Physics 3344
Fall 1997

Professor Scalise
Assignment #4

Due: 23 September

Read Marion & Thornton Chapter 2, Shankar Chapter 7.

1. If the scalar function $\Phi = x^2 y \sin(z) + x y^3 z^2$, evaluate:

   (a) $\dfrac{\partial \Phi}{\partial x}$

   (b) $\dfrac{\partial \Phi}{\partial y}$

   (c) $\dfrac{\partial \Phi}{\partial z}$

2. Show that these two forms of the Laplacian in circular cylindrical coordinates are equivalent.

$$\nabla^2 \Phi = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho \frac{\partial \Phi}{\partial \rho}\right) + \frac{1}{\rho}\frac{\partial}{\partial \phi}\left(\frac{1}{\rho}\frac{\partial \Phi}{\partial \phi}\right) + \frac{1}{\rho}\frac{\partial}{\partial z}\left(\rho \frac{\partial \Phi}{\partial z}\right) = \frac{\partial^2 \Phi}{\partial \rho^2} + \frac{1}{\rho}\frac{\partial \Phi}{\partial \rho} + \frac{1}{\rho^2}\frac{\partial^2 \Phi}{\partial \phi^2} + \frac{\partial^2 \Phi}{\partial z^2}$$

3. Derive the scale factors h_r, h_θ, and h_ϕ for spherical polar coordinates from the equations relating $\{r, \theta, \phi\}$ to $\{x, y, z\}$.

4. Derive the volume of a sphere of radius a by integrating the constant function 1 over the appropriate spherical coordinates.

5. What is the θ component of the curl in spherical polar coordinates? $(\vec{\nabla} \times \vec{A})_\theta = ?$

6. Evaluate the following. (You may find it convenient to work in spherical polar coordinates, although Cartesian will give the same answers.)

   (a) $\nabla\, r$

   (b) $\vec{\nabla} \cdot \vec{r}$

   (c) $\vec{\nabla} \times \vec{r}$

7. Marion & Thornton 1.28, 1.31

Greek alphabet:

alpha	beta	gamma	delta	epsilon	zeta	eta	theta	iota	kappa	lambda	mu	nu
A	B	Γ	Δ	E	Z	H	Θ	I	K	Λ	M	N
α	β	γ	δ	ϵ	ζ	η	θ	ι	κ	λ	μ	ν

xi	omicron	pi	rho	sigma	tau	upsilon	phi	chi	psi	omega
Ξ	O	Π	P	Σ	T	Υ	Φ	X	Ψ	Ω
ξ	o	π	ρ	σ	τ	υ	ϕ	χ	ψ	ω