Math 6d: Homework 10
Due: December 9

Vocabulary:
Preimage – the original figure in the transformation of a figure in a plane.
Image – the new figure that results from the transformation of a figure in a plane.
Isometry – a transformation that preserves size: preimage and image are congruent.
Mapping – an operation that matches each element of a set with another element, its image, in the same set.
Transformation – the operation that maps, or moves, a preimage onto an image. Three basic rigid transformations are reflections, rotations, and translations. A dilation is a non-rigid transformation (not an isometry).
Translation – sliding a figure without changing the size or shape of figure
Reflection – creates symmetry in the coordinate plane
Rotation – turn a figure about a fixed point ** counterclockwise rotation **
Composite transformations – multiple transformations done on a figure
** first is on the pre-image, second is on the image, the third is on the second image. NEVER GO BACK TO THE ORIGINAL!!

REFLECTIONS:

- ✓ Reflections are a flip.
- ✓ The flip is performed over the "line of reflection." Lines of symmetry are examples of lines of reflection.
- ✓ Reflections are isometric, but do not preserve orientation.

Coordinate plane rules:

Over the x-axis:	**(x, y) → (x, –y)**
Over the y-axis:	**(x, y) → (–x, y)**
Over the line y = x:	**(x, y) → (y, x)**
Through the origin:	**(x, y) → (–x, –y)**

TRANSLATIONS:

- ✓ Translations are a slide or shift.
- ✓ Translations can be achieved by performing two composite reflections over parallel lines.
- ✓ Translations are isometric, and preserve orientation.

Coordinate plane rules:

(x, y) → (x ± h, y ± k) *where h and k are the horizontal and vertical shifts.*

Note: If movement is left, then h is negative. If movement is down, then k is negative.

ROTATIONS:

- ✓ Rotations are a turn.
- ✓ Rotations can be achieved by performing two composite reflections over intersecting lines. The resulting rotation will be double the amount of the angle formed by the intersecting lines.
- ✓ Rotations are isometric, and do not preserve orientation unless the rotation is 360° or exhibit rotational symmetry back onto itself.
- ✓ Rotations of 180° are equivalent to a reflection through the origin.

Coordinate plane rules:

Counter-clockwise:	*Clockwise:*	*Rule:*
90°	*270°*	**(x, y) → (–y, x)**
180°	*180°*	**(x, y) → (–x, –y)**
270°	*90°*	**(x, y) → (y, –x)**

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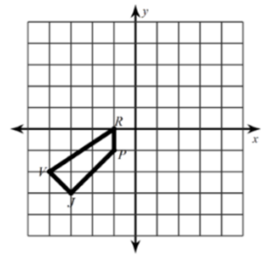
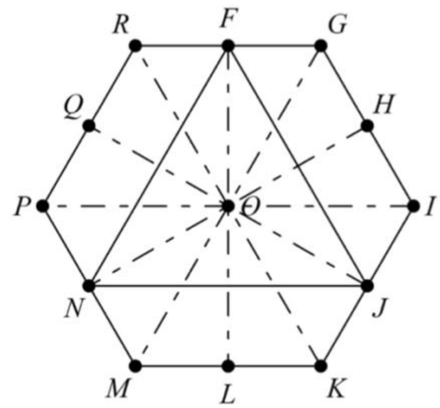
Be prepared to hand in your work.

1. Find the coordinates of the vertices of the figure after the given transformation. (Graph is optional.)
   a) reflection across y = x — R(2, -4), M(1, -2), N(3, 0), V(4, -4)
   b) rotation 180 about the origin — V(-3, 1), Y(0, 4), M(-1, 0)
   c) Rotation 270 — W(-2, -3) G(1, 1) K(1, -4)

2. a) If the figure is translated 3 units right and 4 units up, what are the coordinates of P'?
   b) If the original figure is rotated 90^{o} clockwise about the origin, what are the coordinates of R'?
   c) If the original figure is reflected over the y-axis, what are the coordinates of V'?



3. The hexagon *GIKMPR* and Δ*FJN* are regular. The dashed line segments form 30° angles.
   Find the angle of rotation about *O* that maps *RF* to *IJ*.



4. The vertices of a triangle are *P*(–4, –8), *Q*(–6, 6), and *R*(1, –7).
   Name the vertices of the image reflected in the *y*-axis.

