Sec 9.5

3,6,9,13,21,30

3. $\nabla F = \dfrac{y^2}{z^3}\mathbf{i} + \dfrac{2xy}{z^3}\mathbf{j} - \dfrac{3xy^2}{z^4}\mathbf{k}$

6. $\nabla f = \dfrac{3x^2}{2\sqrt{x^3y - y^4}}\mathbf{i} + \dfrac{x^3 - 4y^3}{2\sqrt{x^3y - y^4}}\mathbf{j};\ \nabla f(3,2) = \dfrac{27}{\sqrt{38}}\mathbf{i} - \dfrac{5}{2\sqrt{38}}\mathbf{j}$

9. $D_{\mathbf{u}}f(x,y) = \lim_{h\to 0} \dfrac{f(x + h\sqrt{3}/2, y + h/2) - f(x,y)}{h} = \lim_{h\to 0} \dfrac{(x + h\sqrt{3}/2)^2 + (y + h/2)^2 - x^2 - y^2}{h}$

$= \lim_{h\to 0} \dfrac{h\sqrt{3}x + 3h^2/4 + hy + h^2/4}{h} = \lim_{h\to 0}(\sqrt{3}x + 3h/4 + y + h/4) = \sqrt{3}x + y$

13. $\mathbf{u} = \dfrac{\sqrt{10}}{10}\mathbf{i} - \dfrac{3\sqrt{10}}{10}\mathbf{j};\ \nabla f = \dfrac{-y}{x^2+y^2}\mathbf{i} + \dfrac{x}{x^2+y^2}\mathbf{j};\ \nabla f(2,-2) = \dfrac{1}{4}\mathbf{i} + \dfrac{1}{4}\mathbf{j}$

$D_{\mathbf{u}}f(2,-2) = \dfrac{\sqrt{10}}{40} - \dfrac{3\sqrt{10}}{40} = -\dfrac{\sqrt{10}}{20}$

21. $\mathbf{u} = (-4\mathbf{i} - \mathbf{j})/\sqrt{17};\ \nabla f = 2(x-y)\mathbf{i} - 2(x-y)\mathbf{j};\ \nabla f(4,2) = 4\mathbf{i} - 4\mathbf{j};\quad D_{\mathbf{u}}F(4,2) = -\dfrac{16}{\sqrt{17}}\dfrac{4}{\sqrt{17}} = -\dfrac{12}{\sqrt{17}}$

30. $\nabla F = \dfrac{1}{x}\mathbf{i} + \dfrac{1}{y}\mathbf{j} - \dfrac{1}{z}\mathbf{k};\ \nabla F(1/2, 1/6, 1/3) = 2\mathbf{i} + 6\mathbf{j} - 3\mathbf{k}$

The minimum $D_{\mathbf{u}}$ is $-[2^2 + 6^2 + (-3)^2]^{1/2} = -7$ in the direction $-2\mathbf{i} - 6\mathbf{j} + 3\mathbf{k}$.