranging a shape or shapes to fill a space with no gaps or overlaps

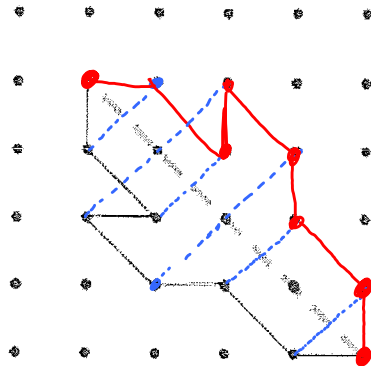


Math 9 – Chapter 8: Symmetry

Ex: 3) Identify the lines of symmetry in this tessellation:

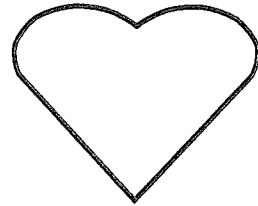
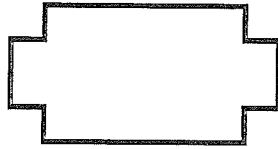
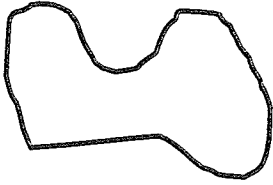


Ex: 4) If we know that a shape is symmetrical and its line of symmetry, we can sketch the other half. Complete the object below:

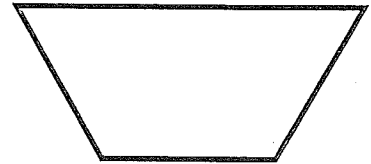
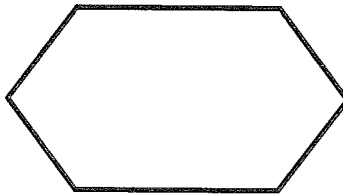
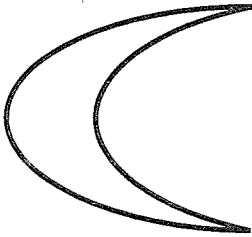


## 8.1 Line Symmetry Worksheet

1. Identify if the following objects have any line symmetry?

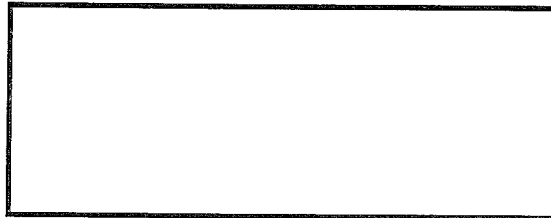


2. How many lines of symmetry do the following objects have?  
Draw them!

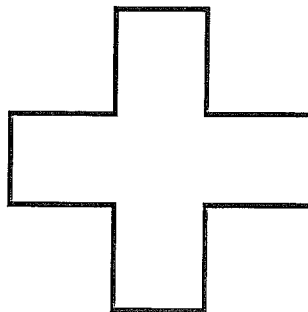


3. Draw the lines of symmetry for each object:

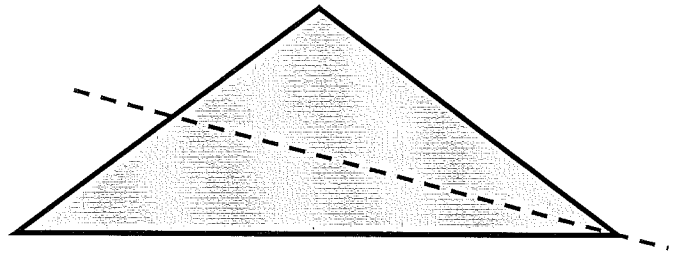
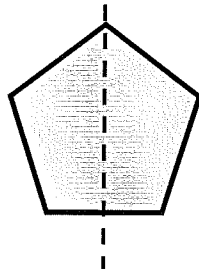
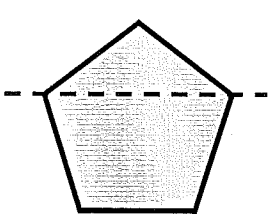
a)



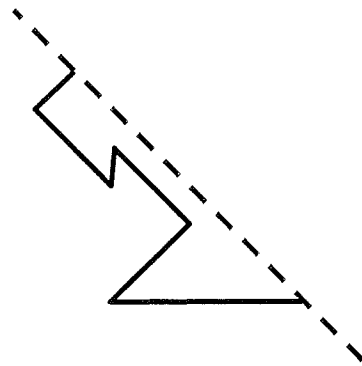
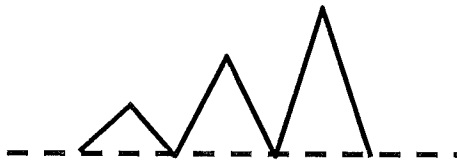
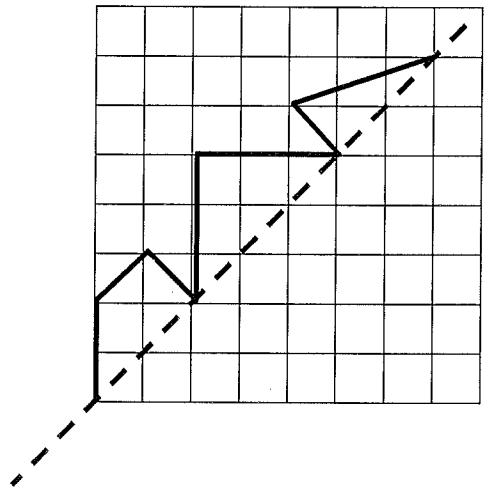
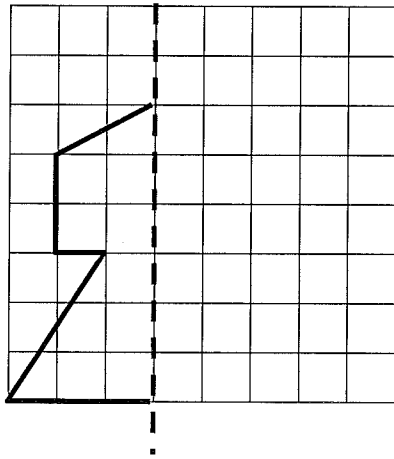
b)



4. Do the following diagrams show symmetry? Yes or No.



5. Complete the following symmetry drawings:



8.2 Rotation Symmetry

Definitions:

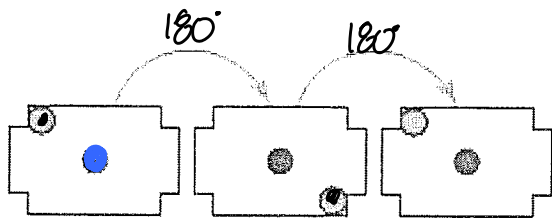
- Rotation symmetry - when a shape fits exactly over itself with a turn of less than  $360^\circ$ .
- clockwise  $\rightarrow$  'cw'
- counterclockwise  $\curvearrowright$  'ccw'
- Order of rotation symmetry - number of times a shape rotate onto itself within  $360^\circ$ .

