

AOSC 470/600 Exam #3 Topics and Study Guide: FALL 2016

1. Material from Exams 1-2
2. Fronts and Frontogenesis
 - a. Three dynamic characteristics of fronts
 - b. What is frontogenesis (describe in words of physically)?
 - c. Role of various kinematic terms of frontogenesis
 - i. In particular, what about vorticity (is it frontogenetical or not and why)?
 - d. What type of vertical circulation is induced by positive frontogenesis (thermally direct or indirect, and why)
 - i. Difference between thermally direct/indirect circulations
 - e. Sawyer-Elliason
 - i. Deformation forcing terms
 - ii. Ageostrophic secondary circulation that is induced
 - f. 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 (Q_s and Q_n)
 1. Direction of Q_n to imply Frontogenesis/Frontolysis
 2. What does Q_s represent?
 - g. Semi-geostrophic assumptions versus QG
 - i. How would fronts be if only considering QG effects?
 - h. 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. Norwegian Cyclone Model / Polar Front Theory
 - 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 describe 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