10.1.14
Domain: We need $9-x^2-y^2 > 0$, which implies that the domain is $\{(x,y) \mid x^2+y^2 \leq 9\}$

Range: One should be able to see that $0 \leq 9-x^2-y^2 \leq 9$.
Thus the range of $z = f(x,y)$ is $\{z \mid 0 \leq z \leq 3\}$

Level curves: Fix $C$, $0 \leq C \leq 3$, we have
$$C = 9-x^2-y^2,$$ so that $x^2+y^2 = 9-C^2$, which is a circle of radius $\sqrt{9-C^2}$.

10.1.16

Domain: Since $\exp$ is defined everywhere, domain is $\mathbb{R}^2$.

Range: Since $-(x^2+y^2) \leq 0$ and $\exp$ is increasing, range is $\{0 \leq z \leq 1\}$. ($0$ is not included since $\exp$ is non-zero).

Level curves:
Fix $C$, $0 \leq C \leq 1$, we have $C = \exp(-(x^2+y^2))$, so that $-(x^2+y^2) = \ln C$, and $x^2+y^2 = \ln C$, which is a circle with radius $\sqrt{\ln C}$.

10.2.2

Since $2xy+3x^2$ is continuous at $(-1,1)$, we have
$$\lim_{(x,y) \to (-1,1)} 2xy+3x^2 = 2(-1)(1) + 3(1)^2 = 1$$

10.2.12

Since $2xy+2$ is nonzero at $(-1,-2)$, so the rational function $\frac{x^2-y^2}{2xy+2}$ is continuous at $(-1,-2)$.
$$\lim_{(x,y) \to (-1,-2)} \frac{x^2-y^2}{2xy+2} = \frac{-3}{-6} = \frac{1}{2}$$
10.2.16
Along positive $x$-axis
\[ \lim_{x \to 0^+ \atop y=0} \frac{3x^2-y^2}{x^2+y^2} = \lim_{x \to 0^+} \frac{3x^2}{x^2} = 3 \]

Along positive $y$-axis
\[ \lim_{x \to 0^+ \atop y \to 0^+} \frac{3x^2-y^2}{y^2+y^2} = \lim_{x \to 0^+} \frac{-y^2}{2y^2} = -\frac{1}{2} \]

Since the two limits do not agree, \( \lim_{(x,y) \to (0,0)} \frac{3y^2-y^2}{x^2+y^2} \) DNE.

**Remark on 10.2.2 and 10.2.12**

You can also apply the properties of limit to those two problems i.e., Limit Laws on page 513. For example,

\[ \lim_{(x,y) \to (1,-1)} 2xy + 3x^2 = \lim_{(x,y) \to (1,-1)} 2xy + \lim_{(x,y) \to (1,-1)} 3x^2 = 2\lim_{(x,y) \to (1,-1)} x \left( \lim_{(x,y) \to (1,-1)} y \right) + 3\lim_{(x,y) \to (1,-1)} x^2 \]

\[ \lim_{(x,y) \to (-1,1)} \frac{x^2-y^2}{2xy + 2} = \lim_{(x,y) \to (-1,1)} x^2-y^2 \]

\[ \lim_{(x,y) \to (-1,-1)} 2xy + 2 \]