$order = \frac{360^\circ}{angle}$

$angle = \frac{360^\circ}{order}$

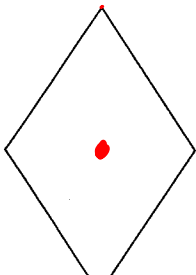
- Angle of rotation symmetry - number of degrees needed for a shape to rotate on to itself.

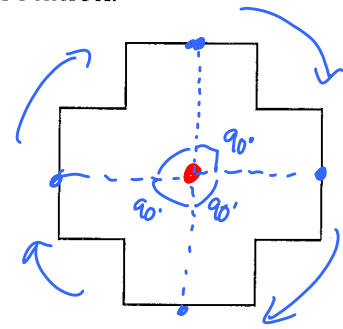
\* if  
order = 1  
angle =  $360^\circ$   
no rotational  
symmetry



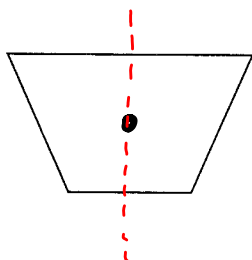
This shape has a rotation angle of  $180^\circ$  and a rotation order of 2.

Ex: 1) Find the i) order of rotation and ii) the angle of rotation.

a)  i) order = 2  
ii) angle =  $180^\circ$

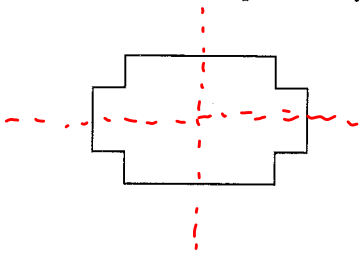
b)  i) order: 4  
ii) angle:  $90^\circ$   
 $\frac{360^\circ}{90^\circ} = 4$

Ex: 2) For each shape, determine the number of lines of symmetry, its order of rotation, and the angle of rotation.

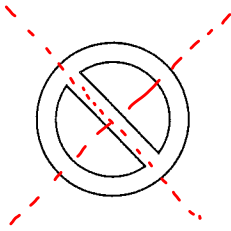


Lines of symmetry: 1  
Order of rotation: 1  
Angle of rotation:  $360^\circ$

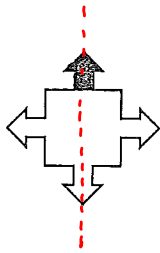
Math 9 - Chapter 8: Symmetry



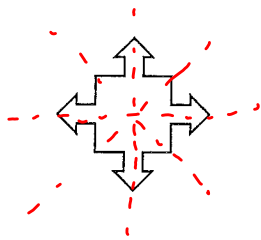
Lines of symmetry: 2  
Order of rotation: 2  
Angle of rotation:  $180^\circ$



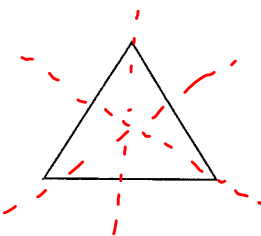
Lines of symmetry: 2  
Order of rotation: 2  
Angle of rotation:  $180^\circ$



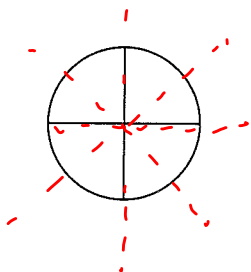
Lines of symmetry: 1  
Order of rotation: 1  
Angle of rotation:  $360^\circ$



Lines of symmetry: 4  
Order of rotation: 4  
Angle of rotation:  $90^\circ$



Lines of symmetry: 3  
Order of rotation: 3  
Angle of rotation:  $120^\circ$

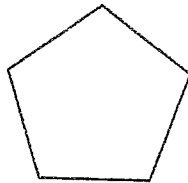
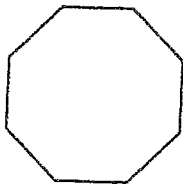
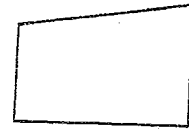
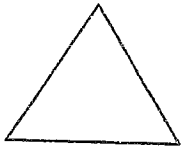
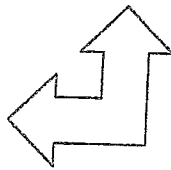
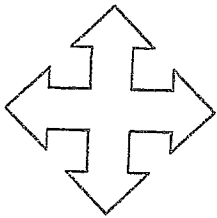
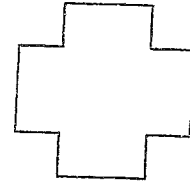
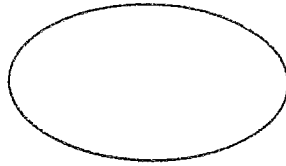
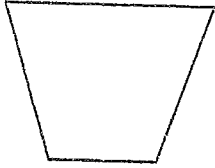


Lines of symmetry: 4  
Order of rotation: 4  
Angle of rotation:  $90^\circ$

# ROTATIONAL SYMMETRY

A shape has rotational symmetry if it fits onto itself two or more times in one turn.  
The order of rotational symmetry is the number of times the shape fits onto itself in one turn.  
A 2D shape has a line of symmetry if the line divides the shape into two halves – one being the mirror image of the other.

