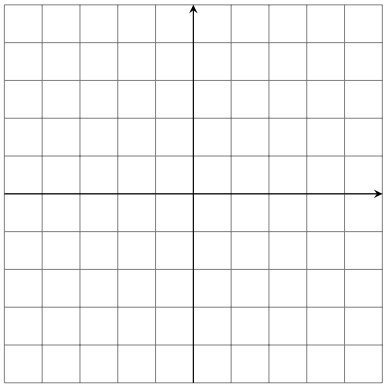
Taxicab Geometry Worksheets

Exploring Mathematics, Spring 2010

Day 1: Taxicab Distances

1. (a) Graph the points $A = (1, 3)$, $B = (1, -2)$, $C = (-3, -1)$, and $D = (0, 3)$.



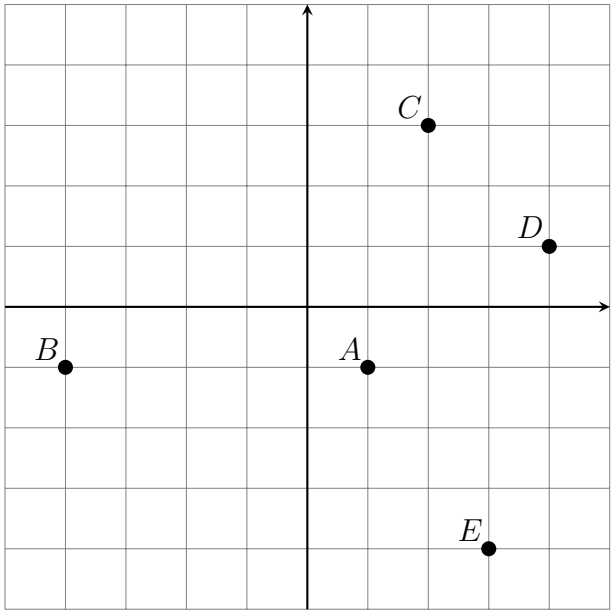
(b) Now find the following distances in both Euclidean and taxicab geometries. Give a decimal approximation to 2 decimal places.

	Euclidean distance	Taxicab distance
from A to B		
from B to C		
from C to D		

(c) If you know the Euclidean distance between two points, does that tell you what the taxicab distance is? Why or why not?

(d) If you know the taxicab distance between two points, does that tell you what the Euclidean distance is? Why or why not?

2. (a) Consider the points in the following graph:

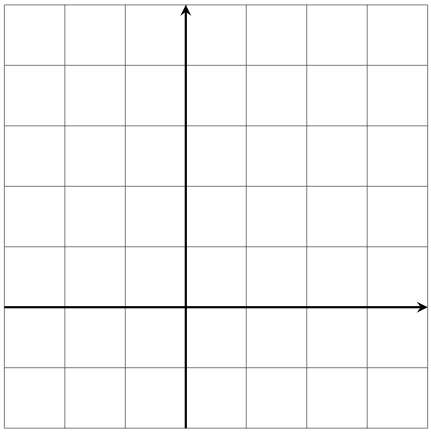


Calculate the following distances in both Euclidean and taxicab geometries. Give a decimal approximation to 2 decimal places.

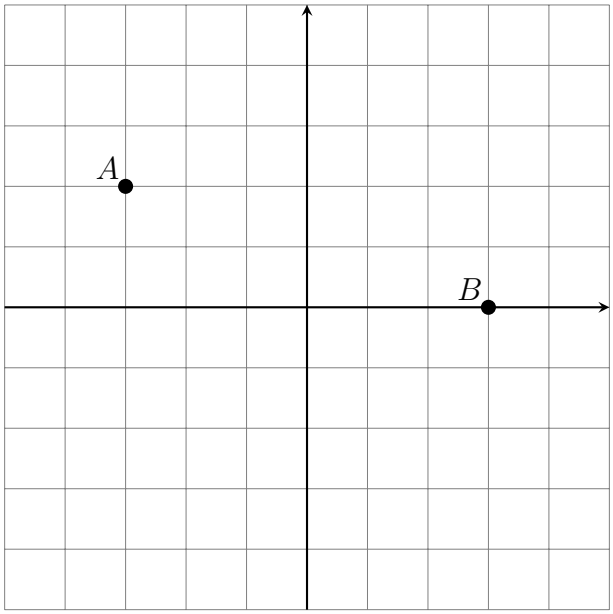
	Euclidean distance	Taxicab distance
from A to B		
from A to C		
from A to D		
from A to E		

(b) Is the Euclidean distance between two points always less than or equal to the taxicab distance? If so, explain why. If not, give an example where the Euclidean distance is greater than the taxicab distance.

