

MSC 409 Midterm Spring 2008 (105 points total)

1. (10 pts) Sketch out a Kohler curve. Label axes.
2. (5 pts) what is meant by “curvature effect” and “solute effect” as it pertains to a Kohler curve?
3. (5 pts) large (“giant”) sea salt particles can reach sizes of 2-3 micron. Why is it thought that they may help precipitation to form ? relate your answer to the Kohler curve of question 1.
4. (5 pts) what impact do variations in updraft speed have on the ability of aerosols to nucleate a cloud particle ? again relate this answer to a Kohler curve diagram.

5. (10 pts) write down the condensational growth equation. Sketch out pictorially how a droplet can grow through condensation, relate the graphic to the terms within the equation.
6. (10 pts) write out the collision coalescence equation. Similar to above, sketch out pictorially how droplet growth occurs through this mechanism, relate the graphic to the terms within the equation.
7. (10 pts) An ice particle is growing through riming. Its fall velocity is determined in part by the drag force $F_{\text{drag}} = 6 \cdot \pi \cdot \eta \cdot v \cdot R$ where η is a constant (the air's dynamic viscosity).
- what is the particle's fall velocity ? just show the needed equation.
 - what does the growth equation look like for the ice particle ?
8. (5 pts) An ice particle is growing through accretion. Its fall speed is given by $v = 2.4M^{0.24}$. What does the growth equation look like and how would one go about solving it? Just show how you set it up.

9. (10 pts) what are the different nucleation pathways through which ice particles can form ?

10. (5 pts) why is -15 Celsius an optimal temperature for snowflake growth ?

11. (5 pts) if you see a snowflake, what does the particle shape tell you about its growth process ?

12. (15 pts) what kinds of aerosol are good cloud condensation nuclei and good ice nuclei ? what are typical concentrations of each ?

13. (10 pts) a cloud has a liquid water content of 0.3 g m^{-3} and is composed of drops with radius 10 micron. What is the number of drops per cm^{-3} ? By how many drop radii are the drops separated from each other ?