EX.2

(a) From the table we know that \( f(35, 60) = 48 \), which means the perceived air temperature is 48°C when the actual temperature is 35°C and the relative humidity is 60%.

(b) \( f(30, h) = 36 \) when \( h = 50 \).

(c) \( f(T, 40) = 42 \) when \( T = 35 \).

(d) \( I = f(20, h) \) is the perceived air temperature as a function of humidity, given that the actual temperature is 20°C. Similarly, \( I = f(40, h) \) is the perceived air temperature as a function of humidity, given that the actual temperature is 40°C. Looking at the rows of the table corresponding to \( T = 20 \) and \( T = 40 \), we see that \( f(20, h) \) increases at a relatively constant rate of at most 1°C per 10% relative humidity, while \( f(40, h) \) increases at a constant rate of 4°C per 10% relative humidity.

EX.10

(a) \( F(3, 1) = 1 + \sqrt{4 - 1} = 1 + \sqrt{3} \).

(b) \( \sqrt{4 - y^2} \) is defined only when \( 4 - y^2 \geq 0 \iff -2 \leq y \leq 2 \).

Thus the domain of \( F \) is \( \{(x, y) | -2 \leq y \leq 2\} \).

(c) Since \( 0 \leq \sqrt{4 - y^2} \leq 2 \forall y \in [-2, 2] \), we have \( 1 \leq F(x, y) \leq 3 \) and thus range of \( F \) is \([1, 3]\).

EX.15

Since \( \ln(9 - x^2 - 9y^2) \) is defined only when \( 9 - x^2 - 9y^2 > 0 \iff x^2 + 9y^2 < 9 \), or \( \frac{x^2}{9} + y^2 < 1 \). Thus the domain of \( f \) is \( \{(x, y)| \frac{x^2}{9} + y^2 < 1\} \), the interior of an ellipse.
EX.19

Since $\sqrt{y-x^2}$ is defined only when $y-x^2 > 0 \iff y > x^2$. In addition, $f$ is not defined if $1-x^2 = 0 \iff x = \pm 1$.

Thus the domain of $f$ is $\{(x,y)| y \geq x^2, x \neq \pm 1\}$.

EX.32

Investigating the trace of $f(x,y)$ along $x = 0$ and $y = 0$, we may conclude that:
(a) VI, (b) V, (c) I, (d) IV, (e) II, (f) III.

EX.36

If we start moving away from the origin along , say, the $x$-axis, the $z$-values of a cone centered at the origin increase at constant rate, so we would expect its level curves to be equally spaced. A paraboloid with vertex the origin, on the other hand, has $z$-values which change slowly near the origin and more quickly as we move further away. Thus, we would expect its curves near the origin to be spaced more widely apart than those further from the origin. Therefore contour map I must correspond to the paraboloid and contour map II the cone.

EX.61

$z = \sin(x-y)$

(a) F, (b) I
Reasons: The function is periodic in both $x$ and $y$, and have constant values along $x - y = k$, a condition satisfied only by F and I.

**EX.63**

$$z = (1 - x^2)(1 - y^2)$$

(a) B, (b) VI

Reasons: The function is 0 along $x = \pm 1$ and $y = \pm 1$ ⇒ contour map VI. Note also that the trace of the function along $y = 0$ is $z = 1 - x^2$, so the graph is B.

**EX.66**

$$x^2 + 3y^2 + 5z^2 = k$$ is a family of ellipsoids for $k > 0$ and the origin for $k = 0$.

**EX.69**

(a) The graph of $g$ is the graph of $f$ shifted upward by 2 units.

(b) The graph of $g$ is the graph of $f$ stretched along the $z$-axis by a factor of two.

(c) The graph of $g$ is the graph of $f$ reflected with respect to the $xy$-plane.

(d) The graph of $g$ is the graph of $f$ reflected with respect to the $xy$-plane and then shifted upward by 2 units.