Write the order of rotational symmetry under each shape & letter. Also draw dotted lines to indicate lines of symmetry.



M

A

T

H

S

8.4 Symmetry on the Co-ordinate Plane Pt. 1

Translations, Reflections and Rotations

A. Translations:

Translation - movement of an object up/down and left/right  
 - order of points remain same  
 - all points move same amount

Ex: 1) Translate  $\triangle ABC$ ,  $A(2,1)$ ,  $B(4,5)$ ,  $C(9,1)$ , (Left 3, Down 4)

Mapping diagram

$x-3$   $y-4$

$A(2,1) \rightarrow (2-3; 1-4) \rightarrow (-1, -3) A'$

$B(4,5) \rightarrow (4-3, 5-4) \rightarrow (1, 1) B'$

$C(9,1) \rightarrow (9-3, 1-4) \rightarrow (6, -3) C'$

$(x,y) \rightarrow (x-3, y-4)$

Ex:2) Translate  $\triangle ABC$  (Left 6, Up 3)

$(x,y) \rightarrow (x-6, y+3)$

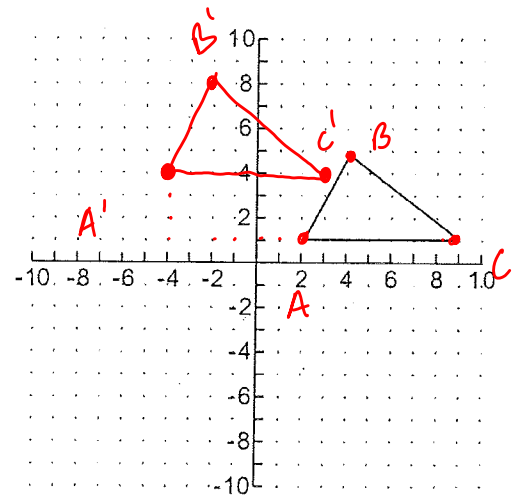
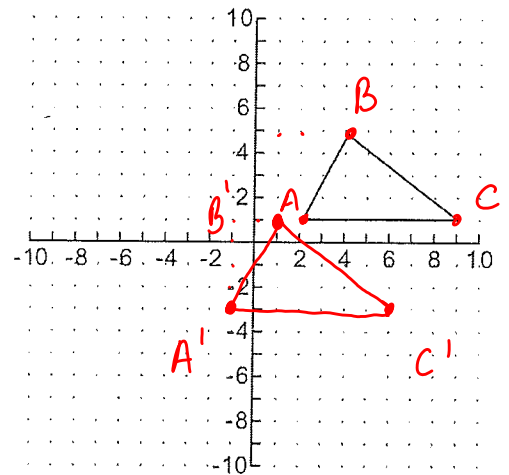
$A(2,1) \rightarrow (2-6, 1+3) = (-4, 4) A'$

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

$C(9,1) \rightarrow (9-6, 1+3) = (3, 4) C'$

B. Reflections:

Reflections - flipping of a shape over a line - mirror image  
 - each point flips to the other side of the line of reflection but stays the same distance away at  $90^\circ$  to the line  
 - order of points change



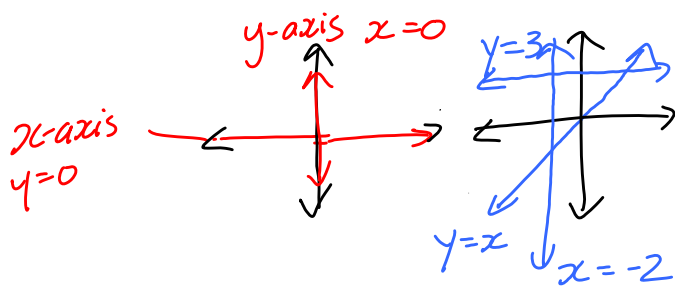
General mapping rule



Math 9 - Chapter 8: Symmetry

Shapes can be reflected over:

- $x$ -axis,  $y=0$
- $y$ -axis,  $x=0$
- $y=x$  through  $(-2,-2)(-1,-1)(0,0)(1,1)(2,2)$   $45^\circ$
- any other horizontal  $y=3$  vertical line  $x=-2$

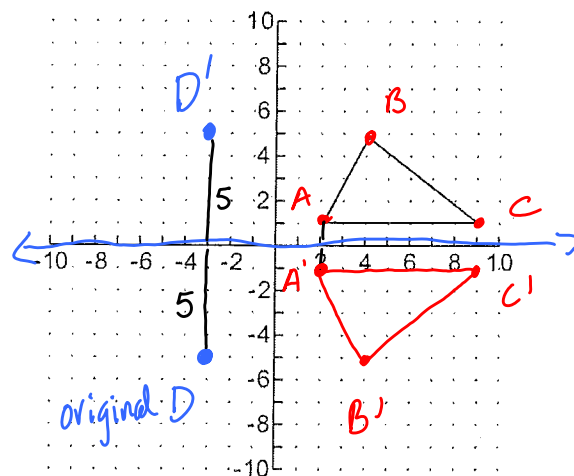


Ex: 1) Reflect  $\triangle ABC$ ,  $A(2,1)$ ,  $B(4,5)$ ,  $C(9,1)$  over the  $x$ -axis.

When you reflect over the  $x$ -axis:

- $A(2,1) \rightarrow A'(2,-1)$
- $B(4,5) \rightarrow B'(4,-5)$
- $C(9,1) \rightarrow C'(9,-1)$

$D(-3,-5) \rightarrow D'(-3,5)$   
 $-(-5) = 5$

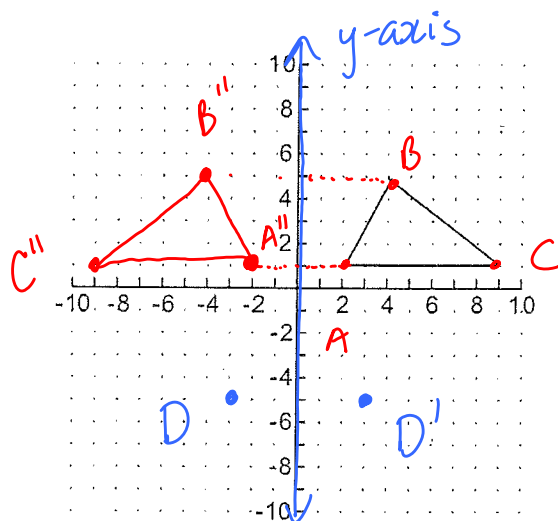


Ex: 2) Now reflect  $\triangle ABC$  over the  $y$ -axis:

