AOSC 470/600 Exam #2 Topics and Study Guide (FALL 2016)

1. Ageostrophy
   a. Relation to acceleration of total wind (k-cross)
      i. Be sure to know how to take k-cross or minus-k-cross a vector. (RH Rule)
      ii. Evaluate divergence of ageostrophic wind. Relation to UVM/DVM through continuity (Curvature, Jet Streaks, or Both)
   b. Isallobaric and Intertial-Advective Components
2. Sutcliffe perspective on net ageostrophic wind (top minus bottom) in a column
   a. Relation to net divergence in a column, UVM/DVM, movements of L/H relative to thermal wind
   b. Expand $(\vec{V}_s \cdot \nabla \vec{V}_0)$ into components and diagnose for idealized high/low (zero out terms for particular configuration)
3. Sutcliffe development theorem
   a. Greater divergence aloft related to synoptic scale UVM, forced by cyclonic geostrophic vorticity "advection by the thermal wind".
4. Geostrophic Paradox
   a. Geostrophic wind advects itself out of thermal wind balance. Why/How?
   b. What is the result of (a)
   c. Diagnose for idealized case (jet streak, for example). How is this resolved? What is the secondary circulation? How does adiabatic warming/cooling and coriolis deflection of agostrophic wind help?
5. Quasi-Geostrophy
   a. Assumptions and what we are trying to diagnose with it.
   b. Two equations with two unknows (QG vorticity and thermodynamic energy equations, unknowns are omega and height tendency)
      i. Recognize them, be able to identify/name them
   c. Combined/Eliminate one term to derive (recognize them, be able to name them)
      i. Omega Equation (diagnostic) & Height Tendency (prognostic) Equations
         1. Recognize them, be able to name/identify them
         2. Be able to identify terms and what they represent
         3. Be able to diagnose terms on a map
         4. Understand the role of "3D Laplacian" and evaluating sign based on sign of forcing (assuming sinusoidal)
      ii. Cancelation problem
         1. Two forcing terms in omega equation (Trenberth approximation similar to Sutcliffe development, deformation terms neglected)
         2. Q-vectors
            a. Identify if see expression
            b. Be able to draw them (using natural coordinates) for idealized scenarios
            c. How are they used and what is forcing for UVM/DIV (convergence/divergence)
      iii. Quasi-Geostrophic Potential Vorticity
         1. Came from condensing height tendency equation
         2. What does it mean to be conserved? For what type of flow is it conserved?
         3. How does it related to (negative/positive) height tendencies?

Final Note: Some questions on the exam may be combinations of the above (i.e. to tie ideas/themes together).