2E2 Tutorial Sheet 20 Third Term[1]

13 April 2004

Vectors calculus. With $f(x,y,z)$ a scalar field the grad of f, ∇f, is

$$\text{grad}\, f = \frac{\partial f}{\partial x}\mathbf{i} + \frac{\partial f}{\partial y}\mathbf{j} + \frac{\partial f}{\partial z}\mathbf{k} \tag{1}$$

1. (2) $f = x^2 + 2x^2yz$, find $\text{grad}\, f$. If $g = x^2yz + 2z$, what is $\nabla f \cdot \nabla g$.
2. (2) Find the directional derivative of $z/(x^2+y^2)$ in the direction $\mathbf{i}$.
3. (2) $f = xyz$, work out $\text{grad}\, f$. What is the value of $\text{grad}\, f$ at $(2,1,2)$. What is the directional derivative of f in the $\mathbf{i}$-direction at $(2,1,2)$.
4. (2) $f = x^2 + y^2 + z^2$, find $\text{grad}\, f$. What is the directional derivative of f in the direction of $\mathbf{b} = (1,1,1)$ at the point $(1,1,1)$. Remember to use a unit vector when working out the directional derivative. What is the directional derivative in the $\mathbf{i}$ direction at $(1,0,0)$; what about the $\mathbf{j}$ direction?

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