① Find grad ϕ , if $\phi = \log_e (x^2 + y^2 + 3^2)$.

Ans. $\dfrac{2(x\hat{i} + y\hat{j} + 3\hat{k})}{x^2 + y^2 + 3^2}$

② Find the directional derivative of

$f = 2xy + 3^2$ at $(1, -1, 3)$ in the direction

of $\hat{i} + 2\hat{j} + 2\hat{k}$.   Ans. $\dfrac{14}{3}$

③ Find the directional derivative of

$\phi = 5x^2 y - 5y^2 3 + \dfrac{5}{2} 3^2 x$ at $(1, 1, 1)$ in

the direction of the line $\dfrac{x-1}{2} = \dfrac{y-3}{-2} = \dfrac{3}{1}$.

Ans. $\dfrac{35}{3}$

④ Find the directional derivative of $\vec{V}^2$ where

$\vec{V} = xy^2 \hat{i} + 3y^2 \hat{j} + x3^2 \hat{k}$ at $(2, 0, 3)$ in

the direction of the outward normal

to the sphere $x^2 + y^2 + 3^2 = 14$ at $(3, 2, 1)$.

Ans. $\dfrac{1404}{\sqrt{14}}$

$\left[\text{Note: } \vec{V}^2 = \vec{V} \cdot \vec{V} \right]$