3. One night the 911 dispatcher for Taxicab City receives a report of an accident at $X = (-1, 4)$. There are two police cars in the area, car C at $(2, 1)$ and car D at $(-1, -1)$. Which car should be sent to the scene of the accident to arrive most quickly? (Since the cars must drive on the streets, we use taxicab geometry to measure distances.)



4. Using taxicab geometry, consider the points $A = (-3, 2)$ and $B = (3, 0)$.



   (a) Is the point $(-2, -3)$ closer to A or to B?

   (b) Is the point $(1, -2)$ closer to A or to B?

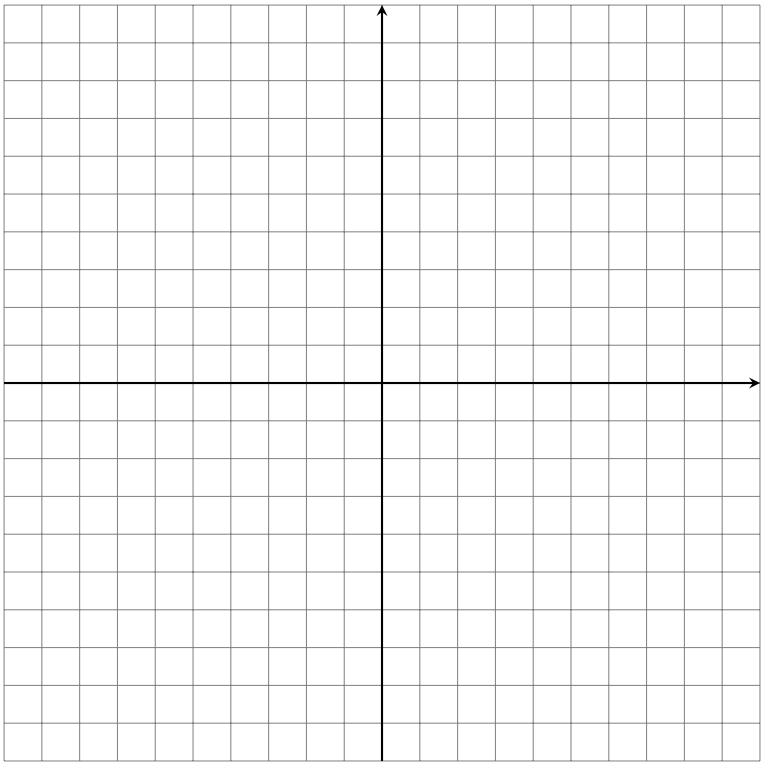
   (c) Find one point that is exactly the same distance from A is it is from B. Mark it on the graph.

   (d) Find another such point. Mark it on the graph.

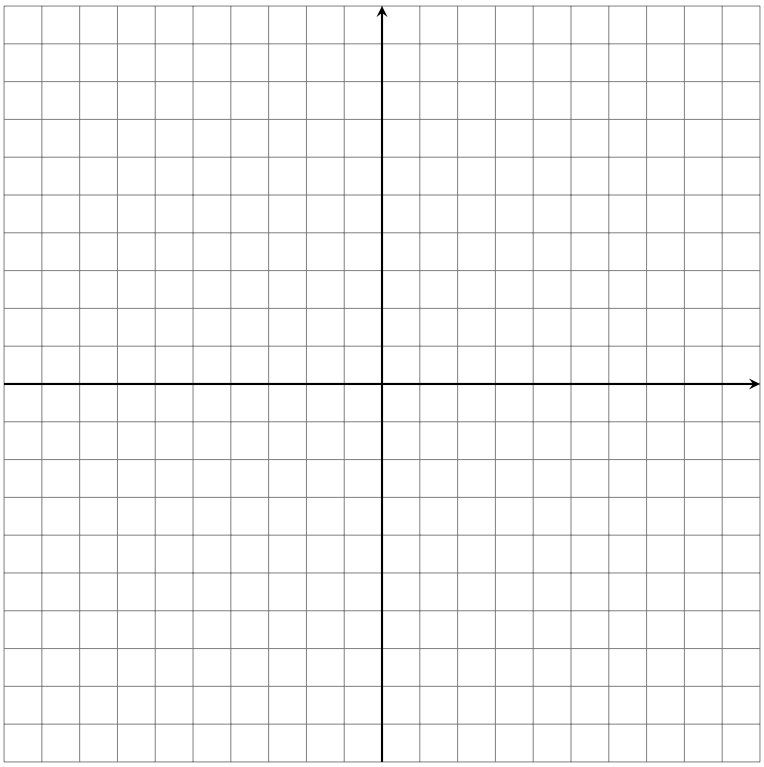
   (e) Mark all points on the graph that are equally distant from A and from B. (Remember, this includes points with non-integer coordinates.)

