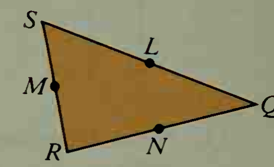
10. Given $A(4, 1)$, $B(1, 5)$, and $C(0, 1)$. S and T are translations. $S:(x, y) \rightarrow (x + 1, y + 4)$ and $T:(x, y) \rightarrow (x + 3, y - 1)$. Draw $\triangle ABC$ and its images under $S \circ T$ and $T \circ S$.
   a. Does $S \circ T$ appear to be a translation?
   b. Is $S \circ T$ equal to $T \circ S$?
   c. $S \circ T:(x, y) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$ and $T \circ S:(x, y) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$



Exs. 11, 12

11. L, M, and N are midpoints of the sides of $\triangle QRS$.
   a. $H_N \circ H_M:S \rightarrow \underline{\ ?\ }$
   b. $H_M \circ H_N:Q \rightarrow \underline{\ ?\ }$
   c. $D_{S, \frac{1}{2}} \circ H_N:Q \rightarrow \underline{\ ?\ }$
   d. $H_N \circ D_{S, 2}:M \rightarrow \underline{\ ?\ }$
   e. $H_L \circ H_M \circ H_N:Q \rightarrow \underline{\ ?\ }$

B 12. If T is a translation that maps R to N, then:
   a. $T:M \rightarrow \underline{\ ?\ }$
   b. $T \circ D_{S, \frac{1}{2}}:R \rightarrow \underline{\ ?\ }$
   c. $T \circ T:R \rightarrow \underline{\ ?\ }$

In Exercises 13–16 tell which of the following properties are invariant under the given transformation.
a. distance **b. angle measure** **c. area** **d. orientation**

13. The composite of a reflection and a dilation
14. The composite of two reflections
15. The composite of a rotation and a translation
16. The composite of two dilations

For each exercise draw a grid and find the coordinates of the image point. O is the origin and A is the point (3, 1). R_x and R_y are reflections in the x- and y-axes.

17. $R_x \circ R_y:(3, 1) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$
18. $R_y \circ H_O:(1, -2) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$
19. $H_A \circ H_O:(3, 0) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$
20. $H_O \circ H_A:(1, 1) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$
21. $R_x \circ D_{O, 2}:(2, 4) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$
22. $\mathcal{R}_{O, 90} \circ R_y:(-2, 1) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$
23. $\mathcal{R}_{A, 90} \circ \mathcal{R}_{O, -90}:(-1, -1) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$
24. $D_{O, -\frac{1}{3}} \circ D_{A, 4}:(3, 0) \rightarrow (\underline{\ ?\ }, \underline{\ ?\ })$

25. Let R_l be a reflection in the line $y = x$ and R_y be a reflection in the y-axis. Draw a grid and label the origin O.
   a. Plot the point $P(5, 2)$ and its image Q under the mapping $R_y \circ R_l$.
   b. According to Theorem 14-8, $m\angle POQ = \underline{\ ?\ }$.
   c. Use the slopes of $\overline{OP}$ and $\overline{OQ}$ to verify that $\overline{OP} \perp \overline{OQ}$.
   d. Find the images of (x, y) under $R_y \circ R_l$ and $R_l \circ R_y$.

26. Let R_k be a reflection in the line $y = -x$ and R_x be a reflection in the x-axis.
   a. Plot $P(-6, -2)$ and its image Q under the mapping $R_k \circ R_x$.
   b. Use slopes to show that $m\angle POQ = 90$ where O is the origin. (Do you see that this result agrees with Theorem 14-8?)
   c. Find the images of (x, y) under $R_k \circ R_x$ and $R_x \circ R_k$.

C 27. Explain how you would construct line j so that $R_k \circ R_j:A \rightarrow B$.