When you reflect over the  $y$ -axis:

- $A(2,1) \rightarrow A''(-2,1)$
- $B(4,5) \rightarrow B''(-4,5)$
- $C(9,1) \rightarrow C''(-9,1)$

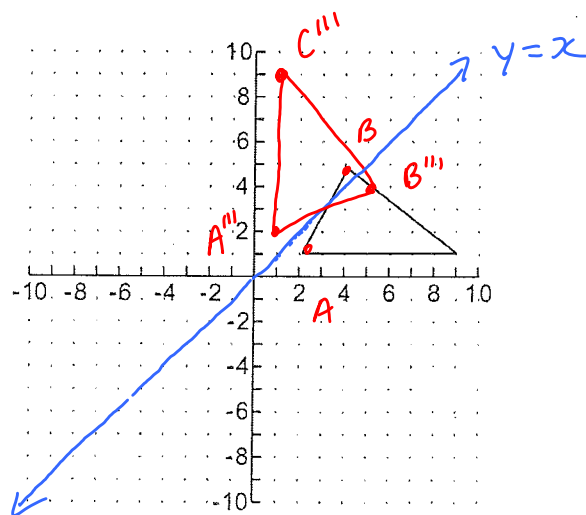
$D(-3,-5) \rightarrow D'(3,-5)$



Ex: 3) Now, reflect  $\triangle ABC$  over the line  $y=x$

When you reflect over the  $y=x$ :

- $A(2,1) \rightarrow A'''(1,2)$
- $B(4,5) \rightarrow B'''(5,4)$
- $C(9,1) \rightarrow C'''(1,9)$



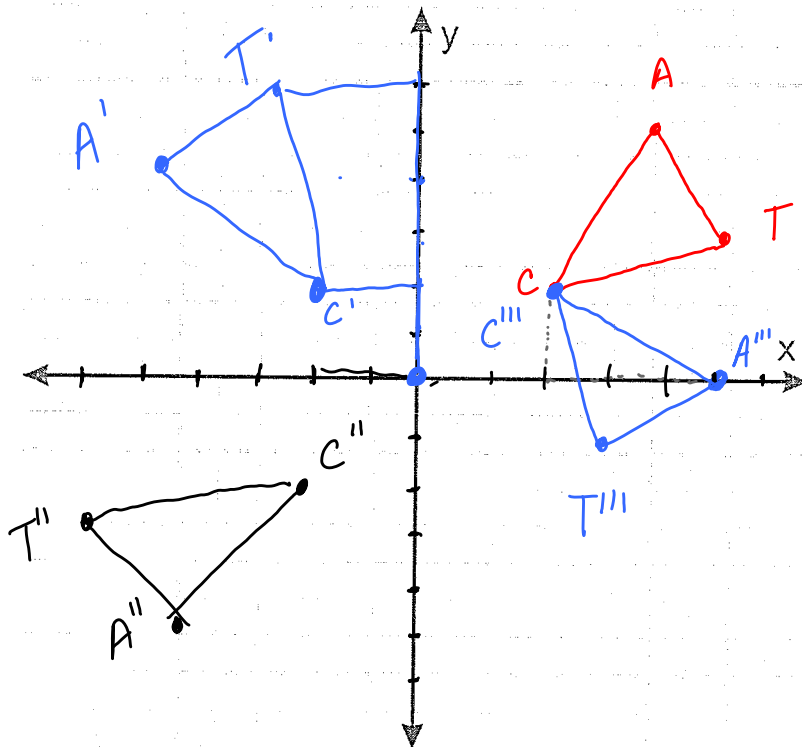
8.4 Symmetry on the Co-ordinate Plane Pt. 2

C. Rotations

Rotations - each point in a shape is moved about a fixed point through the same angle

- point of rotation could be
  - outside object
  - on the object
  - inside object

Ex:1 ) Sketch  $\triangle CAT$  if  $C(2, 2)$ ,  $A(4, 5)$  and  $T(6, 3)$ .



- \* a) Rotate  $\triangle CAT$   $90^\circ$  CCW around the origin  $(0, 0)$ .
- \* b) Rotate  $\triangle CAT$   $180^\circ$  CW around the origin.  $C''A''T''$
- \* c) Rotate  $\triangle CAT$   $90^\circ$  CW about point C.  $C'''A'''T'''$

Reflect this shape over the line  $y = x$

A (3, 1), B (7, 3), C (7, 0), D (4, -1)

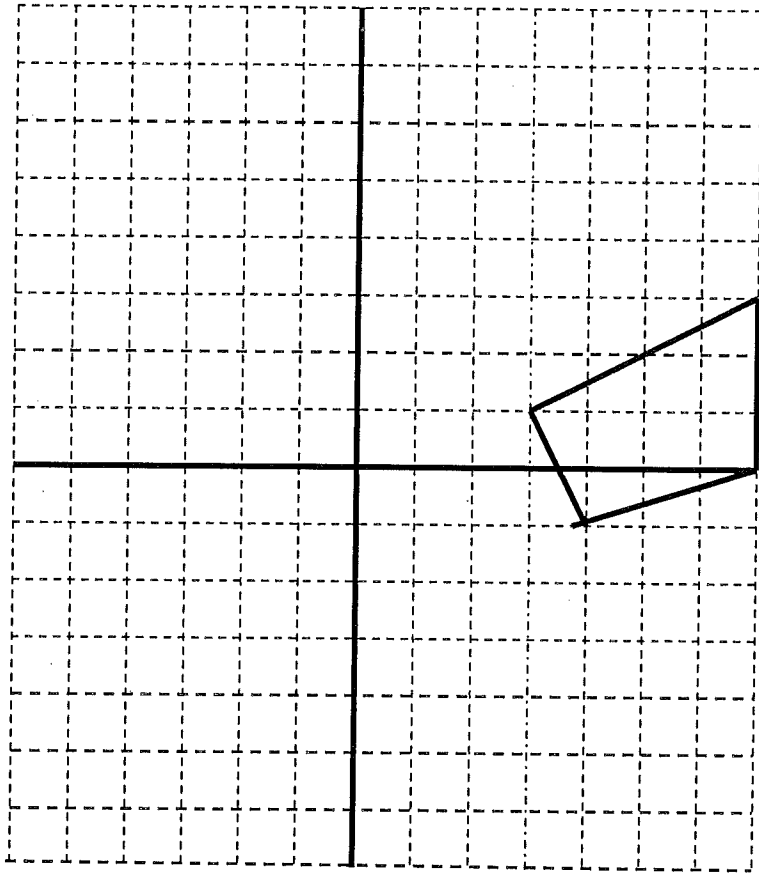
A (3, 1)