Day 2: Taxicab Circles

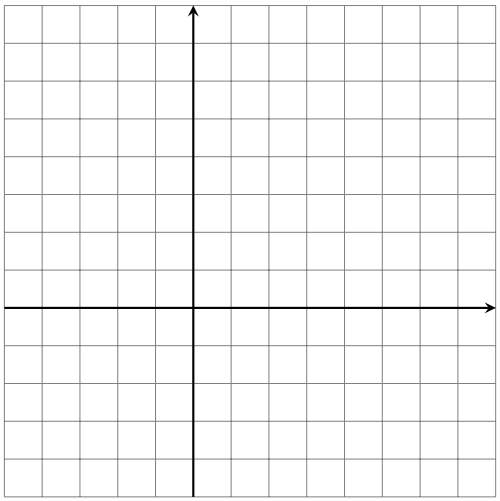
1. Draw the taxicab circle of radius 5 around the point $P = (3, 4)$.



2. Draw the taxicab circle of radius 6 around the point $Q = (2, -1)$.



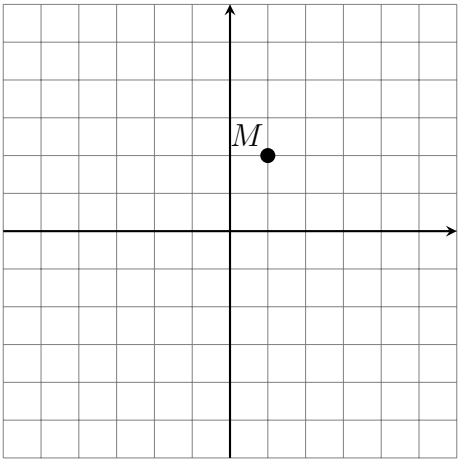
3. On a single graph, draw taxicab circles around point $R = (1, 2)$ of radii 1, 2, 3, and 4.



4. Describe a quick technique for drawing a taxicab circle of radius r around a point P.

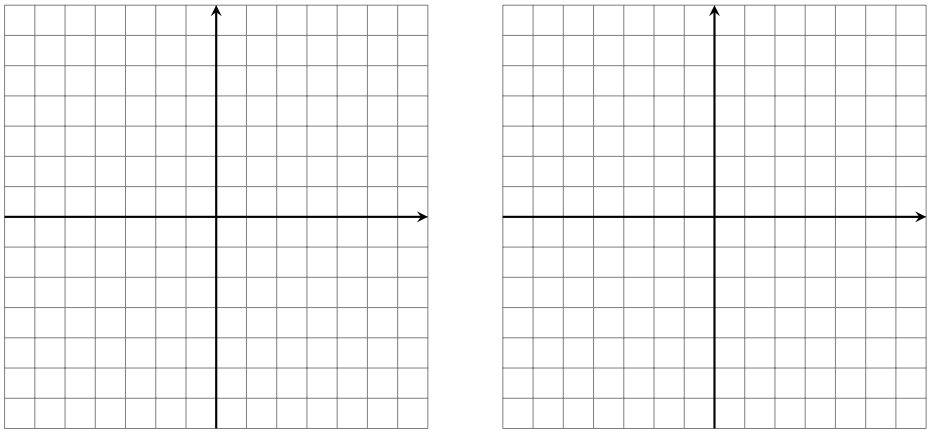
5. What is a good value for π in taxicab geometry?

6. George works in Taxicab City for the 3M plant, located at $M = (1, 2)$. He goes out to eat for lunch once a week, and out of company loyalty, he likes to walk exactly 3 blocks from the plant to do so. Where in the city are restaurants at which George can eat? Draw their locations on the graph.

