Hints and Answer

Problem set 9(Vector Analysis)

1. Find the gradient $\nabla\phi$ at the given point and the unit vector along the gradient $\left(\frac{\nabla\phi}{|\nabla\phi|}\right)$.
2. Find $\nabla f|_{(x,y,z)} \cdot \hat{n}$.
   (a) $-1/\sqrt{5}$.
   (b) -3.
   (c) 1.
   (d) $3(1+2\sqrt{3})$.
3. Maximum directional derivative is $96\sqrt{19}$, and it's direction is $\hat{i} + 3\hat{j} - 3\hat{k}$.
4. Use $\nabla\phi_1 \cdot \nabla\phi_2 = |\nabla\phi_1| \cdot |\nabla\phi_2| \cos\theta$, and find θ. (Ans - $\theta = \cos^{-1}(2/3\sqrt{6})$)
5. $a = 5/2, b = 1$.
6. -
7. -
8. -
9. Find $\vec{\nabla} \times \vec{v}$.
10. $\vec{F}$ is solenoidal, but not irrotational.
11. Show $\nabla \cdot (\vec{A} \times \vec{B}) = 0$.
12. Make $\nabla \cdot (r^n \vec{r}) = 0$.
13. Show $\nabla \times \vec{v} = 0$, and find f such that $\vec{v} = \nabla f$.
14. -
15. -

16. -

17. -

18. -