B (7, 3)

C (7, 0)

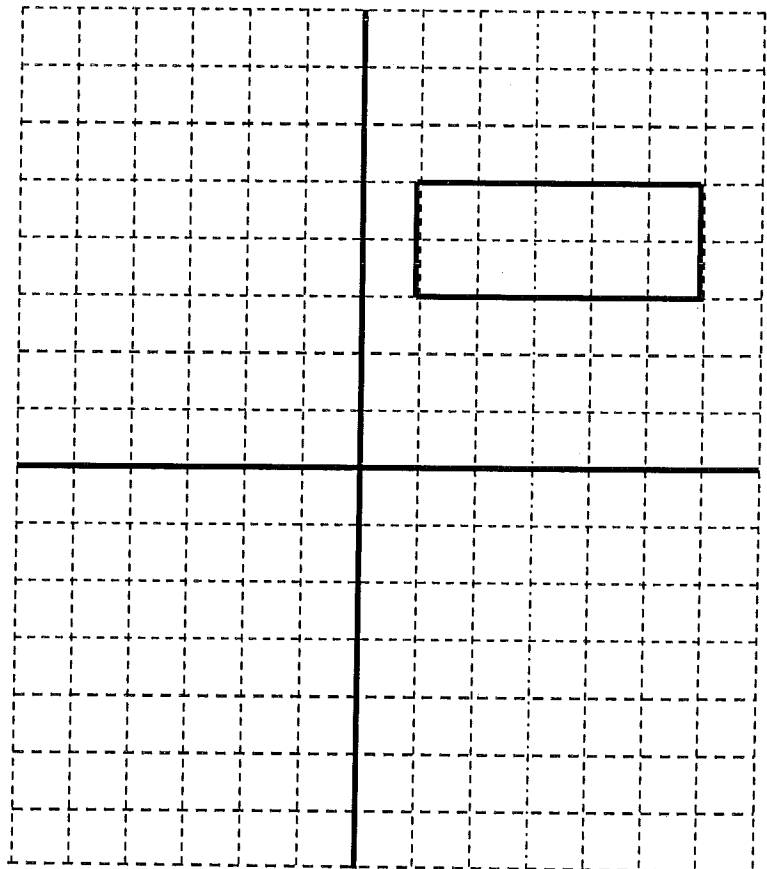
D (4, -1)

(x, y)

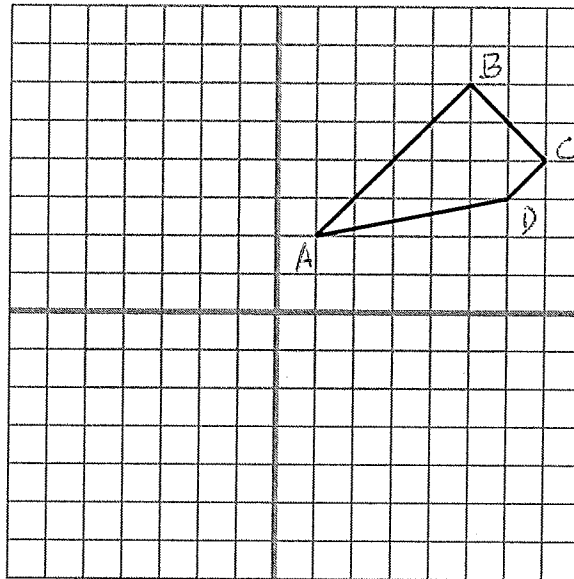
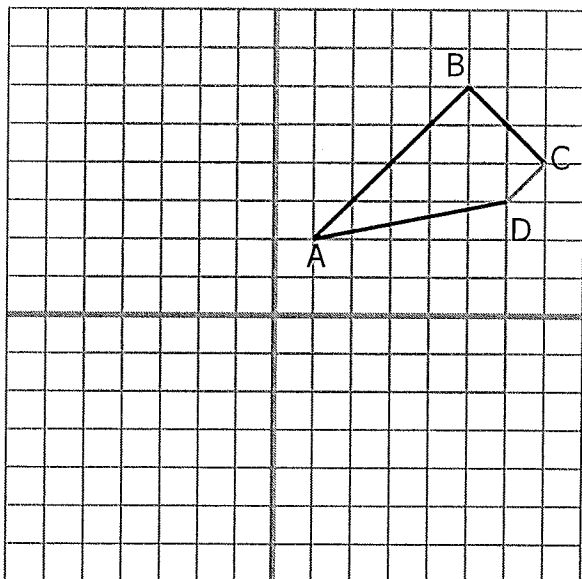


Rotate this shape  $90^\circ$  CW

E (1, 3), F (1, 5), G (6, 5), H (6, 3)