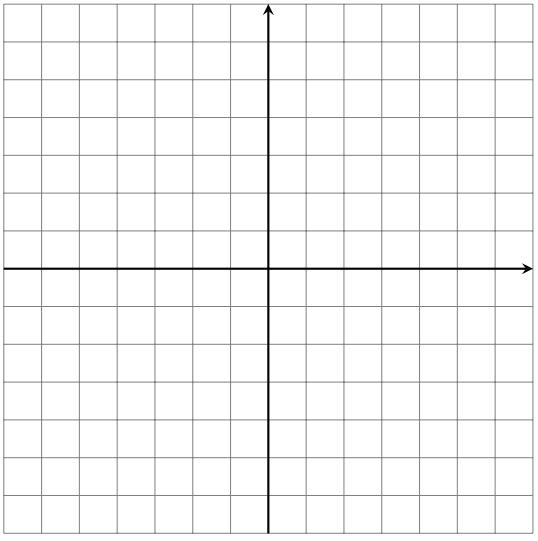


7. Fred Finnegan campaigned to become mayor of Taxicab City on a platform of installing drinking fountains throughout the city, so that no one would ever be more than three blocks from a free drink of water. He won the election, but since his predecessor depleted the city treasury, he needs to spend money judiciously. Suppose the city is 14 blocks square, as shown in the grids below.

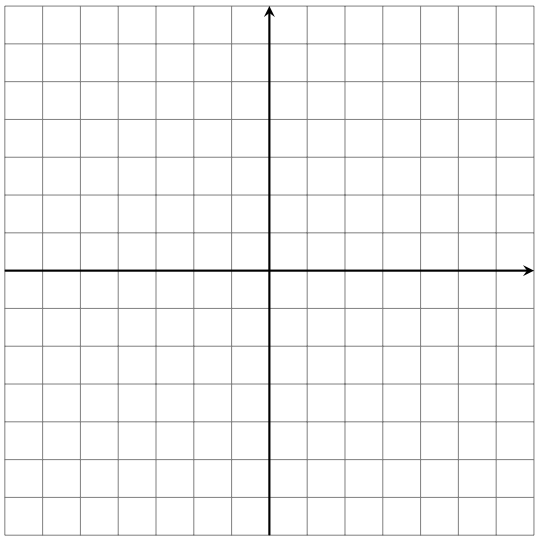
   (a) Come up with at least 2 different plans for where to locate the drinking fountains. (If you need more room to practice, there are more grids on the back of this page.)

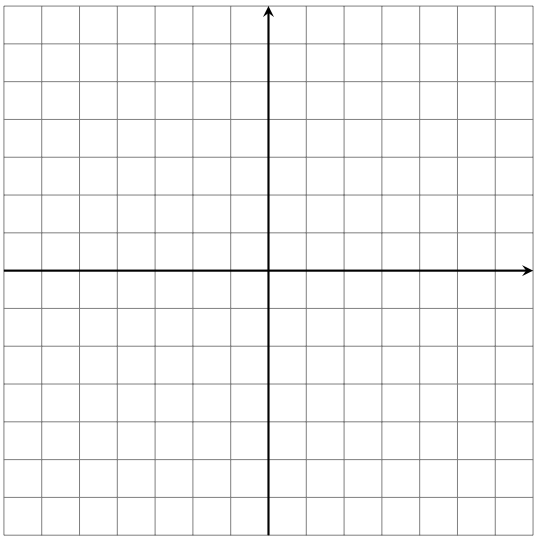


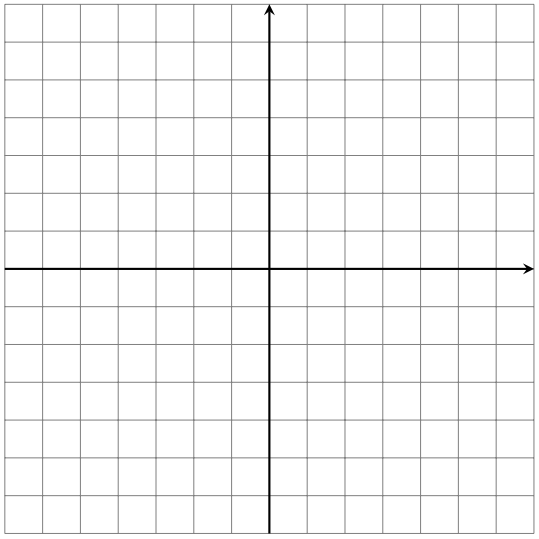
   (b) Come up with the most cost-efficient way for the mayor to fulfill his campaign promise. (That is, give a map of where to locate the drinking fountains.)