5. When point (-2,5) is reflected in the line x = 1, what are the coordinates of the new image?

6. When point (-4,-7) is reflected in the line y = -2, what are the coordinates of the new image?

7. If a translation maps (2,3) onto (4,8). What are the coordinates of B′, the image of B(4,6) under the same translation?

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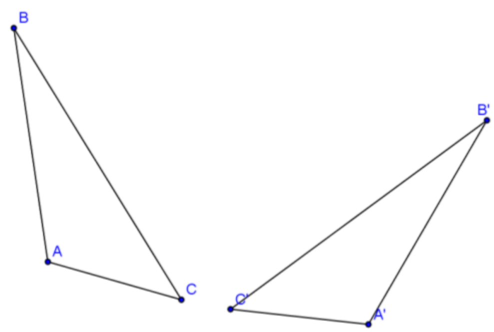
8. **Construct** the line of reflection for the pair of figures below.



9. **Construct** the line of reflection for the pair of figures below.

10. Find the midpoint of the line segment with the given endpoints.

(1, 3), (3, 1)

11. Find the other endpoint of the line segment with the given endpoint and midpoint.

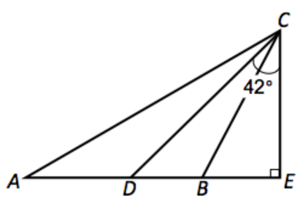
Endpoint: (−10, 10), midpoint: (−4, −4)

12. Find the distance between each pair of points.

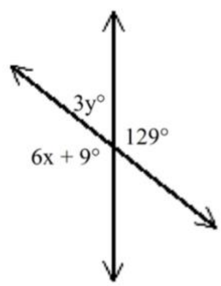
(8, 1), (6, 5)

13. Find the coordinate of the point P that lies along the directed segment from C (-3, -2) to D(6,1) and partitions the segment in the ratio 2 to 1.

14. In the figure below, $\overline{CD}$ bisects $\angle ACB$, $AB = BC$, $m\angle BEC = 90°$, and $m\angle DCE = 42°$.
Find the measure of $\angle A$.



15. Find the values of *x* and *y*.



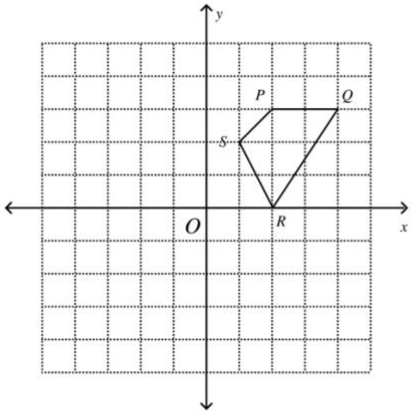
Drawing not to scale

16. Construct a square $ABCD$ with side $\overline{AB}$.

17. Solve the equation .

$$\frac{3}{4}t - \frac{5}{6} = \frac{2}{3}t$$

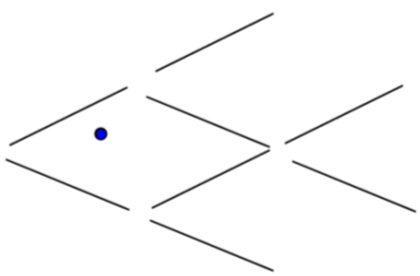
18. Quadrilateral PQRS is plotted on the grid below.
On the graph, draw the translation of polygon PQRS three units to the left and four units down. Label the image P'Q'R'S'.



Now create polygon P"Q"R"S" by translating polygon P'Q'R'S' using the rule (x, y)→ (x + 2, y +1). What will be the coordinates of point Q"?
Write a single translation rule from polygon PQRS to polygon P"Q"R"S".

19. Draw a triangle with angles $90°$, $60°$, and $30°$ using only a compass and straightedge. Locate the midpoint of the longest side using your compass. Rotate the triangle $180°$ around the midpoint of the longest side. What figure have you formed?

20. Two classic toothpick puzzles appear below. Solve each puzzle.
Each segment on the fish represents a toothpick. Move (translate) exactly three toothpicks and the eye to make the fish swim in the opposite direction. Show the translation vectors needed to move each of the three toothpicks and the eye.



21. Again, each segment represents a single toothpick. Move (translate) exactly three toothpicks to make the triangle point downward. Show the translation vectors needed to move each of the three toothpicks.