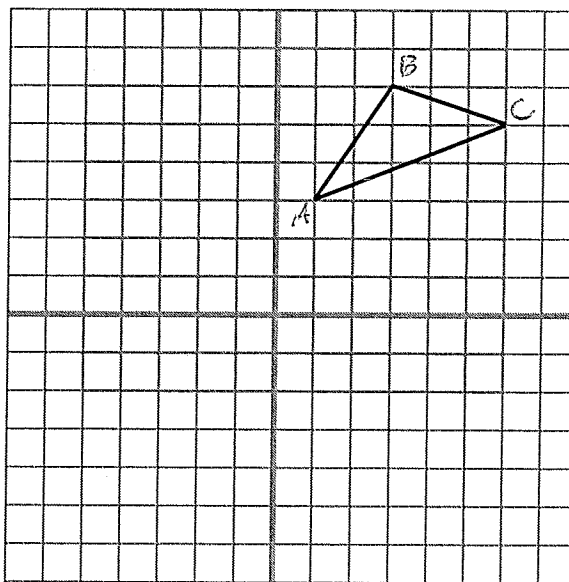
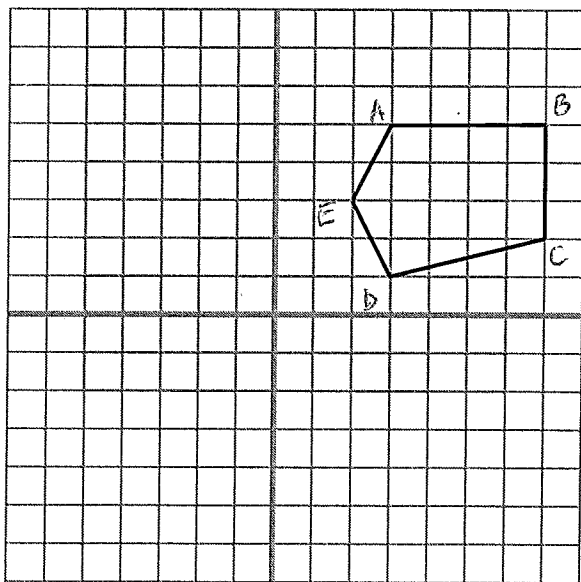
- 1) a) On the first graph, reflect the following shape over a) the x-axis and then b) the y-axis  
 b) On the second graph, rotate the same shape 90° CW and then 90° CCW around (0,0)



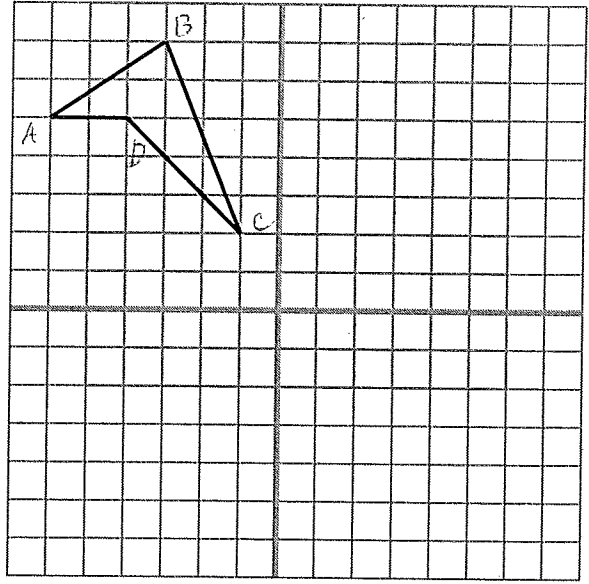
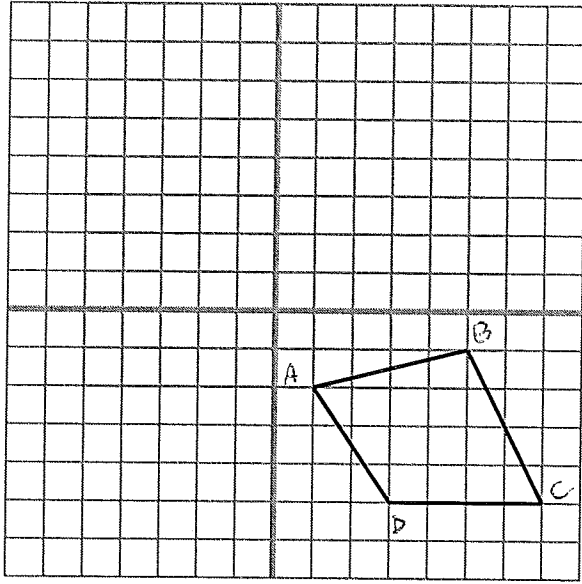
Complete a mapping diagram for the reflection over the x-axis

- A(1,2) → A'  
 B(5,6) → B'  
 C(7,4) → C'  
 D(6,3) → D'

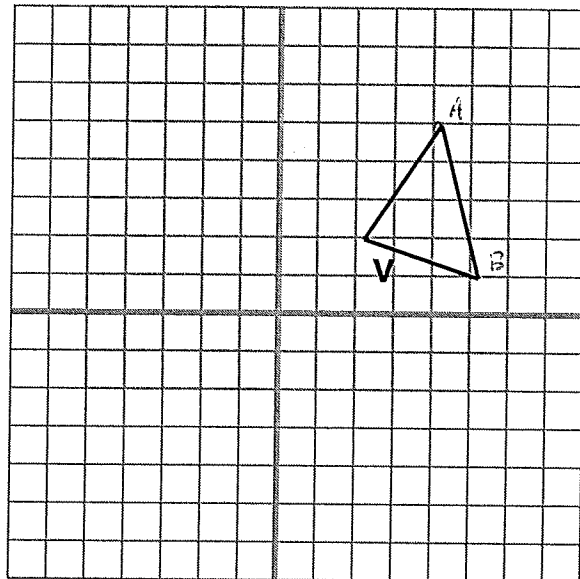
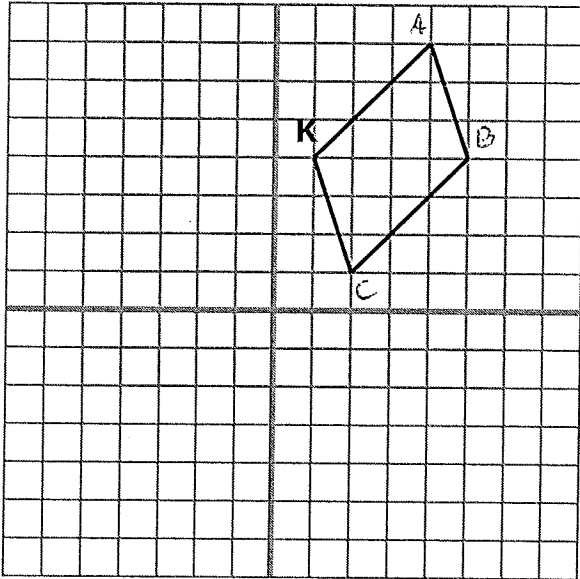
- 2) a) On the first graph, reflect the shape over  $y = x$ .  
 b) On the second graph rotate the shape 180° CW. (around (0,0))