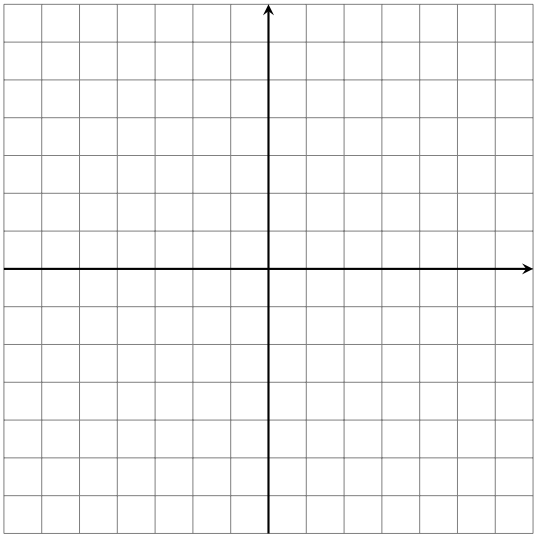


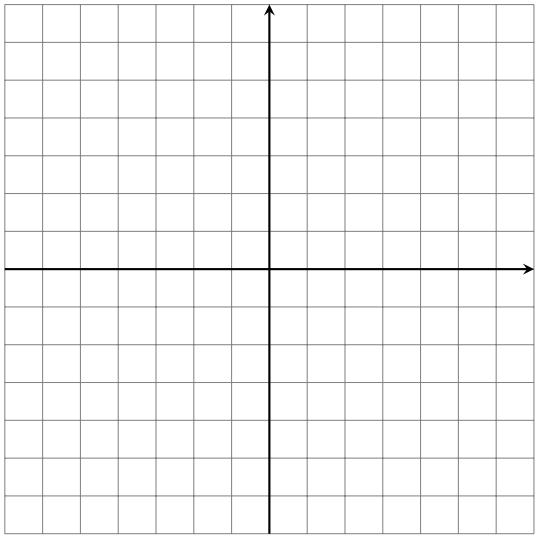
   (c) Suppose Taxicab City were to expand into the surrounding countryside as the population grows. Describe how to extend your pattern indefinitely into the new, surrounding blocks.

