1 | $f(x) = x^3$

$\begin{bmatrix} 3x^2 \end{bmatrix}$

2 | $f(x) = \ln(\sin(x^7))$

$\begin{bmatrix} 7\frac{1}{\sin x^7} \cos x^7 x^6 \end{bmatrix} = \begin{bmatrix} 7x^6 \cot x^7 \end{bmatrix}$

4 | $f(x, y) = \cos(x^2 y) + y^3$

$\begin{bmatrix} \frac{\partial}{\partial x} f(x,y) & \frac{\partial}{\partial y} f(x,y) \end{bmatrix} = \begin{bmatrix} -2xy \sin(x^2 y) & -x^2 \sin(x^2 y) + 3y^2 \end{bmatrix}$

11 | $f(x, y, z) = \langle xy + 2yz, 2x^2 y^2 \rangle$

$\begin{bmatrix} y & x + 2z & 2y \\ 4xy^2 & 4x^2 y & 0 \end{bmatrix}$

13 | $f(t) = t^5 \hat{i} - 2t\hat{j} + t^2 \hat{k}$

$\begin{bmatrix} 5t^4 \\ -2 \\ 2t \end{bmatrix}$

23 | surface slope by parameterization

23.1 | the slope

Let $g(t) = \langle x + t\cos\theta, y + t\sin\theta \rangle$ be the parameterization s.t. the slope at $(f \circ g)(0)$ is the slope that we want.

$$\frac{d}{dt} f \circ g \Big|_0$$

23.2 | the angle

We want to find the θ where the slope is maximal, so we can set the derivative to zero

$$\frac{d}{d\theta} \left(\frac{d}{dt} f \circ g \Big|_0 \right) = 0$$