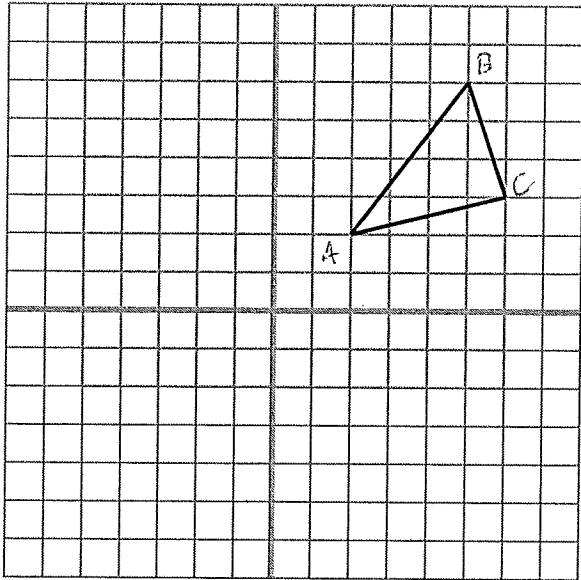
- 3) a) On the first graph, translate the following shape  $(x, y) \longrightarrow (x - 7, y + 6)$   
 b) On the second graph, translate the shape  $(x, y) \longrightarrow (x + 5, y - 8)$



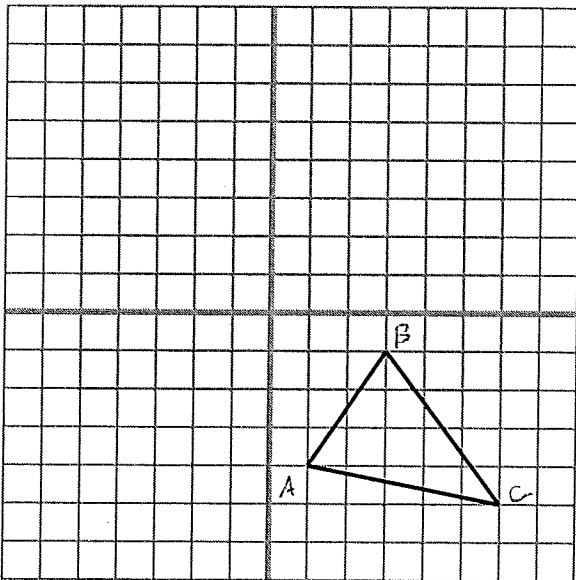
- 4) a) Rotate the shape in the first graph  $90^\circ$  CW around point K  
 b) Rotate the shape in the second graph  $180^\circ$  CCW around point V



- 5) Translate the following shape  $(x, y) \longrightarrow (x - 7, y - 8)$ , then reflect the translated shape over the x-axis



- 6) Rotate the following shape  $90^\circ$  CCW around the origin, and then translate the rotated shape  $(x, y) \longrightarrow (x - 5, y + 2)$

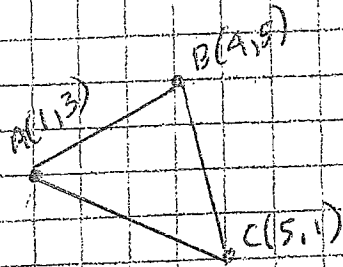


Pm 9

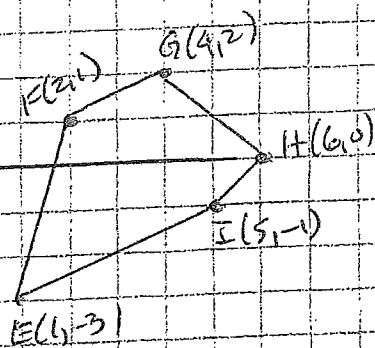
8.4

1 TO THE END

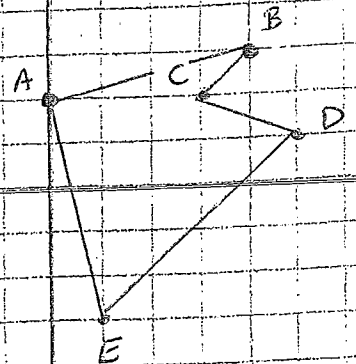
1. Reflect  $\triangle ABC$  over a)  $x$ -axis b)  $y$ -axis  
Show mapping diagrams. Describe the symmetry, if any



2. Reflect  $\triangle EFGHI$  over  $y=x$ . Include a mapping diagram. Describe the symmetry, if any



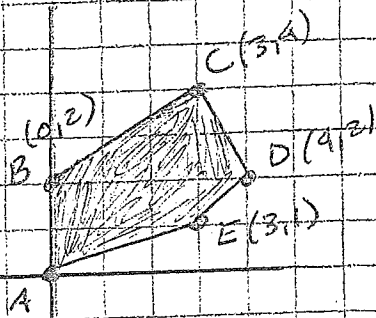
3. Reflect the shape below over  $y=x$



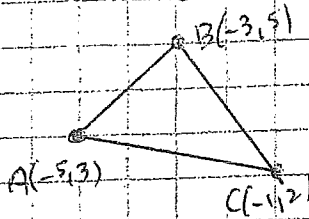
© MCGRAW HILL EDUCATION, A DIVISION OF THE MCGRAW HILL COMPANIES, INC. ALL RIGHTS RESERVED. 2012

4 TO THE RIGHT

4. Rotate the following figure cw  $90^\circ$ , into  $G_{IV}$ , then cw  $90^\circ$  into  $G_{III}$ , then cw  $90^\circ$ , into  $G_{II}$ . Show the mapping diagram for  $G_I$  to  $G_{IV}$ .  
 a) Describe the symmetry b) What is the order of rotation