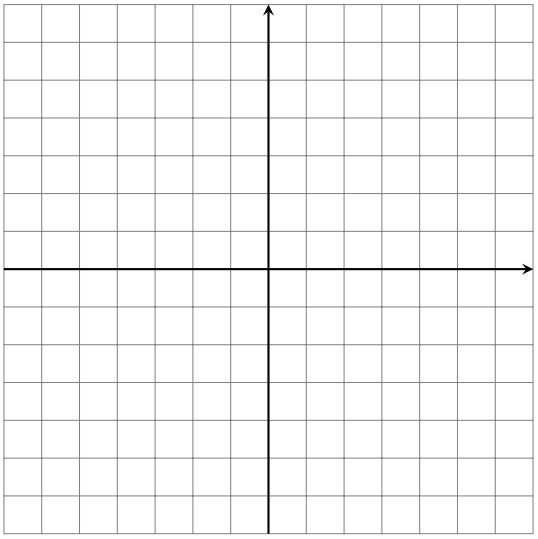






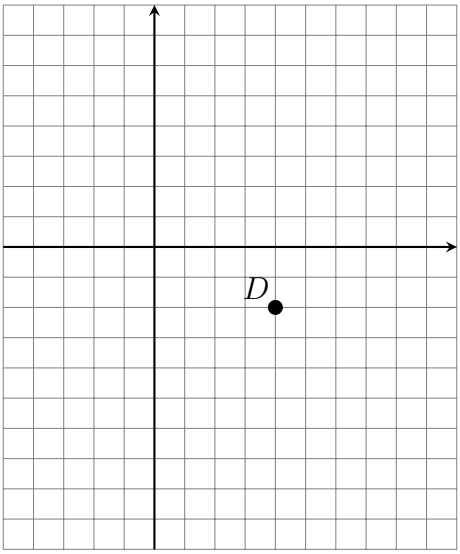




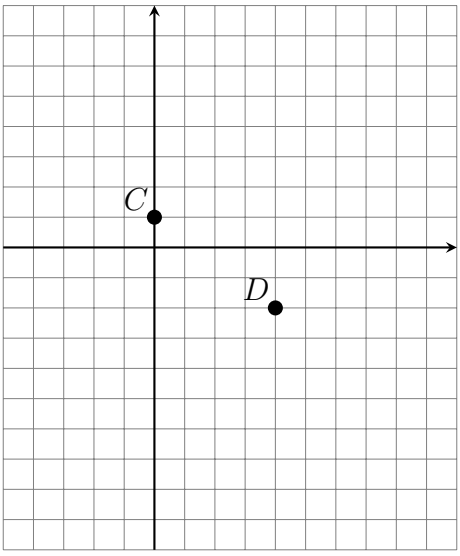


Day 3: Taxicab Applications

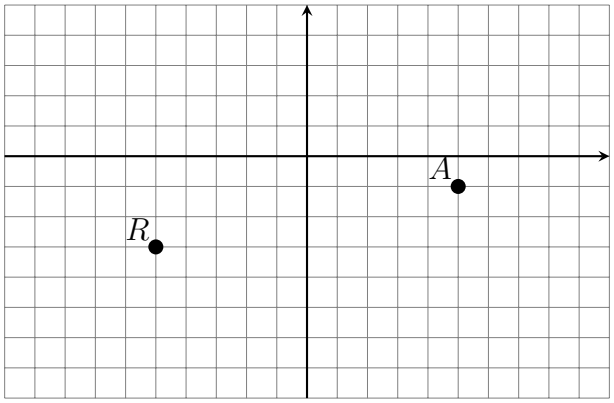
1. Doug moves to Taxicab City and works at the distillery at $D = (4, -2)$. Like Alice and Bob, he walks to work along the city blocks. Because of a heart condition, Doug cannot live more than 5 blocks from work. On a graph, shade in all the places Doug can live.



2. On second thought, Doug realizes that he also wants to live near the church at $C = (0, 1)$. He is looking for an apartment A so that the distance from A to C *plus* the distance from A to D is at most 9 blocks. Shade in all the places Doug can live.

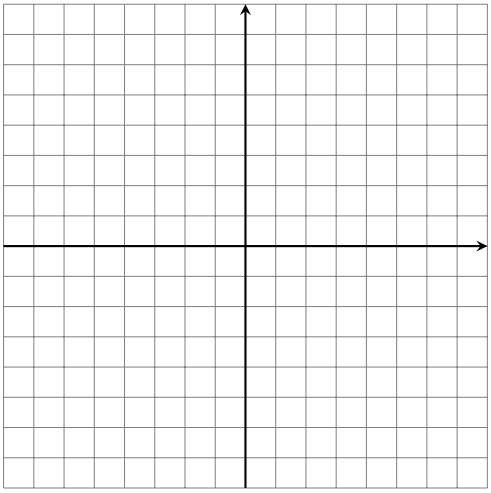


3. Acme Industrial Parts wants to build a factory in Taxicab City. It needs to receive shipments from the railroad depot at $R = (-5, -3)$ and ship parts out by plane, so it wants the factory to be located so that the total distance from the depot to the factory to the airport at $A = (5, -1)$ is at most 16 blocks. However, a city noise ordinance prohibits any factories from being built within 3 blocks of the public library at $L = (-4, 2)$. Where can Acme build its factory?

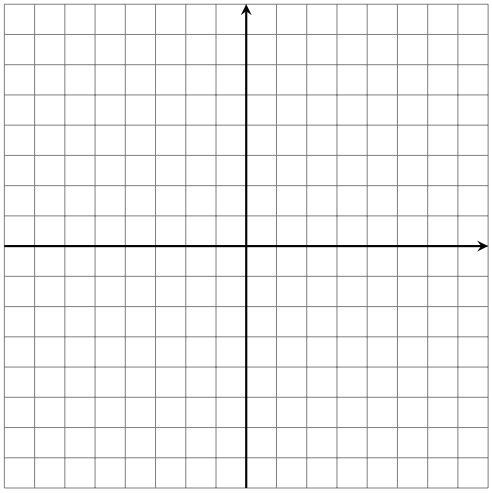


4. (a) Draw the taxicab ellipse with foci $(-2, 1)$ and $(4, 1)$, so that the total distance from each point to the foci is 8.

   (b) Draw the taxicab ellipse with foci $(-3, -2)$ and $(4, 3)$, so that the total distance from each point to the foci is 16.



(a)



(b)

5. Describe how to draw a taxicab ellipse if you know the foci and the total distance from each point to the two foci.