14.1, number 18: **Let $f(x, y) = \sqrt{y - x}$.**

(a) **Find the domain of f.**

(b) **Find the image of f.**

(c) **Describe f's level sets.**

(d) **Find the boundary of f's domain.**

(e) **Is the boundary open region, or a closed region, or neither?**

(f) **Is the domain bounded or unbounded?**

Answer:

$$\boxed{\text{The domain of } f \text{ is the set of points } (x, y) \text{ with } x \leq y.}$$

This is all points on or above the line $y = x$.

$$\boxed{\text{The image of } f \text{ is the set of real numbers that are } 0 \text{ or higher.}}$$

$$\boxed{\text{The level sets of } f \text{ are the lines parallel to and above (or equal to) } y = x.}$$

In particular, $y = x$ is the level set $f(x, y) = 0$; $y = x + 1$ is the level set $f(x, y) = 1$; $y = x + 4$ is the level set $f(x, y) = 2$; etc.

$$\boxed{\text{The line } y = x \text{ is the boundary of the domain of } f.}$$

$$\boxed{\text{The domain is closed}}$$

because all of the boundary of the domain is in the domain.

$$\boxed{\text{The domain is unbounded}}$$

because is not possible to draw a circle so that all of the domain is inside the circle.