PHYS 301

Homework #2

Due : 3 February 2012

Your solutions must be complete and show clearly the steps and logic you use to reach your answers. Answers appearing with no explanation can receive no credit.

1. Prove :

$$\mathbf{A} \times (\mathbf{B} \times \mathbf{C}) + \mathbf{B} \times (\mathbf{C} \times \mathbf{A}) + \mathbf{C} \times (\mathbf{A} \times \mathbf{B}) = 0$$

2. Evaluate :

$$\epsilon_{ijk}\, \delta_{jk}$$

where ϵ_{ijk} is the Levi - Civita permutation tensor and δ_{jk} is the Kronecker delta.

3. Using Einstein summation (only), prove :

$$\nabla \cdot (f\, \mathbf{A}) = f\, (\nabla \cdot \mathbf{A}) + \mathbf{A} \cdot (\nabla f)$$

where f is a scalar and A is a vector.

4. Prove using Einstein summation notation :

$$\nabla \times (f\, \mathbf{A}) = f\, (\nabla \times \mathbf{A}) - \mathbf{A} \times (\nabla f)$$

where f is a scalar and A is a vector. Be sure you explain explicitly how the minus sign arises.

5. If **r** is the position vector, show that curl **r** = 0.

6. Consider two vectors **A** and **B** in the x - y plane. **A** = (10.8, 12.6) and **B** = (-8, 14). Vector **C** also lies in the x - y plane and is perpendicular to **A;** the value of the dot product $\mathbf{B} \cdot \mathbf{C} = 24$. Write a short Mathematica program to find the components of vector **C**. Either on your Mathematica output or on a separate sheet, explain the logic of your steps and be sure the identify the meaning of all variables you use.