5. Translate the following triangle as follows  $(x, y) \rightarrow (x+4, y-5)$ . Show a mapping diagram. Is there any symmetry? Explain



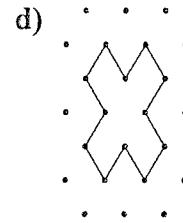
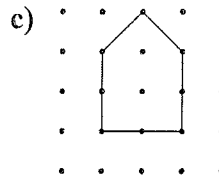
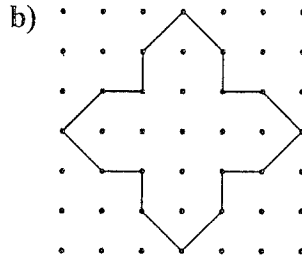
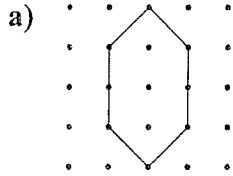
(a) Sketch  $\triangle ABC$ ,  $A(1,3)$ ,  $B(3,5)$ ,  $C(6,3)$ . Translate so A is (0,0), then rotate cw  $90^\circ$

MEGA MATHS SOURCE © Mrs. TEASDALE PRESS



Name \_\_\_\_\_

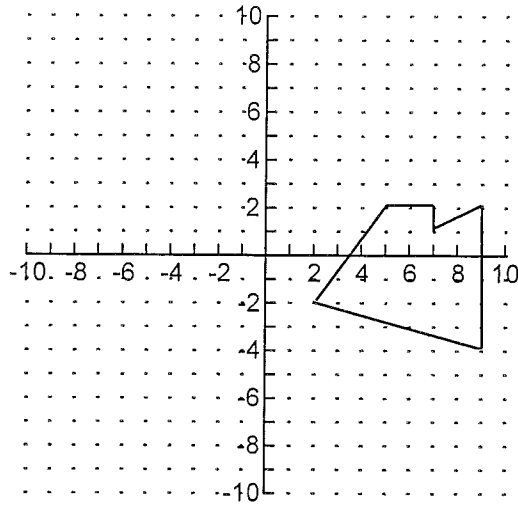
1. Which polygons have rotational symmetry? State the order of rotation and the angle of rotation symmetry for each.



2. What is the order of rotation and the angle of rotation symmetry, if any, for:

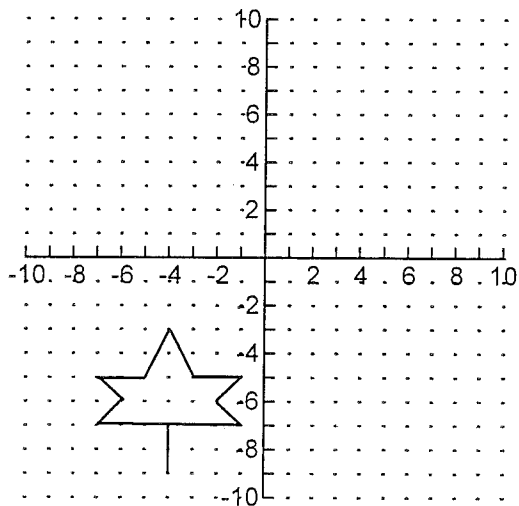
a) an equilateral triangle    b) a regular pentagon    c) the plus sign +

b) Reflect this shape over the line  $y = x$



c) Translate this shape as follows  $(x, y) \longrightarrow (x + 9, y + 2)$

Then reflect the new shape over the  $x$  - axis

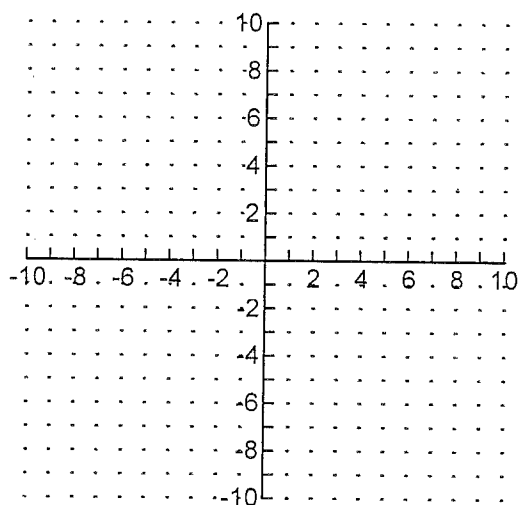


6. The point  $P(1, -3)$  undergoes the transformations listed below. Determine the co-ordinates of the final point  $P'''$  using a series of mapping diagrams. (You can sketch the graph first to help you with the mapping)

a) rotated  $180^\circ$  CW

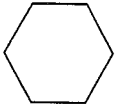
b) reflected over the x axis

c) translated as follows  $(x, y) \rightarrow (x + 5, y - 3)$



3. Determine the number of lines of symmetry for the following shapes

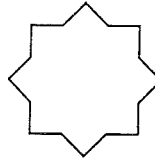
a)



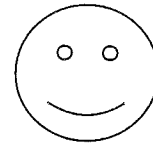
b)



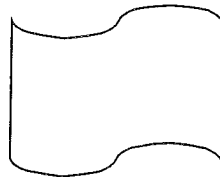
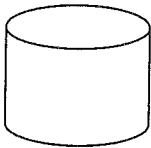
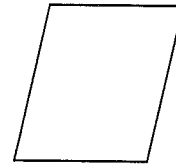
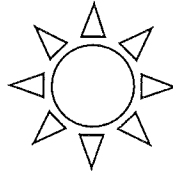
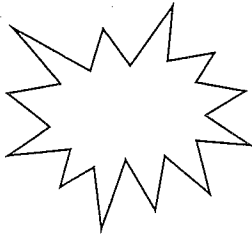
c)



d)



4. Which of the following shapes have line symmetry and which do not?



5. a) Rotate this shape  $90^\circ$  CW, and then reflect the rotation over the  $y$ -axis. Include a mapping diagram for the rotation

