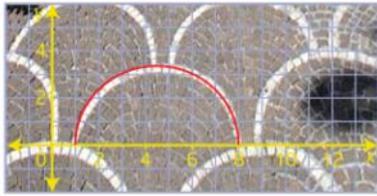**13.** Architects and designers often use translations in their designs. The image shown is from an Italian roadway.

a) Use the coordinate plane overlay with the base semicircle shown to describe the approximate transformations of the semicircles.

b) If the semicircle at the bottom left of the image is defined by the function $y = f(x)$, state the approximate equations of three other semicircles.
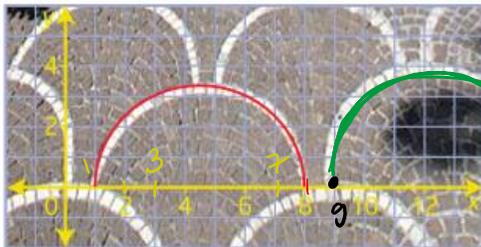
a) assume a transformation from the red to the green semicircle, then the x coordinate:

$$x = 1 \rightarrow 9$$

$x = 1$ of the red, moved to $x = 9$ of the green semicircle. This describes the movement of the leftmost point of the semicircle for both red and green.
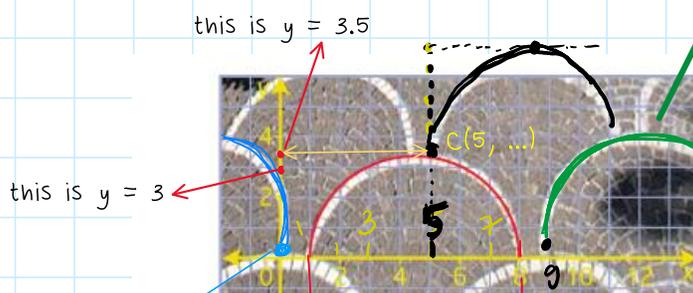
this is a shift by 8 units to the Right.

Nothing else is happening to the green semicircle.

Thus we conclude: all semicircles at the same height as the red one, move 8 units to the right from each other.

b) We pick 3 other than the red: **blue, black and green.** Let's read a few points and name them.

we have already seen in section a) that the green semicircle hs shifted only horizontally to the right by 8 units, thus the green semicircle is: $g(x) = f(x-8)$.

this is $y = 3.5$

this is $y = 3$

C(5, ...)

D(0, 0)

A(1, 0)

B(8, 0)
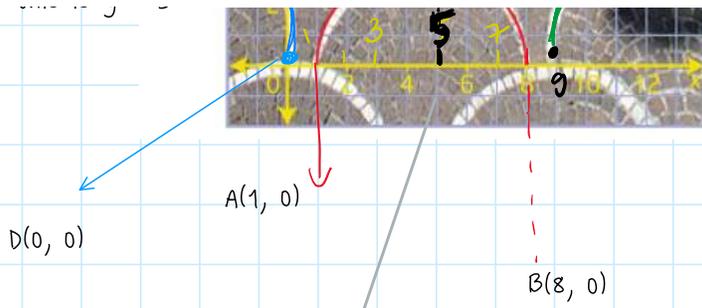
it appears that the black circle joints at point C(5, ...)

the elevation of C seems to be at 3.5, so it's C(5, 3.5)

How did A transform to C?

x: 1 -> 5 (to the right)

y: 0 -> 3.5 (upwards)

Therefore the black semicircle: $g(x) = f(x-5) + 3.5$

The blue semicircle has the point D(0,0) moved away from the red point B(8, 0) and there is no change in elevation. This is a horizontal shift to the left by 8 units, thus the blue semicircle is: $g(x) = f(x+5)$.