1 | read the things

2 | read the other thing

3 | find the derivative

$$f\begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix} = \begin{bmatrix} x_3^2 - 5x_3^7 + 12 - \ln x_1 \\ \frac{x_2 x_4}{x_1} \\ 1873.9485 \\ e^{x_2}\cos x_4 \\ \left(x_2^5 - 45\right)^{8357} \end{bmatrix}$$

$$\nabla f = \begin{bmatrix} -\frac{1}{x_1} & -\frac{x_2 x_4}{x_1^2} & 0 & 0 & 0 \\ 0 & \frac{x_4}{x_1} & 0 & e^{x_2}\cos x_4 & 8357(5)(x_2^5 - 45)^{8356}x_2^4 \\ 2x_3 - 35x_3^6 & 0 & 0 & 0 & 0 \\ 0 & \frac{x_2}{x_1} & 0 & -e^{x_2}\sin x_4 & 0 \end{bmatrix}^T$$

4 | windy times

North northwest is 70 mph in the direction $\frac{5\pi}{8}$

In the south-southeast direction, the wind is blowing at -70 mph.

In the southwest direction, it's blowing $e^{i\frac{3\pi}{2}} \cdot 70e^{i\frac{5\pi}{8}} = 70\cos\frac{7\pi}{8}$

Due north: $70\cos\frac{\pi}{8}\hat{j}$ Due east: $70\cos\frac{5\pi}{8}\hat{i}$