HOMEWORK 2

METR 5403/4403: Applications of Meteorological Theory to Severe-Thunderstorm Forecasting

Instructors: Dr. Ariel Cohen, Rich Thompson, and Dr. Steven Cavallo

Teaching Assistant: Andrew Moore

Due: Wednesday, February 22, 2017 at the beginning of class

Instructions: STATE ALL ASSUMPTIONS. CARRY THROUGH ALL UNITS OF ALL PROBLEMS TO EACH SOLUTION'S END. YOU MAY WORK WITH OTHERS; EACH SUBMITTED SOLUTION WILL BE UNIQUE.

Problem 1: Consider 2 vectors: $\vec{X} = A\hat{\imath} + B\hat{\jmath} + C\hat{k}$ and $\vec{Y} = D\hat{\imath} + E\hat{\jmath} + F\hat{k}$.

(a) Evaluate $\vec{X} \cdot \vec{Y}$ in terms of individual vector components.

(b) Evaluate $\vec{X} \times \vec{Y}$ in terms of individual vector components.

(c) Evaluate $mag(\vec{X} \times \vec{Y})$ in terms of individual vector components.

Problem 2: Evaluate the following vector cross product: $\vec{\nabla} \times \vec{\nabla} A$, where A defined as a function of spatial coordinates such that $A = A(x, y, z)$.

Problem 3: Using the methods of Laplace transforms and partial-fraction decomposition, find the solution, y, of the initial value problem:

$$y'' + 5y' + 6y = 0; y(0) = 1; y'(0) = 1.$$

Problem 4: Evaluate the following expression: $\frac{\partial}{\partial y}(\frac{3x^2y}{siny})$.

Problem 5: Assume that an angle $\alpha = 210°$. Express α in units of radians, and evaluate $\tan(\alpha)$.

Problem 6: Evaluate the following vector cross product: $\hat{k} \times \vec{\nabla} A$, where A defined as a function of spatial coordinates such that $A = A(x, y, z)$.

Problem 7: Consider 2 vectors: $\vec{A}_i =< 3, 3 >$ and $\vec{A}_f =< 3, -3 >$. Let $\vec{B} = \vec{A}_i + \vec{A}_f$, and let $\vec{C} = \vec{A}_f - \vec{A}_i$.

(a) Express $\vec{B}$ and $\vec{C}$ in component form.

(b) On the same Cartesian coordinate system, plot arrows corresponding to $\vec{A}_i$, $\vec{A}_f$, $\vec{B}$, and $\vec{C}$.