AOSC 470/600 Exam #3 Topics and Study Guide: FALL 2017

1. Material from Exams 1-2
2. Fronts and Frontogenesis
    a. Role of various kinematic terms of frontogenesis
        i. In particular, what about vorticity (is it frontogenetical or not and why)?
    b. What type of vertical circulation is induced by positive frontogenesis (thermally direct or indirect, and why)
        i. Difference between thermally direct/indirect circulations
    c. Sawyer-Elliason
        i. Deformation forcing terms
        ii. Ageostrophic secondary circulation that is induced
    d. Relationship of S-E circulation and Frontogenesis to Q-vectors
        i. Relation to sign of Q forcing for thermally direct/indirect circulation
        ii. Division of Q-vectors into normal coordinates (Qs and Qn)
            1. Direction of Qn to imply Frontogenesis/Frontolysis
            2. What does Qs represent?
    e. Semi-geostrophic assumptions versus QG
        i. How would fronts be if only considering QG effects?
    f. Upper Fronts (why do we care about them?)
        i. Role of thermally indirect circulation in formation, relation to Q(S-E)
        ii. Impact of having cold (warm) thermal advection along jet axis
1. Precipitation Processes along fronts
    a. Three ingredients (forcing, sufficiently weak static stability, sufficient moisture)
    b. Role of static stability in types of ascent/descent
    c. Slantwise instability and negative PVe
        i. Can exist even if no gravitational or inertial instability
        ii. Relative slope of M versus Theta E for slantwise Instability
        iii. Relationship to sign of PVe
2. Cyclogenesis
    a. Energetics: Diagnosing and understanding (Lackmann material)
    b. Vorticity Equation Perspective
        i. Exponential growth in areas of larger than average background vorticity
    c. Continuity Perspective
    d. Importance of wavelengths for forcing strength
    e. Self-Development (Sutcliffe-Petterssen)
        i. Feedback mechanism
        ii. Thermal advection perspective
        iii. Relate to (2) and be able to describe from PV perspective
    f. Role of Latent Heating in accelerating cyclogenesis
3. Isentropic/Ertel Potential Vorticity
    a. What is it and why is it important?
    b. What are ***two*** important characteristics of PV and how is it used to described dynamic parts of that atmosphere?
    c. What are the two main attributes of all positive PV anomalies?
    d. Under what circumstances is PV "created/destroyed" (really, redistributed)?
        i. How/why is this useful?
    e. Use of isopleth of PV (1.5-2.0 PVU surface) to define dynamic tropopause
        i. Tropopause cold perturbations as positive PV anomalies
    f. Surface warm anomalies can be treated as positive PV anomalies