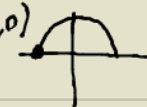


$$2. f(x, y) = e^{2x} - \cos y, P(0, \pi) \quad \vec{v} = 2\vec{i} + 4\vec{j}$$

$$\begin{aligned} \textcircled{1} \quad \vec{u} &= \frac{\vec{v}}{\|\vec{v}\|} = \frac{2\vec{i} + 4\vec{j}}{\sqrt{2^2 + 4^2}} = \frac{2\vec{i} + 4\vec{j}}{\sqrt{4+16}} = \frac{2\vec{i} + 4\vec{j}}{\sqrt{20}} = \frac{2\vec{i} + 4\vec{j}}{2\sqrt{5}} \\ &= \frac{2}{2\sqrt{5}}\vec{i} + \frac{4}{2\sqrt{5}}\vec{j} \\ &= \frac{1}{\sqrt{5}}\vec{i} + \frac{2}{\sqrt{5}}\vec{j} \\ \vec{u} &= \frac{\sqrt{5}}{5}\vec{i} + \frac{2\sqrt{5}}{5}\vec{j} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad \nabla f(x, y) &= f_x \vec{i} + f_y \vec{j} \\ &= e^{2x} \cdot 2\vec{i} + (-(-\sin y))\vec{j} \\ &= 2e^{2x}\vec{i} + \sin y \vec{j} \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad \nabla f\left(\begin{matrix} 0 \\ \pi \end{matrix}\right) &= 2e^{2 \cdot 0} \vec{i} + \sin \pi \vec{j} \quad (-1, 0) \\ &= 2\vec{i} \end{aligned}$$


$$\begin{aligned} \textcircled{4} \quad D_u f(0, \pi) &= \nabla f(0, \pi) \cdot \vec{u} \\ &= (2\vec{i}) \cdot \left(\frac{\sqrt{5}}{5}\vec{i} + \frac{2\sqrt{5}}{5}\vec{j}\right) \\ &= \frac{2\sqrt{5}}{5} \end{aligned}$$